Engineering
Simplicity

Junos® OS

Time Management Administration Guide

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Junos® OS Time Management Administration Guide
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Table of Contents

About This Guide | xvi

1 Configuring Date and Time

Setting the Date and Time Locally | 3

NTP Overview | 4

Understanding NTP Time Servers | 7

Synchronizing and Coordinating Time Distribution Using NTP | 8

- Configuring NTP | 8
- Configuring the NTP Boot Server | 9
- Specifying a Source Address for an NTP Server | 9

Configuring NTP | 11

Configuring the NTP Time Server and Time Services | 14

- Configuring the Router or Switch to Operate in Client Mode | 15
- Configuring the Router or Switch to Operate in Symmetric Active Mode | 16
- Configuring the Router or Switch to Operate in Broadcast Mode | 16
- Configuring the Router or Switch to Operate in Server Mode | 17

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring NTP Authentication Keys | 19

Configuring the Router or Switch to Listen for Broadcast Messages Using NTP | 20

Configuring the Router or Switch to Listen for Multicast Messages Using NTP | 21

Automatic Clock Selection Overview | 22

External Clock Synchronization Overview for ACX Series Routers | 23

Configuring External Clock Synchronization for ACX Series Routers | 26

Global Positioning System (GPS) and the ACX Series Routers | 34

Integrated Global Navigation Satellite System (GNSS) on ACX500 Series Routers | 35

Assisted Partial Timing Support on ACX500 Routers Overview | 36

2 Configuring Time Zones

Modifying the Default Time Zone for a Router or Switch Running Junos OS | 40

Updating the IANA Time Zone Database on Junos OS Devices | 41

- Importing and Installing Time Zone Files | 41
- Configuring a Custom Time Zone | 43

3 Configuring Network Time Protocols

Understanding NTP Time Servers | 46

Configuring NTP Authentication Keys | 47

Configuring NTP Authentication Keys (QFabric System) | 48

Configuring the NTP Time Server and Time Services | 49

- Configuring the Switch to Operate in Client Mode | 49
- Configuring the Router or Switch to Operate in Symmetric Active Mode | 50
- Configuring the Router or Switch to Operate in Broadcast Mode | 51
- Configuring the Router or Switch to Operate in Server Mode | 51

Configuring the NTP Time Server and Time Services (QFabric System) | 53

Configuring the Switch to Listen for Broadcast Messages Using NTP | 54

Configuring the Switch to Listen for Multicast Messages Using NTP | 55

Setting the Date and Time | 55

Synchronizing and Coordinating Time Distribution Using NTP | 57

- Configuring NTP | 57
- Configuring the NTP Boot Server | 58
- Specifying a Source Address for an NTP Server | 58

Example: Configuring NTP | 59

- Requirements | 60
- Overview | 60
- Configuration | 60
- Verification | 62

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 64

4

Configuring Precision Time Protocols

Precision Time Protocol Overview | 68

Configuring G.8275.1 Profile | 74

PTP Trace Overview | 76

Line Card Redundancy Overview | 81

Configuring Precision Time Protocol | 82

- Configuring PTP Options | 83
- Configuring Member Clock Options | 84
- Configuring Primary Clock Options | 87

Example: Configuring Precision Time Protocol | 90

- Requirements for PTP Configuration | 93
- Overview | 93
- Verification | 94

Understanding Transparent Clocks in Precision Time Protocol | 97

IEEE 1588v2 PTP Boundary Clock Overview | 99

IEEE 1588v2 Precision Timing Protocol (PTP) | 103

Understanding the PTP G.8275.2 Enhanced Profile (Telecom Profile) | 105

Understanding the PTP Media Profiles | 108

PTP over Ethernet on ACX Series Routers Overview | 110

Guidelines for Configuring PTP over Ethernet | 112

Understanding the Precision Time Protocol Enterprise Profile | 115

Configuring Transparent Clock Mode for Precision Time Protocol | 117

Configuring a PTP Transparent Clock | 118

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

- Configuring Precision Time Protocol and Its Options | **120**
  - Configuring PTP Options | **120**
  - Configuring Member Clock Options | **121**
  - Configuring Primary Clock Options | **123**

Configuring the PTP Media Profiles | 125

- Configuring the AES67, SMPTE, and AES67+SMPTE Profiles | **125**
  - Optional and Required Parameters for SMPTE ST-2059-2, AES67, and AES67+SMPTE ST-2059-2 Profiles | **125**
  - Configuring the PTP Media Profile | **127**

Configuring Precision Time Protocol Default Profile | 132

- Configuring Precision Time Protocol and its Options | **132**
  - Configuring PTP Options | **132**
  - Configuring Member Clock Options | **134**
  - Configuring Primary Clock Options | **135**

Configuring the Precision Time Protocol Enterprise Profile | 137

- Configuring Precision Time Protocol and its Options | **137**
  - Configuring PTP Options | **137**
  - Configuring Member Clock Options | **138**
  - Configuring Primary Clock Options | **140**

Configuring Precision Time Protocol Clocking | 141

Configuring a PTP Primary Boundary Clock | 143

- Configuring the PTP Primary Boundary Clock Parameters | **144**
- Configuring a PTP Primary Boundary Clock Interface | **146**

Example: Configuring a PTP Boundary Clock | 148

- Requirements | **148**
- Overview | **149**

Configuration | 149

Example: Configuring a PTP Boundary Clock With Unicast Negotiation | 152

Requirements | 153

Overview | 153

Configuration | 154

Configuring a PTP Member Clock | 158

Configuring the PTP Member Clock Parameters | 159

Configuring the PTP Member Clock Interface | 161

Example: Configuring an Ordinary Member Clock With Unicast-Negotiation | 163

Requirements | 163

Overview | 164

Configuration | 164

Example: Configuring an Ordinary Member Clock Without Unicast-Negotiation | 167

Requirements | 168

Overview | 168

Configuration | 169

Configuring Precision Time Protocol Over Integrated Routing and Bridging | 171

Configuring PHY Timestamping | 175

Enabling PHY Timestamping for Ordinary Clock Member | 176

Enabling PHY Timestamping for Boundary Clock | 177

Enabling PHY Timestamping for Reference Clock | 178

Configuring PHY Timestamping on ACX2200 Routers | 178

Enabling PHY Timestamping for Boundary Clock | 179

G.703 2.048MHz Signal Type for BITS Interfaces Overview | 180

Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | 181

Configuring the PTP over Ethernet Primary Boundary Clock Parameters | 182

Configuring the PTP over Ethernet Primary Boundary Clock Interface | 184

Configuring the PTP over Ethernet Member Clock Parameters | 185

Configuring the PTP over Ethernet Member Clock Interface | 186

Configuring PTP Dynamic Ports for Ethernet Encapsulation | 187

Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | 189

Requirements | 190

Overview | 190

Configuration | 191

Verifying the PTP over Ethernet Multicast Dynamic, Master, and Slave Settings | 197

Hybrid Mode on ACX Series Routers Overview | 200

Guidelines for Configuring Hybrid Mode on ACX Series Routers | 202

Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204

Configuring the Router in Hybrid Mode | 205

Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | 206

Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | 207

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping | 208

Requirements for Hybrid Mode Configuration | 209

Overview | 209

Configuration | 210

Verification | 213

Understanding Timing Defects and Event Management on ACX Series | 217

Understanding SNMP MIB for Timing on ACX Series | 221

Understanding IEEE 1588 Precision Timing Protocol (PTP) over IRB for Broadcast profiles | 226

5 Configuring Synchronous Ethernet

Synchronous Ethernet Overview | 232

Ethernet Synchronization Message Channel Overview | 244

Synchronous Ethernet on 10-Gigabit Ethernet MIC Overview | 247

Understanding ESMC Quality Level Mapping | 251

Example: Configuring Synchronous Ethernet on MX Series Routers | 256

- Requirements | 257
- Overview | 257
- Configuration | 257
- Verification | 260

Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC | 263

- Requirements | 264
- Overview | 264
- Configuration | 265

6 Configuring Clocking and Synchronization

Centralized Clocking Overview | 270

Understanding Clock Synchronization | 277

Getting Started Configuring Clock Synchronization on PTX Series Routers | 297

Interface and Router Clock Sources Overview | 298

Configuring Junos OS to Support an External Clock Synchronization Interface for M Series, MX Series, and T Series Routers | 301

Configuring Clock Synchronization Interface on MX Series Routers | 303

- Configuring Clock Synchronization Options | 304
- Display the External Clock Synchronization Configuration for SCB | 313
- Display the External Clock Synchronization Configuration for SCBE | 315
- Display the External Clock Synchronization Configuration for SCBE2 | 317
- Displaying the External Clock Synchronization Configuration for MX2020 Control Board | 319

Clock Sources for PTX Series Packet Transport Routers | 321

Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers | 323

- Configuring a Recovered Clock for an FPC | 323
- Configuring External Clock Synchronization Options | 324

Example: Configuring Centralized Clocking on the Enhanced MX Switch Control Board | 328

- Requirements | 328
- Overview | 329
- Configuration | 330
- Verification | 337

Example: Configuring Centralized Clocking on an MX2020 | 341

- Requirements | 342
- Overview | 342
- Configuration | 343
- Verification | 351

7

Configuring Hybrid Mode

Understanding Hybrid Mode | 357

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361

- Configuring the Router in Hybrid Mode | 361
- Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | 362
- Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | 363

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping | 365

- Requirements for Hybrid Mode Configuration | 366
- Overview | 366
- Configuration | 367
- Verification | 371

8

Configuration Statements

aggregated-ether | 378

acquiring-state-announce-grandmaster | 379

bits (Chassis Synchronization) | 381

clock-class | 384

clock-class-to-quality-level-mapping | 385

clock-ipv6-source | 387

clock-source (hybrid) | 389

clock-mode | 391

clock-mode (Clock Synchronization) | 392

clock-ipv6-client | 394

convert-clock-class-to-quality-level | 396

domain | 398

e1-options (BITS Interfaces Signal Type) | 399

e1-options (Clock Synchronization) | 401

e2e-transparent | 403

esmc-transmit (Chassis Synchronization) | 405

force-switch | 407

framing (E1 Options) | 408

framing (T1 Options) | 410

framing (E1 Options for BITS Interfaces) | 411

framing (T1 Options for BITS Interfaces) | 413

global-wait-to-restore | 415

hold-interval (Clock Synchronization) | 417

holdover-mode-disable | 419

holdover-time-error-budget | 420

hold off time | 422

hybrid | 423

interface | 425

interfaces external | 427

ipv4-dscp | 429

line-encoding (E1 Options) | 430

line-encoding (E1 Options) | 432

line-encoding (T1 Options) | 433

local-priority | 435

master | 436

max-transmit-quality-level | 440

minimum-quality | 443

network-option | 445

ntp | 447

ntp (QFabric) | 454

output interfaces (Chassis Synchronization) | 455

phy-timestamping | 458

port (Chassis Synchronization) | 459

primary | 461

priority1 | 463

priority2 | 465

priority (Clock Synchronization) | 466

profile-type | 468

pulse-per-second-enable | 472

quality-level (Clock Synchronization) | 474 quality-level (hybrid) | 476

quality-mode-enable (MX) | 478

quality-mode-enable (PTX) | 480

recovered-clock | 482

remote-ip-address | 483

request (Clock Synchronization) | 486

sabit | 487

secondary | 489

selection-mode | 491

signal-type | 492

signal-type (BITS Interfaces) | 494

server (NTP) | 496

slave | 498

source-address (RADIUS, System Logging, or TACACS+) | 503

source-mode | 505

source interfaces | 507

stateful | 510

squelch | 512

switchover-mode | 515

synchronization (ACX Series) | 517

synchronization (M Series and T Series) | 521

synchronization (MX Series) | 524

synchronization (PTX Series) | 531

synchronous-ethernet-mapping | 534

t1-options | 535

t1-options (BITS Interfaces Signal Type) | 537

time-zone | 539

tx-dnu-to-line-source-enable | 543

unicast-mode | 544

unicast-negotiation | 547

use-imported-time-zones | 549

wait-to-restore | 550

wander-filter-disable | 552

9

Operational Commands

clear synchronous-ethernet esmc statistics | 556

clear synchronous-ethernet wait-to-restore | 557

request chassis ccg | 559

request chassis clock master switch | 561

request chassis pcg | 563

request chassis scg | 565

request chassis synchronization mode | 568

request chassis synchronization switch | 570

set date | 573

show chassis synchronization | 576

show chassis synchronization (MX Series Routers) | 590

show ntp associations | 608

show ntp status | 612

show ptp clock | 616

show ptp aggregated-ethernet interfaces | 621

show ptp hybrid | 624

show ptp global-information | 627

show ptp lock-status | 632

show ptp master | 637

show ptp path-trace detail | 642

show ptp phy-timestamping-interfaces | 645

show ptp port | 647

show ptp quality-level-mapping | 651

show ptp slave | 653

show ptp stateful detail | 658

show ptp statistics | 660

show synchronous-ethernet esmc statistics | 666

show synchronous-ethernet esmc transmit | 669

show synchronous-ethernet global-information | 672

About This Guide

Use this guide to configure time-based protocols for your network devices running Junos OS.

1

CHAPTER

Configuring Date and Time

Setting the Date and Time Locally | 3

NTP Overview | 4

Understanding NTP Time Servers | 7

Synchronizing and Coordinating Time Distribution Using NTP | 8

Configuring NTP | 11

Configuring the NTP Time Server and Time Services | 14

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring NTP Authentication Keys | 19

Configuring the Router or Switch to Listen for Broadcast Messages Using NTP | 20

Configuring the Router or Switch to Listen for Multicast Messages Using NTP | 21

Automatic Clock Selection Overview | 22

External Clock Synchronization Overview for ACX Series Routers | 23

Configuring External Clock Synchronization for ACX Series Routers | 26

Global Positioning System (GPS) and the ACX Series Routers | 34

Integrated Global Navigation Satellite System (GNSS) on ACX500 Series Routers | 35

Assisted Partial Timing Support on ACX500 Routers Overview | 36

Setting the Date and Time Locally

You can set the date and time on a device running Junos OS by using the **set date** operational mode command:

To enter the date and time locally:

1. From operational mode, manually set the date and time.

   Because this is an operational-mode command, there is no need to perform a commit operation.

   ```
   user@host> set date YYYYMMDDhhmm.ss
   ```

   For example:

   ```
   user@host> set date 201307251632
   Thu Jul 25 16:32:00 PDT 2013
   ```

2. Verify the time.

   The **show system uptime** command provides the following information: current time, last boot time, protocols start time, last configuration commit time.

   ```
   user@host> show system uptime
   Current time: 2013-07-25 16:33:38 PDT
   System booted: 2013-07-11 17:14:25 PDT (1w6d 23:19 ago)
   Protocols started: 2013-07-11 17:16:35 PDT (1w6d 23:17 ago)
   Last configured: 2013-07-23 12:32:42 PDT (2d 04:00 ago) by user
    4:33PM  up 13 days, 23:19, 1 user, load averages: 0.00, 0.01, 0.00
   ```

Starting in Junos OS 13.3, you can use the **set date** command from operational mode to instruct the device to retrieve the date and time from a configured NTP server. For example:

- From operational mode, issue the **set date** command and specify **ntp** to retrieve the date and time from a configured NTP server, or specify **ntp** ***ntp-server*** to retrieve the date and time from the given NTP server.

  ```
  user@host> set date ntp ntp-server
  ```

For example:

```
user@host> set date ntp
 25 Jun 16:38:28 ntpdate[2314]: step time server 192.0.2.1 offset -0.004182
sec
```

Release History Table

Release	Description
13.3	Starting in Junos OS 13.3, you can use the set date command from operational mode to instruct the device to retrieve the date and time from a configured NTP server.

RELATED DOCUMENTATION

> Time Management Administration Guide
>
> *set date*

NTP Overview

Network Time Protocol (NTP) is a widely used protocol used to synchronize the clocks of routers and other hardware devices on the Internet. Primary NTP servers are synchronized to a reference clock directly traceable to Coordinated Universal Time (UTC). Reference clocks include GPS receivers and telephone modem services, NTP accuracy expectations depend on the environment application requirements, however, NTP can generally maintain time to within tens of milliseconds over the public internet.

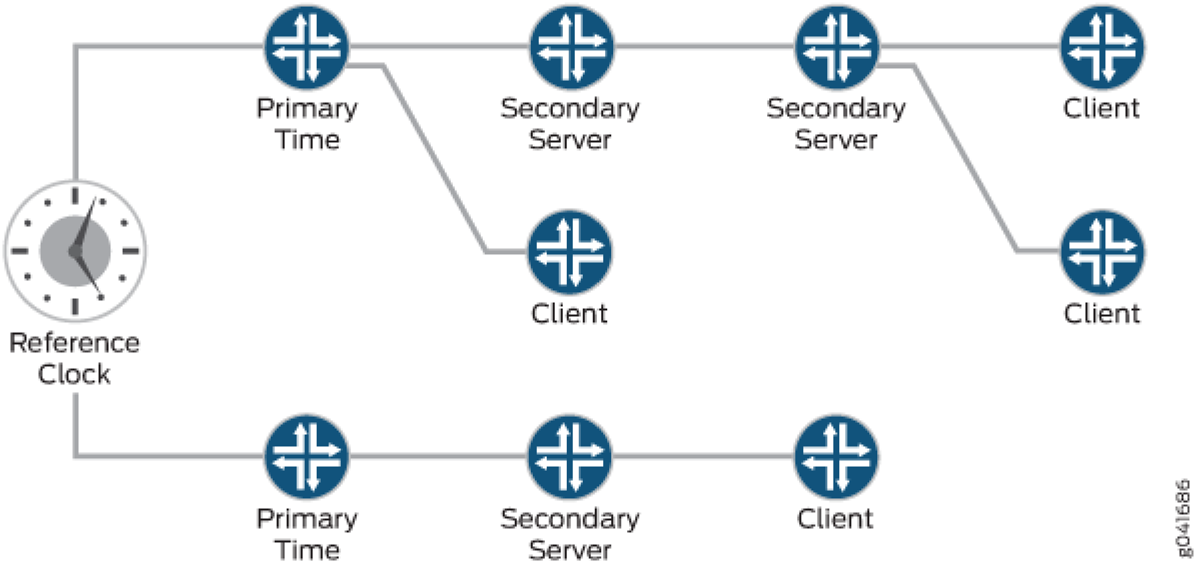
NTP is defined in the RFC 5905: Network Time Protocol Version 4: Protocol and Algorithms Specification

Devices running Junos OS can be configured to act as an NTP client, a secondary NTP server, or a primary NTP server. These variations are as follows:

- Primary NTP Server—Primary NTP servers are synchronized to a reference clock that is directly traceable to UTC. These servers then re-distribute this time data downstream to other Secondary NTP servers or NTP clients.

- Secondary NTP Server—Secondary NTP servers are synchronized to a primary or secondary NTP server. These servers then re-distribute this data downstream to other Secondary NTP servers or NTP clients.

- NTP Client—NTP clients are synchronized to a primary or secondary NTP server. Clients do not re-distribute this time data to other devices.



NOTE: The NTP subnet includes a number of widely accessible public primary time servers that can be used as a network's primary NTP server. Juniper Networks strongly recommends that you authenticate any primary servers you use.

Each device on your network can be configured to run in one or more of the following NTP modes:

- Broadcast Mode—One or more devices is set up to transmit time information to a specified broadcast or multicast address. Other devices listen for time sync packets on these addresses. This mode is less accurate than the client/server mode.

- Client/Server Mode—Devices are organized hierarchically across the network in client/server relationships.

- Symmetric Active (peer) Mode—Two or more devices are configured as NTP server peers to provide redundancy.

By default, if an NTP client time drifts so that the difference in time from the NTP server exceeds 128 milliseconds, the NTP client is automatically stepped back into synchronization. The NTP client will still synchronize with the server even if the offset between the NTP client and server exceeds the 1000-second threshold. You can manually request that a device synchronize with an NTP server by using the

set date ntp operational command on the router. On devices running Junos OS that have dual Routing Engines, the backup Routing Engine synchronizes directly with the primary Routing Engine.

For more details about the Network Time Protocol, go to the Network Time Foundation website at http://www.ntp.org.

NOTE: All Juniper platforms that run Junos OS support the leap second adjustment. By default, if the NTP server is aware of the leap second calculations, then the Junos device will automatically add the 1 second delay. PTP (Precision Time Protocol) is used to detect and propagate leap second synchronization changes throughout all nodes in a network.

NOTE: NTP is required for Common Criteria compliance. For more information on the Common Criteria certification, see Public Sector Certifications.

In Junos operating system (Junos OS) Release 11.2 or later, NTP supports IPv4 VPN routing and forwarding (VRF) requests. This enables an NTP server running on a provider edge (PE) router to respond to NTP requests from a customer edge (CE) router. As a result, a PE router can process any NTP request packet coming from different routing instances. In Junos OS Release 11.4 and later, NTP also supports IPv6 VRF requests. Starting in Junos OS Release 18.2R1, there must be no space in the password for configuring the Network Time Protocol (NTP) authentication-key.

Release History Table

Release	Description
18.2R1	Starting in Junos OS Release 18.2R1, there must be no space in the password for configuring the Network Time Protocol (NTP) authentication-key.

RELATED DOCUMENTATION

Synchronizing and Coordinating Time Distribution Using NTP | 8

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Understanding NTP Time Servers

The IETF defined the Network Time Protocol (NTP) to synchronize the clocks of computer systems connected to each other over a network. Most large networks have an NTP server that ensures that time on all devices is synchronized, regardless of the device location. If you use one or more NTP servers on your network, ensure you include the NTS server addresses in your Junos OS configuration.

When configuring the NTP, you can specify which system on the network is the authoritative time source, or time server, and how time is synchronized between systems on the network. To do this, you configure the router, switch, or security device to operate in one of the following modes:

- Client mode—In this mode, the local router or switch can be synchronized with the remote system, but the remote system can never be synchronized with the local router or switch.

- Symmetric active mode—In this mode, the local router or switch and the remote system can synchronize with each other. You use this mode in a network in which either the local router or switch or the remote system might be a better source of time.

  NOTE: Symmetric active mode can be initiated by either the local or the remote system. Only one system needs to be configured to do so. This means that the local system can synchronize with any system that offers symmetric active mode without any configuration whatsoever. However, we strongly encourage you to configure authentication to ensure that the local system synchronizes only with known time servers.

- Broadcast mode—In this mode, the local router or switch sends periodic broadcast messages to a client population at the specified broadcast or multicast address. Normally, you include this statement only when the local router or switch is operating as a transmitter.

- Server mode—In this mode, the local router or switch operates as an NTP server.

  NOTE: In NTP server mode, the Junos OS supports authentication as follows:

  - If the NTP request from the client comes with an authentication key (such as a key ID and message digest sent with the packet), the request is processed and answered based on the authentication key match.

  - If the NTP request from the client comes without any authentication key, the request is processed and answered without authentication.

RELATED DOCUMENTATION

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Synchronizing and Coordinating Time Distribution Using NTP

IN THIS SECTION

- Configuring NTP | 8
- Configuring the NTP Boot Server | 9
- Specifying a Source Address for an NTP Server | 9

Using NTP to synchronize and coordinate time distribution in a large network involves these tasks:

Configuring NTP

To configure NTP on the router or switch, include the **ntp** statement at the **[edit system]** hierarchy level:

```
[edit system]
ntp {
    authentication-key number type type value password;
    boot-server (address | hostname);
    broadcast <address> <key key-number> <routing-instance-name routing-instance-
name> <ttl value> <version value> ;
    broadcast-client;
    multicast-client <address>;
    peer address <key key-number> <version value> <prefer>;
    server address <key key-number> <version value> <prefer>;
    source-address <source-address> <routing-instance routing-instance-name>;
    trusted-key [ key-numbers ];
}
```

Configuring the NTP Boot Server

When you boot the router or switch, it issues an **ntpdate** request, which polls a network server to determine the local date and time. You need to configure a server that the router or switch uses to determine the time when the router or switch boots. If you configure an NTP boot server, then when the router or switch boots, it immediately synchronizes with the boot server even if the NTP process is explicitly disabled or if the time difference between the client and the boot server exceeds the threshold value of 1000 seconds.

To configure the NTP boot server, include the **boot-server** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
boot-server (address | hostname);
```

Specify the address of the network server. You must specify an IP address or a hostname.

Specifying a Source Address for an NTP Server

For IP version 4 (IPv4), you can specify that if the NTP server configured at the **[edit system ntp]** hierarchy level is contacted on one of the loopback interface addresses, the reply always uses a specific source address. This is useful for controlling which source address NTP will use to access your network when it is either responding to an NTP client request from your network or when it itself is sending NTP requests to your network.

NOTE: The configuration of the source IP address in a routing instance by using the source-address statement at the [edit system ntp source-address *source-address*] hierarchy level is supported only for an NTP server. It is not supported for an NTP client

To configure the specific source address that the reply will always use, and the source address that requests initiated by NTP server will use, include the **source-address** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
source-address source-address;
```

source-address is a valid IP address configured on one of the router or switch interfaces.

Starting in Junos OS 13.3, you can also configure the source address using the **routing-instance** statement at the **[edit system ntp source-address *source-address*]** hierarchy level:

```
[edit system ntp source-address source-address]
user@host# set routing-instance routing-instance-name
```

For example, the following statement is configured:

```
[edit system ntp source-address source-address]
user@host# set system ntp source-address 12.12.12.12 routing-instance ntp-source-test
```

As a result, while sending NTP message through any interface in the *ntp-source-test* routing instance, the source address 12.12.12.12 is used.

NOTE: The **routing-instance** statement is optional and if not configured, the primary address of the interface will be used.

NOTE: If a firewall filter is applied on the loopback interface, ensure that the **source-address** specified for the NTP server at the **[edit system ntp]** hierarchy level is explicitly included as one of the match criteria in the firewall filter. This enables the Junos OS to accept traffic on the loopback interface from the specified source address.

The following example shows a firewall filter with the source address **10.0.10.100** specified in the **from** statement included at the **[edit firewall filter *firewall-filter-name*]** hierarchy:

```
[edit firewall filter Loopback-Interface-Firewall-Filter]
term Allow-NTP {
    from {
        source-address {
                172.17.27.46/32; // IP address of the NTP server
                10.0.10.100/32; // Source address specified for the NTP
server
                }
           then accept;
     }
}
```

If no **source-address** is configured for the NTP server, include the primary address of the loopback interface in the firewall filter.

Release History Table

Release	Description
13.3	Starting in Junos OS 13.3, you can also configure the source address using the routing-instance statement at the [edit system ntp source-address source-address] hierarchy level:

RELATED DOCUMENTATION

NTP Overview | 4

Understanding NTP Time Servers | 7

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring NTP

The Network Time Protocol (NTP) provides the mechanisms to synchronize time and coordinate time distribution in a large, diverse network. Debugging and troubleshooting are much easier when the timestamps in the log files of all the routers or switches are synchronized, because events that span the network can be correlated with synchronous entries in multiple logs. We recommend using the Network Time Protocol (NTP) to synchronize the system clocks of routers, switches, and other network equipment.

To configure NTP:

1. Configure Junos OS to retrieve the time when it first boots up.

Use the **boot-server** statement with the IP address of your NTP server. If DNS is configured, you can use a domain name instead of an IP address.

```
[edit system ntp]
user@host# set boot-server (name | ip-address)
```

For example, set an IP address of 172.16.1.1 for your NTP server.

```
[edit system ntp]
user@host# set boot-server 172.16.1.1
```

For example, set a domain name. In this example, the domain name is provided by pool.ntp.org.

```
[edit system ntp]
user@host# set boot-server 0.north-america.pool.ntp.org
```

2. (Optional) Configure one or more reference NTP servers to keep the device synchronized with periodic updates.

   It is a good practice to do this, as the Junos OS device can remain up for a long time, and therefore the clock can drift.

```
[edit system ntp]
user@host# set server (name | ip-address)
```

For example, set an IP address of 172.16.1.1 for your NTP server.

```
[edit system ntp]
user@host# set server 172.16.1.1
```

For example, set a domain name provided by pool.ntp.org.

```
[edit system ntp]
user@host# set server 0.north-america.pool.ntp.org
```

3. (Optional) Set the local time zone to match the device's location.

   Universal Coordinated Time (UTC) is the default. Many administrators prefer to keep all their devices configured to use the UTC time zone. This approach has the benefit of allowing you to easily compare the time stamps of logs and other events across a network of devices in many different time zones.

On the other hand, setting the time zone allows Junos OS to present the time in the correct local format.

```
[edit system ntp]
user@host# set time-zone time-zone
```

For example:

```
[edit system ntp]
user@host# set time-zone America/Los_Angeles
```

4. Verify the configuration.

   Check the system uptime. This command provides the current time, when the device was last booted, when the protocols started, and when the device was last configured.

```
user@host> show system uptime
Current time: 2013-07-25 16:33:38 PDT
System booted: 2013-07-11 17:14:25 PDT (1w6d 23:19 ago)
Protocols started: 2013-07-11 17:16:35 PDT (1w6d 23:17 ago)
Last configured: 2013-07-23 12:32:42 PDT (2d 04:00 ago) by user
 4:33PM  up 13 days, 23:19, 1 user, load averages: 0.00, 0.01, 0.00
```

   Check the NTP server status and associations of the clocking sources used by your device.

```
user@host> show ntp associations

     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
 tux.brhelwig.co .INIT.          16 -    -  512    0    0.000    0.000 4000.00
```

```
user@host > show ntp status
status=c011 sync_alarm, sync_unspec, 1 event, event_restart,
version="ntpd 4.2.0-a Thu May 30 19:14:15 UTC 2013 (1)",
processor="i386", system="JUNOS13.2-20130530_ib_13_3_psd.1", leap=11,
stratum=16, precision=-18, rootdelay=0.000, rootdispersion=5.130,
peer=0, refid=INIT,
reftime=00000000.00000000  Wed, Feb  6 2036 22:28:16.000, poll=4,
clock=d59d4f2e.1793bce9  Fri, Jul 26 2013 12:40:30.092, state=1,
offset=0.000, frequency=62.303, jitter=0.004, stability=0.000
```

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7
Time Management Administration Guide

Configuring the NTP Time Server and Time Services

IN THIS SECTION

- Configuring the Router or Switch to Operate in Client Mode | 15
- Configuring the Router or Switch to Operate in Symmetric Active Mode | 16
- Configuring the Router or Switch to Operate in Broadcast Mode | 16
- Configuring the Router or Switch to Operate in Server Mode | 17

When you use NTP, configure the router or switch to operate in one of the following modes:

- Client mode
- Symmetric active mode
- Broadcast mode
- Server mode

The following topics describe how to configure these modes of operation:

Configuring the Router or Switch to Operate in Client Mode

To configure the local router or switch to operate in client mode, include the **server** statement and other optional statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
server address <key key-number> <version value> <routing-instance routing-
instance> <prefer>;
authentication-key key-number type type value password;
boot-server address;
trusted-key [ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in "Configuring NTP Authentication Keys" on page 19.

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1, 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

For information about how to configure trusted keys, see "Configuring NTP Authentication Keys" on page 19. For information about how to configure an NTP boot server, see "Configuring the NTP Boot Server" on page 9. For information about how to configure the router or switch to operate in server mode, see "Configuring the Router or Switch to Operate in Server Mode" on page 17.

The following example shows how to configure the router or switch to operate in client mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$9$EgfcrvX7VY4ZEcwgoHjkP5Q3CuREyv87";
boot-server 10.1.1.1;
server 10.1.1.1 key 1 prefer;
trusted-key 1;
```

Configuring the Router or Switch to Operate in Symmetric Active Mode

To configure the local router or switch to operate in symmetric active mode, include the **peer** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
peer address <key key-number> <version value> <prefer>;
```

Specify the address of the remote system. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the remote system, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in "Configuring NTP Authentication Keys" on page 19.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2 or 3, include the **version** option.

If you configure more than one remote system, you can mark one system preferred by including the **prefer** option:

```
peer address <key key-number> <version value> prefer;
```

Configuring the Router or Switch to Operate in Broadcast Mode

To configure the local router or switch to operate in broadcast mode, include the **broadcast** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
broadcast address <key key-number> <version value> <ttl value>;
```

Specify the broadcast address on one of the local networks or a multicast address assigned to NTP. You must specify an address, not a hostname. If the multicast address is used, it must be **224.0.1.1**.

To include an authentication key in all messages sent to the remote system, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in "Configuring NTP Authentication Keys" on page 19.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2, or 3, include the **version** option.

Configuring the Router or Switch to Operate in Server Mode

In server mode, the router or switch acts as an NTP server for clients when the clients are configured appropriately. The only prerequisite for “server mode” is that the router or switch must be receiving time from another NTP peer or server. No other configuration is necessary on the router or switch.

To configure the local router or switch to operate as an NTP server, include the following statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key key-number type type value password;
server address <key key-number> <version value> <routing-instance routing-instance> <prefer>;
trusted-key [ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in "Configuring NTP Authentication Keys" on page 19.

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1, 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

For information about how to configure trusted keys, see "Configuring NTP Authentication Keys" on page 19. For information about how to configure the router or switch to operate in client mode, see "Configuring the Router or Switch to Operate in Client Mode" on page 15.

The following example shows how to configure the router or switch to operate in server mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$9$txERuBEreWx-wtuLNdboaUjH.T3AtOESe";
server 172.17.27.46 prefer;
trusted-key 1;
```

NOTE: When a host is added as an NTP server, it resolves to an IP address prior to being adding to the configuration. When using a public NTP server, the host might resolve to different IP addresses.

If the resolved IP address becomes unreachable for any reason, the switch cannot access the NTP server. In order to leverage public NTP pool entities, this functionality has been modified so that a host is accepted as a string without DNS resolution.

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7
Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization

Debugging and troubleshooting are much easier when the timestamps in the log files of all the routers or switches are synchronized, because events that span the network can be correlated with synchronous entries in multiple logs. We strongly recommend using the Network Time Protocol (NTP) to synchronize the system clocks of routers, switches, and other network equipment.

By default, NTP operates in an entirely unauthenticated manner. If a malicious attempt to influence the accuracy of a router or switch's clock succeeds, it could have negative effects on system logging, make troubleshooting and intrusion detection more difficult, and impede other management functions.

The following sample configuration synchronizes all the routers or switches in the network to a single time source. We recommend using authentication to make sure that the NTP peer is trusted. The **boot-server** statement identifies the server from which the initial time of day and date is obtained when the router boots. The **server** statement identifies the NTP server used for periodic time synchronization. The **authentication-key** statement specifies that an HMAC-Message Digest 5 (MD5) scheme should be used to hash the key value for authentication, which prevents the router or switch from synchronizing with an attacker's host posing as the time server.

```
[edit]
system {
    ntp {
        authentication-key 2 type md5 value "$ABC123"; # SECRET-DATA
        boot-server 10.1.4.1;
        server 10.1.4.2;
    }
}
```

RELATED DOCUMENTATION

- NTP Overview | **4**
- Understanding NTP Time Servers | **7**
- show ntp associations | **608**
- show ntp status | **612**

Configuring NTP Authentication Keys

Time synchronization can be authenticated to ensure that the local router or switch obtains its time services only from known sources. By default, network time synchronization is unauthenticated. The system will synchronize to whatever system appears to have the most accurate time. We strongly encourage you to configure authentication of network time services.

To authenticate other time servers, include the **trusted-key** statement at the **[edit system ntp]** hierarchy level. Only time servers transmitting network time packets that contain one of the specified key numbers and whose key matches the value configured for that key number are eligible to be synchronized to. Other systems can synchronize to the local router without being authenticated.

```
[edit system ntp]
trusted-key [ key-numbers ];
```

Each key can be any 32-bit unsigned integer except 0. Include the **key** option in the **peer**, **server**, or **broadcast** statements to transmit the specified authentication key when transmitting packets. The key is necessary if the remote system has authentication enabled so that it can synchronize to the local system.

To define the authentication keys, include the **authentication-key** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key key-number type type value password;
```

number is the key number, ***type*** is the authentication type (Message Digest 5 [MD5], SHA1, and SHA2-256 are supported), and ***password*** is the password for this key. The password can be up to 20 characters in ASCII format, or 40 characters using hex digits. The key number, type, and password must match on all systems using that particular key for authentication.

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring the Router or Switch to Listen for Broadcast Messages Using NTP

When you are using NTP, you can configure the local router or switch to listen for broadcast messages on the local network to discover other servers on the same subnet by including the **broadcast-client** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
broadcast-client;
```

When the router or switch detects a broadcast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *broadcast client* mode, in which it listens for, and synchronizes to, succeeding broadcast messages.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

RELATED DOCUMENTATION

- Configuring the Router or Switch to Listen for Multicast Messages Using NTP | **21**
- Configuring the NTP Time Server and Time Services | **14**
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | **18**

Configuring the Router or Switch to Listen for Multicast Messages Using NTP

When you are using NTP, you can configure the local router or switch to listen for multicast messages on the local network to discover other servers on the same subnet by including the **multicast-client** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
multicast-client <address>;
```

When the router or switch receives a multicast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *multicast client* mode, in which it listens for, and synchronizes to, succeeding multicast messages.

You can specify one or more IP addresses. (You must specify an address, not a hostname.) If you do, the router or switch joins those multicast groups. If you do not specify any addresses, the software uses **224.0.1.1**.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

RELATED DOCUMENTATION

- Configuring the Router or Switch to Listen for Broadcast Messages Using NTP | **20**
- Configuring the NTP Time Server and Time Services | **14**
- Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | **18**

Automatic Clock Selection Overview

IN THIS SECTION

- Clock Source Selection Algorithm | 22
- Clock Selection and Quality Level | 22
- Selection Mode for the Incoming ESMC Quality | 23

Automatic clock selection is the selection of the best quality clock source by the clock source selection algorithm based on the Ethernet Synchronization Message Channel (ESMC) Synchronization Status Message (SSM) quality level, the configured quality level, and the priority.

Clock Source Selection Algorithm

The clock source selection algorithm is triggered by the following events:

- Changes in the received ESMC SSM quality level (QL)
- Configuration changes. For example, the addition or deletion of a clock source, a change to the QL mode, and so on.
- Signal failure detected on the currently selected source.

When the router is configured with automatic clock selection, the system chooses up to two best upstream clock sources. The system then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable good quality is not available or if the system is configured in free-run mode, the system uses the internal oscillator.

Clock Selection and Quality Level

Automatic clock selection supports two modes: QL enabled and QL disabled.

- QL disabled— In this mode, the best clock is selected based on the configured ESMC SSM QL. If the QL of the configured clocks are equal, the clock selection is based on the configured priority. If both the configured QL and priority are equal, one of the sources is randomly selected. Absence of the

quality-mode-enable statement at the [**edit chassis synchronization**] hierarchy level means that QL is disabled.

NOTE: The default setting is QL disable.

- QL enabled—In this mode, the best clock is selected based on the incoming ESMC SSM QL as long as the incoming QL is at least as good as the source's configured QL. If the QLs are equal, the clock selection is based on the configured priority. If both the received QL and the priority are equal, one of the sources is selected randomly.

Selection Mode for the Incoming ESMC Quality

Depending on the configuration, the clock source selection algorithm uses the configured or received ESMC SSM quality level for clock selection. In both configured and received selection modes, the interface qualifies for clock source selection only when the received ESMC SSM quality level on the interface is equal to or greater than the configured ESMC SSM quality level for the interface.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | 23
Configuring External Clock Synchronization for ACX Series Routers | 26
synchronization (ACX Series) | 517

External Clock Synchronization Overview for ACX Series Routers

IN THIS SECTION

Automatic Clock Selection | 24
Clock Source Selection Algorithm | 25

The ACX Series Universal Metro routers support external clock synchronization and automatic clock selection for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs. Configuring external clock synchronization and automatic clock selection requires making clock selection, quality level (QL), and priority considerations. The clock source selection algorithm is used to pick the two best upstream clock sources from among all the various sources, based on system configuration and execution criteria such as QL, priority, and hardware restrictions.

Automatic Clock Selection

With automatic clock selection, the system chooses up to two best upstream clock sources. The system then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable good quality is not available or if the system is configured in free-run mode, the system uses the internal oscillator. The following automatic clock selection features are supported for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs:

NOTE: Automatic clock selection does not apply to the IEEE 1588v2 recovered clock.

Automatic clock selection is supported on the ACX Series routers. Automatic clock selection of the best quality clock source is based on the Ethernet Synchronization Message Channel (ESMC) Synchronization Status Message (SSM) quality level, the configured quality level, and the priority. To configure automatic clock selection, include the **auto-select** option at the [**edit chassis synchronization**] hierarchy level. You can also configure the chassis to lock to the free-running local oscillator, which is the Stratum 3E oscillator, by including the **free-run** option at the [**edit chassis synchronization**] hierarchy level. The **auto-select** option enables the clock source selection algorithm to run. The clock source selection algorithm is triggered by the following events:

- Signal failure detected on the currently selected source
- Changes in the received Ethernet Synchronization Message Channel (ESMC) Synchronization Status Message (SSM) quality level (QL)
- Configuration changes. For example, the addition or deletion of a clock source, a change to the QL mode, and so on.

Automatic clock selection supports two modes on the ACX Series router: QL enabled and QL disabled. To configure QL mode, include the **quality-mode-enable** statement at the [**edit chassis synchronization**] hierarchy level.

- QL disabled—The default setting is disable, which means that when the **quality-mode-enable** statement is not configured, QL is disabled. In this mode, the best clock is selected based on the configured ESMC SSM QL. If the QL of the best clocks are equal, the clock selection is based on the configured priority. If both the configured QL and priority are equal, one of the sources is randomly selected.

- QL enabled—In this mode, the best clock is selected based on the incoming ESMC SSM QL as long as the incoming QL is at least as good as the source's configured QL. If the QLs are equal, the clock selection is based on the configured priority. If both the received QL and the priority are equal, one of the sources is selected randomly.

Clock Source Selection Algorithm

The clock source selection algorithm uses the following logic and restrictions:

- QL must be configured for non-external clocks, whether or not QL is enabled.
- For **network-option option-1**, QL must be configured for external clocks (**gps** or **bits**) whether or not QL is enabled.
- In the case of **network-option option-2**, the default QL for the external clocks is QL_STU, whether or not QL is enabled.
- Configuring priority is optional. When not specified, **gps** has a higher default priority than **bits**, and **bits** has a higher default priority than Gigabit Ethernet, 10-Gigabit Ethernet, and T1 or E1 clock, which have the lowest default priority.
- When QL is enabled, the received QL must be equal to or better than the configured QL for that particular source or else that source will not be considered for clock selection. This is so that a downstream client is guaranteed clock quality of a certain level (that "certain level" being the configured QL).

During clock selection:

- The active source with the highest QL is selected.
- If QL is the same for two or more sources, then the source with the highest priority is selected.
- If two or more sources have the same QL and priority, then the currently active source, if any, among these sources is selected.
- If two or more sources have the same QL and priority, and none of these is currently active, then any one of these may be selected.
- If selection-mode is *configured quality*, then the configured (or default) QL of the selected clock source is used for transmitting ESMC. If selection-mode is *received quality*, then the received QL of the selected clock source is used for ESMC transmit.

- In order to receive or transmit ESMC messages out of an interface, at least one *logical interface* should be configured on that interface. If the interface is currently not configured with a logical interface, you may do so using the **set interfaces *interface-name* unit 0** statement at the **edit** hierarchy level.

RELATED DOCUMENTATION

> Configuring External Clock Synchronization for ACX Series Routers | 26
>
> *Understanding Interfaces on ACX Series Universal Metro Routers*

Configuring External Clock Synchronization for ACX Series Routers

The ACX Series Universal Metro Routers support external clock synchronization for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs. Configuring external clock synchronization requires making clock selection, quality level (QL), and priority considerations. The clock source selection algorithm is used to pick the two best upstream clock sources from among all the various sources, based on system configuration and execution criteria such as QL, priority, and hardware restrictions.

To configure external synchronization on the router, include the `synchronization` statement at the **[edit chassis]** hierarchy level.

Setting the Ethernet equipment clock (EEC) network type

The network type options set the frequency of the configured clock. When **bits** is configured with **option-1** on the ACX router, the Synchronous Ethernet equipment is optimized for 2048 Kbps, the speed of an E1 interface. When **bits** is configured with **option-2** on the ACX router, the Synchronous Ethernet equipment is optimized for 1544 Kbps, the speed of a T1 interface. To set the clock type, use the following command:

```
set chassis synchronization network-option (option-1 | option-2)
```

For **option-1**, QL must be configured for external clocks (**gps** or **bits**) whether or not QL is enabled. For **option-2**, the default QL for external clocks is QL_STU whether or not QL is enabled.

The following output shows an example of the configuration of the **network type** with **option-1**:

```
[edit]
user@host# show chassis
synchronization {
    network-option option-1;
}
```

Setting the clock mode

Clock mode sets the selection of the clock source from a free-running local oscillator or from an external qualified clock. The default clock mode is **auto-select**, which uses the best clock source. To set the clock mode, use the following command:

```
set chassis synchronization clock-mode (free-run | auto-select)
```

The following output shows an example of the configuration of the **free-run** option:

```
[edit]
user@host# show chassis
synchronization {
    clock-mode free-run;
}
```

NOTE: Automatic clock selection does not apply to the IEEE 1588v2 recovered clock.

Setting the quality mode

Specify the expected quality of the incoming clock on this source. The default is disable. To set the synchronization quality mode, use the following command:

```
set chassis synchronization quality-mode-enable
```

The following output shows the configuration of the **quality-mode-enable** statement:

```
[edit]
user@host# show chassis
```

```
synchronization {
    quality-mode-enable;
}
```

Setting the selection mode

The selection mode specifies whether the clock source selection algorithm should use the configured or received ESMC SSM quality level for clock selection. In both selection modes (**configured-quality** and **received-quality**), the interface qualifies for clock source selection only when the received ESMC SSM quality level on the interface is equal to or greater than the configured ESMC SSM quality level for the interface. To configure the ESMC SSM quality-based clock source selection mode, use the following command:

```
set chassis synchronization selection-mode (configured-quality | received-
quality)
```

The following output shows the configuration of the **selection-mode** statement with the **configured-quality** option and the mandatory **quality-mode-enable** statement:

```
[edit]
user@host# show chassis
synchronization {
    selection-mode configured-quality;
    quality-mode-enable;
}
```

NOTE: For the **selection-mode** statement configuration to take effect, you must set the **quality-mode-enable** statement at the **[edit chassis synchronization]** hierarchy level.

Setting the time interval before a new clock source is selected

For routers operating with Synchronous Ethernet , set the time interval to wait before the router selects a new clock source. After a change in the configuration, the time to wait is between 15 and 60 seconds. After a reboot (restart), the time to wait is from 60 to 180 seconds. After clock recovery (switchover), the time to wait is from 30 to 60 seconds. The default switchover time is 30 seconds and cold boot time is 120 seconds. To set the time interval before a new clock source is selected, use the following command:

```
set chassis synchronization hold-interval (configuration-change | restart |
switchover) seconds
```

The following output shows the configuration of the **hold-interval** statement with the **configuration-change** option:

```
[edit]
user@host# show chassis
synchronization {
    hold-interval {
        configuration-change 20;
    }
}
```

Setting the synchronization switching mode

The configured switching mode determines the clock source used. In revertive mode, the system switches from a lower to a higher quality clock source whenever the higher clock source becomes available. In non-revertive mode, the system continues to use the current clock source as long as it is valid. The default mode is revertive. To set the synchronization switchover mode, use the following command:

```
set chassis synchronization switchover-mode (revertive | non-revertive)
```

The following output shows the configuration of the **switchover-mode** statement with the **non-revertive** option:

```
[edit]
user@host# show chassis
synchronization {
    switchover-mode non-revertive;
}
```

Setting the clock source

The configured clock source is the candidate for selection by the clock selection algorithm. The clock source can be the router’s BITS T1 or E1 interface, GPS, or an interface with an upstream clock source. To set the clock source, use the following command:

```
set chassis synchronization source (bits | gps | interfaces interface-name)
```

The following output shows the configuration of the **source** statement with the **bits** option and the mandatory **network-option** statement. When **bits** is configured with **option-1** on the ACX2000 router, the Synchronous Ethernet equipment is optimized for 2048 Kbps, the speed of an E1 interface.

```
[edit]
user@host# show chassis
synchronization {
    network-option option-1;
    source {
        bits;
    }
}
```

NOTE: For the **source** statement configuration to take effect, you must set the **network-option (option-1 | option-2)** statement at the **[edit chassis synchronization]** hierarchy level.

The **bits** option is not supported on the ACX1000 router.

Setting ESMC transmit interface

The ESMC transmit interface is the interface on which ESMC transmit messages are permitted. To enable ESMC packet transmit, use the following command:

```
set chassis synchronization esmc-transmit interfaces interface-name
```

The following output shows the configuration of the **esmc-transmit** statement:

```
[edit]
user@host# show chassis
synchronization {
    esmc-transmit {
        interfaces ge-0/1/0;
    }
}
```

You can also enable ESMC on all interfaces with the **interfaces all** statement at the preceding hierarchy level.

Setting the synchronization source quality level

Specify the expected quality of the incoming clock on this source. Specific quality-level options are valid depending on the configured **network-option**; **option-1** or **option-2**. Both option-1 and option-2 SSM quality levels are supported. To set the synchronization source quality level, use the following command:

```
set chassis synchronization source (bits | gps | interfaces interface-name)
quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 |
stu | tnc)
```

The following output shows the configuration of the **quality-level** statement configured with the **prc** option:

```
[edit]
user@host# show chassis
synchronization {
    source {
        bits {
            quality-level prc;
        }
    }
}
```

Setting the synchronization source priority

Specify a priority level between 1 and 5. When not specified, **gps** has a higher priority than **bits**,and **bits** has a higher default priority than other Gigabit Ethernet or 10 Gigabit Ethernet clock sources, which have the lowest priority. To set the synchronization source priority, use the following command:

```
set chassis synchronization source (bits | gps | interfaces interface-name)
priority number
```

The following output shows the configuration of the **priority** statement:

```
[edit]
user@host# show chassis
synchronization {
    source {
        bits {
            priority 2;
        }
    }
}
```

Setting the synchronization source wait to restore time

A wait-to-restore time can be configured for each port. When a port’s signal transitions out of the signal fail state, it must be fault free for the wait-to-restore time before it is again considered by the selection process. The range is from **0** through **12** minutes. The default time is 5 minutes.

To set the synchronization source wait-to-restore time, use the following command:

```
set chassis synchronization source interfaces interface-name wait-to-restore
minutes
```

The following output shows the configuration of the **wait-to-restore** statement:

```
[edit]
user@host# show chassis
synchronization {
    network-option option-1;
    source {
        interfaces ge-0/1/0 {
            wait-to-restore 2;
        }
    }
}
```

Setting the synchronization source lockout

A lockout may be configured for any source. When a lockout is configured for a source, that source will not be considered by the selection process. To set the synchronization source lockout, use the following command:

```
set chassis synchronization source (bits | gps | interfaces interface-name)
request lockout
```

The following output shows the configuration of the **request lockout** statement:

```
[edit]
user@host# show chassis
synchronization {
    network-option option-1;
    source {
        bits {
            request lockout;
        }
    }
}
```

Setting the forced switch

Force a switch to the source provided that the source is enabled and not locked out. Only one configured source may be force-switched. To set the forced switch, use the following command:

```
set chassis synchronization source (bits | gps | interfaces interface-name)
request force-switch
```

The following output shows the configuration of the **request force-switch** statement:

```
[edit]
user@host# show chassis
synchronization {
    network-option option-1;
    source {
        bits {
            request force-switch;
        }
        }
}
```

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**

synchronization (ACX Series) | **517**

Interface and Router Clock Sources Overview | **298**

Global Positioning System (GPS) and the ACX Series Routers

Global Positioning System (GPS) is a navigation aid system that uses signals from satellites to calculate the actual position of a GPS-capable receiver. These signals are not only used for determining the position of the receiver on Earth but also as a very accurate time base. There are GPS receivers with 10-MHz clock frequency output synchronized to a GPS satellite. The ACX Series router has a SubMiniature version B (SMB) connector that can take 10-MHz sine-wave input from a GPS receiver. To configure this 10-MHz clock from a GPS receiver as a candidate clock source for chassis synchronization, include the **gps** statement and options at the [**edit chassis synchronization source**] hierarchy level.

NOTE: ACX500 routers do not require an external GPS receiver because the GPS receiver is integrated into the system.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**

Configuring External Clock Synchronization for ACX Series Routers | **26**

source

Integrated Global Navigation Satellite System (GNSS) on ACX500 Series Routers

Global Navigation Satellite System (GNSS) is a navigation aid system that uses signals from satellites to calculate the actual position of a GPS-capable receiver. These signals are not only used for determining the position of the receiver on Earth but also as a very accurate time base.

The ACX500 series router has the GNSS receiver integrated into the system. This eliminates the need to have an external GPS receiver. However, you will need a GPS antenna. The ACX500 series routers support GNSS input through SubMiniature version A (SMA) connector. You can configure the GNSS port and its associated parameters at the [**edit chassis synchronization**] hierarchy level.

You can configure the GNSS port by including the **constellation *gps***] CLI statement at the [**edit chassis synchronization port gnss**] hierarchy level. If you do not specify a **constellation** option, then the *gps* constellation option is considered by default.

The following is the [**edit chassis synchronization port gnss**] hierarchy level:

```
[edit chassis synchronization]
port gnss client {
    cable-length-compensation {
        time delay-in-nanoseconds;
    }
    constellation [gps];
    anti-jamming;
}
```

NOTE:

- The range for **cable-length-compensation** is from *0 to 50000000* nanoseconds.
- The integrated GNSS receiver in the ACX500 series routers do not support 10-MHz frequency input and output.

ACX500 series routers support reference clock functionality with the integrated GNSS receiver.

Use the **show chassis synchronization gnss** command to check the status of the GNSS receiver. For more information, see "show chassis synchronization" on page 576.

RELATED DOCUMENTATION

show chassis synchronization | 576

source

Assisted Partial Timing Support on ACX500 Routers Overview

The assisted partial timing support (APTS), which is a Global Navigation Satellite System (GNSS) backed by Precision Time Protocol (PTP), delivers accurate timing and synchronization in mobile backhaul networks.

NOTE: The APTS feature is supported only on the Junos OS Release 12.3X54–D25 for ACX500 router.

On the ACX500 router, the APTS feature helps you to configure PTP client ports on a GNSS reference clock serving as the PTP primary.

APTS uses GNSS as the primary time reference at cell site locations, or at an aggregation point close to the cell sites. APTS uses network-based timing distribution to assist and maintain the timing during holdover periods when GNSS is unavailable.

To support this feature, you need an APTS node with GNSS source configured at the [**edit chassis synchronization**] hierarchy level and PTP boundary clock configured at the [**edit protocols ptp**] hierarchy level as shown below:

GNSS configuration

```
[edit chassis]
  synchronization {
             network-option <option-1 | option-2>;
             port gnss {
                   client {
                        constellation <constellation-type>;
                       anti-jamming;
                    }
             }
            esmc-transmit {
                 interface <interfaces-name>;
           }
     }
```

PTPoE Configuration

```
[edit protocols]
 ptp {
            clock-mode boundary;
            slave {
                      interface <slave-ptp-ifl> {
                      multicast-mode {
                             transport ieee-802.3 [ link-local ] ;
                      }
                  }
           }
          master {
                interface <master-ptp-ifl> {
                    multicast-mode {
                    transport ieee-802.3 [ link-local ] ;
                  }
               }
        }
```

PTPoIP Configuration

```
[edit protocols]
clock-mode boundary;
    slave {
            interface <logical-interface-name> {
            unicast-mode {
                transport ipv4;
                clock-source <remote-master-ip-address> local-ip-address <local-
slave-ip-address>;
            }
        }
    }
    master {
        interface <logical-interface-name>{
            unicast-mode {
                transport ipv4;
```

```
                    clock-client <remote-slave-ip> local-ip-address  <local-master-
ip>;
               }
          }
     }
    }
```

The priority of clock source would be GNSS first and then PTP.

You can use the **show ptp lock-status detail**, **show chassis synchronization extensive**, and **show chassis synchronization gnss extensive** show commands to monitor and troubleshoot the configurations.

RELATED DOCUMENTATION

show chassis synchronization | **576**

source

2

CHAPTER

Configuring Time Zones

Modifying the Default Time Zone for a Router or Switch Running Junos OS | 40

Updating the IANA Time Zone Database on Junos OS Devices | 41

Modifying the Default Time Zone for a Router or Switch Running Junos OS

The default local time zone on a router or a switching device is UTC (Coordinated Universal Time, formerly known as Greenwich Mean Time, or GMT). To modify the local time zone, include the **time-zone** statement at the **[edit system]** hierarchy level:

```
[edit system]
time-zone (GMThour-offset | time-zone);
```

You can use the **GMT *hour-offset*** option to set the time zone relative to UTC (GMT) time. By default, ***hour-offset*** is 0. You can configure this to be a value in the range from –14 to +12.

You can also specify ***time-zone*** as a string such as PDT (Pacific Daylight Time) or WET (Western European Time), or specify the continent and major city.

> **NOTE**: Junos OS complies with the POSIX time-zone standard, which is counter-intuitive to the way time zones are generally indicated relative to UTC. A time zone ahead of UTC (east of the Greenwich meridian) is commonly indicated as GMT +*n*; for example, the Central European Time (CET) zone is indicated as GMT +1. However, this is not true for POSIX time zone designations. POSIX indicates CET as GMT-1. If you include the **set system time-zone GMT+1** statement for a router or a switch in the CET zone, your device time will be set to one hour behind GMT, or two hours behind the actual CET time. For this reason, you might find it easier to use the POSIX time-zone strings, which you can list by entering **set system time-zone ?**.

For the time zone change to take effect for all processes running on the router or switch, you must reboot the router or switch.

The following example shows how to change the current time zone to **America/New_York**:

```
[edit]
user@host# set system time-zone America/New_York
[edit]
user@host# show
system {
    time-zone America/New_York;
}
```

Starting in Junos OS Release 15.1F6, for the routers with the RE-MX-X6, RE-MX-X8, and RE-PTX-X8 Routing Engines, the date and time zones are synchronized from the admin guest Junos OS to the host OS. Thus, the guest OS and the host OS use the same time zone and there is no difference in the timestamps in system log files of Junos OS and the host OS. This time zone and date synchronization changes the time zone of the host from the default UTC to the configured time zone. However, for the time zone change to take effect for all processes running on the router, reboot the router by using the **request vmhost reboot** command.

RELATED DOCUMENTATION

NTP Overview | 4
Updating the IANA Time Zone Database on Junos OS Devices | 41

Updating the IANA Time Zone Database on Junos OS Devices

IN THIS SECTION

- Importing and Installing Time Zone Files | 41
- Configuring a Custom Time Zone | 43

Junos OS devices use the tz database, also known as the IANA Time Zone Database to manage time zones. This database is periodically updated by IANA to reflect political and time changes. As such, you may need from time to time to update this file to ensure the Junos devices continue to accurately reflect worldwide time zones and daylight savings time intervals.

To update the IANA Time Zone Database, perform the following steps:

Importing and Installing Time Zone Files

The IANA Time Zone Database is maintained by the Internet Assigned Numbers Authority (IANA), which is a department of the Internet Corporation for Assigned Names and Numbers (ICANN). You can download the latest IANA Time Zone Database file from the following URL: http://www.iana.org/time-zones.

The following steps will guide you through one method of installing the file to your device. However, depending on your network access and other preferences, you may need to modify these steps.

1. Log into the Junos device.
2. If you are in the CLI interface, open the shell interface.

```
device@user# start shell
```

3. Create a **tz** directory in the **/var/tmp** and navigate to that directory.

```
# mkdir /var/tmp/tz
# cd /var/tmp/tz
```

4. Using FTP, download the time zone files archive.

NOTE: FTP must be enabled on your device before you can use FTP. FTP is enabled by adding the **ftp** statement into the **[edit system services]** hierarchy.

```
# ftp ftp.iana.org/tz
# bin
# get tzdata-latest.tar.gz
```

NOTE: If needed, you can edit the above untarred files to create or modify the time zones.

5. Select the names of time zone files to compile and feed them to the following script. For example, to generate **northamerica** and **asia** tz files:

```
# /usr/libexec/ui/compile-tz northamerica asia
```

6. Enable the use of the generated tz files using the CLI:

```
[edit]
# set system use-imported-time-zones
```

```
[edit]
# set system time-zone ?
```

This should show the newly generated tz files in **/var/db/zoneinfo/**.

7. Set the time zone and commit the configuration:

```
[edit]
# set system time-zone <your-time-zone>
# commit
```

8. Verify that the time zone change has taken effect:

```
[edit]
# run show system uptime
```

Configuring a Custom Time Zone

To use a custom time zone, follow these steps:

1. Download a time zones archive (from a known or designated source) to the router or switch. Compile the time zone archive using the *zic* time zone compiler, which generates *tz* files.
2. Using the CLI, configure the router or switch to enable the use of the generated tz files as follows:

```
[edit]
user@host# set system use-imported-time-zones
```

3. Display the imported time zones (saved in the directory **/var/db/zoneinfo/**):

```
[edit]
user@host# set system time-zone ?
```

If you do not configure the router to use imported time zones, the Junos OS default time zones are shown (saved in the directory **/usr/share/zoneinfo/**).

RELATED DOCUMENTATION

Modifying the Default Time Zone for a Router or Switch Running Junos OS | **40**

NTP Overview | **4**

Understanding NTP Time Servers | **7**

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | **18**

use-imported-time-zones | **549**

3
CHAPTER

Configuring Network Time Protocols

Understanding NTP Time Servers | 46

Configuring NTP Authentication Keys | 47

Configuring NTP Authentication Keys (QFabric System) | 48

Configuring the NTP Time Server and Time Services | 49

Configuring the NTP Time Server and Time Services (QFabric System) | 53

Configuring the Switch to Listen for Broadcast Messages Using NTP | 54

Configuring the Switch to Listen for Multicast Messages Using NTP | 55

Setting the Date and Time | 55

Synchronizing and Coordinating Time Distribution Using NTP | 57

Example: Configuring NTP | 59

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 64

Understanding NTP Time Servers

The IETF defined the Network Time Protocol (NTP) to synchronize the clocks of computer systems connected to each other over a network. Most large networks have an NTP server that ensures that time on all devices is synchronized, regardless of the device location. If you use one or more NTP servers on your network, ensure you include the NTS server addresses in your Junos OS configuration.

When configuring the NTP, you can specify which system on the network is the authoritative time source, or time server, and how time is synchronized between systems on the network. To do this, you configure the router, switch, or security device to operate in one of the following modes:

- Client mode—In this mode, the local router or switch can be synchronized with the remote system, but the remote system can never be synchronized with the local router or switch.

- Symmetric active mode—In this mode, the local router or switch and the remote system can synchronize with each other. You use this mode in a network in which either the local router or switch or the remote system might be a better source of time.

  NOTE: Symmetric active mode can be initiated by either the local or the remote system. Only one system needs to be configured to do so. This means that the local system can synchronize with any system that offers symmetric active mode without any configuration whatsoever. However, we strongly encourage you to configure authentication to ensure that the local system synchronizes only with known time servers.

- Broadcast mode—In this mode, the local router or switch sends periodic broadcast messages to a client population at the specified broadcast or multicast address. Normally, you include this statement only when the local router or switch is operating as a transmitter.

- Server mode—In this mode, the local router or switch operates as an NTP server.

  NOTE: In NTP server mode, the Junos OS supports authentication as follows:

  - If the NTP request from the client comes with an authentication key (such as a key ID and message digest sent with the packet), the request is processed and answered based on the authentication key match.

  - If the NTP request from the client comes without any authentication key, the request is processed and answered without authentication.

RELATED DOCUMENTATION

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring NTP Authentication Keys

Time synchronization can be authenticated to ensure that the switch obtains its time services only from known sources. By default, network time synchronization is unauthenticated. The switch will synchronize to whatever system appears to have the most accurate time. We strongly encourage you to configure authentication of network time services.

To authenticate other time servers, include the **trusted-key** statement at the **[edit system ntp]** hierarchy level. Only time servers that transmit network time packets containing one of the specified key numbers are eligible to be synchronized. Additionally, the key needs to match the value configured for that key number. Other systems can synchronize to the local switch without being authenticated.

```
[edit system ntp]
 trusted-key[ key-numbers ];
```

Each key can be any 32-bit unsigned integer except 0. Include the **key** option in the **peer**, **server**, or **broadcast** statements to transmit the specified authentication key when transmitting packets. The key is necessary if the remote system has authentication enabled so that it can synchronize to the local system.

To define the authentication keys, include the **authentication-key** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key key-number type type value password;
```

number is the key number, ***type*** is the authentication type (only Message Digest 5 [MD5] is supported), and ***password*** is the password for this key. The key number, type, and password must match on all systems using that particular key for authentication.

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring NTP Authentication Keys (QFabric System)

To configure the authentication keys using the CLI:

1. Configure the authentication-key number.

   ```
   [edit system ntp]
   user@switch# set authentication-key key-number
   ```

   For example, to specify key **5**:

   ```
   user@switch# set authentication-key 5
   ```

2. Specify the type of authentication you want to use.

   ```
   [edit system ntp]
   user@switch# set authentication-key  type type
   ```

   NOTE: MD5 is the only authentication type supported.

   For example, to specify **MD5**:

   ```
   user@switch# set authentication-key type md5
   ```

RELATED DOCUMENTATION

NTP Time Server and Time Services Overview (QFabric System)

Configuring the NTP Time Server and Time Services (QFabric System) | **53**

Configuring the NTP Time Server and Time Services

IN THIS SECTION

- Configuring the Switch to Operate in Client Mode | **49**
- Configuring the Router or Switch to Operate in Symmetric Active Mode | **50**
- Configuring the Router or Switch to Operate in Broadcast Mode | **51**
- Configuring the Router or Switch to Operate in Server Mode | **51**

When you use NTP, configure the switch to operate in one of the following modes:

- Client mode
- Symmetric active mode
- Broadcast mode
- Server mode

The following topics describe how to configure these modes of operation:

Configuring the Switch to Operate in Client Mode

To configure the local router or switch to operate in client mode, include the **server** statement and other optional statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
server address <key key-number> <version value> <prefer>;
authentication-key key-number type type value password;
boot-server address;
trusted-key[ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement, as described in .

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1, 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

The following example shows how to configure the router or switch to operate in client mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$ABC123";
boot-server 10.1.1.1;
server 10.1.1.1 key 1 prefer;
trusted-key 1;
```

SEE ALSO

Configuring NTP Authentication Keys | **47**

Synchronizing and Coordinating Time Distribution Using NTP | **57**

Configuring the Router or Switch to Operate in Symmetric Active Mode

To configure the local router or switch to operate in symmetric active mode, include the **peer** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
peer address <key key-number> <version value> <prefer>;
```

Specify the address of the remote system. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the remote system, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2 or 3, include the **version** option.

If you configure more than one remote system, you can mark one system preferred by including the **prefer** option:

```
peer address <key key-number> <version value> prefer;
```

SEE ALSO

Configuring NTP Authentication Keys | 47

Configuring the Router or Switch to Operate in Broadcast Mode

To configure the local router or switch to operate in broadcast mode, include the **broadcast** statement at the **[edit system ntp]** hierarchy level:

```
 [edit system ntp]
broadcast address <key key-number> <version value> <ttl value>;
```

Specify the broadcast address on one of the local networks or a multicast address assigned to NTP. You must specify an address, not a hostname. If the multicast address is used, it must be 224.0.1.1.

To include an authentication key in all messages sent to the remote system, include the key option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the remote system. To set the NTP version level to 1, 2, or 3, include the version option.

SEE ALSO

Configuring NTP Authentication Keys | 47

Configuring the Router or Switch to Operate in Server Mode

In server mode, the router or switch acts as an NTP server for clients when the clients are configured appropriately. The only prerequisite for “ server mode” is that the router or switch must be receiving time from another NTP peer or server. No other configuration is necessary on the router or switch.

To configure the local router or switch to operate as an NTP server, include the following statements at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
authentication-key  key-number type type value password;
server address <key key-number> <version value> <prefer>;
 [ key-numbers ];
```

Specify the address of the system acting as the time server. You must specify an address, not a hostname.

To include an authentication key in all messages sent to the time server, include the **key** option. The key corresponds to the key number you specify in the **authentication-key** statement.

By default, the router or switch sends NTP version 4 packets to the time server. To set the NTP version level to 1,or 2, or 3, include the **version** option.

If you configure more than one time server, you can mark one server preferred by including the **prefer** option.

The following example shows how to configure the router or switch to operate in server mode:

```
[edit system ntp]
authentication-key 1 type md5 value "$ABC123";
server 192.168.27.46 prefer;
trusted-key 1;
```

SEE ALSO

Configuring NTP Authentication Keys | 47

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7
Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring the NTP Time Server and Time Services (QFabric System)

To configure the external time server using the CLI:

1. Configure the IP address of the external time server.

```
[edit system ntp]
user@switch# set server address
```

   For example, to set an IP address of 10.1.1.1 for your external time server:

```
user@switch# set server 10.1.1.1
```

2. (Optional) Configure the key number to encrypt authentication fields in packets that are sent to the external time server.

```
[edit system ntp]
user@switch# set server address key key-number
```

   For example, to set a key number of 1:

```
user@switch# set server address key
```

3. (Optional) Specify the external time server as a preferred host. Doing this enables the switch to synchronize with the external time server.

   NOTE: The switch can synchronize with the external time server, but the external time server cannot synchronize with the switch.

```
[edit system ntp]
user@switch# set server address prefer
```

4. (Optional) Specify the NTP version number to be used in outgoing NTP packets.

   ```
   user@switch#  set server address version
   ```

   For example, to specify version 3:

   ```
   user@switch#  set server address version 3
   ```

RELATED DOCUMENTATION

NTP Time Server and Time Services Overview (QFabric System)

ntp (QFabric) | 454

Configuring the Switch to Listen for Broadcast Messages Using NTP

When you are using NTP, you can configure the local switch to listen for broadcast messages on the local network to discover other servers on the same subnet by including the **broadcast-client** statement at the **[edit system ntp]** hierarchy level:

```
 [edit system ntp]
broadcast-client;
```

When the switch detects a broadcast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *broadcast client* mode, in which it listens for, and synchronizes to, succeeding broadcast messages.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

RELATED DOCUMENTATION

Configuring the Switch to Listen for Multicast Messages Using NTP | 55

Configuring the NTP Time Server and Time Services | 49

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Configuring the Switch to Listen for Multicast Messages Using NTP

When you are using NTP, you can configure the local switch to listen for multicast messages on the local network to discover other servers on the same subnet by including the **multicast-client** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
multicast-client <address>;
```

When the switch receives a multicast message for the first time, it measures the nominal network delay using a brief client-server exchange with the remote server. It then enters *multicast client* mode, in which it listens for, and synchronizes to, succeeding multicast messages.

You can specify one or more IP addresses. (You must specify an address, not a hostname.) If you do, the router or switch joins those multicast groups. If you do not specify any addresses, the software uses 224.0.1.1.

To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.

RELATED DOCUMENTATION

Configuring the Switch to Listen for Broadcast Messages Using NTP | 54

Configuring the NTP Time Server and Time Services | 49

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Setting the Date and Time

1. Enter operational mode in the CLI.

2. Enter the following command:

```
user@switch> set date  YYYYMMDDHHMM.ss  source-address
```

   For example, the following command sets the date and time.

```
user@switch> set date 201102151010.55
```

3. To set the date and time from an NTP server, enter the following command:

```
user@switch> set date ntp  servers
```

   For example, the following command sets the date and time from an NTP server:

```
user@switch> set date ntp 192.168.40.1
```

4. To set the date and time from more than one NTP server, enter the same command:

```
user@switch> set date ntp  servers
```

   For example, the following command sets the date and time from more than one NTP server:

```
user@switch> set date ntp 192.168.40.1 192.168.40.2
```

RELATED DOCUMENTATION

set date

Synchronizing and Coordinating Time Distribution Using NTP

IN THIS SECTION

- Configuring NTP | 57
- Configuring the NTP Boot Server | 58
- Specifying a Source Address for an NTP Server | 58

Using NTP to synchronize and coordinate time distribution in a large network involves these tasks:

Configuring NTP

- To configure NTP on the switch, include the **ntp** statement at the **[edit system]** hierarchy level:

```
[edit system]
ntp {
    authentication-key number type type value password;
    boot-server (address | hostname);
    broadcast <address> <key key-number> <version value> <ttl value>;
    broadcast-client;
    multicast-client <address>;
    peer address <key key-number> <version value> <prefer>;
    server address <key key-number> <version value> <prefer>;
    source-address source-address;
    trusted-key [ key-numbers ];
}
```

Configuring the NTP Boot Server

When you boot the switch, it issues an **ntpdate** request, which polls a network server to determine the local date and time. You need to configure a server that the switch uses to determine the time when the switch boots. Otherwise, NTP will not be able to synchronize to a time server if the server’s time appears to be very far off of the local switch’s time.

- To configure the NTP boot server, include the **boot-server** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
boot-server (address | hostname);
```

Specify either the IP address or the hostname of the network server.

Specifying a Source Address for an NTP Server

For IP version 4 (IPv4), you can specify that if the NTP server configured at the **[edit system ntp]** hierarchy level is contacted on one of the loopback interface addresses, the reply always uses a specific source address. This is useful for controlling which source address NTP uses to access your network when it is either responding to or sending an NTP client request from your network.

To configure the specific source address that the reply will always use, and the source address that requests initiated by NTP server will use, include the **source-address** statement at the **[edit system ntp]** hierarchy level:

```
[edit system ntp]
source-address source-address;
```

source-address is a valid IP address configured on one of the switch interfaces.

NOTE: If a firewall filter is applied on the loopback interface, ensure that the source address specified for the NTP server at the **[edit system ntp]** hierarchy level is explicitly included as one of the match criteria in the firewall filter. This enables the Junos OS to accept traffic on the loopback interface from the specified source address.

The following example shows a firewall filter with the source address **10.0.10.100** specified in the **from** statement included at the **[edit firewall filter *firewall-filter-name*]** hierarchy:

```
[edit firewall filter Loopback-Interface-Firewall-Filter]
term Allow-NTP {
    from {
        source-address {
            192.168.27.46/16; // IP address of the NTP server
            10.0.10.100/10; // Source address specified for the NTP
server
            }
        then accept;
    }
}
```

If no source address is configured for the NTP server, include the primary address of the loopback interface in the firewall filter.

RELATED DOCUMENTATION

Understanding NTP Time Servers | 7

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization | 18

Example: Configuring NTP

IN THIS SECTION

- Requirements | 60
- Overview | 60
- Configuration | 60
- Verification | 62

The Network Time Protocol (NTP) provides the mechanisms to synchronize time and coordinate time distribution in a large, diverse network. NTP uses a returnable-time design in which a distributed subnet of time servers operating in a self-organizing, hierarchical primary-secondary configuration synchronizes local clocks within the subnet and to national time standards by means of wire or radio. The servers also can redistribute reference time using local routing algorithms and time daemons.

This example shows how to configure NTP:

Requirements

This example uses the following software and hardware components:

- Junos OS Release 11.1 or later
- A switch connected to a network on which an NTP boot server and NTP server reside

Overview

Debugging and troubleshooting are much easier when the timestamps in the log files of all switches are synchronized, because events that span a network can be correlated with synchronous entries in multiple logs. We recommend using the Network Time Protocol (NTP) to synchronize the system clocks of your switch and other network equipment.

In this example, an administrator wants to synchronize the time in a switch to a single time source. We recommend using authentication to make sure that the NTP peer is trusted. The **boot-server** statement identifies the server from which the initial time of day and date are obtained when the switch boots. The **server** statement identifies the NTP server used for periodic time synchronization. The **authentication-key** statement specifies that an HMAC-Message Digest 5 (MD5) scheme is used to hash the key value for authentication, which prevents the switch from synchronizing with an attacker's host that is posing as the time server.

Configuration

IN THIS SECTION

- Procedure | 61

To configure NTP:

Procedure

CLI Quick Configuration

To quickly configure NTP, copy the following commands and paste them into the switch's terminal window:

```
[edit system]
set ntp boot-server 10.1.4.1
set ntp server 10.1.4.2
set ntp authentication-key 2 type md5 value "$ABC123"
```

Step-by-Step Procedure

To configure NTP :

1. Specify the boot server:

   ```
   [edit system]
   user@switch# set ntp boot-server 10.1.4.1
   ```

2. Specify the NTP server:

   ```
   [edit system]
   user@switch# set ntp server 10.1.4.2
   ```

3. Specify the key number, authentication type (MD5), and key for authentication:

   ```
   [edit system]
   user@switch# set ntp authentication-key 2 type md5 value "$ABC123"
   ```

Results

Check the results:

```
[edit system]
user@switch# show
ntp {
    boot-server 10.1.4.1;
    authentication-key 2 type md5 value "$ABC123"; ## SECRET-DATA
    server 10.1.4.2;
}
```

Verification

IN THIS SECTION

- Checking the Time | 62
- Displaying the NTP Peers | 63
- Displaying the NTP Status | 64

To confirm that the configuration is correct, perform these tasks:

Checking the Time

Purpose

Check the time that has been set on the switch.

Action

Enter the **show system uptime** operational mode command to display the time.

```
user@switch> show system uptime
fpc0:
```

```
--------------------------------------------------------------------------
Current time: 2009-06-12 12:49:03 PDT
System booted: 2009-05-15 06:24:43 PDT (4w0d 06:24 ago)
Protocols started: 2009-05-15 06:27:08 PDT (4w0d 06:21 ago)
Last configured: 2009-05-27 14:57:03 PDT (2w1d 21:52 ago) by admin1
12:49PM  up 28 days,  6:24, 1 user, load averages: 0.05, 0.06, 0.01
```

Meaning

The output shows that the current date and time are June 12, 2009 and 12:49:03 PDT. The switch booted 4 weeks, 6 hours, and 24 minutes ago, and its protocols were started approximately 3 minutes before it booted. The switch was last configured by user **admin1** on May 27, 2009, and there is currently one user logged in to the switch.

The output also shows that the load average is 0.05 seconds for the last minute, 0.06 seconds for the last 5 minutes, and 0.01 seconds for the last 15 minutes.

Displaying the NTP Peers

Purpose

Verify that the time has been obtained from an NTP server.

Action

Enter the **show ntp associations** operational mode command to display the NTP server from switch obtained its time.

```
user@switch> show ntp associations
     remote           refid      st t when poll reach   delay   offset  jitter
==============================================================================
*ntp.net .GPS.            1 u  414 1024  377    3.435    4.002   0.765
```

Meaning

The asterisk (*) in front of the NTP server name, or peer, indicates that the time is synchronized and obtained from this server. The delay, offset, and jitter are displayed in milliseconds.

Displaying the NTP Status

Purpose

View the configuration of the NTP server and the status of the system.

Action

Enter the **show ntp status** operational mode command to view the status of the NTP.

```
user@switch> show ntp status
status=0644 leap_none, sync_ntp, 4 events, event_peer/strat_chg,
version="ntpd 4.2.0-a Mon Apr 13 19:09:05 UTC 2009 (1)",
processor="powerpc", system="JUNOS9.5R1.8", leap=00, stratum=2,
precision=-18, rootdelay=2.805, rootdispersion=42.018, peer=48172,
refid=192.168.28.5,
reftime=cddd397a.60e6d7bf  Fri, Jun 12 2009 13:30:50.378, poll=10,
clock=cddd3b1b.ec5a2bb4  Fri, Jun 12 2009 13:37:47.923, state=4,
offset=3.706, frequency=-23.018, jitter=1.818, stability=0.303
```

Meaning

The output shows status information about the switch and the NTP.

RELATED DOCUMENTATION

- Understanding NTP Time Servers | **7**
- Configuring the NTP Time Server and Time Services | **49**
- CLI Explorer

Example: Configuring NTP as a Single Time Source for Router and Switch Clock Synchronization

Debugging and troubleshooting are much easier when the timestamps in the log files of all the routers or switches are synchronized, because events that span the network can be correlated with synchronous entries in multiple logs. We strongly recommend using the Network Time Protocol (NTP) to synchronize the system clocks of routers, switches, and other network equipment.

By default, NTP operates in an entirely unauthenticated manner. If a malicious attempt to influence the accuracy of a router or switch's clock succeeds, it could have negative effects on system logging, make troubleshooting and intrusion detection more difficult, and impede other management functions.

The following sample configuration synchronizes all the routers or switches in the network to a single time source. We recommend using authentication to make sure that the NTP peer is trusted. The **boot-server** statement identifies the server from which the initial time of day and date is obtained when the router boots. The **server** statement identifies the NTP server used for periodic time synchronization. The **authentication-key** statement specifies that an HMAC-Message Digest 5 (MD5) scheme should be used to hash the key value for authentication, which prevents the router or switch from synchronizing with an attacker's host posing as the time server.

```
[edit]
system {
    ntp {
        authentication-key 2 type md5 value "$ABC123"; # SECRET-DATA
        boot-server 10.1.4.1;
        server 10.1.4.2;
    }
}
```

RELATED DOCUMENTATION

- NTP Overview | **4**
- Understanding NTP Time Servers | **7**
- show ntp associations | **608**
- show ntp status | **612**

4

CHAPTER

Configuring Precision Time Protocols

Precision Time Protocol Overview | 68

Configuring G.8275.1 Profile | 74

PTP Trace Overview | 76

Line Card Redundancy Overview | 81

Configuring Precision Time Protocol | 82

Example: Configuring Precision Time Protocol | 90

Understanding Transparent Clocks in Precision Time Protocol | 97

IEEE 1588v2 PTP Boundary Clock Overview | 99

IEEE 1588v2 Precision Timing Protocol (PTP) | 103

Understanding the PTP G.8275.2 Enhanced Profile (Telecom Profile) | 105

Understanding the PTP Media Profiles | 108

PTP over Ethernet on ACX Series Routers Overview | 110

Guidelines for Configuring PTP over Ethernet | 112

Understanding the Precision Time Protocol Enterprise Profile | 115

Configuring Transparent Clock Mode for Precision Time Protocol | 117

Configuring a PTP Transparent Clock | 118

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

Configuring the PTP Media Profiles | 125

Configuring Precision Time Protocol Default Profile | 132

Configuring the Precision Time Protocol Enterprise Profile | 137

Configuring Precision Time Protocol Clocking | 141

Configuring a PTP Primary Boundary Clock | 143

Example: Configuring a PTP Boundary Clock | 148

Example: Configuring a PTP Boundary Clock With Unicast Negotiation | 152

Configuring a PTP Member Clock | 158

Example: Configuring an Ordinary Member Clock With Unicast-Negotiation | 163

Example: Configuring an Ordinary Member Clock Without Unicast-Negotiation | 167

Configuring Precision Time Protocol Over Integrated Routing and Bridging | 171

Configuring PHY Timestamping | 175

Configuring PHY Timestamping on ACX2200 Routers | 178

G.703 2.048MHz Signal Type for BITS Interfaces Overview | 180

Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | 181

Configuring PTP Dynamic Ports for Ethernet Encapsulation | 187

Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | 189

Hybrid Mode on ACX Series Routers Overview | 200

Guidelines for Configuring Hybrid Mode on ACX Series Routers | 202

Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping | 208

Understanding Timing Defects and Event Management on ACX Series | 217

Understanding SNMP MIB for Timing on ACX Series | 221

Understanding IEEE 1588 Precision Timing Protocol (PTP) over IRB for Broadcast profiles | 226

Precision Time Protocol Overview

IN THIS SECTION

- G.8275.1 Telecom Profile | **72**
- PTP over Link Aggregation Group | **73**

Increase in bandwidth requirements on wireless backhaul networks and the need to reduce costs and to improve flexibility have triggered the need for a packet-based backhaul infrastructure. Traditional metro deployments do not cater to the delivery of synchronization services, and this leaves operators with no other choice than to keep older parallel infrastructure. Physical layer–based Synchronous Ethernet and packet-based Precision Time Protocol (PTP) enable routers and switches to deliver synchronization services that meet the requirements of today's mobile network, as well as Long Term Evolution (LTE)–based infrastructures. Physical layer–based technologies function regardless of network load, whereas packet-based technologies require careful architecture and capacity planning. For information about Synchronous Ethernet, see "Synchronous Ethernet Overview" on page 232.

PTP, also known as IEEE 1588v2, is a packet-based technology that enables the operator to deliver synchronization services on packet-based mobile backhaul networks. IEEE 1588 PTP (Version 2) clock synchronization standard is a highly precise protocol for time synchronization that synchronizes clocks in a distributed system. The time synchronization is achieved through packets that are transmitted and received in a session between a *primary clock* and a *client clock*.

The system clocks can be categorized based on the role of the node in the network. They are broadly categorized into ordinary clocks and boundary clocks. The primary clock and the client clock are known as ordinary clocks. The boundary clock can operate as either a primary clock or a client clock. The following list explains these clocks in detail:

- Primary clock—The primary clock transmits the messages to the PTP clients (also called client node or boundary node). This allows the clients to establish their relative time distance and offset from the primary clock (which is the reference point) for phase synchronization. Delivery mechanism to the clients is either unicast or multicast packets over Ethernet or UDP.

- Member clock—Located in the PTP client (also called client node), the client clock performs clock and time recovery operations based on the received and requested timestamps from the primary clock.

- Boundary clock—The boundary clock operates as a combination of the primary and client clocks. The boundary clock endpoint acts as a client clock to the primary clock, and also acts as the primary to all the slaves reporting to the boundary endpoint.

For more information about configuring PTP, see "Configuring Precision Time Protocol" on page 82 and "Example: Configuring Precision Time Protocol" on page 82.

Table 1 on page 69 summarizes the first Junos OS release that supports PTP on various Juniper Networks devices:

Table 1: Precision Time Protocol Support

Juniper Networks Devices	Junos OS Release
MX80 Universal Routing Platforms with model number MX80-P	12.2
MX-MPC2E-3D-P (MPC2E P) on MX240, MX480, and MX960 routers	12.2
MX-MPC2E-3D-P (MPC2E P) on MX2010 and MX2020 routers	12.3
MX-MPC2E- 3D-NG (MPC2E NG)	15.1R2
MPC4E-3D-32XGE-SFPP on MX240, MX480, MX960, MX2010, MX2020	15.1R1
MPC4E-3D-2CGE-8XGE on MX240, MX480, MX960, MX2010, MX2020	15.1R1
MPC3E-3D-NG-Q on MX240, MX480, MX960, MX2010, MX2020	15.1R2
MPC3E-3D-NG on MX240, MX480, MX960, MX2010, MX2020	15.1R2

Table 1: Precision Time Protocol Support *(Continued)*

Juniper Networks Devices	Junos OS Release
Following enhanced MPCs support PTP (1588v2): • MPC5E-40G10G on MX240, MX480, MX960, MX2010, and MX2020 routers • MPC5EQ-40G10G on MX240, MX480, MX960, MX2010, and MX2020 routers • MPC5E-100G10G on MX240, MX480, MX960, MX2010, and MX2020 routers • MPC5EQ-100G10G on MX240, MX480, MX960, MX2010, and MX2020 routers • MX2K-MPC6E on MX2010, and MX2020 routers	14.2R2
Ethernet Modular Interface Cards (MICs) on MX240, MX480, and MX960 routers	12.2
Ethernet Modular Interface Cards (MICs) on MX2010 and MX2020 routers	12.3
On MX240, MX480, MX960, MX2010, and MX2020 routers, the following Enhanced MPCs (MPCEs) support PTP (1588v2) under express licensing only: • MPC1E (MX-MPC1E-3D) • MPC1E Q (MX-MPC1E-3D-Q) • MPC2E (MX-MPC2E-3D) • MPC2E Q (MX-MPC2E-3D-Q) • MPC2E EQ (MX-MPC2E-3D-EQ) For more information about obtaining a license, contact JTAC.	12.3

Table 1: Precision Time Protocol Support ***(Continued)***

Juniper Networks Devices	Junos OS Release
ACX Series Universal Metro Routers	12.2
MPC6E, MPC7E, MPC8E, MPC9E, MPC2E NG, and MPC3E NG on MX2008.	17.2
Fixed port PIC (6xQSFPP) and modular MIC (JNP-MIC1) on MX10003 routers	17.3
Fixed port PICs (4xQSFP28 and 8xSFPP) on MX204 routers	17.4
MPC7E-10G and MPC7E-MRATE on MX240, MX480, MX960, MX2010, MX2020	17.4
MPC8E and MPC9E on MX2010, MX2020	17.4

You can configure timestamping either at the physical layer or at the nonphysical layer on the 10-Gigabit Ethernet and 100-Gigabit Ethernet ports. Juniper Networks recommends that you configure timestamping at the physical layer if the port supports IEEE 1588 timestamping, which is also known as *PHY timestamping*.

NOTE:

- On 10-Gigabit Ethernet ports, PHY timestamping and WAN-PHY framing are mutually exclusive—that is, you cannot configure PHY timestamping on a 10-Gigabit Ethernet port if you have configured WAN-PHY framing mode on that port. This is applicable only for MPC5E and MPC6E with 24x10XGE MIC.
- PHY timestamping is *not* supported on the enhanced MPCs MPC1E, MPC2E, and MPC4E. Only hardware timestamping is supported on these MPCs. Therefore, a packet delay variation (also known as jitter) of up to 1 microsecond is observed on these MPCs for a very small percentage of packets occasionally. Hardware timestamping is typically timestamping either at FPGA or similar device.

- Unified in-service software upgrade (unified ISSU) is currently not supported when clock synchronization is configured for PTP on the MICs and Enhanced MPCEs on MX240, MX480, MX960, MX2010, and MX2020 routers.
- To switch between the PTP and Synchronous Ethernet modes, you must first deactivate the configuration for the current mode and then commit the configuration. Wait for a short period of 30 seconds, configure the new mode and its related parameters, and then commit the configuration.

G.8275.1 Telecom Profile

Profiles were introduced in IEEE 1588-2008 to define a combination of options and attribute values, aimed at supporting a given application. G.8275.1 is a PTP profile for telecom applications requiring accurate phase and time synchronization. It supports the architecture defined in ITU-T G.8275 to enable the distribution of phase and time with full timing support and is based on the second version of PTP defined in [IEEE 1588].

NOTE: If you don’t configure a profile, the device operates in IEEE1588v2 profile which is the default profile.

NOTE: ACX Series routers do not support G.8275.1 Telecom Profile.

The following sections give a brief overview about the types of clocks supported in the G.8275.1 profile and about the Alternate BMCA:

Types of Clocks Supported in the G.8275.1 Profile

There are two types of clocks supported in this profile, the ordinary clock and the boundary clock.

There are two types of ordinary clocks:

- One that can be only a reference clock (T-GM)
- One that can be only a client clock (a client-only ordinary clock or T-TSC)

There are two types of boundary clocks:

- One that can be only a reference clock (T-GM)

- One that can become a primary clock and a client clock to another PTP clock (T-BC)

NOTE: MX Series routers support the TSC and TBC clock types.

Alternate BMCA

The G.8275.1 profile uses an alternate Best Master Clock Algorithm (BMCA). The alternate BMCA allows:

- A new per-port attribute named **notSlave**. The **notSlave** port attribute is implemented using the **protocols ptp master** stanza configuration.
- Multiple active reference clocks.
- Per-port attribute **local-priority** to be used as a tie-breaker in the dataset comparison algorithm.

PTP over Link Aggregation Group

Junos Supports PTP over LAG based on the recommendation in ITU-T-G.8275.1. For each aggregated Ethernet link configured as PTP primary or client, you can specify one member link of the aggregated Ethernet bundle as primary and another as secondary. PTP switches over to the secondary member in the aggregated Ethernet bundle when the primary aggregated Ethernet link is down. For providing both link-level and FPC-level redundancy, the primary and secondary interfaces of the aggregated Ethernet bundle must be configured on separate line cards. If both primary and secondary are configured on the same line card, it would provide only link-level redundancy.

PTP primary streams are created on the FPC on which the primary interface is present. Announce and sync packets are transmitted on this active PTP aggregated Ethernet link. The line card on the PTP client containing this active PTP aggregated Ethernet link will receive announce and sync packets from the remote primary.

This table summarizes the first Junos OS release that supports PTP over LAG on various Juniper Networks devices:

Table 2: PTP over LAG Support

Juniper Network Devices	PTP over IPv4	PTP over Ethernet
MPC2E NG	17.2R1	–

MPC3E NG	17.2R1	–
MPC5E	17.2R1	18.2R1
MPC6E	17.2R1	18.2R1
MPC7E-10G	18.1R1	18.3R1
MPC7E–MRATE	18.1R1	18.3R1
MPC8E	18.1R1	18.3R1
MPC9E	18.1R1	18.3R1

RELATED DOCUMENTATION

Centralized Clocking Overview | **270**

Synchronous Ethernet Overview | **232**

Understanding Hybrid Mode | **357**

Configuring G.8275.1 Profile

You can configure the G.8275.1 PTP profile for applications requiring accurate phase and time synchronization. It supports the architecture defined in ITU-T G.8275 to enable the distribution of phase and time with full timing support and is based on the second version of PTP defined in [IEEE 1588].

To configure the G8275.1 profile:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

```
[edit]
user@host# edit protocols ptp
```

2. Configure the G.8275.1 profile.

```
[edit protocols ptp]
user@host# set profile-type g.8275.1
```

3. Configure the clock mode as either boundary or ordinary.

   The **boundary** option signifies that the clock can be both a primary clock and a client clock. The **ordinary** option signifies that the clock is either a primary clock or a client clock.

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

4. Configure the PTP domain option with values from 24 through 43. The default value is 24.

```
[edit protocols ptp]
user@host# set domain domain-value
```

5. Configure the **priority2** option with values from 0 through 255. The default value is 128.

   The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

```
[edit protocols ptp]
user@host# set priority2 priority2-value
```

6. Configure stateful interface for boundary clock mode of operation.

```
[edit protocols ptp stateful]
user@host# edit interface interface-name
```

   NOTE: For the configuration to work, the interface you specify must be configured at the [**edit interfaces *interface-name***] hierarchy level.

7. Configure multicast transmission of Precision Time Protocol (PTP) packets.

```
[edit protocols ptp stateful interface interface-name]
user@host# set multicast-mode
```

8. Configure the **local-priority** option. This attribute to be used as a tie-breaker in the dataset comparison algorithm, in the event that all other previous attributes of the datasets being compared are equal.

```
[edit protocols ptp stateful interface interface-name multicast-mode]
user@host# set local-priority local priority-value
```

9. Specify the encapsulation type for PTP packet transport as Ethernet or IEEE 802.3.

```
[edit protocols ptp stateful interface interface-name multicast-mode]
user@host# set transport ieee-802.3
```

10. Specify the asymmetry value.

```
[edit protocols ptp stateful interface interface-name multicast-mode]
user@host# set asymmetry asymmetry value
```

After you have configured the PTP G.8275.1 profile, enter the **commit** command from configuration mode.

RELATED DOCUMENTATION

Centralized Clocking Overview | 270
Synchronous Ethernet Overview | 232
Understanding Hybrid Mode | 357

PTP Trace Overview

IN THIS SECTION

- PTP Ring Topology | 77
- Path Trace Mechanism Overview | 78
- Steady State | 79

Failure Handling | 80
PTP Ring Topology Without Path Trace Mechanism | 81

Precision Time Protocol (PTP), also known as IEEE 1588v2, works on the principle of phase synchronization and frequency synchronization—it synchronizes both frequency and phase, including time of day. Phase synchronization is achieved either by adjusting the phase of the client clock (the router's internal clock oscillator) discontinuously—by receiving clock signals from the primary clock at irregular periods of time—or by adjusting the phase-locked loop of the client's internal clock at regular intervals. The accuracy of clock synchronization depends on factors such as packet delay variation, quality of oscillator used, network asymmetry, and so on. For information about PTP, see "Precision Time Protocol Overview" on page 68.

Starting with Junos OS Release 13.3R4, you can implement a path trace mechanism to detect PTP loops that circulate endlessly within a PTP ring of boundary clocks over an IPv4 network. The PTP ring topology implementation uses the 1588v2 path trace mechanism to prevent PTP loops and to provide PTP convergence in the event of any single-point failure.

The following sections explain the path trace mechanism and how it is implemented in a multiple-reference clock PTP ring topology over an IPv4 network. The sections also explain steady state and failure handling in a PTP ring topology:

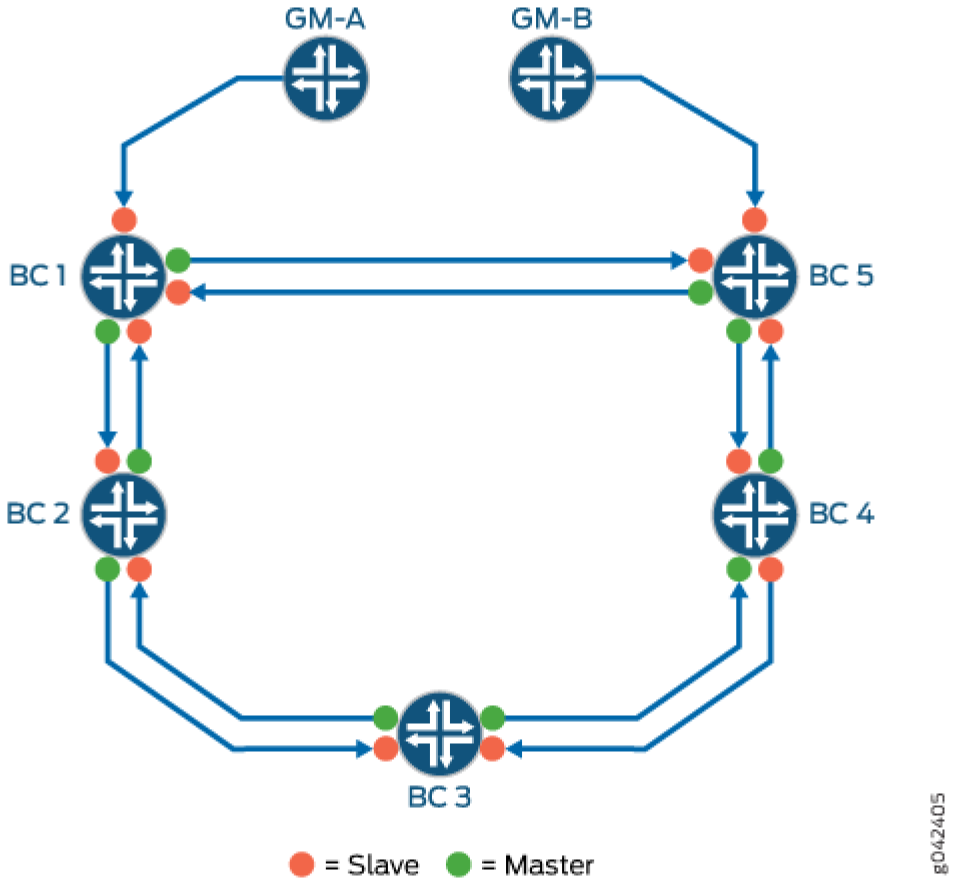
PTP Ring Topology

A PTP ring topology is a ring topology that consists of one or more reference clocks and several boundary clocks.

Consider a simple ring topology of boundary clocks—BC1 through BC5—driven by one primary PTP reference clock and one backup PTP reference clock—GM-A and GM-B, respectively—as illustrated in

Figure 1 on page 78. Assume that GM-A is superior to GM-B—that is, the quality level of GM-A's clock is higher than that of GM-B's clock.

Figure 1: Multiple-reference Clock PTP Ring Topology



Each boundary clock in the PTP ring is configured as both client and primary to its immediate neighbor to provide seamless PTP reference clock switchover in case of reference or boundary clock failure. For example, in Figure 1 on page 78 BC2 is both primary and client to both BC1 and BC3, BC3 is both primary and client to BC2 and BC4, and so on.

Path Trace Mechanism Overview

During the process of synchronization in a PTP ring topology, certain announce messages—timing information messages that are sent from primary to client—might form in an infinite loop (also called *PTP loop*) in a network trail of boundary clocks. These PTP loops create issues such as a boundary clock potentially synchronizing its local clock with its own timing information, thereby compromising the quality of the recovered clock. The path trace mechanism is used to detect such loops.

A *path trace* is the route that a PTP announce message takes through the network trail of boundary clocks and is tracked through the path trace TLV in the announce message. A path trace TLV (type, length, and value) is a set of octets in an announce message that includes the TLV type, the length field, and the path sequence. The path trace sequence contains the clock ID of each boundary clock that an announce message traverses through the PTP ring.

One of the principal uses of the path trace mechanism is to detect the so-called *rogue announce messages* that circulate endlessly in loops in the PTP ring of boundary clocks. A boundary clock detects a PTP loop when it finds its own clock ID in the path trace of the received announce message. When such a loop is detected, the router discards the received announce message.

To view the trail of the announce message or path trace, use the **show ptp path-trace detail** operational mode command. For more information, see "show ptp path-trace detail" on page 642.

NOTE:

- During GRES, the path trace and the best primary clock algorithm information are pushed to the kernel. Therefore, this information is available on the backup Routing Engine as well.
- When the number of boundary clocks in a topology exceeds 20, the path trace TLV is dropped.
- Currently, the PTP ring topology is supported only for PTP over IPv4 networks.

Steady State

The PTP ring is considered to be in steady state or operating normally when a router, say BC1, is locked—that is, is connected and synchronized—to a reference clock that has a higher quality level value—higher than the quality level of other reference clocks in the network—and all the other routers in the PTP ring are locked to the reference clock through this router BC1. For example in Figure 1 on page 78, during steady state, BC1 is locked to GM-A, BC2 and BC5 are locked to BC1, BC3 is locked to BC2, and BC4 is locked to BC5. When the path trace mechanism is implemented in this ring topology, a clock ID is assigned to each boundary clock that, in turn, is included in the path trace TLV within the announce message. Therefore, the path trace TLV in the announce message originating from BC1 has its own clock ID—CID1. Similarly, the announce message from BC2 has its own clock ID—CID2—and BC1's clock ID–CID1—and so on.

As router BC2 is primary to BC1, BC1 constantly receives BC2's announce messages. The announce messages from BC2 received on BC1 contains BC1's own clock ID—CID1—along with BC2's clock ID—

CID2. Because BC1 receives its own clock ID—CID1—in the announce message, BC1 drops BC2’s announce messages. Similarly, BC2 drops BC3’s announce messages as the messages contain BC2’s clock ID—CID2—along with other clock IDs—CID1 and CID3. Note that this behavior is intentional and by design, as is explained in "Failure Handling" on page 80.

Failure Handling

Consider a scenario where the router BC1 crashes in the PTP ring illustrated in Figure 1 on page 78. This failure is handled in the following way:

1. The router BC2 stops receiving announce messages from BC1.

2. The announce messages now received by BC2 are only those sent by BC3. BC2 drops these announce messages because these messages contain BC2’s own clock ID—CID2.

3. Because BC2 does not receive any valid announce messages, it goes into holdover mode and lowers the value of its announce parameters, such as clock class, which results in BC2 announce messages carrying an inferior clock class.

4. When BC3 receives these announce messages with inferior clock class from BC2, it in turn announces this inferior clock class to all the downstream routers.

5. When BC5 eventually receives this announce message with the inferior quality level value from BC4, the best primary clock algorithm running on the BC5 router switches BC5 to GM-B automatically and the BC5 router sends announce messages corresponding to the parameters as set by GM-B.

6. When BC4 receives this announce message—carrying superior clock class information as compared to that carried by BC3's announce message—the BC4 router switches to BC5. Similarly, BC3 locks to BC4 and then BC2 locks to BC3. In other words, the ring topology shown in Figure 1 on page 78 converges to a clockwise hierarchy of boundary clocks. This entire process takes a few tens of seconds.

Note that each PTP best primary clock algorithm switchover at each boundary clock is seamless and thereby ensures that the performance of the PTP ring does not degrade. However, when there are multiple simultaneous failures in the ring topology—for example, simultaneous link failures between GM-A and BC1 and between BC4 and BC5—the short-term absolute maximum time interval error (MTIE) might go up to 650ns—for example, between routers BC2 to BC4. Note that this type of multiple failures in a ring topology is rare.

MTIE is a maximum phase variation error that is measured over a period of time, where the error is calculated between the phase variation of a signal with the perfect signal.

PTP Ring Topology Without Path Trace Mechanism

When the PTP path trace mechanism is not implemented, the BC2 router cannot detect announce messages from BC3 that are actually BC2's looped announce messages. This, in turn, results in BC2 attempting to lock to BC3 (while BC3 is already locked to BC2) and a PTP deadlock is created. Because of the PTP deadlock, there is a significant clock drift over a period of time on both BC2 and BC3 and potentially on all the boundary clocks that can be traced to BC3.

Note that when the crashed router BC1 comes up, it chooses GM-A as its primary, and it sends out announce messages that carry superior clock class information compared to those carried by announce messages sent out by GM-B. The BC2 router's best primary clock algorithm determines that the BC1's announce messages carry superior clock class information as compared to BC3's, resulting in BC2 switching back to BC1. Similarly, BC3 switches back to BC2. This way, the ring topology is restored to the pre-crash topology.

Release History Table

Release	Description
13.3R4	Starting with Junos OS Release 13.3R4, you can implement a path trace mechanism to detect PTP loops that circulate endlessly within a PTP ring of boundary clocks over an IPv4 network.

RELATED DOCUMENTATION

Centralized Clocking Overview | 270
Synchronous Ethernet Overview | 232
Understanding Hybrid Mode | 357

Line Card Redundancy Overview

Line card redundancy is one the PTP redundancy scenarios possible in a mobile backhaul solution. Multiple client streams are configured across line cards and if the currently active client line card crashes or all streams on that line card lose their timing packets another client line card can take over if it has been primed to do so.

When you configure line card redundancy, client streams are created on appropriate line cards. At this time all of the line cards are in DPLL mode. All of the client streams are primed to receive and process announce messages.

Each line card executes the BMCA algorithm and identifies the best primary and the stream serving the best primary. The line card sends the best primary information to the RE. After receiving best primary information from individual line cards, the RE selects the best primary to serve the BC node. This information is propagated to all of the line cards. Once the best primary is selected by the RE, the regular PTP state machine will be executed.

If the BMCA algorithm results in a stream switchover and the new stream falls on a different line card, a hitless switchover will be triggered. The new client card may be configured in pure PTP or Hybrid mode. The old client card may in pure PTP client or Hybrid client mode. The line cards need to go through following steps:

- A client line card transition needs to happen via holdover state on the primary line card.
- FSM needs to convert the old client line card to pure PTP primary mode.
- On the new client card, FSM needs to be triggered based on pure PTP or hybrid mode of operation. All these transitions need to be hitless.

NOTE: Line card redundancy is currently only supported on MPC2E P line cards.

RELATED DOCUMENTATION

Centralized Clocking Overview | 270
Synchronous Ethernet Overview | 232
Understanding Hybrid Mode | 357

Configuring Precision Time Protocol

IN THIS SECTION

- Configuring PTP Options | 83
- Configuring Member Clock Options | 84
- Configuring Primary Clock Options | 87

You can configure the primary clock and the client clock for Precision Time Protocol (PTP) to help synchronize clocks in a distributed system. This time synchronization is achieved through packets that are transmitted and received in a session between the primary clock and the client clock.

Configuring PTP Options

To configure PTP options:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

   ```
   [edit]
   user@host# edit protocols ptp
   ```

2. Configure the clock mode as either boundary or ordinary. This attribute is mandatory and has no default value.

   The **boundary** option signifies that the clock can be both a primary clock and a client clock. The **ordinary** option signifies that the clock is either a primary clock or a client clock.

   ```
   [edit protocols ptp]
   user@host# set clock-mode (boundary | ordinary)
   ```

3. Configure the PTP domain option with values from 0 through 127. The default value is 0.

   ```
   [edit protocols ptp]
   user@host# set domain domain-value
   ```

4. Configure the **priority1** option with values from 0 through 254. The default value is 128.

   The **priority1** value determines the best primary clock. The *priority1-value* is also advertised in the primary clock's announce message to other slaves.

   ```
   [edit protocols ptp]
   user@host# set priority1 priority1-value
   ```

5. Configure the **priority2** option with values from 0 through 255. The default value is 128.

The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

```
[edit protocols ptp]
user@host# set priority2 priority2-value
```

6. Configure the **unicast-negotiation** option to enable unicast negotiation.

   Unicast negotiation is a method by which the announce, sync, and delay response packet rates are negotiated between the primary clock and the client clock before a PTP session is established.

```
[edit protocols ptp]
user@host# set unicast-negotiation
```

> **NOTE**: Unicast negotiation, when enabled, does not allow you to commit any packet rate–related configuration.

Configuring Member Clock Options

Configure the following options after the aforementioned PTP options have been set.

1. Configure the client clock.

```
[edit protocols ptp]
user@host# edit slave
```

2. Configure the **announce-timeout** option in the client node with values from 2 through 10. The default value is 3.

   The announce timeout value signifies the number of times an announce interval message has to pass through the client without receiving the announce message—that is, the timeout period for announce messages.

```
[edit protocols ptp slave]
user@host# set announce-timeout announce-timeout-value
```

3. Configure the **delay-request** option in the client node with values from –6 through 6. The default value is –4.

The delay request value is the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary.

```
[edit protocols ptp slave]
user@host# set delay-request delay-request-value
```

4. Configure the **frequency-only** option to enable only frequency synchronization in the client.

```
[edit protocols ptp slave]
user@host# set frequency-only
```

NOTE: This option is configured only when PTP is used for frequency synchronization and not for phase synchronization. Also, note that this option can only be set for an ordinary clock acting as client.

5. Configure the interface for the client.

```
[edit protocols ptp slave]
user@host# edit interface interface-name
```

6. Configure the **unicast-mode** option for the client. You can set this option when PTP unicast mode of messaging is needed.

```
[edit protocols ptp slave interface interface-name]
user@host# edit unicast-mode
```

7. Configure the **transport** option in unicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# set transport ipv4
```

8. Configure the IP address of the client.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# edit clock-source ip-address
```

9. Configure the IP address of the interface acting as the local PTP client port.

```
[edit protocols ptp slave interface interface-name unicast-mode clock-source
ip-address]
user@host# set local-ip-address local-ip-address
```

NOTE: You must configure this IP address at the [**edit interfaces *interface-name***] hierarchy level.

10. You can configure PTP over IPv4 over a link aggregation group for MPC2E NG, MPC3E NG, MPC5E, MPC6E, MPC7E-10G, MPC7E-MRATE, MPC8E, and MPC9E.

    For each aggregated Ethernet link configured as PTP client, you can specify one member link of the aggregated Ethernet bundle as primary and another as secondary.

```
[edit protocols ptp slave interface interface-name ]
user@host# set primary interface-name
user@host# set secondary interface-name
```

11. Starting in Junos OS Release 15.2R1, you can configure multicast mode option for the client port. In this mode, PTP over Ethernet uses multicast addresses and a client port can automatically start receiving the multicast announce messages transmitted by the primary ports on a network. The client port can start communicating with the primary port with minimal or no configuration.

```
[edit protocols ptp slave interface interface-name ]
user@host# set multicast-mode
```

12. Configure Ethernet as the encapsulation type of transport for the PTP packets. You can further enable 802.3 Ethernet encapsulation to use a specific set of multicast MAC addresses while transmitting the PTP packets over Ethernet.

```
[edit protocols ptp slave interface interface-name multicast-mode]
asymmetry number;
transport 802.3 link-local;
```

NOTE: It is mandatory to use the **transport** statement while configuring the multicast-mode for primary and client interfaces.

13. You can configure PTP over Ethernet over a link aggregation group for MPC5E, MPC6E, MPC7E-10G, MPC7E-MRATE, MPC8E, MPC9E, and MPC10E line cards.

    For each aggregated Ethernet link configured as PTP client, you can specify one member link of the aggregated Ethernet bundle as primary and another as secondary.

    ```
    [edit protocols ptp slave interface interface-name ]
    user@host# set primary interface-name
    user@host# set secondary interface-name
    ```

Configuring Primary Clock Options

Configure the following options after the aforementioned PTP options and client clock options have been set.

1. Configure the primary clock.

    ```
    [edit protocols ptp]
    user@host# edit master
    ```

2. Configure the **announce interval** option for the primary with values from 0 through 4. The default value is 1.

    The announce interval is the logarithmic mean interval between announce messages that is sent by the primary. By default, one announce message is sent in every two seconds.

    ```
    [edit protocols ptp master]
    user@host# set announce-interval announce-interval-value
    ```

3. Configure the **clock step** option as either one-step or two-step for the primary. The default value is one-step.

    The clock step determines whether the timing information is sent along with the sync message only (one-step) or a subsequent follow-up message (two-step) is sent corresponding to the previous sync message.

    ```
    [edit protocols ptp master]
    user@host# set clock-step (one-step | two-step)
    ```

4. Configure the **sync interval** option for the primary clock with values from –6 through 6. The default value is –6.

   The sync interval is the logarithmic mean interval between synchronous messages that is sent by the primary. By default, 64 synchronous interval messages are sent per second.

   ```
   [edit protocols ptp master]
   user@host# set sync-interval sync-interval-value
   ```

5. Configure the interface for the primary.

   ```
   [edit protocols ptp master]
   user@host# edit interface interface-name
   ```

6. Configure the unicast mode option for the primary. You can set this option when PTP unicast mode of messaging is needed.

   ```
   [edit protocols ptp master interface interface-name]
   user@host# edit unicast-mode
   ```

7. Configure the **transport** option in unicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

   ```
   [edit protocols ptp master interface interface-name unicast-mode]
   user@host# set transport ipv4
   ```

8. Configure the IP address for the client.

   ```
   [edit protocols ptp master interface interface-name unicast-mode]
   user@host# edit clock-client ip-address
   ```

9. Configure the IP address of the interface acting as the local PTP primary port.

   ```
   [edit protocols ptp master interface interface-name unicast-mode clock-
   client ip-address]
   user@host# set local-ip-address local-ip-address
   ```

10. You can configure PTP over IPv4 over a link aggregation group for MPC2E NG, MPC3E NG, MPC5E, MPC6E, MPC7E-10G, MPC7E-MRATE, MPC8E, and MPC9E.

For each aggregated Ethernet link configured as PTP primary, you can specify one member link of the aggregated Ethernet bundle as primary and another as secondary.

```
[edit protocols ptp master interface interface-name ]
user@host# set primary interface-name
user@host# set secondary interface-name
```

11. Starting with Junos OS Release 15.2R1, you can configure multicast mode option for the primary port. In this mode, PTP over Ethernet uses multicast addresses and a client port can automatically start receiving the multicast announce messages transmitted by the primary ports on a network. The client port can start communicating with the primary port with minimal or no configuration.

```
[edit protocols ptp master interface interface-name ]
user@host# set multicast-mode
```

12. Configure Ethernet as the encapsulation type of transport for the PTP packets. You can further enable 802.3 Ethernet encapsulation to use a specific set of multicast MAC addresses while transmitting the PTP packets over Ethernet.

```
[edit protocols ptp master interface interface-name multicast-mode]
asymmetry number;
transport 802.3 link-local;
```

NOTE: It is mandatory to use the **transport** statement while configuring the multicast-mode for primary and client interfaces.

13. You can configure PTP over Ethernet over a link aggregation group for MPC5E, MPC6E, MPC7E-10G, MPC7E-MRATE, MPC8E, MPC9E, and MPC10E line cards.

    For each aggregated Ethernet link configured as PTP primary, you can specify one member link of the aggregated Ethernet bundle as primary and another as secondary.

```
[edit protocols ptp master interface interface-name ]
user@host# set primary interface-name
user@host# set secondary interface-name
```

Release History Table

Release	Description
15.2R1	Starting in Junos OS Release 15.2R1, you can configure multicast mode option for the client port.
15.2R1	Starting with Junos OS Release 15.2R1, you can configure multicast mode option for the primary port.

RELATED DOCUMENTATION

Centralized Clocking Overview | 270

Synchronous Ethernet Overview | 232

Understanding Hybrid Mode | 357

Example: Configuring Precision Time Protocol

IN THIS SECTION

- Requirements for PTP Configuration | 93
- Overview | 93
- Verification | 94

Configuration

CLI Quick Configuration

To quickly configure PTP on an interface, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

```
[edit]
set interfaces ge-0/1/0 unit 0 family inet address 192.0.2.5/24

set interfaces ge-0/1/5 unit 0 family inet address 198.51.100.5/24
set protocols ptp clock-mode boundary priority1 1 priority2 2 domain 0 unicast-negotiation

set protocols ptp slave interface ge-0/1/0.0 unicast-mode transport ipv4

set protocols ptp slave announce-timeout 2 delay-request –4 frequency-only

set protocols ptp slave interface ge-0/1/0.0 unicast-mode clock-source 192.0.2.3 local-ip-address 192.0.2.5

set protocols ptp master interface ge-0/1/5.0 unicast-mode transport ipv4

set protocols ptp master announce-interval 0 clock-step one-step sync-interval 0

set protocols ptp master interface ge-0/1/5.0 unicast-mode clock-client 198.51.100.3 local-ip-address 198.51.100.5
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

For step-by-step configuration, see "Configuring Precision Time Protocol" on page 82.

To configure PTP, perform the following tasks:

1. Configure two interfaces and assign IP addresses to it.

   ```
   [edit]
   user@host# set interfaces ge-0/1/0 unit 0 family inet address 192.0.2.5/24
   user@host# set interfaces ge-0/1/5 unit 0 family inet address 198.51.100.5/24
   ```

2. Configure the clock mode, priorities, domain, and unicast negotiation options for PTP.

   ```
   [edit protocols ptp]
   user@host# set clock-mode boundary priority1 1 priority2 2 domain 0 unicast-negotiation
   ```

3. Configure the client interface

   ```
   [edit protocols ptp slave]
   user@host# set interface ge-0/1/0.0 unicast-mode transport ipv4
   ```

4. Configure the announce timeout, delay request, and frequency synchronization parameters for the client.

```
[edit protocols ptp slave]
user@host# set announce-timeout 2 delay-request -4 frequency-only
```

5. Assign the IP address of the remote primary using the **clock-source** option and the IP address of the local interface acting as the client.

```
[edit protocols ptp slave interface ge-0/1/0.0 unicast-mode]
user@host# set clock-source 192.0.2.3 local-ip-address 192.0.2.5
```

6. Configure the primary interface

```
[edit protocols ptp master]
user@host# set interface ge-0/1/5.0 unicast-mode transport ipv4
```

7. Configure the announce interval, clock step, and synchronous interval parameters for the primary.

```
[edit protocols ptp master]
user@host# set announce-interval 0 clock-step one-step sync-interval 0
```

8. Configure the remote PTP host that will receive time from the PTP primary using the clock-client option and the IP address of the local interface acting as primary.

```
[edit protocols ptp master interface ge-0/1/5.0 unicast-mode]
user@host# set clock-client 198.51.100.3 local-ip-address 198.51.100.5
```

Results

Display the results of the configuration:

```
[edit protocols ptp]
user@host# show
clock-mode boundary;
```

```
priority1 1;
priority2 2;
domain 0;
unicast-negotiation;
slave {
    frequency-only;
    delay-request -4;
    announce-timeout 2;
    interface ge-0/1/0.0 {
        unicast-mode {
            transport ipv4;
            clock-source 192.0.2.3 local-ip-address 192.0.2.5;
        }
    }
}
master {
    announce-interval 0;
    sync-interval 0;
    clock-step one-step;
    interface ge-0/1/5.0 {
        unicast-mode {
            transport ipv4;
            clock-client 198.51.100.3 local-ip-address 198.51.100.5;
        }
    }
}
```

Requirements for PTP Configuration

This example uses the following hardware and software components:

- One MX80, MX240, MX480, or MX960 router
- Junos OS Release 12.2 or later

Overview

This example shows the configuration of Precision Time Protocol (PTP) on all Ethernet Modular Interface Cards (MICs) on the enhanced Module Port Concentrator (MPCE) MX-MPC2E-3D-P on MX240, MX480, and MX960 routers and on the MX80 Universal Routing Platforms with precision timing support (MX80-P).

PTP synchronizes clocks between nodes in a network, thereby enabling the distribution of an accurate clock over a packet switched network. This synchronization is achieved through packets that are transmitted and received in a session between the primary clock and the client clock. PTP also supports boundary clock.

NOTE: You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.

Verification

IN THIS SECTION

- Verifying the PTP Clock Details | 94
- Verifying the Lock Status of the Member | 95
- Verifying the PTP Options on the Member | 95
- Verifying the PTP Options and the Current Status of the Primary | 96
- Verifying the Number and Status of the PTP Ports | 96

Confirm that the configuration is working properly.

Verifying the PTP Clock Details

Purpose

Verify that the PTP clock is working as expected.

Action

In operational mode, enter the **run show ptp clock** command to display the clock details.

Meaning

The output displays the clock details, which include the parameters configured on the node. For more information about the **run show ptp clock** operational command, see "show ptp clock" on page 616.

Verifying the Lock Status of the Member

Purpose

Verify that the client clock is aligned to the primary clock by checking the lock status of the client.

Action

In operational mode, enter the **run show ptp lock-status** command to display the lock status of the client.

Meaning

The output displays information about the lock status of the client. The output shows whether the client is aligned to the primary clock or not. For more information about the **run show ptp lock-status** operational command, see "show ptp lock-status" on page 632.

Verifying the PTP Options on the Member

Purpose

Verify the PTP options that are set on the client and its current status.

Action

In operational mode, enter the **run show ptp slave** command to display the configured client.

Meaning

The output displays information about the configured client and the status of the client. For more information about the **run show ptp slave** operational command, see "show ptp slave" on page 653.

Verifying the PTP Options and the Current Status of the Primary

Purpose

Verify the PTP options that are set for the ` and its current status.

Action

In operational mode, enter the **run show ptp master** command to display the configured options for the primary.

Meaning

The output displays information about the configured primary and the current status of the primary. For more information about the **run show ptp master** operational command, see "show ptp master" on page 637.

Verifying the Number and Status of the PTP Ports

Purpose

Verify the number of PTP ports and their current status.

Action

In operational mode, enter the **run show ptp port** command to display the configured ports.

Meaning

The output displays information about the number of ports created according to the configuration and their current status. For each unique local IP address, one PTP port is created. For more information about the **run show ptp port** operational command, see "show ptp port" on page 647.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | **82**

Precision Time Protocol Overview | **68**

Understanding Transparent Clocks in Precision Time Protocol

The Precision Time Protocol (PTP) standardized by IEEE 1588 improves the current methods of synchronization used within a distributed network. You can use PTP across packet-based networks including, but not limited to, Ethernet networks. Queuing and buffering delays in the switch can cause variable delay to packets, which affects path delay measurements. Queuing delays vary based on the network load and also depend on the architecture of the switch or the router.

Transparent clocks measure and adjust for packet delay. The transparent clock computes the variable delay as the PTP packets pass through the switch or the router.

The QFX5100, EX4600, ACX5048, ACX5096, ACX6360-OR, and PTX10001-20C devices act as transparent clocks only and operate between the primary and client clocks in a distributed network. Transparent clocks improve synchronization between the primary and client clocks and ensure that the primary and client clocks are not impacted by the effects of packet delay variation. The transparent clock measures the residence time (the time that the packet spends passing through the switch or the router), and adds the residence time into the correction field of the PTP packet. The client clock accounts for the packet delay by using both the timestamp of when it started and the information in the correction field.

ACX5048 , ACX5096, ACX6360-OR, and PTX10001-20C devices support end-to-end transparent clocks. With an end-to-end transparent clock, only the residence time is included in the correction field of the PTP packets. The residence timestamps are sent in one packet as a one-step process. In a two-step process, which is not supported on ACX6360-OR, and PTX10001-20C devices, estimated timestamps are sent in one packet, and additional packets contain updated timestamps.

NOTE: ACX5048 , ACX5096, ACX6360-OR, and PTX10001-20C devices support only the one-step process, which means that the timestamps are sent in one packet.

You can enable or disable a transparent clock globally for the switch or router. With a global configuration, the same configuration is applied to each interface. If the transparent clock is disabled, PTP packet correction fields are not updated. If the transparent clock is enabled, the PTP packet correction fields are updated.

On QFX5100 and EX4600 switches, PTP over Ethernet, IPv4, IPv6, unicast, and multicast for transparent clocks are supported.

NOTE: ACX5048 and ACX5096 routers do not support PTP over IPv6 for transparent clocks.

NOTE: ACX6360-OR and PTX10001-20C devices support PTP over IPv6 for transparent clocks.

ACX5048 and ACX5096 routers do not support the following:

- Boundary clock
- Ordinary clock
- Transparent clock over MPLS switched path
- Transparent clock with more than two VLAN tags

ACX6360-OR and PTX10001-20C devices do not support the following:

- Boundary, ordinary, primary, and client clocks
- Transparent clock over MPLS switched path
- Transparent clock with more than two VLAN tags
- PTP over Ethernet
- PTP over IPv4
- PTP multicast mode
- Configuration of unicast and broadcast modes.

  Unicast mode is enabled by default.
- Transparent clock in transponder mode
- PTP while MACSec is enabled
- Two-step process

NOTE: You might notice higher latency when you use copper SFP ports instead of fiber SFP ports. In this case, you must compensate the latency introduced by the copper SFP ports for the accurate CF (correction factor) measurement.

RELATED DOCUMENTATION

Configuring Transparent Clock Mode for Precision Time Protocol | **117**

e2e-transparent | **403**

IEEE 1588v2 PTP Boundary Clock Overview

IN THIS SECTION

- IEEE 1588v2 PTP Boundary Clock | **99**
- Clock Clients | **102**

The IEEE 1588v2 standard defines the Precision Time Protocol (PTP), which is used to synchronize clocks throughout a network. The standard describes the PTP boundary clock's hierarchical primary/client architecture for the distribution of time-of-day.

IEEE 1588v2 PTP Boundary Clock

Starting with Junos OS Release 17.3R1, IEEE 1588v2 boundary clock is supported on QFX10002 switches. An IEEE 1588v2 boundary clock has multiple network connections and can act as a source (primary) and a destination (client) for synchronization messages. It synchronizes itself to a best *primary clock* through a client port and supports synchronization of remote clock clients to it on primary ports. Boundary clocks can improve the accuracy of clock synchronization by reducing the number of 1588v2-unaware hops between the primary and the client. Boundary clocks can also be deployed to deliver better scale because they reduce the number of sessions and the number of packets per second on the primary.

The boundary clock intercepts and processes all PTP messages and passes all other traffic. The best primary clock algorithm (BMCA) is used by the boundary clock to select the best configured acceptable primary clock that a boundary client port can see. To configure a boundary clock, include the **boundary** statement at the [**edit protocols ptp clock-mode**] hierarchy level and at least one primary with the **master** statement and at least one client with the **slave** statement at the [**edit protocols ptp**] hierarchy level.

ACX5448 router supports PTP boundary clocks for phase and time synchronization using IEEE-1588 Precision Timing Protocol (PTP). The ACX5448 router supports the following features:

- PTP over IPv4 (IEEE-1588v2)
- PTP ordinary and boundary clocks
- One step clock mode operation for PTP Primary
- 10Mhz and 1PPS output for measurement purpose

All PTP packets uses the best-effort queue instead of network control queue.

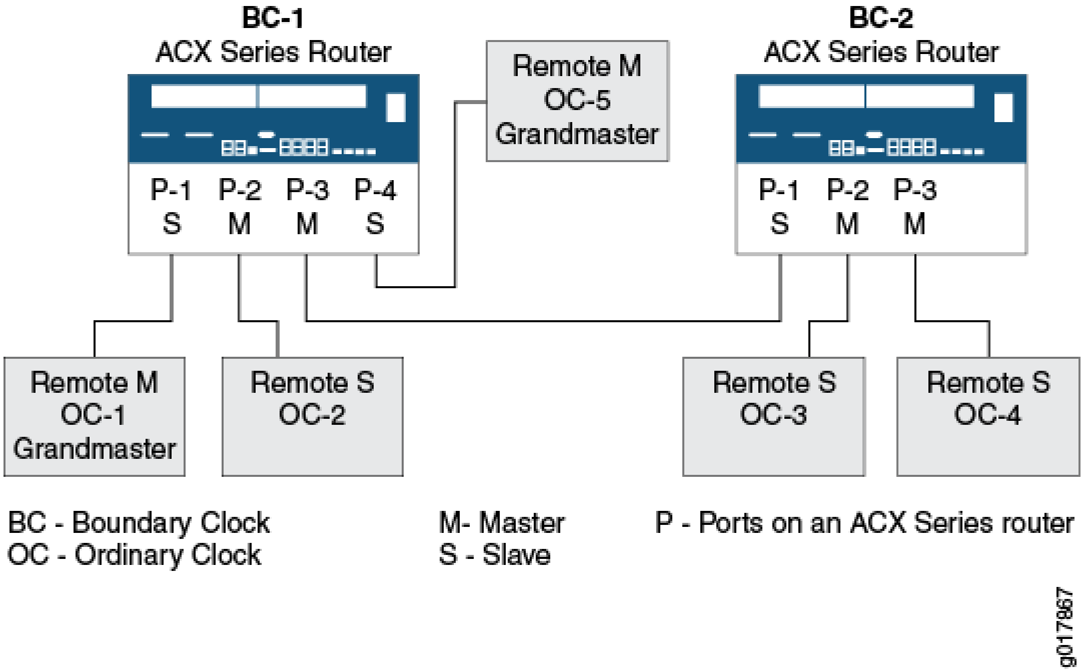
If **clksyncd-service** restart is initiated, then the **show ptp lock status detail** CLI command output of **Clock reference state** and **1pps reference state** fields shows incorrect information. The following is a sample of output for **show ptp lock status detail**:

```
user@host> show ptp lock-status detail
Lock Status:

Lock State     : 5 (PHASE ALIGNED)
Phase offset   : 0.000000010 sec
State since    : 2018-11-22 00:38:56 PST (00:10:18 ago)

Selected Master Details:
Upstream Master address     : 12.0.0.1
Slave interface             : xe-0/0/20.0
Clock reference state       : Clock locked
1pps reference state        : Clock qualified
```

Figure 2 on page 101 illustrates two boundary clocks in a network in which the clock flow is from the upstream node (BC-1) to the downstream node (BC-2).

NOTE: This figure also applies to MX Series routers and QFX Series switches.

Figure 2: Boundary Clocks in a Network


BC-1
ACX Series Router
P-1 S
P-2 M
P-3 M
P-4 S
Remote M
OC-5
Grandmaster
BC-2
ACX Series Router
P-1 S
P-2 M
P-3 M
Remote M
OC-1
Grandmaster
Remote S
OC-2
Remote S
OC-3
Remote S
OC-4
BC - Boundary Clock
OC - Ordinary Clock
M- Master
S - Slave
P - Ports on an ACX Series router
g017867

The first boundary clock—BC-1—has four ports. Each port is configured as follows:

- BC-1 P-1 and BC-1 P-4 are boundary client ports connected to two reference clocks—OC-1 and OC-5. The reference clocks are included as the clock sources in the client port configurations. From the packets received on the client ports, BC-1 selects the best primary, synchronizes its clock, and generates PTP packets, which are sent over the primary ports—BC-1 P-2 and BC-1 P-3—to the downstream clients.

- BC-1 P-2, a primary port, is connected to OC-2, an ordinary remote client. OC-2 is included as a clock client in BC-1 P-2's primary configuration, and so receives PTP packets from BC-1 P-2.

- BC-1 P-3, a primary port, is connected to BC-2 P-1, a remote boundary client port. In this situation, the primary port—BC-1 P-3—is included as a clock source in the configuration of the boundary client port—BC-2 P-1. In addition, the boundary client port—BC-2 P-1—is included as a clock client in the configuration of the primary port—BC-1 P-3. With this configuration, the boundary client—BC-2 P1—receives PTP packets from BC-1 P3.

The second boundary clock—BC-2—has three ports. Each port is configured as follows:

- BC-2 P-1 is a boundary client port connected to the upstream primary port—BC-1 P3. As described previously, BC-2 P-1 receives PTP packets from BC-1 P3. The primary ports—BC-2 P-2 and BC-2 P-3—synchronize their time from the packets received from BC-2 P1.
- BC-2 P-2 and BC-2 P-3, boundary primary ports, are connected to ordinary remote slaves—OC-3 and OC-4. OC-3 and OC-4 are included as clock clients in the configuration of the primary ports—BC-2 P2 and BC-2 P-3. Both slaves receive PTP packets from the primary boundary port to which they are connected.

In this example, the boundary clock synchronizes its clock from the packets received on its client ports from the upstream primary. The boundary clock then generates PTP packets, which are sent over the primary port to downstream clients. These packets are timestamped by the boundary clock by using its own time, which is synchronized to the selected upstream primary.

Clock Clients

A clock client is the remote PTP host, which receives time from the PTP primary and is in a client relationship to the primary.

NOTE: The term *client* is sometimes used to refer to the clock client.

An device acting as a primary boundary clock supports the following types of downstream clients:

- Automatic client—An automatic client is configured with an IP address, which includes the subnet mask, indicating that any remote PTP host belonging to that subnet can join the primary clock through a unicast negotiation. To configure an automatic client, include the subnet mask in the **clock-client** ***ip-address*** statement at the [**edit protocols ptp master interface** ***interface-name*** **unicast-mode**] hierarchy level.
- Manual client—A manual client is configured with the **manual** statement at the [**edit protocols ptp master interface** ***interface-name*** **unicast-mode clock-client ip-address local-ip-address** ***local-ip-address***] hierarchy level. A manual client does *not* use unicast negotiation to join the primary clock. The **manual** statement overrides the **unicast negotiation** statement configured at the [**edit protocols ptp**] hierarchy level. As soon as you configure a manual client, it starts receiving announce and synchronization packets.
- Secure client—A secure client is configured with an exact IP address of the remote PTP host, after which it joins a primary clock through unicast negotiation. To configure a secure client, include the exact IP address in the **clock-client** ***ip-address*** statement at the [**edit protocols ptp master interface** ***interface-name*** **unicast-mode**] hierarchy level.

NOTE: You can configure the maximum number of clients (512) in the following combination:

- Automatic clients 256.
- Manual and secure clients 256—Any combination of manual and secure clients is allowed as long as the combined total amounts to 256.

Release History Table

Release	Description
17.3R1	Starting with Junos OS Release 17.3R1, IEEE 1588v2 boundary clock is supported on QFX10002 switches.

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

Precision Time Protocol Overview | **68**

Configuring Precision Time Protocol Clocking | **141**

Supported IPv4, TCP, and UDP Standards

IEEE 1588v2 Precision Timing Protocol (PTP)

Starting with Junos OS Release 19.1R1, on QFX5110 switches, the IEEE 1588v2 Precision Time Protocol default profile supports aggregated Ethernet interfaces and the loopback interface using IPv4 and IPv6 unicast transport.The IEEE 1588v2 standard defines the Precision Time Protocol (PTP), which is used to synchronize clocks throughout a packet-switched network. This synchronization is achieved through packets that are transmitted and received in a session between a *primary clock* and a *client clock* or remote clock client. The clocks used for the distribution of accurate time are in an hierarchical primary/client architecture, which includes boundary clocks, ordinary clocks, and reference clocks. A boundary clock is both a clock source *and* a clock client. An ordinary clock is either a clock source *or* a clock client. However, a reference clock is always a clock source. An ordinary clock on a device is always a clock client. In addition, User UDP over IPv4 and unicast mode are used to transport PTP messages.

NOTE: In ACX Series routers, the reference clock functionality is supported only on ACX500 router.

The following key PTP features are supported:

- Boundary clock—A boundary clock has multiple network connections and can act as a source (primary) and a destination (client or clock client) for synchronization messages. It synchronizes itself to a best primary clock through a client port and supports synchronization of clients to it on primary ports. Boundary clocks can improve the accuracy of clock synchronization by reducing the number of 1588v2-unaware hops between the primary and the client. Boundary clocks can also be deployed to deliver better scale because they reduce the number of sessions and the number of packets per second on the primary.

- Ordinary clock—The PTP ordinary clock has a single network connection and can act as a source (primary) or destination (client or clock client) for synchronization messages. On devices, the ordinary clock is a client, which receives synchronization reference messages from a primary, either a reference or a primary boundary clock. You cannot configure an ordinary primary on a device. However, a boundary clock can provide time to the ordinary client.

- PTP reference clock—The PTP reference clock communicates time information to destination or client ports. The reference clock is an external device to which the boundary or ordinary clock synchronizes. You cannot configure a reference clock on a device. However, a boundary clock client or an ordinary clock client can receive time from a reference clock.

- Clock source—A clock source is the PTP primary clock to which the client synchronizes. The clock source is included in the configuration of the client clock.

  NOTE: The term *primary* is sometimes used to refer to the clock source.

- Clock client—A clock client is the remote PTP host, which receives time from the PTP primary. The clock client is included in the configuration of the primary clock.

  NOTE: The term *client* is sometimes used to refer to the clock client.

- PTP over UDP over IPv4—The IEEE1588v2 standard specifies different transport protocols for carrying PTP packets. For example, PTP over Ethernet, PTP over UDP over IPv4, and PTP over UDP over IPv6. ACX Series routers support PTP over UDP over IPv4.

- Unicast mode (IPv4 on Gigabit Ethernet interfaces only)—Unicast mode is a user-to-user protocol used to send a datagram to a single recipient. Unicast mode is used for transporting PTP messages.
- Support for aggregated Ethernet interfaces.

  You can configure an aggregated Ethernet interface and its configured IP address for PTP streams acting as slaves or primaries. IP hashing determines which physical link to use for the PTP traffic flows. Both IPv4 unicast and IPv6 unicast transport are supported.
- Support for loopback interface.

  You can configure a loopback interface (there is only one loopback interface, and it is lo0.0) and its corresponding IP addresses for PTP streams acting as slaves or primaries. The IP address configured on lo0.0 is used as the local IP address in the PTP configuration statements, and the remote primary or client IP address is used to identify the destination forwarding direction. You can configure multiple IP addresses on lo0.0, which allows different unique PTP streams to co-exist on lo0.0. Although, the loopback interface is the same for both primaries and slaves, the IP addresses must be unique. Both IPv4 unicast and IPv6 unicast transport are supported.

Release History Table

Release	Description
19.1R1	Starting with Junos OS Release 19.1R1, on QFX5110 switches, the IEEE 1588v2 Precision Time Protocol default profile supports aggregated Ethernet interfaces and the loopback interface using IPv4 and IPv6 unicast transport.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

IEEE 1588v2 PTP Boundary Clock Overview | 99

Configuring Precision Time Protocol Clocking | 141

Supported IPv4, TCP, and UDP Standards

Understanding the PTP G.8275.2 Enhanced Profile (Telecom Profile)

The Precision Time Protocol (PTP) G.8275.2 enhanced profile supports telecom applications that require accurate phase and time synchronization for phase alignment and time of day synchronization over a wide area network. This profile supports partial timing support (PTS) using PTP over IPv4 unicast, ordinary and boundary clocks, and unicast negotiation.

With the G.8275.2 enhanced profile, you can use either boundary or ordinary clocks. Up to 512 downstream client clocks are supported. Member clock ports can recover clocks from one-step or two-step primary clocks, but primary clocks only support one-step PTP.

The G.8275.2 enhanced profile includes the following functionality:

- Support for both ordinary clocks and boundary clocks.
- Support for primary-only and client-only ports.
- Support for node types T-BC-P (BC) and T-TSC-P (OC/BC).
- Support for the alternate best primary clock algorithm.
- Support for PTP with or without VLAN encapsulation and for two-way transfer. Unicast PTP over IPv4 transport is required.
- Unicast negotiation with single and multiple TLVs support on the primary port. The primary accepts single and multiple TLV messages from the remote client for request, cancel, and ack messages. The primary responds with single or multiple TLV messages as appropriate. The “rate” TLV is ignored.
- Reception and transmission of unicast Announce and Sync PTP packets.
- Support for full domain and packet-rate ranges.
- Support for manual mode, rather than unicast negotiation.
- Support for aggregated Ethernet interfaces.

  You can configure an aggregated Ethernet interface and its configured IP address for PTP streams acting as slaves or primaries. IP hashing determines which physical link to use for the PTP traffic flows. Both IPv4 unicast and IPv6 unicast transport are supported.

- Support for loopback interface.

  You can configure a loopback interface (there is only one loopback interface, and it is lo0.0) and its corresponding IP addresses for PTP streams acting as slaves or primaries. The IP address configured on lo0.0 is used as the local IP address in the PTP configuration statements, and the remote primary or client IP address is used to identify the destination forwarding direction. You can configure multiple IP addresses on lo0.0, which allows different unique PTP streams to co-exist on lo0.0. Although, the loopback interface is the same for both primaries and slaves, the IP addresses must be unique. Both IPv4 unicast and IPv6 unicast transport are supported.

With the G.8275.2 enhanced profile enabled, the following parameters can apply:

- Priority1

The allowed (and default) value is 128. (Not user-configurable.)

- Priority2

  The range is from 0 to 255, and the default value is 128.

- Domain number

  The range is from 44 to 63, and the default value is 44.

- Clock mode

  The clock mode can be ordinary or boundary.

- Duration of neighborhood rates

  The range is 60 to 1000 seconds, and the default value is 300 seconds.

- clockAccuracy

  0xFE

- offsetScaledLogVariance

  0xFFFF

- slaveOnly

  The allowed values are True and False; the default value is False. (Not user-configurable; the value is set according to the setting of the clock mode: boundary or ordinary.)

- localPriority

  The range is 1 to 255; the default value is 128.

- **Table 3: Announce, Sync, and Delay Request/ Response Rate Parameters**

Parameter	Default Value	Allowed Range of Values
Announce rate	• Primary: -3 • Member: 0	-3 – 0
Delay request/response rate	• Primary: -6 • Member: -7	-7 – -3

Table 3: Announce, Sync, and Delay Request/ Response Rate Parameters *(Continued)*

Parameter	Default Value	Allowed Range of Values
Sync rate	• Primary: -7 • Member: -6	-7 – -3

RELATED DOCUMENTATION

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | **119**

Understanding the PTP Media Profiles

IN THIS SECTION

- Benefits of the PTP Media Profiles | **109**
- Functionality Common to the SMPTE ST-2059-2, AES67, and the AES67+SMPTE ST-2059-2 Profiles | **109**
- Understanding the SMPTE Profile | **109**
- Understanding the AES67 Profile | **110**
- Understanding the AES67+SMPTE ST-2059-2 Profile | **110**

The PTP media profiles comprise three profiles: SMPTE ST-2059-2, AES67, and AES67+SMPTE ST-2059-2. These profiles support video and audio applications for capture (for example, cameras) to be used in professional broadcast environments. These profiles supports PTP over IPv4 multicast and ordinary and boundary clocks.

Benefits of the PTP Media Profiles

- The PTP media profiles enable multiple video and audio sources to stay in synchronization across multiple devices.

Functionality Common to the SMPTE ST-2059-2, AES67, and the AES67+SMPTE ST-2059-2 Profiles

These profiles include the following functionality:

> **NOTE**: These profiles do not use an alternate primary clock, path trace, unicast message negotiation, alternate time scales, or acceptable primary table.

- Support for both ordinary clocks and boundary clocks as part of the IEEE 1588 PTP specification.
- Support for encapsulating PTP over IPv4/UDP.

  Multicast is required for both PTP over IPv4 and PTP over UDP.
- Support for IEEE 1588 delay request and response method for the path delay measurement.
- Support for the default IEEE 1588 BMCA algorithm.
- Support for standard management packets.
- Support for IGMPv2.

  IGMPv3 is optional.

Understanding the SMPTE Profile

The SMPTE profile is based on the SMPTE ST-2059-2 standard and was created specifically to synchronize video equipment in a professional broadcast environment. The standard allows multiple video sources to stay in synchronization across various equipment by providing time and frequency synchronization to all devices. This standard is used with other SMPTE standards such as SMPTE ST 2059-1, which defines a point in time (the SMPTE Epoch) used for aligning real-time signals, and formula for ongoing signal alignment. Alignment is considered met when two clocks are within 1 microsecond of each other. This implies that each client should be accurate with +/- .5 microseconds of the central clock.

Understanding the AES67 Profile

The AES67 profile is based on the AES67 standard and supports professional quality audio applications for high performance streaming over IPv4 multicast transport in media networks with low latencies. This profile enables audio streams to be combined at a receiver and maintain stream synchronization. The standard uses IPv4 multicast and IGMP, plus the DiffServ and DSCP fields, to select packet quality of service. Audio devices transmit their content using RTP (Real Time Protocol).

Understanding the AES67+SMPTE ST-2059-2 Profile

The AES67+SMPTE ST-2059-2 profile is based on both the AES67 and SMPTE ST-2059-2 standards and is used in professional audio and video media applications. This profile enables the two standards to operate together over the same network.

RELATED DOCUMENTATION

Configuring the PTP Media Profiles | 125

PTP over Ethernet on ACX Series Routers Overview

Precision Time Protocol (PTP) is supported over IEEE 802.3 or Ethernet links on ACX Series routers. This functionality is supported in compliance with the IEEE 1588-2008 specification. PTP over Ethernet enables effective implementation of packet-based technology that enables the operator to deliver synchronization services on packet- based mobile backhaul networks that are configured in Ethernet rings. Deployment of PTP at every hop in an Ethernet ring by using the Ethernet encapsulation method enables robust, redundant, and high-performance topologies to be created that enables a highly precise time and phase synchronization to be obtained.

The ACX Series routers can be directly connected to different types of base stations (for example, base transceiver station (BTS) in 2G, NodeB in 3G, and eNodeB in 4G networks) and different types of routers that hand off time- division multiplexing (TDM), ATM, and Ethernet traffic to the base station controller.

ACX Series routers must extract the network clock from these sources and pass on synchronization information to the base stations to help the routers synchronize with the base station controller.

Most of the network deployments that use Ethernet contain a minimum of two Ethernet rings, while some of the network topologies might also contain up to three Ethernet rings. Consider a scenario in which the first ring contains aggregation routers (MX Series routers) and the second ring contains access routers (ACX Series routers). In such a network, about 10 or 12 nodes of MX Series routers and ACX Series routers are present in the aggregation and access Ethernet rings.

Some of the 4G base stations that are connected to ACX Series routers need to receive the timing and synchronization information in a packet-based form. Such base station vendors support only packet interfaces that use Ethernet encapsulation for PTP packets for time and phase synchronization. Therefore, any node (an ACX Series router) that is directly connected to a 4G base station must be able to use the Ethernet encapsulation method for PTP on a primary port to support a packet-based timing capability.

PTP over Ethernet encapsulation also facilitates an easier, optimal network deployment model than PTP over IPv4. Using IPv4, the nodes (primary and client devices) participate in unicast negotiation in which the client node is provisioned with the IP address of the primary node and requests unicast messages to be sent to it from the primary node. A primary node is the router that functions as the PTP server where the primary clock is located and a client node is the router that functions as the PTP client where the client clock is located. Because PTP over Ethernet uses multicast addresses, the client node automatically learns about the primary nodes in the network. Also, the client node is able to immediately receive the multicast messages from the primary node and can begin sending messages to the primary node without the need for any provisioning configuration.

An interface on which the primary clock is configured is called a primary interface and an interface on which the client clock is configured is called a client interface. A primary interface functions as the primary port and a client interface functions as the client port. For PTP over Ethernet, apart from configuring a port or a logical interface to operate as a primary clock or a client clock, you can also configure a port or a logical interface to function as both a primary clock and a client clock. This type of port is called a *dynamic port*, *stateful port*, or a *bidirectional port*. Such a stateful port enables the network to more efficiently adapt to the introduction and failure of timing sources by forming the shortest synchronization trees from a particular source. This behavior is implemented as defined by the best primary clock algorithm (BMCA) in the *ITU-T G.8265.1 Precision time protocol telecom profile for frequency synchronization* specification.

On both MX Series and ACX Series routers, you can achieve the highest quality performance if you configure every node in a synchronization chain as a PTP boundary clock. In Ethernet ring-based topologies, you can configure a port or a logical interface to function either as a primary port or as a client port to enable redundancy when a node or link failure occurs. This dynamic port or dual-port functionality is in accordance with the IEEE 1588-2008 standard and enables the implementation of PTP in data center or financial applications.

Apart from enabling every node to be available for configuration as a PTP boundary clock, it is also necessary to enable a logical interface to be configured either as a primary port or a client port. When you configure a logical interface or even a shared IP address to be a primary port or a client port, a PTP protocol stack can represent dynamic ports and the PTP application selects the correct state (primary or client) for any specific port in the system based on the output of the default PTP BMCA and the states of other ports in the system.

While an ACX Series router supports the PTP over Ethernet functionality, a Brilliant Grand Primary such as an MX Series router or a TCA Series Timing Client does not support PTP over Ethernet. In such a scenario, the ACX Series router functions as a boundary clock with a PTP client port using IPv4 as the encapsulation mode and primary ports using Ethernet as the encapsulation mode for PTP traffic. For example, consider an ACX Series router named ACX1 to have two potential client interfaces, one that is fixed as a client-only port using IPv4 on the link toward an MX Series router named MX1, and a dynamic port that functions as a client port using PTP over Ethernet on the link toward another ACX Series router named ACX2. In addition, ACX1 also contains a port that is a primary-only port using PTP over Ethernet and connects to the base station.

Because PTP over Ethernet uses multicast addresses, a client port can automatically start receiving the multicast announce messages transmitted by the primary ports on a network and can also start communication with the primary node with minimal or no configuration. Unlike PTP over IPv4 where IP addresses are used to identify the primary and client ports, with PTP over Ethernet, multicast MAC addresses are used in the forwarding of PTP traffic. The IEEE 1588 standard defines two types of multicast MAC addresses 01-80-C2-00-00-0E (link local multicast) and 01-1B-19-00-00-00 (standard Ethernet multicast) for PTP over Ethernet operations.

RELATED DOCUMENTATION

Guidelines for Configuring PTP over Ethernet | **112**
Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | **181**
Configuring PTP Dynamic Ports for Ethernet Encapsulation | **187**
Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | **189**

Guidelines for Configuring PTP over Ethernet

Keep the following points in mind when you configure PTP over Ethernet for multicast mode of transmission of PTP traffic:

- You can configure a port or a logical interface to be a primary clock for PTP over Ethernet to provide packet-based synchronization to base stations that support time and phase alignment; this configuration is compliant with Annexure F of the IEEE 1588-2008 specification.

- Two multicast MAC addresses are used for PTP over Ethernet: 01-1B-19-00-00-00 and 01-80-C2-00-00-0E. The first address is a more standard Ethernet MAC address that is expected to be flooded by all types of Ethernet bridges and switches and also by a large number of base station vendors. A node with this MAC address can be a node that does not process PTP packets. The second address is a reserved address in the IEEE 802.1Q standard for Ethernet encapsulation that is required to be filtered and not forwarded. This MAC address is used to ensure complete end-to-end support of PTP, instead of transmission of packets through any network element that does not support PTP. This address is the default address for G.8275.1 (PTP Profile for time or phase distribution) and a node with this MAC address is a node that supports processing of PTP packets.

- Both of the MAC addresses, 01-1B-19-00-00-00 and 01-80-C2-00-00-0E, are supported on multiple ports simultaneously to enable maximum flexibility and extension of existing networks for future deployments. A single PTP port is configured for one of the MAC addresses at a time.

- PTP packets are sent with the unique MAC address assigned to each port as the MAC source address. In the PTP packet, the Ethernet frame portion of the packet contains the Destination MAC field. This field contains either of the two MAC addresses, 01-1B-19-00-00-00 or 01-80-C2-00-00-0E. Also, the Ethernet frame portion contains the Source MAC field that contains the MAC address of the source port and the Ethertype field that contains the PTP Ethertype value of 0x88F7. Apart from the Ethernet frame, the PTP packet contains the PTP payload.

- When you configure a port for PTP over Ethernet to be a client port, a primary port, or both by having a dynamic port that can be either a primary port or a client port depending on the states of the other ports in the PTP application, it is possible to build an easily provisioned, redundant PTP service in an Ethernet ring where every node is configured as a boundary clock.

- A boundary clock can function as a client clock to a device using IP (such as a TCA Series Timing Client or an MX Series router) on one port and can also function as a client clock, a primary clock, or both on other ports using Ethernet as the encapsulation method. This behavior occurs within a single PTP domain number.

- Best Master Clock Algorithm (BMCA) and the port state machine are supported to determine the states of all the ports in a system and the correct state (primary or client) for a certain port to process PTP packets.

- PTP over Ethernet supports fully redundant and resilient ring-based configurations of up to 10 nodes for a form of fourth-generation (4G) evolution known as Long-Term Evolution-Time Division Duplex (LTE-TDD). ACX Series routers support a single node or link failure and all nodes maintain a phase accuracy of plus or minus 1.5 microseconds matching a common source.

- You can configure the asymmetry value between the primary port and the client port, which indicates a value to be added to the path delay value to make the delay symmetric and equal to the path from the primary port to the client port, on either a dynamic-state port or a client-only port.

- You cannot enable PTP over Ethernet on Ethernet interfaces that are configured with 802.1Q VLAN tags or contain a user-configured MAC address.

- While you can configure unique PTP client interfaces or client ports with different encapsulation mechanisms (such as IPv4 and Ethernet), the boundary clock can use only a single encapsulation method for all of the primary ports. Therefore, you must define either IPv4 or Ethernet encapsulation for all the ports or logical interfaces that can possibly function as boundary clock primaries. Primary ports select the link-local flag based on each port.

- The following limitations apply to the maximum number of ports that you can configure when you use PTP over Ethernet:

  - You can configure a maximum of four client ports on a router. A client port or logical interface is defined as any client-only port configured for IPv4 or Ethernet, or any dynamic port configured for Ethernet.

  - You can configure up to 29 primary ports on a router. A primary port or logical interface is defined as any primary-only port configured for IPv4 or Ethernet, or any dynamic port configured for Ethernet.

  - Any logical interface that you configure as a dynamic port is considered to be both a client port and a primary port, even if it functions only as a client port or a primary port in a network, when the total number of client ports and primary ports on a router is computed.

- In PTP over IPv4 deployment, it is necessary to configure certain basic settings on a PTP primary port before the PTP client ports to connect to the primary port. PTP over Ethernet offers a plug-and-play service because any PTP client starts receiving packets and can request delay-response packets from the primary port after you configure an interface to be a primary.

- PTP over Ethernet is compatible with Junos OS releases earlier than Release 12.3X51. When you perform an upgrade to Release 12.3X51 and later from a previous release on an ACX Series router, you can modify the client and primary ports previously configured for IPv4 to enable PTP over Ethernet based on your network needs.

- You cannot configure a fully redundant PTP ring using IP. A fully redundant PTP ring is supported only when Ethernet encapsulation is used.

- Configuration of dynamic ports in conjunction with Synchronous Ethernet to enable hybrid mode is not supported.

- Multiple PTP timing domains are not supported for PTP over Ethernet, similar to PTP over IPv4. Although a single node can contain interfaces configured for PTP over IPv4 and PTP over Ethernet, both of these interfaces must be part of the same PTP domain.
- SONET/SDH networks define the ability to configure a local priority to a synchronization source in the ITU G.781 standard. Addition of such locally configured priorities to PTP sources to influence BMCA to determine a particular path for PTP packets is not supported.
- Although you can configure a client port to use either IP or Ethernet simultaneously, a single client port is selected based on the announce messages it receives from the primary port and the PTP event packets are exchanged only with a single primary port.
- The IPv4 unicast implementation of PTP enables you to limit the number of client ports that can be supported simultaneously in the system. With multicast Ethernet-based implementation, in which the primary port is not provisioned with the client port information, the primary port cannot limit the number of client ports that it services. This control must be exercised with proper networking planning and design.

RELATED DOCUMENTATION

PTP over Ethernet on ACX Series Routers Overview | **110**
Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | **181**
Configuring PTP Dynamic Ports for Ethernet Encapsulation | **187**
Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | **189**

Understanding the Precision Time Protocol Enterprise Profile

The enterprise profile is based on Precision Time Protocol (PTPv1) as defined in IEEE 1588-2002. This profile was designed to distribute system time of day (TOD) and clock frequency from a grand primary clock to client clocks within the same network and clock domain, and to use multicast communications. The enterprise profile PTPv2 is not backwards compatible with PTPv1.

With the enterprise profile, you can use either boundary or ordinary clocks. Up to 512 downstream client clocks are supported. Member clock ports can recover clocks from one-step or two-step primary clocks, but primary clocks only support one-step PTP.

The enterprise profile supports PTP over IPv4 and UDP encapsulation, which includes the following functionality:

- Reception and transmission of Multicast Announce and Sync PTP packets.
- Reception of multicast or unicast Delay Request packets for the primary clock interfaces.

  The Delay Response is sent with the same multicast or unicast transmission to match the request.
- Transmission of unicast Delay Request packets for the client clock interfaces.

  The switch will not transmit Multicast Delay Request packets.
- IPv4 Multicast address of 224.0.1.129 for PTP.
- PTP Interfaces can be trunk or access ports, so the traffic might or might not be part of a VLAN.

The enterprise profile supports dynamic primary clock interface and client clock interface detection as Announce and Delay Request packets are received and supports the following functionality:

- Streams are identified by the clock identity, rather than the IP address.
- Up to four remote primary clocks that use the best primary clock (BMC) algorithm to select the clock source.
- Up to 512 remote client clocks with up to 64 logical interfaces.
- Remote devices are ignored when the number of primary and client clocks has reach the limit.

  If messages are no longer being received from a remote device; a timeout mechanism is used. Streams are removed if they are no longer receiving packets after a default value of 30 seconds.

To support a 1-Gigabit Ethernet connection to a reference clock, you can use a special interface that is labeled **PTP** on the faceplate of the QFX10002 switch. This interface is named **ptp0** in the Junos OS CLI. This interface only supports encapsulated PTP, ARP, and PING packets to support the reference clock connection. Non-PTP traffic is not supported. You can configure this interface as a client clock interface to connect to a reference but not as a tagged interface. You can, however, configure 10-, 40-, and 100-Gigabit Ethernet interfaces as primary clock, client clock, and in tagged and untagged configurations.

With the enterprise profile enabled, there are restrictions on which parameters you can configure or cannot configure.

With the enterprise profile enabled, you can configure the following parameters:

- Priority1

  The range is from 0 to 255, and the default value is 128.
- Priority2

  The range is from 0 to 255, and the default value is 128.

- Domain number

  The range is from 0 to 127, and the default value is 0.

- Clock mode

  Clock mode can be ordinary or boundary.

- Delay request

  The Range -7 to +7 seconds, and the default value is 0 (1pps).

- Sync interval

  The range is -7 to +4 seconds, and the default value is 0 (1pps).

With the enterprise profile enabled, you cannot configure the following parameters:

- Announce interval

  Default value is 0 (1pps).

- Announce timeout

  The announce receipt timeout interval is set for three announce intervals for preferred primary clocks, and four announce intervals for all other primary clocks. All primary clocks will be treated as preferred primary clocks, so the announce receipt timeout interval is set to three announce intervals.

- Unicast negotiation

Configuring Transparent Clock Mode for Precision Time Protocol

In a distributed network, you can configure transparent clock for Precision Time Protocol (PTP) for synchronizing the timing across the network. Junos OS supports the **e2e-transparent** CLI statement at the [**edit protocols ptp**] hierarchy level to configure transparent clock for Precision Time Protocol (PTP).

NOTE: Starting in Junos OS Release 17.2 onwards, to configure PTP transparent clock, include the **e2e-transparent** CLI command at the [**edit protocols ptp**] hierarchy level. The **transparent-clock** CLI command to configure transparent clock at the [**edit protocols ptp**] hierarchy level is supported only in Junos OS Release 12.3X54.

To configure the transparent clock mode for Precision Time Protocol (PTP):

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level.

```
[edit]
user@host# edit protocols ptp
```

2. Specify transparent clock mode:

```
[edit protocols ptp]
user@host# set e2e-transparent
```

RELATED DOCUMENTATION

Understanding Transparent Clocks in Precision Time Protocol | 97

e2e-transparent | 403

show ptp global-information | 627

Configuring a PTP Transparent Clock

ACX Series routers supports transparent clock functionality. A Precision Time Protocol (PTP) Transparent clock measures the residence time of PTP packets as they pass through router. This residence time is added to the Correction Field of the PTP packet.

NOTE: Starting in Junos OS Release 17.1 onwards, to configure transparent clock, include the **e2e-transparent** CLI command at the [**edit protocols ptp**] hierarchy level. Prior to Junos OS Release 17.1, to configure transparent clock, include the **transparent-clock** CLI command at the [**edit protocols ptp**] hierarchy level.

The following points need to be considered while configuring a PTP transparent clock in ACX routers:

- Domain numbers—Transparent clock functionality would compute the residence time for PTP packets belonging to all domains.

- PTP-over-MPLS—Transparent clock functionality do not support PTP carried over MPLS in ACX routers.

The PTP transparent clock functionality is supported on PTP-over-IP and PTP-over-Ethernet (PTPoE).

> **NOTE**: ACX routers do not support PTPoE over VLANs when it works in ordinary clock or boundary clock mode.

To configure a PTP transparent clock:

1. Configure the clock mode:

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

2. Configure the transparent clock:

```
[edit protocols ptp]
user@host# set e2e-transparent
```

3. (Optional) Enable PHY Timestamping. The PHY timestamping is disabled by default.

```
[edit protocols ptp]
user@host# set e2e-transparent
```

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile)

IN THIS SECTION

- Configuring Precision Time Protocol and Its Options | 120

NOTE: When you enable the G.8275.2 enhanced profile, you cannot enable any other profile.

Configuring Precision Time Protocol and Its Options

IN THIS SECTION

- Configuring PTP Options | **120**
- Configuring Member Clock Options | **121**
- Configuring Primary Clock Options | **123**

This topic includes the following tasks:

Configuring PTP Options

To configure PTP options:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

```
[edit]
user@host# edit protocols ptp
```

2. Configure the clock mode as either boundary or ordinary. This attribute is mandatory and has no default value.

   The **boundary** option signifies that both primary and client must be configured. The **ordinary** option signifies that only the primary, or only the client, must be configured.

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

3. Configure the profile type as g.8275.2.enh (the G.8275.2.enh profile type provides the telecom profile). This attribute is mandatory.

```
[edit protocols ptp]
user@host# set profile-type g.8275.2.enh
```

4. (Optional) Configure the PTP domain option with a value from 44 through 63. The default value is 44.

```
[edit protocols ptp]
user@host# set domain domain-value
```

5. (Optional) Configure the **priority2** option with values from 0 through 255. The default value is 128.

   The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

```
[edit protocols ptp]
user@host# set priority2 priority2-value
```

6. Configure the **unicast-negotiation** option.

   Unicast negotiation is a method by which the announce, sync, and delay response packet rates are negotiated between the primary clock and the client clock before a PTP session is established.

```
[edit protocols ptp]
user@host# set unicast-negotiation
```

> **NOTE**: Unicast negotiation, when enabled, does not allow you to commit any packet rate–related configuration.

Configuring Member Clock Options

Configure the following options after the aforementioned PTP options have been set.

1. Configure the client clock.

```
[edit protocols ptp]
user@host# edit slave
```

2. (Optional) Configure the **delay-request** option in the client node. The range is -7 to -3 seconds, and the default values are -6 for the primary and -7 for the client.

   The delay request value is the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary.

   ```
   [edit protocols ptp slave]
   user@host# set delay-request delay-request-value
   ```

3. Configure the interface for the client.

   ```
   [edit protocols ptp slave]
   user@host# set interface interface-name
   ```

   NOTE: You can configure an aggregated Ethernet interface and its configured IP address for PTP streams acting as slaves or primaries.

   For example, to configure a client using an aggregated Ethernet interface:

   ```
   user@switch# set protocols ptp slave interface ae0.0
   ```

   NOTE: You can configure a loopback interface (there is only one loopback interface, and it is lo0.0) and its corresponding IP addresses for PTP streams acting as slaves or primaries. Although the loopback interface is the same for both primaries and slaves, the IP addresses must be unique.

   For example, to configure a client using the loopback interface:

   ```
   user@switch# set protocols ptp slave interface lo0.0
   ```

4. Configure the **unicast-mode** option for the client.

   ```
   [edit protocols ptp slave interface interface-name]
   user@host# set unicast-mode
   ```

5. Configure the **transport** option in unicast mode as IPv4 or IPv6.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# set transport (ipv4 | ipv6)
```

6. Configure the clock source and the IP address of the interface acting as the local PTP client port.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# set clock-source ip-address local-ip-address local-ip-address
```

NOTE: You must configure this IP address at the [**edit interfaces** ***interface-name***] hierarchy level.

7. (Optional) Configure the priority assigned to the interface acting as the local PTP client port.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# set local-priority number
```

Configuring Primary Clock Options

Configure the following options after the aforementioned PTP options and client clock options have been set.

1. Configure the primary clock.

```
[edit protocols ptp]
user@host# edit master
```

2. Configure the interface for the primary.

```
[edit protocols ptp master]
user@host# set interface interface-name
```

NOTE: You can configure an aggregated Ethernet interface and its configured IP address for PTP streams acting as slaves or primaries.

For example, to configure a primary using an aggregated Ethernet interface:

```
user@switch# set protocols ptp master interface ae0.0
```

NOTE: You can configure a loopback interface (there is only one loopback interface, and it is lo0.0) and its corresponding IP addresses for PTP streams acting as slaves or primaries. Although the loopback interface is the same for both primaries and slaves, the IP addresses must be unique.

For example, to configure a primary using the loopback interface:

```
user@switch# set protocols ptp master interface lo0.0
```

3. Configure the unicast mode option for the primary.

```
[edit protocols ptp master interface interface-name]
user@host# edit unicast-mode
```

4. Configure the **transport** option in unicast mode as IPv4 or IPv6.

```
[edit protocols ptp master interface interface-name unicast-mode]
user@host# set transport (ipv4 | ipv6)
```

5. Configure the remote clock source and the IP address of the interface acting as the primary.

```
[edit protocols ptp master interface interface-name unicast-mode transport
type]
user@host# set clock-client ip-address local-ip-address ip-address
```

RELATED DOCUMENTATION

Understanding the PTP G.8275.2 Enhanced Profile (Telecom Profile) | 105

Configuring the PTP Media Profiles

IN THIS SECTION

- Configuring the AES67, SMPTE, and AES67+SMPTE Profiles | 125

NOTE: When you enable any of the PTP media profiles (AES67, AES67+SMPTE, or SMPTE), you cannot enable any other profile.

Configuring the AES67, SMPTE, and AES67+SMPTE Profiles

IN THIS SECTION

- Optional and Required Parameters for SMPTE ST-2059-2, AES67, and AES67+SMPTE ST-2059-2 Profiles | 125
- Configuring the PTP Media Profile | 127

This topic provides the configuration necessary to enable any of the three media profiles (AES67, SMPTE, and AES67+SMPTE), and includes the following sections.

Optional and Required Parameters for SMPTE ST-2059-2, AES67, and AES67+SMPTE ST-2059-2 Profiles

Table 4 on page 126 and Table 5 on page 126 provide default values and ranges for optional and required PTP parameters:

Table 4: Defaults and Ranges for PTP Parameters

Profile	SM (Synchronization Metadata) TLV	Domain	Priority1	Priority2
SMPTE	Yes	• Default: 127 • Range: 0 through 127	• Default: 128 • Range: 0 through 255	• Default: 128 • Range: 0 through 255
AES67	No	• Default: 0 • Range: 0 through 127	• Default: 128 • Range: 0 through 255	• Default: 128 • Range: 0 through 255
AES67+SMPTE	Yes	• Default: 0 • Range: 0 through 127	• Default: 128 • Range: 0 through 255	• Default: 128 • Range: 0 through 255

Table 5: Defaults and Ranges for PTP Parameters

Profile	Announce	Announce Timeout	Sync	Delay-Req
SMPTE	• Default: -2 • Range: -3 through 1	• Default: 3 • Range: 2 through 10	• Default: -3 • Range: -7 through -1	• Default: -3 • Range: -7 through -3
AES67	• Default: 1 • Range: 0 through 4	• Default: 3 • Range: 2 through 10	• Default: -3 • Range: -4 through 1	• Default: -3 • Range: -7 through -3

Table 5: Defaults and Ranges for PTP Parameters *(Continued)*

Profile	Announce	Announce Timeout	Sync	Delay-Req
AES67+SMPTE	• Default: 0 • Range: 0 through 1	• Default: 3 • Range: 2 through 10	• Default: -3 • Range: -4 through -1	• Default: -3 • Range: -7 through -3

Configuring the PTP Media Profile

To configure the any of the media profiles:

NOTE: On the QFX Series, when you configure either a primary or client port, it must be on the same subnet as the remote device to which it is connected.

NOTE: When either the enterprise or any of the media profiles are enabled, the primary and client ports must be configured in multicast-mode. The primary sends the announce and sync packets as multicast IP packets, but the QFX Series client will send the delay-req packets as unicast IP packets.

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

```
[edit]
user@host# edit protocols ptp
```

2. Configure the clock mode as either boundary or ordinary. This attribute is mandatory and has no default value.

   The **boundary** option signifies that both primary and client must be configured. The **ordinary** option signifies that only the primary, or only the client, must be configured.

   For example:

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

3. Configure the profile type.

   Configuring the profile type is mandatory.

```
[edit protocols ptp]
user@host# set profile-type (aes67 | smpte | aes67-smpte)
```

4. Configure the clock mode.

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

5. Configure the interface for the client.

```
[edit protocols ptp ]
user@host# set slave interface interface-name
```

6. Configure the **multicast-mode** option for the client.

```
[edit protocols ptp slave interface interface-name]
user@host# set multicast-mode
```

7. Configure the **transport** option in multicast-mode as IPv4.

```
[edit protocols ptp slave interface interface-name multicast--mode]
user@host# set transport ipv4
```

8. Configure the IP address of the interface acting as the local PTP client port.

```
[edit protocols ptp slave interface interface-name multicast-mode]
user@host# set local-ip-address local-ip-address
```

NOTE: You must also configure this IP address at the [**edit interfaces *interface-name***] hierarchy level.

9. Configure the interface for the primary.

```
[edit protocols ptp master]
user@host# set interface interface-name
```

10. Configure the multicast-mode option for the primary.

```
[edit protocols ptp master interface interface-name]
user@host# set multicast-mode
```

11. Configure the **transport** option in multicast-mode as IPv4.

```
[edit protocols ptp master interface interface-name multicast-mode]
user@host# set transport ipv4
```

12. Configure the local IP address for the primary.

    NOTE: You must also configure this IP address at the [**edit interfaces** ***interface-name***] hierarchy level.

```
[edit protocols ptp master interface interface-name multicast-mode]
user@host# set local-ip-address local IP address
```

13. (Optional) Configure the PTP domain option.

```
[edit protocols ptp]
user@host# set domain domain-value
```

14. (Optional) Configure the **priority1** option.

    The **priority1** value determines the best primary clock. The *priority1-value* is also advertised in the primary clock's announce message to other slaves.

```
[edit protocols ptp]
user@host# set priority1 priority1-value
```

15. (Optional) Configure the **priority2** option.

The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

```
[edit protocols ptp]
user@host# set priority2 priority2-value
```

16. (Optional) Configure the **announce-timeout** option in the client node.

    The announce timeout value signifies the number of times an announce interval message has to pass through the client without receiving the announce message—that is, the timeout period for announce messages.

    ```
    [edit protocols ptp slave]
    user@host# set announce-timeout announce-timeout-value
    ```

17. (Optional) Specify the log mean interval between announce messages.

    The primary boundary clock sends announce messages to manual clock clients as specified in the announce-interval value.

    ```
    [edit protocols ptp master]
    user@host# set announce-interval announce-interval-value
    ```

18. (Optional) Configure the **sync interval** option for the primary clock.

    The sync interval is the logarithmic mean interval between synchronous messages that is sent by the primary.

    ```
    [edit protocols ptp master]
    user@host# set sync-interval sync-interval-value
    ```

19. (Optional) Configure the **delay-request** option in the client node.

    The delay request value is the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary.

    ```
    [edit protocols ptp slave]
    user@host# set delay-request delay-request-value
    ```

20. Verify the lock status of the client.

NOTE: On the QFX Series, the client will not lock to the primary unless at least eight sync packets per second are received from the primary.

For example:

```
user@switch> show ptp lock-status detail
Lock Status:

Lock State     : 5 (PHASE ALIGNED)
Phase offset   : -0.000000202 sec
```

The output shows that the lock state is aligned.

21. Verify the status of the primary.

    For example:

```
user@switch> show ptp master detail
PTP Master Interface Details:
Interface   : et-0/0/0:31.0
Status      : Master, Active
Clock Info :
Local Address: 192.168.99.42  Status: Configured, Master, Active
Remote Address: 192.168.1.12    Status: Configured, Slave, Active
Total Remote Slaves: 1
```

The output shows that the primary is active.

RELATED DOCUMENTATION

Understanding the PTP Media Profiles | **108**

Configuring Precision Time Protocol Default Profile

IN THIS SECTION

- Configuring Precision Time Protocol and its Options | 132

You can configure the primary clock and the client clock for Precision Time Protocol (PTP) to help synchronize clocks in a distributed system. This time synchronization is achieved through packets that are transmitted and received in a session between the primary clock and the client clock. The default profile is enabled by default. You do not need to enable the **profile-type** statement to use the default profile.

Configuring Precision Time Protocol and its Options

IN THIS SECTION

- Configuring PTP Options | 132
- Configuring Member Clock Options | 134
- Configuring Primary Clock Options | 135

This topic includes the following tasks:

Configuring PTP Options

NOTE: For information on how to configure PTP using unicast negotiation, see "Example: Configuring a PTP Boundary Clock With Unicast Negotiation" on page 152 .

To configure PTP options:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

   ```
   [edit]
   user@host# edit protocols ptp
   ```

2. Configure the clock mode as either boundary or ordinary. This attribute is mandatory and has no default value.

   The **boundary** option signifies that the clock can be both a primary clock and a client clock. The **ordinary** option signifies that the clock is either a primary clock or a client clock.

   ```
   [edit protocols ptp]
   user@host# set clock-mode (boundary | ordinary)
   ```

3. Configure the PTP domain option with values from 0 through 127. The default value is 0.

   ```
   [edit protocols ptp]
   user@host# set domain domain-value
   ```

4. Configure the **priority1** option with values from 0 through 255. The default value is 128.

   The **priority1** value determines the best primary clock. The *priority1-value* is also advertised in the primary clock's announce message to other slaves.

   ```
   [edit protocols ptp]
   user@host# set priority1 priority1-value
   ```

5. Configure the **priority2** option with values from 0 through 255. The default value is 128.

   The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

   ```
   [edit protocols ptp]
   user@host# set priority2 priority2-value
   ```

6. Configure the **multicast-mode** option to enable multicast transport.

   ```
   [edit protocols ptp]
   user@host# set multicast-mode
   ```

Configuring Member Clock Options

Configure the following options after the aforementioned PTP options have been set.

1. Configure the client clock.

```
[edit protocols ptp]
user@host# edit slave
```

2. (Optional) Configure the **delay-request** option in the client node with values from –7 through 7. The default value is 0.

   The delay request value is the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary.

```
[edit protocols ptp slave]
user@host# set delay-request delay-request-value
```

3. Configure the interface for the client.

```
[edit protocols ptp slave]
user@host# set interface interface-name
```

4. Configure the **multicast-mode** option for the client. You can set this option when PTP multicast mode of messaging is needed.

```
[edit protocols ptp slave interface interface-name]
user@host# set multicast-mode
```

5. Configure the **transport** option in multicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

```
[edit protocols ptp slave interface interface-name multicast-mode]
user@host# set transport ipv4
```

6. Configure the IP address of the local logical interface.

```
[edit protocols ptp slave interface interface-name multicast-mode]
user@host# set local-ip-address IP address
```

Configuring Primary Clock Options

Configure the following options after the aforementioned PTP options and client clock options have been set.

1. Configure the primary clock.

   ```
   [edit protocols ptp]
   user@host# edit master
   ```

2. Configure the **delay-req-timeout** option for the primary.

   The maximum timeout for delay request messages is between 30 and 300 seconds. We recommend 30 seconds.

   ```
   [edit protocols ptp master]
   user@host# set delay-req-timeout seconds
   ```

3. Configure the interface for the primary.

   ```
   [edit protocols ptp master]
   user@host# set interface interface-name
   ```

4. Configure the **multicast-mode** option for the primary. You can set this option when PTP multicast mode of messaging is needed.

   ```
   [edit protocols ptp master interface interface-name]
   user@host# set multicast-mode
   ```

5. Configure the **transport** option in multicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

   ```
   [edit protocols ptp master interface interface-name multicast-mode]
   user@host# set transport ipv4
   ```

6. Configure the IP address of the interface acting as the local PTP primary port.

   ```
   [edit protocols ptp master interface interface-name multicast-mode clock-
   client ip-address]
   user@host# set local-ip-address local-ip-address
   ```

7. Configure the interface to be used to connect with the PTP reference clock.

```
[edit protocols ptp master]
user@host# set interface interface-name
```

If the primary clock connection is through a 1-Gigabit Ethernet interface, configure the **ptp0** interface.

This interface is named **ptp0** by default.

```
[edit protocols ptp master]
user@host# set interface ptp0
```

8. Configure the **multicast-mode** option for the PTP reference clock interface. You can set this option when PTP multicast mode of messaging is needed.

```
[edit protocols ptp master interface]
user@host# set interface-name multicast-mode
```

9. Configure the **transport** option in multicast mode as IPv4.

The encapsulation type for PTP packet transport is IPv4.

```
[edit protocols ptp master interface interface-name multicast-mode]
user@host# set transport ipv4
```

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Example: Configuring Precision Time Protocol | 90

Configuring the Precision Time Protocol Enterprise Profile

IN THIS SECTION

- Configuring Precision Time Protocol and its Options | 137

NOTE: When you enable the enterprise profile, you cannot enable any other profile. Also, unicast negotiation is disabled when you enable the enterprise profile.

Configuring Precision Time Protocol and its Options

IN THIS SECTION

- Configuring PTP Options | 137
- Configuring Member Clock Options | 138
- Configuring Primary Clock Options | 140

This topic includes the following tasks:

Configuring PTP Options

To configure PTP options:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level:

```
[edit]
user@host# edit protocols ptp
```

2. Configure the clock mode as either boundary or ordinary. This attribute is mandatory and has no default value.

   The **boundary** option signifies that the clock can be both a primary clock and a client clock. The **ordinary** option signifies that the clock is either a primary clock or a client clock.

   ```
   [edit protocols ptp]
   user@host# set clock-mode (boundary | ordinary)
   ```

3. Configure the profile type as enterprise. This attribute is mandatory.

   ```
   [edit protocols ptp]
   user@host# set profile-type enterprise-profile
   ```

4. (Optional) Configure the PTP domain option with values from 0 through 127. The default value is 0.

   ```
   [edit protocols ptp]
   user@host# set domain domain-value
   ```

5. (Optional) Configure the **priority1** option with values from 0 through 255. The default value is 128.

   The **priority1** value determines the best primary clock. The *priority1-value* is also advertised in the primary clock's announce message to other slaves.

   ```
   [edit protocols ptp]
   user@host# set priority1 priority1-value
   ```

6. (Optional) Configure the **priority2** option with values from 0 through 255. The default value is 128.

   The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when ***priority1-value*** is the same for different primary clocks in a network.

   ```
   [edit protocols ptp]
   user@host# set priority2 priority2-value
   ```

Configuring Member Clock Options

Configure the following options after the aforementioned PTP options have been set.

1. Configure the client clock.

   ```
   [edit protocols ptp]
   user@host# edit slave
   ```

2. (Optional) Configure the **delay-request** option in the client node with values from –7 through 7. The default value is 0.

   The delay request value is the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary.

   ```
   [edit protocols ptp slave]
   user@host# set delay-request delay-request-value
   ```

3. Configure the interface for the client.

   ```
   [edit protocols ptp slave]
   user@host# set interface interface-name
   ```

4. Configure the **multicast-mode** option for the client. You can set this option when PTP multicast mode of messaging is needed.

   ```
   [edit protocols ptp slave interface interface-name]
   user@host# set multicast-mode
   ```

5. Configure the **transport** option in multicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

   ```
   [edit protocols ptp slave interface interface-name multicast-mode]
   user@host# set transport ipv4
   ```

6. Configure the IP address of the local logical interface.

   ```
   [edit protocols ptp slave interface interface-name multicast-mode]
   user@host# set local-ip-address IP address
   ```

Configuring Primary Clock Options

Configure the following options after the aforementioned PTP options and client clock options have been set.

1. Configure the primary clock.

   ```
   [edit protocols ptp]
   user@host# edit master
   ```

2. (Optional) Configure the **delay-req-timeout** option for the primary.

   The maximum timeout for delay request messages is between 30 and 300 seconds. We recommend 30 seconds.

   ```
   [edit protocols ptp master]
   user@host# set delay-req-timeout seconds
   ```

3. Configure the interface for the primary.

   ```
   [edit protocols ptp master]
   user@host# set interface interface-name
   ```

4. Configure the **multicast-mode** option for the primary. You can set this option when PTP multicast mode of messaging is needed.

   ```
   [edit protocols ptp master interface interface-name]
   user@host# set multicast-mode
   ```

5. Configure the **transport** option in multicast mode as IPv4.

   The encapsulation type for PTP packet transport is IPv4.

   ```
   [edit protocols ptp master interface interface-name multicast-mode]
   user@host# set transport ipv4
   ```

6. Configure the IP address of the interface acting as the local PTP primary port.

   ```
   [edit protocols ptp master interface interface-name multicast-mode clock-
   client ip-address]
   user@host# set local-ip-address local-ip-address
   ```

If the primary clock connection is through a 1-Gigabit Ethernet interface, configure the interface named **ptp0** interface.

This interface is named **ptp0** by default.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Example: Configuring Precision Time Protocol | 90

Configuring Precision Time Protocol Clocking

In a distributed network, you can configure Precision Time Protocol (PTP) primary and client clocks to help synchronize the timing across the network. The synchronization is achieved through packets that are transmitted and received in a session between the primary clock and the client clock or clock client.

To configure Precision Time Protocol (PTP) options:

1. In configuration mode, go to the **[edit protocols ptp]** hierarchy level.

```
[edit]
user@host# edit protocols ptp
```

2. Specify the clock as a boundary or ordinary clock. The **boundary** option signifies that the clock can be both a primary clock and a client clock. The **ordinary** option signifies that the clock is a client clock.

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

3. (Optional) Enable PHY Timestamping. The PHY timestamping is disabled by default.

```
[edit protocols ptp]
user@host# set transparent-clock
```

4. (Optional) Configure the PTP domain with values from 0 through 127. The default value is 0.

```
[edit protocols ptp]
user@host# set domain domain-value
```

5. (Optional) Specify the DiffServ code point (DSCP) value (0 through 63) for all PTP IPv4 packets originated by the router. The default value is 56.

```
[edit protocols ptp]
user@host# set ipv4-dscp number
```

6. Specify the primary clock parameters.

```
[edit protocols ptp]
user@host# set master
```

   For details about configuring the primary clock parameters, see "Configuring a PTP Primary Boundary Clock" on page 143.

7. (Optional) Configure the priority value of the clock (0 through 255). This value is used in selecting the best primary clock. The *priority1-value* is advertised in the primary clock's announce message to clock clients. The default value is 128.

```
[edit protocols ptp]
user@host# set priority1 priority1-value
```

8. (Optional) Configure the tie-breaker in selecting the best primary clock (0 through 255). The **priority2** value differentiates and prioritizes the primary clock to avoid confusion when the ***priority1-value*** is the same for different primary clocks in a network. The default value is 128.

```
[edit protocols ptp]
user@host# set priority2 priority2-value
```

9. Specify the PTP client clock parameters.

```
[edit protocols ptp]
user@host# set slave
```

For information about configuring the client clock options, see "Configuring a PTP Member Clock" on page 158.

10. (Optional) Enable unicast negotiation. Unicast negotiation is a method by which the announce, synchronization, and delay response packet rates are negotiated between the primary clock and the clock client before a PTP session is established.

```
[edit protocols ptp]
user@host# set unicast-negotiation
```

> **NOTE**: Unicast negotiation, when enabled, does not allow you to commit packet rate–related configurations.

RELATED DOCUMENTATION

- IEEE 1588v2 PTP Boundary Clock Overview | **99**
- Configuring a PTP Primary Boundary Clock | **143**
- Configuring a PTP Member Clock | **158**
- Example: Configuring a PTP Boundary Clock With Unicast Negotiation | **152**
- Example: Configuring a PTP Boundary Clock | **148**

Configuring a PTP Primary Boundary Clock

IN THIS SECTION

- Configuring the PTP Primary Boundary Clock Parameters | **144**
- Configuring a PTP Primary Boundary Clock Interface | **146**

A Precision Time Protocol (PTP) primary boundary clock sends PTP messages to the clients (ordinary and boundary) so that they can establish their relative time offset from this primary's clock or clock reference. You cannot configure an ordinary primary clock on a device. The primary boundary clock synchronizes time through a boundary client port. To configure a primary boundary clock, you must include the **boundary** statement at the [**edit protocols ptp clock-mode**] hierarchy level and at least one primary with the **master** statement and at least one client with the **slave** statement at the [**edit protocols ptp**] hierarchy level.

> **NOTE**: ACX5048 and ACX5096 routers do not support ordinary and boundary clock.

To configure a PTP primary boundary clock, complete the following tasks:

Configuring the PTP Primary Boundary Clock Parameters

To configure the parameters of a PTP primary boundary clock:

1. Configure the clock mode.

   ```
   [edit protocols ptp]
   user@host# set clock-mode boundary
   ```

2. Configure the primary clock.

   ```
   [edit protocols ptp]
   user@host# edit master
   ```

3. (Optional) Specify the log mean interval between announce messages—from **0** through **4**. By default, one announce message is sent every two seconds. This configuration is used for manual clock clients. The primary boundary clock sends announce messages to manual clock clients as specified in the announce-interval value.

   ```
   [edit protocols ptp master]
   user@host# set announce-interval announce-interval-value
   ```

4. Configure the interface on which to respond to downstream PTP clients and slaves.

   ```
   [edit protocols ptp master]
   user@host# edit interface interface-name
   ```

   For details about configuring the parameters for the primary boundary clock interface, see "Configuring a PTP Primary Boundary Clock Interface" on page 146

5. (Optional) Specify the maximum log mean interval between announce messages—from **0** through **4**. The default value is 4.

```
[edit protocols ptp master]
user@host# set max-announce-interval max-announce-interval-value
```

6. (Optional) Specify the maximum log mean interval between delay-response messages—from **–7** through **4**. The default value is **4**.

```
[edit protocols ptp master]
user@host# set max-delay-response-interval max-delay-response-interval-value
```

7. (Optional) Specify the maximum log mean interval between synchronization messages—from **–7** through **4**. The default value is **4**.

```
[edit protocols ptp master]
user@host# set max-sync-interval max-sync-interval-value
```

8. (Optional) Specify the minimum log mean interval between announce messages—from **–0** through **4**. The default value is **0**.

```
[edit protocols ptp master]
user@host# set min-announce-interval min-announce-interval
```

9. (Optional) Specify the minimum log mean interval between delay-response messages—from **–7** through **4**. The default value is **–7**.

```
[edit protocols ptp master]
user@host# set min-delay-response-interval min-delay-response-interval
```

10. (Optional) Specify the minimum log mean interval between synchronization messages—from **–7** through **4**. The default value is **–7**.

```
[edit protocols ptp master]
user@host# set min-sync-interval min-sync-interval-value
```

11. (Optional) Specify the log mean interval between synchronization messages—from **–7** through **4**. The default value is **–6**. This configuration is used for manual clock clients. The primary boundary

clock sends synchronization messages to manual clock clients as specified in the **syn-interval-value** statement.

```
[edit protocols ptp master]
user@host#  set sync-interval sync-interval-value
```

After you have configured the PTP primary boundary clock parameters, enter the **commit** command from configuration mode. To complete the configuration of the primary boundary clock, complete "Configuring a PTP Primary Boundary Clock Interface" on page 146.

Configuring a PTP Primary Boundary Clock Interface

After you have configured the primary boundary clock parameters, complete the configuration of the primary boundary clock by configuring an interface to act in the role of the primary clock.

To configure a PTP primary boundary clock interface:

1. Configure the interface on which to respond to downstream PTP slaves or clients.

   ```
   [edit protocols ptp master]
   user@host#  edit interface interface-name
   ```

   NOTE: For the configuration to work, the interface you specify must be configured at the [**edit interfaces *interface-name***] hierarchy level.

2. On this interface, configure downstream PTP clients.

   ```
   [edit protocols ptp master interface interface-name]
   user@host#  edit unicast-mode
   ```

3. Configure the IP address of the remote PTP host, or configure a subnet mask so that any host belonging to that subnet can join the primary clock. You can configure up to 512 clients for each primary boundary clock.

   ```
   [edit protocols ptp master interface interface-name unicast-mode]
   user@host#  edit clock-client ip-address
   ```

NOTE: You can configure the maximum number of clients (512) in the following combination:

- Automatic clients 256.
- Manual and secure clients 256—Any combination of manual and secure clients is allowed as long as the combined total amounts to 256.

NOTE: When you toggle from a secure client to an automatic client or vice versa in the PTP configuration of a boundary clock, you need to delete the existing PTP configuration and issue the commit command, and then you add a new PTP configuration and issue the commit command.

4. Configure the IP address of the interface acting as the local PTP primary.

```
[edit protocols ptp master interface interface-name unicast-mode clock-client
ip-address]
user@host# set local-ip-address local-ip-address
```

5. (Optional) When the **unicast-negotiation** statement is configured at the [**edit protocols ptp**] hierarchy level, configure a clock client to immediately receive announce and synchronization messages from the primary boundary clock without unicast negotiation.

```
[edit protocols ptp master interface interface-name unicast-mode clock-client
ip-address local-ip-address local-ip-address]
user@host# set manual
```

6. Specify the encapsulation type for PTP packet transport—IPv4. This statement is mandatory.

```
[edit protocols ptp master interface interface-name unicast-mode]
user@host# set transport ipv4
```

After you have configured the PTP primary clock interface, enter the **commit** command from configuration mode.

SEE ALSO

Precision Time Protocol Overview | 68

IEEE 1588v2 PTP Boundary Clock Overview | 99
Configuring Precision Time Protocol Clocking | 141
Configuring a PTP Member Clock | 158
Example: Configuring a PTP Boundary Clock With Unicast Negotiation | 152
Example: Configuring a PTP Boundary Clock | 148

Example: Configuring a PTP Boundary Clock

IN THIS SECTION

- Requirements | 148
- Overview | 149
- Configuration | 149

This example shows how to configure a Precision Timing Protocol (PTP) boundary clock. A boundary clock must include the configuration of at least one primary and at least one client. The boundary primary receives time from a remote primary through the client, and in turn passes that time on to clock clients, which are in a client relationship to the boundary primary. In this example, you configure a primary, client, clock source, and clock client.

NOTE: ACX5048 and ACX5096 routers do not support boundary clock.

Requirements

This example uses the following hardware and software components:

NOTE: This example also applies to QFX Series switches. QFX Series switches do not support Gigabit Ethernet interfaces. Instead, configure PTP boundary clock parameters on 10-Gigabit Ethernet interfaces.

- An ACX Series router
- Junos OS Release 12.3 or later

Overview

In this example, the client clock or clock client immediately receives announce and synchronization packets after completion of the configuration.

Configuration

IN THIS SECTION

- Procedure | 149

Procedure

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [**edit**] hierarchy level:

```
set protocols ptp clock-mode boundary
set protocols ptp slave interface ge-1/3/9.0 unicast-mode transport ipv4
set protocols ptp slave interface ge-1/3/9.0 unicast-mode clock-source 192.1.1.2 local-ip-address 192.1.1.1
set protocols ptp master interface ge-1/0/0.0 unicast-mode transport ipv4
set protocols ptp master interface ge-1/0/0.0 unicast-mode clock-client 20.20.20.2/32 local-ip-address
20.20.20.1
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a boundary clock without unicast negotiation:

1. Configure the clock mode.

```
[edit protocols ptp]
user@host# set clock-mode boundary
```

2. Configure the client interface.

```
[edit protocols ptp]
user@host# edit slave interface ge-1/3/9.0
```

3. Configure the upstream unicast PTP primary clock source parameters.

```
[edit protocols ptp slave interface ge-1/3/9.0]
user@host# edit unicast-mode
```

4. Configure the encapsulation type for PTP packet transport.

```
[edit protocols ptp slave interface ge-1/3/9.0 unicast-mode ]
user@host# set transport ipv4
```

5. Configure the IP address of the primary interface.

```
[edit protocols ptp]
user@host# edit master interface ge-1/0/0.0
```

6. Specify the IP address and subnet of the remote PTP host, and the IP address of the local PTP primary interface.

```
[edit protocols ptp master interface ge-1/0/0.0 ]
user@host# edit unicast-mode
user@host# set protocols ptp master interface ge-1/0/0.0 unicast-mode clock-client 20.20.20.2/32
local-ip-address 20.20.20.1
```

> **NOTE**: For the configuration to work, the primary interface you specify must be configured with this IP address at the [**edit interfaces *interface-name***] hierarchy level.

7. Configure the encapsulation type for PTP packet transport.

```
[edit protocols ptp master interface ge-1/0/0.0 unicast-mode]
user@host# set transport ipv4
```

Results

From configuration mode, confirm your configuration by entering the **show** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit protocols ptp]
user@host# show
clock-mode boundary;
slave {
    interface ge-1/3/9.0 {
        unicast-mode {
            transport ipv4;
            clock-source 192.1.1.2 local-ip-address 192.1.1.1;
        }
    }
}
master {
    interface ge-1/0/0.0 {
        unicast-mode {
            transport ipv4;
            clock-client 20.20.20.2/32 local-ip-address 20.20.20.1;
```

```
                }
            }
    }
```

After you have configured the device, enter the **commit** command from configuration mode.

RELATED DOCUMENTATION

- Precision Time Protocol Overview | 68
- IEEE 1588v2 PTP Boundary Clock Overview | 99
- Configuring Precision Time Protocol Clocking | 141
- Configuring a PTP Primary Boundary Clock | 143
- Configuring a PTP Member Clock | 158
- Example: Configuring a PTP Boundary Clock With Unicast Negotiation | 152

Example: Configuring a PTP Boundary Clock With Unicast Negotiation

IN THIS SECTION

- Requirements | 153
- Overview | 153
- Configuration | 154

This example shows how to configure a boundary clock with unicast negotiation turned on and a mixture of manual, secure and automatic clock clients, which have a client relationship to the primary boundary clock. The unicast negotiation applies to clock sources, which are configured on the client or clock client. Clock clients, configured on the primary, are not affected by unicast negotiation.

NOTE: ACX5048 and ACX5096 routers do not support boundary clock.

In this example, unicast-negotiation is applicable only to clock-sources. For clock clients, the statement **unicast-negotiation** at the [**edit protocols ptp**] hierarchy level is not effective.

Requirements

This example uses the following hardware and software components:

> **NOTE**: This example also applies to QFX Series switches. QFX Series switches do not support Gigabit Ethernet interfaces. Instead, configure PTP boundary clock parameters on 10-Gigabit Ethernet interfaces.

- An ACX Series router
- Junos OS Release 12.3 or later

Overview

A PTP client clock or clock client can join a primary clock with and without unicast negotiation. With unicast negotiation, the announce, synchronization, and delay response packet rates are negotiated between the primary and the client before a PTP session is established. Without unicast negotiation and after it is configured, the client or client immediately receives announce and synchronization packets.

A clock client is the remote PTP host, which receives time from the PTP primary. The following clock clients are configured in this example:

- Secure client—A secure client is configured with an exact IP address, after which, it joins a primary clock through unicast negotiation. In this example, the clock client **clock-client 117.117.117.117/32 local-ip-address 109.109.109.53** is a secure client, which means that only this specific host from the subnet can join the primary clock through a unicast negotiation .
- Automatic client—An automatic client is configured with an IP address, which includes a subnet mask, indicating that any PTP host belonging to that subnet, can join the primary clock through a unicast negotiation. In this example, the clock client **clock-client 109.109.109.0/24 local-ip-address 109.109.109.53** is an automatic client. Additionally, this automatic client is configured on the same primary clock interface—**109.109.109.53**—as the secure client.
- Manual client—A manual client does *not* use unicast negotiation to join the primary clock. The **manual** statement overrides the **unicast-negotiation** statement configured at the [**edit protocols ptp**] hierarchy level. As soon as you configure a manual client, it starts receiving announce and

synchronization packets. In this example, the clock client **clock-client 7.7.7.7 local-ip-address 7.7.7.53 manual** is the manual client and is configured on a second primary clock interface.

Configuration

IN THIS SECTION

- Procedure | 154

A boundary clock must include the configuration of at least one primary and at least one client. The boundary primary receives time from a remote primary through the client, and in turn passes that time on to clock clients, which are in a client relationship to the boundary primary. In this example, you configure a boundary client, two Precision Time Protocol (PTP) boundary primaries with three different kinds of clock clients—automatic, manual, and secure. Two of the clock clients are configured on the same boundary primary.

Procedure

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [**edit**] hierarchy level:

```
set protocols ptp clock-mode boundary
set protocols ptp unicast-negotiation
set protocols ptp slave interface ge-0/1/0.0 unicast-mode transport ipv4
set protocols ptp slave interface ge-0/1/0.0 unicast-mode clock-source 10.10.10.50 local-ip-address 10.10.10.53
set protocols ptp master interface ge-0/1/3.0 unicast-mode transport ipv4
set protocols ptp master interface ge-0/1/3.0 unicast-mode clock-client 117.117.117.117/32 local-ip-address 109.109.109.53
set protocols ptp master interface ge-0/1/3.0 unicast-mode clock-client 109.109.109.0/24 local-ip-address 109.109.109.53
set protocols ptp master interface ge-0/1/5.0 unicast-mode transport ipv4
set protocols ptp master interface ge-0/1/5.0 unicast-mode clock-client 7.7.7.7/32 local-ip-address 7.7.7.53
manual
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a boundary clock with unicast negotiation:

1. Configure the clock mode.

   ```
   [edit protocols ptp]
   user@host# set clock-mode boundary
   ```

2. Enable unicast negotiation.

   ```
   [edit protocols ptp]
   user@host# set unicast-negotiation
   ```

3. Configure the local client interface from which the boundary primary receives time and passes it on to the configured clock clients.

   ```
   [edit protocols ptp]
   user@host# edit slave interface ge-0/1/0.0
   ```

4. Configure the upstream unicast PTP primary clock source parameters.

   ```
   [edit protocols ptp slave interface ge-0/1/0.0]
   user@host# edit unicast-mode
   ```

5. Configure the encapsulation type for PTP packet transport.

   ```
   [edit protocols ptp slave interface  ge-0/1/0.0 unicast-mode ]
   user@host# set transport ipv4
   ```

6. Configure the PTP primary parameters by specifying the IP address of the PTP primary clock and the IP address of the local interface.

```
[edit protocols ptp slave interface ge-0/1/0.0 unicast-mode ]
user@host# set clock-source 10.10.10.50 local-ip-address 10.10.10.53
```

7. Configure the first primary interface in this example.

```
[edit protocols ptp]
user@host# edit master interface ge-0/1/3.0
```

8. On the first primary interface, configure the downstream PTP clock clients.

```
[edit protocols ptp master interface ge-0/1/3.0 ]
user@host# edit unicast-mode
```

9. On the first primary interface, configure the encapsulation type for PTP packet transport.

```
[edit protocols ptp master interface ge-0/1/3.0  unicast-mode]
user@host# set transport ipv4
```

10. On the first primary interface, configure the PTP primary parameters by specifying the exact IP address of the remote PTP host and the IP address of the local PTP primary interface.

```
[edit protocols ptp master interface ge-0/1/3.0 unicast-mode]
user@host# set clock-client 117.117.117.117 local-ip-address 109.109.109.53
```

11. On the first primary interface, configure a second PTP primary by specifying the IP address and subnet of the second remote PTP host and the IP address of the local PTP primary interface.

```
[edit protocols ptp master interface ge-0/1/3.0 unicast-mode]
user@host# set clock-client 109.109.109.0/24 local-ip-address 109.109.109.53
```

12. Configure the second primary interface with the following parameters: the encapsulation type, the downstream PTP host, the IP address of the local PTP primary interface, and the **manual** statement so that this client does not use unicast negotiation.

    ```
    [edit protocols ptp master]
    user@host# set interface ge-0/1/5.0 unicast-mode transport ipv4
    user@host# set interface ge-0/1/5.0 unicast-mode clock-client 7.7.7.7 local-ip-address 7.7.7.53
    manual
    ```

Results

From configuration mode, confirm your configuration by entering the **show** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```

[edit protocols ptp]
user@host# show
clock-mode boundary;
unicast-negotiation;
slave {
    interface ge-0/1/0.0 {
        unicast-mode {
            transport ipv4;
            clock-source 10.10.10.50 local-ip-address 10.10.10.53;
        }
    }
}
master {
    interface ge-0/1/3.0 {
        unicast-mode {
            transport ipv4;
            clock-client 117.117.117.117/32 local-ip-address 109.109.109.53;
            clock-client 109.109.109.0/24 local-ip-address 109.109.109.53;
        }
    }
    interface ge-0/1/5.0 {
        unicast-mode {
            transport ipv4;
            clock-client 7.7.7.7/32 local-ip-address 7.7.7.53 {
```

```
                        manual;
                    }
                }
            }
        }
```

After you have configured the device, enter the **commit** command from configuration mode.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

IEEE 1588v2 PTP Boundary Clock Overview | 99

Configuring Precision Time Protocol Clocking | 141

Configuring a PTP Primary Boundary Clock | 143

Configuring a PTP Member Clock | 158

Example: Configuring a PTP Boundary Clock | 148

Configuring a PTP Member Clock

IN THIS SECTION

- Configuring the PTP Member Clock Parameters | 159
- Configuring the PTP Member Clock Interface | 161

The client port that you configure can be a Precision Time Protocol (PTP) boundary or ordinary clock, depending on the configuration of the **clock-mode** statement at the [**edit protocols ptp**] hierarchy level. An ordinary or boundary client clock performs frequency and phase recovery based on received and requested timestamps from a primary clock—a reference or a boundary clock primary.

NOTE: In ACX Series routers, the reference clock functionality is supported only on ACX500 router.

To configure a PTP client clock, complete the following tasks:

Configuring the PTP Member Clock Parameters

To configure a PTP client clock.

NOTE: The **clock-class-to-quality-level-mapping quality-level**, **convert-clock-class-to-quality-level**, and **grant-duration** statements are not supported on the QFX10002 switch.

1. Configure the clock mode:

```
[edit protocols ptp]
user@host# set clock-mode (boundary | ordinary)
```

2. Configure the client clock.

```
[edit protocols ptp]
user@host# edit slave
```

3. (Optional) Specify the rate of announce messages that a PTP client requests from the primary during a unicast-negotiation session—from 0 through 4. The default value is 1.

```
[edit protocols ptp slave]
user@host# set announce-interval announce-interval-value
```

NOTE: The configuration of the **announce-interval** statement is effective only when the **unicast-negotiation** statement is also configured at the [**edit protocols ptp**] hierarchy level.

4. (Optional) Specify the number of announce messages that a client—configured on an ACX Series router—must miss before an announce timeout is declared—from 2 through 10. The default value is 3.

```
[edit protocols ptp slave]
user@host# set announce-timeout announce-timeout-value
```

5. (Optional) Override the default PTP clock class to Ethernet Synchronization Message Channel (ESMC) mapping and specify the quality level for the PTP timing source.

```
[edit protocols ptp slave]
user@host# set clock-class-to-quality-level-mapping quality-level (prc | prs |sec | smc | ssu-a | ssu-b |
st2 | st3 | st3e | st4 | stu | tnc)
```

6. (Optional) Enable retrieval of ESMC information from the PTP clock class.

```
[edit protocols ptp slave]
user@host# set convert-clock-class-to-quality-level
```

7. (Optional) Specify the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary—from –6 through 3. The default value is 0.

```
[edit protocols ptp slave]
user@host# set delay-request delay-request-value
```

8. (Optional) Specify the grant duration value. When unicast negotiation is enabled, the local PTP client requests announce, synchronization, and delay-response messages from the primary. In each request, the client asks for the packets to be sent at a specified rate and the client provides a duration for which the rate is valid. The grant-duration value is specified in seconds. The default grant duration is 300 seconds.

```
[edit protocols ptp slave]
user@host# set grant-duration interval
```

9. Configure the interface for the client.

```
[edit protocols ptp slave]
user@host# edit interface interface-name
```

For details about configuring the client interface, see "Configuring the PTP Member Clock Interface" on page 161.

10. (Optional) Configure the log mean interval between synchronization messages—from **–6** through **-3**. The default value is –6 or 64 synchronous interval messages sent per second

```
[edit protocols ptp slave]
user@host#  set sync-interval sync-interval-value
```

After you have configured the PTP client clock parameters, enter the **commit** command from configuration mode. To complete the configuration of the client clock, complete "Configuring the PTP Member Clock Interface" on page 161.

Configuring the PTP Member Clock Interface

The client clock interface responds to the upstream PTP primary clock.

To configure the PTP client clock interface:

1. Configure the interface for the client clock.

```
[edit protocols ptp slave]
user@host#  edit interface interface-name
```

> **NOTE**: On the QFX Series, you can configure an aggregated Ethernet interface and its configured IP address for PTP streams acting as slaves or primaries.

For example, to configure a client using an aggregated Ethernet interface:

```
user@switch#  set protocols ptp slave interface ae0.0
```

> **NOTE**: On the QFX Series, you can configure a loopback interface (there is only one loopback interface, and it is lo0.0) and its corresponding IP addresses for PTP streams acting as slaves or primaries. Although the loopback interface is the same for both primaries and slaves, the IP addresses must be unique.

For example, to configure a client using the loopback interface:

```
user@switch# set protocols ptp slave interface lo0.0
```

2. Configure the upstream unicast PTP primary clock source parameters.

```
[edit protocols ptp slave interface interface-name]
user@host# edit unicast-mode
```

3. Configure the IP address of the primary, which acts as a source of time for this client.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# edit clock-source ip-address
```

NOTE: To configure additional primary clock sources for the client, include the **clock-source** statement up to four times. However, synchronization is to only one primary clock.

4. Specify the IP address of the interface acting as the local PTP client port.

```
[edit protocols ptp slave interface interface-name unicast-mode clock-source
ip-address]
user@host# set local-ip-address local-ip-address
```

NOTE: For the configuration to work, the interface you specify must be configured with this IP address at the [**edit interfaces *interface-name***] hierarchy level.

5. Configure the encapsulation type for PTP packet transport. This statement is mandatory.

```
[edit protocols ptp slave interface interface-name unicast-mode]
user@host# set transport (ipv4 | ipv6)
```

After you have configured the PTP client clock interface, enter the **commit** command from configuration mode.

SEE ALSO

- Precision Time Protocol Overview | 68
- IEEE 1588v2 PTP Boundary Clock Overview | 99
- Configuring Precision Time Protocol Clocking | 141
- Configuring a PTP Primary Boundary Clock | 143
- Example: Configuring a PTP Boundary Clock With Unicast Negotiation | 152
- Example: Configuring a PTP Boundary Clock | 148

Example: Configuring an Ordinary Member Clock With Unicast-Negotiation

IN THIS SECTION

- Requirements | 163
- Overview | 164
- Configuration | 164

This example shows the base configuration of a Precision Time Protocol (PTP) ordinary client clock *with* unicast-negotiation on an ACX Series router.

NOTE: ACX5048 and ACX5096 routers do not support ordinary clock.

Requirements

This example uses the following hardware and software components:

NOTE: This example also applies to QFX Series switches. QFX Series switches do not support Gigabit Ethernet interfaces. Instead, configure PTP boundary clock parameters on 10-Gigabit Ethernet interfaces.

- One ACX Series router
- Junos OS Release 12.2 or later

Overview

In this configuration, the ordinary client clock uses unicast-negotiation and compensates for some network asymmetry.

NOTE: The values in this example are for illustration purposes only. You can set the values for each parameter according to your requirements.

Configuration

IN THIS SECTION

- CLI Quick Configuration | 164
- Configuring an ordinary client clock with unicast-negotiation | 165
- Results | 166

To configure an ordinary client clock with unicast-negotiation, perform these tasks:

CLI Quick Configuration

```
set ptp clock-mode ordinary
set ptp domain 110
set ptp unicast-negotiation
set ptp slave delay-request -6
set ptp slave announce-timeout 2
set ptp slave announce-interval 3
set ptp slave sync-interval -5
set ptp slave grant-duration 7200
set ptp slave interface ge-0/1/0.0 unicast-mode transport ipv4
set ptp slave interface ge-0/1/0.0 unicast-mode clock-source 10.10.10.50 local-
ip-address 10.10.10.75 asymmetry -4500
```

Configuring an ordinary client clock with unicast-negotiation

Step-by-Step Procedure

1. Configure the clock mode, domain, and unicast-negotiation:

   ```
   [edit protocols ptp]
   user@host# set clock-mode ordinary domain 110 unicast-negotiation
   ```

2. Configure the announce timeout and the announce interval:

   ```
   [edit protocols ptp]
   user@host# set slave announce-timeout 2 announce-interval 3
   ```

3. Configure the synchronization interval and the grant duration:

   ```
   [edit protocols ptp]
   user@host#  set slave sync-interval -5 grant-duration 7200
   ```

4. Configure the client interface:

   ```
   [edit protocols ptp]
   user@host# edit slave interface ge-0/1/0.0
   ```

5. Configure the unicast transport mode:

```
[edit protocols ptp slave interface ge-0/1/0.0]
user@host# set unicast-mode transport ipv4
```

6. Configure the clock source:

```
[edit protocols ptp slave interface ge-0/1/0.0]
user@host# edit unicast-mode clock-source 10.10.10.50 local-ip-address 10.10.10.75
```

7. Configure the asymmetric path:

```
 [edit protocols ptp slave interface ge-0/1/0.0 unicast-mode clock-source
10.10.10.50 local-ip-address 10.10.10.75]
user@host# set asymmetry -4500
```

8. Verify the configuration:

```
 [edit protocols ptp slave interface ge-0/1/0.0 unicast-mode clock-source
10.10.10.50 local-ip-address 10.10.10.75]
user@host# top
 [edit]
user@host# edit protocols
 [edit protocols]
user@host# show
```

See the output for the **show** command in the Results section.

Results

The following output shows the configuration of unicast-negotiation and compensation for some network asymmetry. The **unicast-negotiation** statement includes the parameters for the delay request, announce interval, synchronization interval, and grant duration values. Interface **ge-0/1/0.0** is configured to compensate for an asymmetric path to the PTP master by subtracting 4.5 microseconds from the client-to-master direction delay calculations.

```
[edit protocols]
user@host# show
```

```
ptp {
    clock-mode ordinary;
    domain 110;
    unicast-negotiation;
    slave {
        delay-request -6;
        announce-timeout 2;
        announce-interval 3;
        sync-interval -5;
        grant-duration 7200;
        interface ge-0/1/0.0 {
            unicast-mode {
                transport ipv4;
                clock-source 10.10.10.50 local-ip-address 10.10.10.75 {
                    asymmetry -4500;
                }
            }
        }
    }
}
```

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

slave | **498**

unicast-mode | **544**

Example: Configuring an Ordinary Member Clock Without Unicast-Negotiation

IN THIS SECTION

- Requirements | **168**
- Overview | **168**

- Configuration | **169**

This example shows the base configuration of a Precision Time Protocol (PTP) ordinary client clock *without* unicast-negotiation on an ACX Series router.

NOTE: ACX5048 and ACX5096 routers do not support ordinary clock.

Requirements

This example uses the following hardware and software components:

NOTE: This example also applies to QFX Series switches. QFX Series switches do not support Gigabit Ethernet interfaces. Instead, configure PTP boundary clock parameters on 10-Gigabit Ethernet interfaces.

- One ACX Series router
- Junos OS Release 12.2 or later

Overview

In this configuration, unicast-negotiation is *not* configured, so the PTP client has no control over the rate of the negotiation. The PTP primary (a Brilliant Reference Clock or an MX Series router) must be configured with the parameters of the PTP client, such as announce, synchronization, and delay-response packets to control the rate of the negotiation.

NOTE: The values in this example are for illustration purposes only. You can set the values for each parameter according to your requirements.

Configuration

IN THIS SECTION

- CLI Quick Configuration | 169
- Configuring an ordinary client clock without unicast-negotiation | 169
- Results | 171

To configure an ordinary client clock without unicast-negotiation, perform these tasks:

NOTE: The **ipv4-dscp** statement is not supported on the QFX10002 switch.

CLI Quick Configuration

```
set protocols ptp clock-mode ordinary
set protocols ptp ipv4-dscp 46
set protocols ptp slave interface ge-0/2/0.0 unicast-mode transport ipv4
set protocols ptp slave interface ge-0/2/0.0 unicast-mode clock-source 12.1.1.4
local-ip-address 12.1.1.5
```

Configuring an ordinary client clock without unicast-negotiation

Step-by-Step Procedure

1. Configure the clock mode:

   ```
   [edit protocols ptp]
   user@host# set clock-mode ordinary
   ```

2. Configure the Differentiated Services code point (DSCP) value for all PTP IPv4 packets originated by the device:

NOTE: The **ipv4-dscp 46** statement is not supported on QFX Series switches.

```
[edit protocols ptp]
user@host# set ipv4-dscp 46
```

3. Configure the client interface:

```
[edit protocols ptp]
user@host# edit slave interface ge-0/2/0.0
```

4. Configure the unicast transport mode:

```
[edit protocols ptp slave interface ge-0/2/0.0]
user@host# set unicast-mode transport ipv4
```

5. Configure the clock source:

```
[edit protocols ptp slave interface ge-0/2/0.0]
user@host# unicast-mode clock-source 12.1.1.4 local-ip-address 12.1.1.5
```

6. Verify the configuration:

```
[edit protocols ptp slave interface ge-0/2/0.0]
user@host# top
 [edit]
user@host# edit protocols
 [edit protocols]
user@host# show
```

See the output for the **show** command in the Results section.

Results

In this example, the PTP client on the local interface **ge-0/2/0** is assigned a local IP address of **12.1.1.5**. Unicast-negotiation is not configured so the PTP master must be explicitly configured with the details of the PTP client (**12.1.1.5**).

```
[edit protocols]
user@host# show
ptp {
    clock-mode ordinary;
    ipv4-dscp 46;
    slave {
        interface ge-0/2/0.0 {
            unicast-mode {
                transport ipv4;
                clock-source 12.1.1.4 local-ip-address 12.1.1.5;
            }
        }
    }
}
```

RELATED DOCUMENTATION

- IEEE 1588v2 Precision Timing Protocol (PTP) | **103**
- slave | **498**
- unicast-mode | **544**

Configuring Precision Time Protocol Over Integrated Routing and Bridging

Junos OS for ACX Series router supports configuring precision time protocol (PTP) over integrated routing and bridging (IRB). You can configure a boundary clock node with PTP (IPv4) over IRB in a primary-only mode across single or multiple IRB logical interfaces.

NOTE: Starting in Junos OS Release 20.1R1, PTP is supported over IRB on primary interface configurations for MPC7E line cards. This release also supports the configuration of aggregated Ethernet over IRB. The **disable-lag-revertive-switchover** command is also added at a global level. This configuration enables nonrevertive switchover for a LAG.

To configure Precision Time Protocol (PTP) over IRB:

1. Configure physical interfaces with Layer 2 encapsulation and create logical units with VLANs.

   Sample configuration:

```
[edit interfaces ge-0/2/1]
flexible-vlan-tagging;
native-vlan-id 130;
encapsulation flexible-ethernet-services;
unit 615 {
    encapsulation vlan-bridge;
    vlan-id 615;
}

[edit interfaces ge-0/0/3]
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
unit 615 {
    encapsulation vlan-bridge;
    vlan-id 615;
}

[edit interfaces ge-0/1/2]
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
unit 615 {
    encapsulation vlan-bridge;
    vlan-id 615;
}

[edit interfaces ge-0/2/0]
flexible-vlan-tagging;
native-vlan-id 130;
encapsulation flexible-ethernet-services;
```

2. Configure physical interfaces on a bridge domain.

   Sample configuration:

```
[edit bridge-domains]
bd-615 {
    vlan-id 615;
    interface ge-0/1/2.615;
    interface ge-0/2/0.615;
    interface ge-0/2/1.615;
    interface ge-0/0/3.615;
 }
```

3. Configure a routing instance for the bridge domain where physical interfaces are members of the bridge domain.

   Sample configuration:

```
[edit bridge-domains]
bd-615 {
    vlan-id 615;
    interface ge-0/1/2.615;
    interface ge-0/2/0.615;
    interface ge-0/2/1.615;
    interface ge-0/0/3.615;
    routing-interface irb.615;
}
```

4. Configure an IRB logical interface with IPv4 address.

   Sample configuration:

```
[edit interfaces irb]
unit 615 {
    family inet {
        address 10.255.210.130/27;
    }
}
```

5. Configure PTP boundary clock primary on IRB logical interface.

Sample configuration:

```
[edit protocols ptp]
clock-mode boundary;
priority2 210;
unicast-negotiation;
slave {
    interface ge-0/2/0.0 {
        unicast-mode {
            transport ipv4;
            clock-source 122.25.1.4 local-ip-address 122.25.1.5 {
                asymmetry 680;
            }
        }
    }

master {
    interface ge-0/2/1.0 {
        unicast-mode {
            transport ipv4;
            clock-client 122.25.1.7/32 local-ip-address 122.25.1.6;
        }
    }
    interface irb.615 {
        unicast-mode {
            transport ipv4;
            clock-client 10.255.210.128/27 local-ip-address 10.255.210.130;
        }
    }
}
```

You can use the following commands to monitor and troubleshoot the configuration:

- **show interfaces irb**—View the configured logical IRB interface details.
- **show ptp master detail**—View the configured primary and its status along with local and remote client details.
- **show bridge domain**—View the configured bridge domain and the associated physical interfaces and IRB routing instance details.
- **show ptp lock-status detail**—View the PTP lock status details.
- **show ptp port detail**—View the PTP port details.

- **show ptp global-information**—View the configured PTP parameters.
- **show ptp clock**—View the PTP clock information.

RELATED DOCUMENTATION

IEEE 1588v2 PTP Boundary Clock Overview | **99**

Configuring a PTP Primary Boundary Clock | **143**

Configuring a PTP Member Clock | **158**

Example: Configuring a PTP Boundary Clock With Unicast Negotiation | **152**

Example: Configuring a PTP Boundary Clock | **148**

Configuring PHY Timestamping

IN THIS SECTION

- Enabling PHY Timestamping for Ordinary Clock Member | **176**
- Enabling PHY Timestamping for Boundary Clock | **177**
- Enabling PHY Timestamping for Reference Clock | **178**

The PHY timestamping refers to the timestamping of the IEEE 1588 event packets at the 1-Gigabit Ethernet and 10-Gigabit Ethernet PHY. Timestamping the packet in the PHY results in higher stability of recovered clock. The PHY timestamping on ACX updates the correction field of the packet. ACX supports PHY timestamping in ordinary clock and boundary clock modes.

NOTE: PHY timestamping is supported only on ACX500 line of routers.

The following points need to be considered while configuring PHY timestamping in ACX routers:

- PHY timestamping is enabled or disabled on all the PHYs. You cannot selectively enable or disable PHY timestamping on a particular interface.
- When PHY timestamping is enabled, the transparent clock functionality is also enabled.

NOTE: The PHYs on ACX do not support transparent clock functionality for PTP-over-MPLS. You should not enable transparent clock or PHY timestamping if PTP is transported over MPLS.

In ACX2000 router, the transparent clock operation is not supported on the 10-Gigabit Ethernet port.

To enable PHY timestamping on ACX routers, configure **clock-mode** (ordinary clock or boundary clock) along with the **transparent-clock** CLI statement at the [**edit protocols ptp**] hierarchy.

```
[edit protocols ptp]
user@host#  set clock-mode (boundary | ordinary)
```

NOTE: Starting in Junos OS Release 17.1 onwards, to configure transparent clock, include the **e2e-transparent** CLI command at the [**edit protocols ptp**] hierarchy level. Prior to Junos OS Release 17.1, to configure transparent clock, include the **transparent-clock** CLI command at the [**edit protocols ptp**] hierarchy level.

Enabling PHY Timestamping for Ordinary Clock Member

The following procedure enables you to configure PHY timestamping for ordinary clock client in ACX:

1. Configure the clock mode as ordinary.

   ```
   [edit protocols ptp]
   user@host#  set clock-mode ordinary
   ```

2. Configure the transparent clock.

   ```
   [edit protocols ptp]
   user@host#  set e2e-transparent
   ```

3. Configure the interface for client clock. For information on configuring PTP client clock interface, see "Configuring a PTP Member Clock" on page 158.

```
[edit protocols ptp]
user@host# set slave interface interface-name...
```

Enabling PHY Timestamping for Boundary Clock

The following procedure enables you to configure PHY timestamping for boundary clock in ACX:

> **NOTE**: PHY timestamping is supported only on ACX500 line of routers.

1. Configure the clock mode as boundary.

```
[edit protocols ptp]
user@host# set clock-mode boundary
```

2. Configure the transparent clock.

```
[edit protocols ptp]
user@host# set e2e-transparent
```

3. Configure the interface for client clock. For information on configuring PTP client clock interface, see "Configuring a PTP Member Clock" on page 158.

```
[edit protocols ptp]
user@host# set slave interface interface-name...
```

4. Configure the interface for primary clock. For information on configuring PTP primary boundary clock, see "Configuring a PTP Primary Boundary Clock" on page 143.

```
[edit protocols ptp]
user@host# set master interface interface-name...
```

Enabling PHY Timestamping for Reference Clock

The following procedure enables you to configure PHY timestamping for reference clock in ACX:

> **NOTE**: In ACX Series routers, the reference clock functionality is supported only on ACX500 router.

1. Configure the clock mode as ordinary.

   ```
   [edit protocols ptp]
   user@host# set clock-mode ordinary
   ```

2. Configure the transparent clock.

   ```
   [edit protocols ptp]
   user@host# set e2e-transparent
   ```

3. Configure the interface for primary clock. For information on configuring PTP primary boundary clock, see "Configuring a PTP Primary Boundary Clock" on page 143.

   ```
   [edit protocols ptp]
   user@host# set master interface interface-name...
   ```

Configuring PHY Timestamping on ACX2200 Routers

IN THIS SECTION

- Enabling PHY Timestamping for Boundary Clock | 179

The PHY timestamping refers to the timestamping of the IEEE 1588 event packets at the 1-Gigabit Ethernet and 10-Gigabit Ethernet PHY. Timestamping the packet in the PHY results in higher stability of recovered clock. The PHY timestamping on ACX updates the correction field of the packet. ACX2200 supports PHY timestamping in boundary clock mode.

The following points need to be considered while configuring PHY timestamping in ACX routers:

- PHY timestamping is enabled or disabled on all the PHYs. You cannot selectively enable or disable PHY timestamping on a particular interface.
- When PHY timestamping is enabled, the transparent clock functionality is also enabled.

NOTE: The PHYs on ACX do not support transparent clock functionality for PTP-over-MPLS. You should not enable transparent clock or PHY timestamping if PTP is transported over MPLS.

To enable PHY timestamping on ACX2200 routers, configure boundary clock along with **e2e-transparent** CLI statement at the [**edit protocols ptp**] hierarchy.

```
[edit protocols ptp]
user@host# set e2e-transparent
```

Enabling PHY Timestamping for Boundary Clock

The following procedure enables you to configure PHY timestamping for boundary clock in ACX2200 routers:

1. Configure the clock mode as boundary.

   ```
   [edit protocols ptp]
   user@host# set boundary
   ```

2. Enable Phy timestamping on boundary clock.

   ```
   [edit protocols ptp]
   user@host# set e2e-transparent
   ```

3. Configure the interface for client clock. For information on configuring PTP client clock interface, see "Configuring a PTP Member Clock" on page 158.

   ```
   [edit protocols ptp]
   user@host#  set slave interface interface-name...
   ```

4. Configure the interface for primary clock. For information on configuring PTP primary boundary clock, see "Configuring a PTP Primary Boundary Clock" on page 143.

   ```
   [edit protocols ptp]
   user@host#  set master interface interface-name...
   ```

G.703 2.048MHz Signal Type for BITS Interfaces Overview

The ITU-T Recommendation G.703, *Physical/electrical characteristics of hierarchical digital interfaces*, is a standard method for encoding clock and data signals into a single signal. This signal is then used to synchronize various data communications devices, such as switches, routers and multiplexers at a data rate of 2.048 MHz. Both directions of the G.703 signal must use the same signal type. To configure signal type parameters for a building-integrated timing supply (BITS) interface, include the following statements at the [**edit chassis synchronization**] hierarchy level:

```
interfaces bits {
     signal-type (2048khz | e1 | t1);
          e1-options {
               framing (g704 | g704-no-crc4);
          }
          t1-options {
               framing (esf | sf);
          }
     }
}
```

RELATED DOCUMENTATION

synchronization (ACX Series) | 517

show chassis synchronization | 576

Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation

IN THIS SECTION

- Configuring the PTP over Ethernet Primary Boundary Clock Parameters | 182
- Configuring the PTP over Ethernet Primary Boundary Clock Interface | 184
- Configuring the PTP over Ethernet Member Clock Parameters | 185
- Configuring the PTP over Ethernet Member Clock Interface | 186

On an ACX Series router, you can configure a Precision Time Protocol (PTP) primary boundary clock with IEEE 802.3 or Ethernet encapsulation of PTP messages to the clients (ordinary and boundary) so that they can establish their relative time offset from this primary's clock or clock reference. PTP over Ethernet uses multicast addresses for communication of PTP messages between the client clock and the primary clock. The client clock automatically learns of primary clocks in the network, is immediately able to receive the multicast messages from the primary clock, and can begin sending messages to the primary clock without any pre-provisioning. The primary boundary clock synchronizes time through a client boundary port.

To configure PTP over Ethernet with multicast primary and client ports, you must include the **multicast-mode transport ieee-802.3** statement at the **[edit protocols ptp master interface *interface-name*]** and **[edit protocols ptp slave interface *interface-name*]** hierarchy levels, respectively.

To configure a PTP over Ethernet primary boundary clock and client boundary clock for multicast transmission, complete the following tasks:

Configuring the PTP over Ethernet Primary Boundary Clock Parameters

To configure the parameters of a PTP over Ethernet primary boundary clock:

1. Configure the clock mode.

   ```
   [edit protocols ptp]
   user@host# set clock-mode boundary
   ```

2. Configure the primary clock.

   ```
   [edit protocols ptp]
   user@host# edit master
   ```

3. (Optional) Specify the log mean interval between announce messages—from 0 through 4. By default, one announce message is sent every two seconds. This configuration is used for manual clock clients. The primary boundary clock sends announce messages to manual clock clients as specified in the announce-interval value.

   ```
   [edit protocols ptp master]
   user@host# set announce-interval announce-interval-value
   ```

4. Configure the interface on which to respond to downstream PTP clients or client ports.

   ```
   [edit protocols ptp master]
   user@host# edit interface interface-name
   ```

   For details about configuring the parameters for the primary boundary clock interface, see "Configuring the PTP over Ethernet Primary Boundary Clock Interface" on page 184

5. (Optional) Specify the maximum log mean interval between announce messages—from 0 through 4. The default value is 4.

   ```
   [edit protocols ptp master]
   user@host# set max-announce-interval max-announce-interval-value
   ```

6. (Optional) Specify the maximum log mean interval between delay-response messages—from –7 through 4. The default value is 4.

   ```
   [edit protocols ptp master]
   user@host# set max-delay-response-interval max-delay-response-interval-value
   ```

7. (Optional) Specify the maximum log mean interval between synchronization messages—from –7 through 4. The default value is 4.

   ```
   [edit protocols ptp master]
   user@host# set max-sync-interval max-sync-interval-value
   ```

8. (Optional) Specify the minimum log mean interval between announce messages—from 0 through 4. The default value is **0**.

   ```
   [edit protocols ptp master]
   user@host# set min-announce-interval min-announce-interval
   ```

9. (Optional) Specify the minimum log mean interval between delay-response messages—from –7 through 4. The default value is –7.

   ```
   [edit protocols ptp master]
   user@host# set min-delay-response-interval min-delay-response-interval
   ```

10. (Optional) Specify the minimum log mean interval between synchronization messages—from –7 through 4. The default value is –7.

    ```
    [edit protocols ptp master]
    user@host# set min-sync-interval min-sync-interval-value
    ```

11. (Optional) Specify the log mean interval between synchronization messages—from –7 through 4. The default value is –6. This configuration is used for manual clock clients. The primary boundary clock sends synchronization messages to manual clock clients as specified in the **syn-interval-value** statement.

    ```
    [edit protocols ptp master]
    user@host# set sync-interval sync-interval-value
    ```

After you have configured the PTP primary boundary clock parameters, enter the **commit** command from configuration mode. To complete the configuration of the primary boundary clock, complete "Configuring the PTP over Ethernet Primary Boundary Clock Interface" on page 184.

Configuring the PTP over Ethernet Primary Boundary Clock Interface

After you configured the primary boundary clock parameters for PTP over Ethernet with multicast transmission of PTP traffic, complete the configuration of the primary boundary clock by configuring an interface to act in the role of the primary clock.

To configure a PTP over Ethernet primary boundary clock interface:

1. Configure the interface on which to respond to downstream PTP client ports or clients.

   ```
   [edit protocols ptp master]
   user@host# edit interface interface-name
   ```

   NOTE: For the configuration to work, the interface you specify must be configured at the [**edit interfaces *interface-name***] hierarchy level.

2. On this interface, configure multicast as the transmission mode of traffic for PTP clients.

   ```
   [edit protocols ptp master interface interface-name]
   user@host# edit multicast-mode
   ```

3. Specify the encapsulation type for PTP packet transport as Ethernet or IEEE 802.3. This statement is mandatory.

   ```
   [edit protocols ptp master interface interface-name multicast-mode]
   user@host# set transport ieee-802.3
   ```

   Alternatively, specify the encapsulation type as Ethernet with the link-local multicast address to be used in the sending of PTP messages. If you specify the **link-local** attribute, the primary clock chooses either of the two MAC addresses defined in the IEEE 1588-2008 standard. When you configure this option, the system attempts to use the 01 -80-C2-00-00-0E MAC address (link-local multicast MAC address) for multicast transmission. If this MAC address is not available, the 01-1B-19-00-00-00 address (standard Ethernet multicast address) is used as the second priority. The standard Ethernet multicast address is used by default. You need to explicitly configure the link-local multicast address.

```
[edit protocols ptp master interface interface-name multicast-mode]
user@host# set transport ieee-802.3 link-local
```

After you have configured the PTP over Ethernet primary clock interface, enter the **commit** command from configuration mode.

Configuring the PTP over Ethernet Member Clock Parameters

An interface on which the primary clock is configured is called a primary interface and an interface on which the client clock is configured is called a client interface. A primary interface functions as the primary port and a client interface functions as the client port. Because PTP over Ethernet uses multicast addresses, a client port can automatically start receiving the multicast announce messages transmitted by the primary ports on a network and can also start communication with the primary port with minimal or no configuration. You can optionally configure these settings for a client port that communicates with the primary ports using PTP over Ethernet.

To configure a PTP over Ethernet client clock.

1. Configure the clock mode:

```
[edit protocols ptp]
user@host# set clock-mode boundary
```

2. Configure the client clock.

```
[edit protocols ptp]
user@host# edit slave
```

3. (Optional) Specify the number of announce messages that a client clock or port—configured on an ACX Series router—must miss before an announce timeout is declared—from 2 through 10. The default value is 3.

```
[edit protocols ptp slave]
user@host# set announce-timeout announce-timeout-value
```

4. (Optional) Specify the logarithmic mean interval in seconds between the delay request messages sent by the client port to the primary port—from –6 through 3. The default value is 0.

```
[edit protocols ptp slave]
user@host# set delay-request delay-request-value
```

5. Configure the interface for the client clock.

```
[edit protocols ptp slave]
user@host# edit interface interface-name
```

6. (Optional) Configure the log mean interval between synchronization messages—from **–6** through **-3**. The default value is –6, which means by default, 64 synchronous interval messages sent per second.

```
[edit protocols ptp slave]
user@host# set sync-interval sync-interval-value
```

After you have configured the PTP client clock parameters, enter the **commit** command in configuration mode. To complete the configuration of the client clock, complete "Configuring the PTP over Ethernet Member Clock Interface" on page 186

Configuring the PTP over Ethernet Member Clock Interface

The client clock interface responds to the upstream PTP primary clock.

To configure the PTP client clock interface:

1. Configure the interface for the client clock.

```
[edit protocols ptp slave]
user@host# edit interface interface-name
```

2. Configure the upstream multicast PTP primary clock source parameters.

```
[edit protocols ptp slave interface interface-name]
user@host# edit multicast-mode
```

3. Specify the encapsulation type for PTP packet transport as Ethernet or IEEE 802.3. This statement is mandatory.

```
[edit protocols ptp slave interface interface-name multicast-mode]
user@host# set transport ieee-802.3
```

   Alternatively, specify the encapsulation type as Ethernet with the link-local multicast address to be used in the sending of PTP messages. If you specify the **link-local** attribute, the primary clock chooses either of the two MAC addresses defined in the IEEE 1588-2008 standard. When you configure this option, the system attempts to use the 01 -80-C2-00-00-0E MAC address (link-local multicast MAC address) for multicast transmission. If this MAC address is not available, the 01-1B-19-00-00-00 address (standard Ethernet multicast address) is used as the second priority. The standard Ethernet multicast address is used by default. You need to explicitly configure the link-local multicast address.

```
[edit protocols ptp slave interface interface-name multicast-mode]
user@host# set transport ieee-802.3 link-local
```

After you have configured the PTP over Ethernet client clock interface, enter the **commit** command in configuration mode.

RELATED DOCUMENTATION

PTP over Ethernet on ACX Series Routers Overview | **110**

Guidelines for Configuring PTP over Ethernet | **112**

Configuring PTP Dynamic Ports for Ethernet Encapsulation | **187**

Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | **189**

Configuring PTP Dynamic Ports for Ethernet Encapsulation

For PTP over Ethernet, you can also configure a port to function as both a client port and a primary port. This type of port is called a dynamic port, a stateful port, or a bidirectional port. Such a dynamic port enables the transfer of frequency for synchronization services, in addition to time and phase alignment, when PTP functionality is not hop-by-hop and you have provisioned primary and client roles or interfaces.

To configure PTP over Ethernet with dynamic or bidirectional ports for multicast mode of transmission, you must include the **multicast-mode** statement at the **[edit protocols ptp stateful interface *interface-name*]** hierarchy level.

To enable a node to function as both a primary and a client port in PTP over Ethernet networks:

1. Configure the interface on which to respond to downstream PTP client ports or clients.

   ```
   [edit protocols ptp stateful]
   user@host# edit interface interface-name
   ```

   NOTE: For the configuration to work, the interface you specify must be configured at the [**edit interfaces *interface-name***] hierarchy level.

2. Configure the upstream multicast PTP dynamic clock source parameters.

   ```
   [edit protocols ptp stateful interface interface-name]
   user@host# edit multicast-mode
   ```

3. Specify the encapsulation type for PTP packet transport as Ethernet or IEEE 802.3. This statement is mandatory.

   ```
   [edit protocols ptp stateful interface interface-name multicast-mode]
   user@host# set transport ieee-802.3
   ```

   Alternatively, specify the encapsulation type as Ethernet with the link-local multicast address to be used in the sending of PTP messages. If you specify the link-local attribute, the primary clock chooses either of the two MAC addresses defined in the IEEE 1588-2008 standard. When you configure this option, the system attempts to use the 01 -80-C2-00-00-0E MAC address (link-local multicast MAC address) for multicast transmission. If this MAC address is not available, the 01-1B-19-00-00-00 address (standard Ethernet multicast address) is used as the second priority. The standard Ethernet multicast address is used by default. You need to explicitly configure the link-local multicast address.

   ```
   [edit protocols ptp stateful interface interface-name multicast-mode]
   user@host# set transport ieee-802.3 link-local
   ```

After you have configured the PTP over Ethernet client clock interface, enter the **commit** command from configuration mode.

RELATED DOCUMENTATION

PTP over Ethernet on ACX Series Routers Overview | 110
Guidelines for Configuring PTP over Ethernet | 112
Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | 181
Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports | 189

Example: Configuring PTP over Ethernet for Multicast Primary, Member, and Dynamic Ports

IN THIS SECTION

- Requirements | 190
- Overview | 190
- Configuration | 191
- Verifying the PTP over Ethernet Multicast Dynamic, Master, and Slave Settings | 197

In PTP over Ethernet networks, the primary sends the announce, synchronization, and delay-response packets using the multicast method. If any unicast delay-request message is received, the primary disregards the message and does not send delay-response messages to the client. A PTP client receives the multicast announce packets from the primary or multiple primaries and determines the best primary using Best Master Clock Algorithm (BMCA). A client receives and processes the synchronization from the selected primary clock. The client sends delay-request messages to this primary using the multicast method and processes the delay-response messages from the primary to establish synchronization.

Both the link-local MAC address and the standard 802.3 multicast MAC address can be present in a system. However, a PTP interface supports only one of the following at a point in time:

- Layer 2 multicast with link-local MAC address
- Layer 2 multicast with standard multicast MAC address

- PTP over IPv4

When you configure both IPv4 and Ethernet encapsulation, the unicast-negotiation configuration applies only to IPv4 encapsulation. It is not effective for PTP over Ethernet operation.

When you configure a logical interface by using the **stateful** statement at the **[edit protocols ptp]** hierarchy level, each interface that you configure as a stateful or dynamic port is considered to be both a master and a client port. Although an ACX Series router supports up to 32 master ports and 4 client ports, you can configure only 4 unique logical interfaces as potential PTP masters by using the **stateful** statement because the interface is treated as both a client and a master interface. You cannot configure the interface that you specify to be a stateful or dynamic port with the **master** or **slave** statements.

This example shows how to configure a master port, client port, and a dynamic port for PTP over Ethernet and PTP over IPv4 encapsulation, and how to configure unicast and multicast mode of transmission of PTP traffic among the master and client nodes.

Requirements

This example uses the following hardware and software components:

- An ACX Series router
- Junos OS Release 12.3X51 or later

Overview

While an ACX Series router supports the PTP over Ethernet functionality, a Brilliant Reference Clock such as an MX Series router or a TCA Series Timing Client does not support PTP over Ethernet. Consider a sample deployment in which an ACX Series router named ACX1 functions as a boundary clock with a PTP client port using IPv4 as the encapsulation mode and master ports using Ethernet as the encapsulation mode for PTP traffic. ACX1 contains two potential client interfaces, one that is fixed as a client-only port using IPv4 on the link toward an MX Series router named MX2, and a dynamic port that functions as a client using PTP over Ethernet on the link toward another ACX Series router named ACX2. In addition, ACX1 also contains a port that is a master-only port using PTP over Ethernet and connects to the base station.

In this example, the router uses either interface ge-0/2/0.0 or ge-0/2/1.0 as the selected client interface based on the announce messages received from the master and the port that was selected using the Best Master Clock Algorithm (BMCA). The interface ge-0/1/4.0 is always in the master state. According to the IEEE 1588 specification, if port ge-0/2/0.0 is selected as the client interface, interface ge-0/2/1.0

transitions to the master state. If interface ge-0/2/1.0is selected as the client port, interface ge-0/2/0.0 transitions to the listening state. You can also configure the interface ge-0/1/4.0 as a client only interface for PTP over Ethernet, if necessary, for completeness of the configuration.

Configuration

IN THIS SECTION

- CLI Quick Configuration | **191**
- Configuring PTP over Ethernet for Multicast Master, Slave, and Dynamic Ports | **192**
- Results | **196**

In this example, you configure a master port, a client port, and a dynamic port for PTP over Ethernet and PTP over IPv4 encapsulation. You can also configure unicast and multicast modes of transmission of PTP traffic among the master and client nodes.

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [**edit**] hierarchy level:

```
set interfaces ge-0/1/4 description “to base-station”
set interfaces ge-0/1/4 unit 0 family inet address 7.1.1.37/24
set interfaces ge-0/2/0 description “to MX2”
set interfaces ge-0/2/0 unit 0 family inet address 110.1.1.2/24
set interfaces ge-0/1/4 description “to ACX2”
set interfaces ge-0/1/4 unit 0 family inet address 110.1.1.2/24
set protocols ptp clock-mode boundary
set protocols ptp domain 110
set protocols ptp slave interface ge-0/2/0.0 unicast-mode transport ipv4
set protocols ptp slave interface ge-0/2/0.0 unicast-mode clock-source 110.1.1.250 local-ip-address
110.1.1.2
```

```
set protocols ptp master interface ge-0/1/4.0 multicast-mode transport ieee-802.3
set protocols ptp stateful interface ge-0/2/1.0 multicast-mode transport ieee-802.3
```

Configuring PTP over Ethernet for Multicast Master, Slave, and Dynamic Ports

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure the master, client, and dynamic interfaces, and a boundary clock with unicast and multicast mode of transmission of PTP packets in PTP over IPv4 and PTP over Ethernet topologies:

1. Configure the master interface, and enter edit mode for the interface.

   ```
   [edit interfaces]
   user@host#edit ge-0/1/4
   ```

2. Configure a description for the interface.

   ```
   [edit interfaces ge-0/1/4]
   user@host#set description to base-station
   ```

3. Configure a logical unit and specify the protocol family.

   ```
   [edit interfaces ge-0/1/4]
    user@host#set unit 0 family inet
   ```

4. Specify the address for the logical interface

   ```
   [edit interfaces ge-0/1/4 unit 0 family inet]
   user@host#set address 7.1.1.37/24
   ```

5. Configure the client interface, and enter edit mode for the interface.

```
[edit interfaces]
user@host#edit ge-0/2/0
```

6. Configure a description for the interface.

```
[edit interfaces ge-0/2/0]
user@host#set description to-MX2
```

7. Configure a logical unit and specify the protocol family.

```
[edit interfaces ge-0/2/0]
user@host#set unit 0 family inet
```

8. Specify the address for the logical interface

```
[edit interfaces ge-0/2/0 unit 0 family inet]
user@host#set address 110.1.1.2/24
```

9. Configure the stateful interface, and enter edit mode for the interface.

```
[edit interfaces]
user@host#edit ge-0/2/1
```

10. Configure a description for the interface.

```
[edit interfaces ge-0/2/1]
user@host#set description to-ACX2
```

11. Configure a logical unit and specify the protocol family.

```
[edit interfaces ge-0/2/1]
user@host#set unit 0 family inet
```

12. Specify the address for the logical interface

```
[edit interfaces ge-0/2/1 unit 0 family inet]
user@host#set address 110.2.1.1/24
```

13. Configure the clock mode as boundary clock.

```
[edit protocols ptp]
user@host# set clock-mode boundary
```

14. Specify the PTP domain value.

```
[edit protocols ptp]
user@host# set domain 110
```

15. Configure the local client interface from which the boundary master receives time and passes it on to the configured clock clients.

```
[edit protocols ptp]
user@host# edit slave interface ge-0/2/0.0
```

16. Configure the upstream unicast PTP master clock source parameters.

```
[edit protocols ptp slave interface ge-0/2/0.0]
user@host# edit unicast-mode
```

17. Configure the encapsulation type for PTP packet transport.

```
[edit protocols ptp slave interface ge-0/2/0.0 unicast-mode]
user@host# set transport ipv4
```

18. Configure the PTP master parameters by specifying the IP address of the PTP master clock and the IP address of the local interface.

```
[edit protocols ptp slave interface ge-0/1/0.0 unicast-mode]
user@host# set clock-source 110.1.1.250 local-ip-address 110.1.1.2
```

19. Configure the master interface in this example.

```
[edit protocols ptp]
user@host# edit master interface ge-0/1/4.0
```

20. On the master interface, configure multicast transmission for downstream PTP clock clients.

```
[edit protocols ptp master interface ge-0/1/4.0]
user@host# edit multicast-mode
```

21. On the master interface, configure the encapsulation type as Ethernet for PTP packet transport.

```
[edit protocols ptp master interface ge-0/2/1.0  multicast-mode]
user@host# set transport ieee-802.3
```

22. Configure the dynamic or stateful interface in this example.

```
[edit protocols ptp]
user@host# edit stateful interface ge-0/2/1.0
```

23. On the dynamic interface, configure multicast transmission for downstream PTP clock clients.

```
[edit protocols ptp stateful interface ge-0/2/1.0 ]
user@host# edit multicast-mode
```

24. On the dynamic interface, configure the encapsulation type as Ethernet for PTP packet transport and the link-local multicast address to be used.

    ```
    [edit protocols ptp stateful interface ge-0/2/1.0  multicast-mode]
    user@host# set transport ieee-802.3 link-local
    ```

Results

In configuration mode, confirm your configuration by entering the **show** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit protocols ptp]
user@host# show
clock-mode boundary;
        domain 110;
        slave {
            interface ge-0/2/0.0 {
                unicast-mode {
                    transport ipv4;
                    clock-source 110.1.1.250 local-ip-address 110.1.1.2;
                }
            }
        }
        master {
            interface ge-0/1/4.0 {
                multicast-mode {
                    transport ieee-802.3;
                }
            }
        }
        stateful {
            interface ge-0/2/1.0 {
                multicast-mode {
                    transport ieee-802.3 link-local;
                }
            }
        }
```

After you have configured the device, enter the **commit** command in configuration mode.

Verifying the PTP over Ethernet Multicast Dynamic, Master, and Slave Settings

IN THIS SECTION

- Verifying the PTP Clock Details | 197
- Verifying the Lock Status of the Slave | 198
- Verifying the PTP Options on the Slave | 198
- Verifying the PTP Options and the Current Status of the Master | 198
- Verifying the Number and Status of the PTP Ports | 199
- Verifying PTP Statistics | 199

Confirm that the configuration is working properly.

Verifying the PTP Clock Details

Purpose

Verify that the PTP clock is working as expected.

Action

In operational mode, enter the **run show ptp clock** command to display comprehensive, globally configured clock details.

Meaning

The output displays the clock details, such as the encapsulation method used for transmission of PTP traffic and the number of configured stateful or dynamic ports. Although a dynamic port functions as either a client or a master port, the value displayed in the **Stateful Ports** field denotes the dynamic ports that you explicitly configured. The number of dynamic ports is not computed and displayed in the fields that display the explicitly configured master and client ports. For more information about the **run show ptp clock** operational command, see "show ptp clock" on page 616 in the CLI Explorer.

Verifying the Lock Status of the Slave

Purpose

Verify that the client clock is aligned to the master clock by checking the lock status of the client.

Action

In operational mode, enter the **run show ptp lock-status** command to display the lock status of the client.

Meaning

The output displays information about the lock status of the client. The output shows whether the client is aligned to the master clock or not, and the interface name configured for PTP on the client. The **Master Source Port** field displays the address of the master clock when PTP over IPv4 is configured and the multicast MAC address of the source when PTP over Ethernet is configured. For more information about the **run show ptp lock-status** operational command, see "show ptp lock-status" on page 632 in the CLI Explorer.

Verifying the PTP Options on the Slave

Purpose

Verify the PTP options that are set on the client and the current status of the master.

Action

In operational mode, enter the **run show ptp slave** command to display the configured client.

Meaning

The output displays information about the configured client and the status of the client. For more information about the **show ptp slave** operational command, see "show ptp slave" on page 653 in the CLI Explorer.

Verifying the PTP Options and the Current Status of the Master

Purpose

Verify the PTP options that are set for the master and its current status.

Action

In operational mode, enter the **run show ptp master** command to display the configured options for the master.

Meaning

The output displays information about the configured master and the current status of the master. For more information about the **run show ptp master** operational command, see "show ptp master" on page 637 in the CLI Explorer.

Verifying the Number and Status of the PTP Ports

Purpose

Verify the number of PTP ports and their current status.

Action

In operational mode, enter the **run show ptp port** command to display the configured ports.

Meaning

The output displays information about the number of ports created according to the configuration and their current status. The name of the interface configured for PTP and the number of times a stateful port transitioned from the client to the master state and vice versa is displayed. For more information about the **run show ptp port** operational command, see "show ptp port" on page 647 in the CLI Explorer.

Verifying PTP Statistics

Purpose

Verify the statistical details of the PTP configuration.

Action

In operational mode, enter the **run show ptp statistics** command to display the statistical information regarding the configured PTP clocks.

Meaning

The output displays brief or detailed information about the operation of configured PTP clocks. Statistical parameters include information such as the total number of PTP packets transmitted or received by a master or client interface and the number of various messages (such as announce and synchronization messages) that are sent between a master and a client. For more information about the **show ptp statistics** operational command, see "show ptp statistics" on page 660 in the CLI Explorer.

RELATED DOCUMENTATION

PTP over Ethernet on ACX Series Routers Overview | 110
Guidelines for Configuring PTP over Ethernet | 112
Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | 181
Configuring PTP Dynamic Ports for Ethernet Encapsulation | 187

Hybrid Mode on ACX Series Routers Overview

IN THIS SECTION

- Hybrid Mode Overview | 200
- Supporting Platforms | 202

The combined operation of Synchronous Ethernet and Precision Time Protocol (PTP) is also known as hybrid mode. The following sections explain hybrid mode in detail:

Hybrid Mode Overview

In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the Modular Port Concentrator (MPC) derives the frequency from Synchronous Ethernet and the phase and time of day from PTP. Time synchronization includes both phase synchronization and frequency synchronization.

Synchronous Ethernet is a physical layer–based technology that functions regardless of the network load. Synchronous Ethernet supports hop-by-hop frequency transfer, where all interfaces on the trail must support Synchronous Ethernet. PTP (also known as IEEE 1588v2) synchronizes clocks between nodes in a network, thereby enabling the distribution of an accurate clock over a packet-switched network. This synchronization is achieved through packets that are transmitted and received in a session between a primary clock (commonly called the primary) and a client clock (also known as the client in PTP terminology). PTP synchronizes both frequency and phase including time of day. The accuracy of clock synchronization depends on factors such as packet delay variation, quality of oscillator used, network asymmetry, and so on.

Synchronous Ethernet and PTP provide frequency and phase synchronization; however, the accuracy in the order of nanoseconds is difficult to achieve through PTP or Synchronous Ethernet and they do not support a large number of network hops. Hybrid mode resolves these issues by extending the number of network hops and also provides clock synchronization accuracy in the order of tens of nanoseconds.

Hybrid mode is configured on the client. On the client, you can configure one or more interfaces as Synchronous Ethernet source interfaces.

NOTE: Router clocks are categorized based on the role of the router in the network. They are broadly categorized into ordinary clocks and boundary clocks. The primary clock and the client clock are known as ordinary clocks. The boundary clock can operate as either a primary clock or a client clock.

In hybrid mode, the following **show** commands display information regarding the hybrid status configuration:

- The **show ptp status details** command displays the time and phase plane status.
- The **show chassis synchronization extensive** command displays the frequency plane status.
- The **show ptp hybrid status** command displays the hybrid (combined status of frequency and phase plane) status.
- In hybrid mode, the **show ptp hybrid status** and **show ptp lock-status** commands indicate the lock status as **Phase Aligned** in the output.

For information about configuring hybrid mode, see "Configuring Hybrid Mode and ESMC Quality Level Mapping" on page 361. You can use the **show ptp hybrid status** operational command to find the current operating mode.

Supporting Platforms

Hybrid mode is supported on the Juniper Networks ACX Series Universal Metro Routers.

The combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same device and are traceable to the same primary reference clock (also known as PRC).

When acting as PTP slaves, the ACX Series routers can accept any external Synchronous Ethernet clock as reference and do not support building-integrated timing supply (BITS) input as frequency source in hybrid mode of operation. Only Synchronous Ethernet sources are allowed in hybrid mode. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

Unified in-service software upgrade (unified ISSU) is not supported when clock synchronization is configured for hybrid mode.

NOTE: To switch between PTP and Synchronous Ethernet modes, you must first deactivate the configuration for the current mode and then commit the configuration. Wait for 30 seconds, configure the new mode and its related parameters, and then commit the configuration.

RELATED DOCUMENTATION

Guidelines for Configuring Hybrid Mode on ACX Series Routers | 202
Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204
Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204

Guidelines for Configuring Hybrid Mode on ACX Series Routers

Keep the following points in mind while configuring hybrid mode on ACX Series routers:

- In a Hybrid Operation, the Frequency Module derives frequency from the Synchronous Ethernet or BITS (T1/E1) clock or 10 MHz clock and Phase from the IEEE-1588v2 (PTPv2). The current deployments are all LTE-TDD based and require a phase accuracy of only 1.5us and it is expected that this performance can be achieved without requiring frequency assist.

- Frequency Plane (Synchronous Ethernet, BITS (T1/E1), 10 MHz) is not impacted by the phase or time plane. The frequency plane derives the frequency from Synchronous Ethernet, BITS (T1/E1) and 10 MHz.
- Phase/Time Plane uses the Frequency which is derived locally from the equipment (Synchronous Ethernet, BITS (T1/E1), 10 MHz). To achieve phase accuracy of less than 1.5us, both Frequency Input source and PTP sources traceable to a primary reference source (PRS) or primary reference clock (PRC). Hybrid mode is supported in a ring topology.
- You can configure the following frequency sources for hybrid node:
  - Synchronous Ethernet 1G, 10G with/without ESMC
  - BITS T1 Clock
  - BITS E1 Clock
  - 10 MHz Clock
  - T1 Interface
  - E1 Interface
- You can configure the following phase sources for hybrid node:
  - PTP IPv4 with or without unicast negotiation
  - PTPoE with or without stateful port
- By enabling the hybrid mode, the convergence time period is reduced and locking happens quickly.
- You can configure the PTP Source as phase or time source for hybrid mode.
- You can configure Layer 2 rings for PTPoE with stateful ports and Synchronous Ethernet with ESMC for Layer 2 ring topologies.
- When you enable hybrid mode, each node generates a phase error of or plus or minus 100 nanoseconds (without Phy Timestamping) or plus or minus 50 nanoseconds with Phy timestamping feature. This phenomenon requires Frequency (SyncE/BITS/10 MHz) source and PTP source must be traceable to same PRC/PRS source.
- Fully redundant and resilient ring based configurations of up to 10 nodes are supported, targeting the 1 microsecond phase requirement for a form of 4G known as Long-Term Evolution-Time Division Duplex (LTE-TDD). A single node or link failure is accommodated and all nodes are able to maintain phase accuracy to be +/- 1us accurate to a common source.
- Hybrid mode for PTP IPv4 rings is not supported.
- Dynamic switchover from Hybrid to PTP mode is not supported in ACX routers.

- BITS T1 Clock with SSM is not supported. BITS E1 Clock with SSM is not supported.
- Hybrid Mode: Time Of Day (TOD) as Phase and Frequency as SyncE/BITS/10 MHz is not supported. Simultaneous PTP IPv4 Ring and SyncE Hybrid Mode are not supported.
- Hybrid Mode with Phy Timestamping feature is not supported only on ACX500 series routers.
- Dynamic Switchover from Hybrid to PTP Mode feature is not supported.
- Hybrid Feature on aggregated Ethernet (**ae-**) interfaces is not supported.
- When you configure hybrid mode, the following processes take place.
    - The best of the configured PTP time sources is selected by the PTP Best Primary Clock Algoritm (BMCA).
    - The best of configured chassis synchronization sources is selected by the synchronization source selection algorithm.
    - During the boot-up process, if valid sources are configured at the **[edit chassis synchronization]** hierarchy level and chassis synchronization mode in free-running mode, valid PTP source available case, system continues to operate in hybrid mode (In this case, chassis synchronization is in free-run mode, whereas PTP is in locked mode). When both primary and secondary frequency sources fail, system still works under hybrid mode (In this case, chassis synchronization is in hybrid mode and PTP is in locked mode).

RELATED DOCUMENTATION

Hybrid Mode on ACX Series Routers Overview | 200
Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204
Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204

Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers

IN THIS SECTION

Configuring the Router in Hybrid Mode | 205

- Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | 206
- Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | 207

You can configure hybrid mode (that is, the combined operation of Synchronous Ethernet and Precision Time Protocol (PTP)) on ACX Series routers. The combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same device and are traceable to the same primary. When acting as a PTP client, the router can accept any external Synchronous Ethernet clock as reference. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the MPC derives the frequency from Synchronous Ethernet and the phase and time of day from PTP.

The hybrid mode is configured on the client. On the client, one or more interfaces are configured as Synchronous Ethernet source interfaces.

The ESMC quality level value is mapped to the clock class value either by mapping the PTP clock class to the ESMC quality level or by configuring a user-defined mapping of PTP clock class to ESMC quality level. The following procedures explain configuring hybrid mode with either of the modes in detail.

Configuring the Router in Hybrid Mode

To configure the router in hybrid mode, you must:

1. Configure Synchronous Ethernet options at the **[edit chassis synchronization]** hierarchy level:

    - Configure the **auto-select** mode of operation. You can select the clock source either from a free-run local oscillator or from an external qualified clock.

      When the router is configured with the **auto-select** option, the router chooses up to two best upstream clock sources. It then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable quality is not available or if the router is configured in free-run mode, the router uses the internal oscillator.

    - Configure the **esmc-transmit** and **network-option** options at the **[edit chassis synchronization** hierarchy level.

    - Configure one or more interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources as needed.

2. Configure PTP options at the **[edit protocols ptp]** hierarchy level.
3. Configure hybrid mode options at the **[edit protocols ptp slave]** hierarchy level.

Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level

To configure hybrid mode options with mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. In configuration mode, go to the **[edit protocols ptp slave]** hierarchy level:

```
[edit]
user@host# edit protocols ptp slave
```

2. Configure the **convert-clock-class-to-quality-level** option to set the default mapping between the ESMC SSM quality level and the PTP clock class.

```
[edit protocols ptp slave]
user@host# set convert-clock-class-to-quality-level
```

3. Configure the hybrid mode option on the client.

```
[edit protocols ptp slave]
user@host# edit hybrid
```

4. Configure the upstream unicast PTP primary interface and IP address of the clock source.

```
[edit protocols ptp slave]
user@host# set interface interface-name clock-source ip-address
```

5. Configure one or more Synchronous Ethernet source interfaces for the client as needed.

```
[edit protocols ptp slave ]
user@host# set interface interface1-name unicast-mode clock-source ip-address
user@host# set interface interface2-name unicast-mode clock-source ip-address
```

> **NOTE**: You must first configure these interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources. For information about configuring these interfaces, see "synchronization (ACX Series)" on page 517.

Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level

To configure hybrid mode options with a user-defined mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. In configuration mode, go to the **[edit protocols ptp slave]** hierarchy level:

   ```
   [edit]
   user@host# edit protocols ptp slave
   ```

2. To override the default mapping option, perform the following steps:
   a. Configure the **clock-class-to-quality-level-mapping** option with one of the quality level values. The quality level values are prc, prs, sec, smc, ssu-a, ssu-b, st2, st3, st3e, st4, stu, and tnc.

      ```
      [edit protocols ptp slave]
      user@host# edit clock-class-to-quality-level-mapping quality-level prc | prs | sec | smc | ssu-a | ssu-b
      | st2 | st3 | st3e | st4 | stu | tnc
      ```

   b. Configure the **clock-class** option for the set quality level. The clock class value ranges from 80 through 109.

      ```
      [edit protocols ptp slave clock-class-to-quality-level-mapping quality-
      level quality-level-value]
      user@host# set clock-class clock-class
      ```

3. Configure the hybrid mode option on the client.

   ```
   [edit protocols ptp slave]
   user@host# edit hybrid
   ```

4. Configure the upstream PTP primary interface and the IP address of the clock source.

```
[edit protocols ptp slave]
user@host# set interface interface-name unicast-mode clock-source ip-address
```

5. Configure one or more Synchronous Ethernet source interfaces for the client as needed.

```
[edit protocols ptp slave ]
user@host# set interface interface1-name unicast-mode clock-source ip-address
user@host# set interface interface2-name  unicast-mode clock-source ip-address
```

> **NOTE**: You must first configure these interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources. For information about configuring these interfaces, see "synchronization (ACX Series)" on page 517.

RELATED DOCUMENTATION

Guidelines for Configuring Hybrid Mode on ACX Series Routers | **202**

Hybrid Mode on ACX Series Routers Overview | **200**

Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | **204**

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping

IN THIS SECTION

- Requirements for Hybrid Mode Configuration | **209**
- Overview | **209**
- Configuration | **210**
- Verification | **213**

This example shows the configuration of hybrid mode by mapping the PTP clock class to the ESMC quality level and also by configuring a user-defined mapping of the PTP clock class to the ESMC quality level on ACX Series Routers.

Requirements for Hybrid Mode Configuration

This example uses the following hardware and software components:

- One ACX Series router.
- Junos OS Release 12.2R2 or later.

Overview

The combined operation of Synchronous Ethernet and Precision Time Protocol (PTP) is also known as hybrid mode. In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the Modular Port Concentrator (MPC) derives the frequency from Synchronous Ethernet and the phase and time of day from PTP.

You can configure hybrid mode on ACX Series routers. On these routers, the combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same device and are traceable to the same primary. When acting as a PTP client, the router can accept any external Synchronous Ethernet clock as reference. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

Hybrid mode is configured on the client. On the client, one or more interfaces are configured as Synchronous Ethernet source interfaces.

NOTE: You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.

The ESMC quality level value is mapped to the clock class value either by mapping the PTP clock class to the ESMC quality level or by configuring a user-defined mapping of the PTP clock class to the ESMC quality level. The following examples explain configuring hybrid mode with either of the modes in detail.

To configure the router in hybrid mode, you must:

1. Configure Synchronous Ethernet options at the **[edit chassis synchronization]** hierarchy level:

- Configure the **auto-select** mode of operation. You can select the clock source either from a free-run local oscillator or from an external qualified clock.

  When the router is configured with the **auto-select** option, the router chooses up to two best upstream clock sources. It then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable quality is not available or if the router is configured in free-run mode, the router uses the internal oscillator.

- Configure the **esmc-transmit** and **network-option** options at the **[edit chassis synchronization]** hierarchy level.

- Configure one or more interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources as needed.

2. Configure PTP options at the **[edit protocols ptp]** hierarchy level.

3. Configure hybrid mode options at the **[edit protocols ptp slave]** hierarchy level.

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode*.

Configuration

IN THIS SECTION

- Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | **210**
- Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | **212**

Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level

CLI Quick Configuration

To quickly configure hybrid mode on the ge-1/2/3.0 interface with the clock source IP address as 2.2.2.2, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

[edit]

set protocols ptp slave hybrid

set protocols ptp slave interface ge-1/2/3.0 unicast-mode clock-source 2.2.2.2

set protocols ptp slave convert-clock-class-to-quality-level

Step-by-Step Procedure

To configure hybrid mode on an ACX Series router with mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. Configure the **convert-clock-class-to-quality-level** option on the client at the **[edit protocols ptp slave]** hierarchy level.

   ```
   [edit protocols ptp slave]
   user@host# set convert-clock-class-to-quality-level
   ```

2. Configure hybrid mode on the client.

   ```
   [edit protocols ptp slave]
   user@host# edit hybrid
   ```

3. Configure the Synchronous Ethernet mapping option, IP address of the primary clock as 2.2.2.2, and the interface ge-1/2/3.0 for hybrid mode on the client.

   ```
   [edit protocols ptp slave]
   user@host# set interface ge-1/2/3.0 unicast-mode clock-source 2.2.2.2
   ```

Results

Display the results of the configuration of hybrid mode with the mapping of the PTP clock class to the ESMC quality level:

```
[edit protocols ptp slave]
user@host# show
convert-clock-class-to-quality-level
interface  ge-1/2/3.0 unicast-mode clock-source 2.2.2.2
hybrid
```

Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level

CLI Quick Configuration

To quickly configure hybrid mode on the interface ge-1/2/3.0, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

[edit]

set protocols ptp slave hybrid

set protocols ptp slave hybrid

set protocols ptp slave interface unicast-mode ge-1/2/3.0 clock-source 2.2.2.2

set protocols ptp slave clock-class-to-quality-level-mapping quality-level prc clock-class 80

Step-by-Step Procedure

To configure hybrid mode with a user-defined mapping of the PTP clock class to the ESMC quality level on an ACX Series router, perform the following steps:

1. Configure the **quality-level** option for the **clock-class-to-quality-level-mapping** statement on the client at the **[edit protocols ptp slave]** hierarchy level and then configure the **clock-class** option for the set quality level if you want to manually override the mapping of the ESMC quality level to the clock class.

```
[edit protocols ptp slave]
user@host# set clock-class-to-quality-level-mapping quality-level prc clock-class 80
```

2. Configure hybrid mode on the client.

```
[edit protocols ptp slave]
user@host# edit hybrid
```

3. Configure the IP address of the primary clock as 2.2.2.2 , and the interface ge-1/2/3.0 for hybrid mode on the client.

```
[edit protocols ptp slave]
user@host# set interface ge-1/2/3.0 unicast-mode clock-source 2.2.2.2
```

Results

Display the results of the configuration of hybrid mode with a user-defined mapping of the PTP clock class to the ESMC quality level:

```
[edit protocols ptp slave]
user@host# show
clock-class-to-quality-level-mapping {
    quality-level prc {
        clock-class 80;
    }
}
interface  ge-1/2/3.0 unicast-mode clock-source 2.2.2.2
hybrid
```

Verification

IN THIS SECTION

- Verifying That the Router Is Operating in Hybrid Mode | 214
- Verifying the Quality Level Change on the Transmit Side | 214
- Verifying Global Information Parameters After Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode | 215
- Verifying Global Information Parameters After Configuring User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode | 216

Verifying That the Router Is Operating in Hybrid Mode

Purpose

Verify the current mode of operation of the client.

Action

In operational mode, enter the **run show ptp hybrid** command to display the current configuration and current mode of operation of the client.

In operational mode, enter the **run show ptp hybrid config** command to display the PTP source to Synchronous Ethernet interface mappings.

In operational mode, enter the **run show ptp hybrid status** command to display the current hybrid mode operational status.

Meaning

The output displays the current configuration and current mode of operation of the client. For information about the **run show ptp hybrid** operational command, see "show ptp hybrid" on page 624.

Verifying the Quality Level Change on the Transmit Side

Purpose

Verify the quality level change on the transmit side of the router.

Action

In operational mode, enter the **run show synchronous-ethernet esmc transmit detail** command to display the ESMC transmit interface details.

Meaning

The output displays the ESMC SSM quality level transmitted out of various Ethernet interfaces. For information about the **run show synchronous-ethernet esmc transmit detail** operational command, see "show synchronous-ethernet esmc transmit" on page 669.

Verifying Global Information Parameters After Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode

Purpose

Verify the global information parameters after mapping of the PTP clock class to the ESMC quality level in hybrid mode by enabling the **convert-clock-class-to-quality-level** option.

Action

In operational mode, enter the **run show ptp global-information** command to display the following output:

```
user@host> run show ptp global-information
PTP Global Configuration:
Domain number           : 0
Transport Encapsulation : IPv4
Clock mode              : Ordinary
Priority Level1         : 128
Priority Level2         : 128
Unicast Negotiation     : Disabled
ESMC QL From Clock Class: Enabled
Clock Class/ESMC QL     : 84 / (QL SSU-A/SSM 0x4)
Slave Parameters:
  Sync Interval         : -
  Delay Request Interval: -6 (64 packets per second)
  Announce Interval     : -
  Announce Timeout      : 3
Master Parameters:
  Sync Interval         : -6 (64 packets per second)
  Delay Request Interval: -
  Announce Interval     : 1 (1 packet every 2 seconds)
  Clock Step            : one-step
Number of Slaves       : 1
Number of Masters      : 0
```

In operational mode, enter the **run show ptp quality-level-mapping** command to display the following output:

```
user@host> run show ptp quality-level-mapping
quality level         ptp clock class
PRC                      84
SSU-A                    92
SSU-B                    96
SEC                      104
```

Meaning

The output for **run show ptp global-information** displays the parameters set in Synchronous Ethernet mode and the parameters set for the primary and the client.

The output of **run show ptp quality-level-mapping** displays the default mapping of the clock class to the ESMC quality level.

Verifying Global Information Parameters After Configuring User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode

Purpose

Verify the global information parameters after configuring a user-defined mapping of the PTP clock class to the ESMC quality level in hybrid mode by disabling the **convert-clock-class-to-quality-level** option.

Action

In operational mode, enter the **run show ptp global-information** command to display the following output:

```
user@host> run show ptp global-information
PTP Global Configuration:
Domain number           : 0
Transport Encapsulation : IPv4
Clock mode              : Ordinary
Priority Level1         : 128
Priority Level2         : 128
Unicast Negotiation     : Disabled
ESMC QL From Clock Class: Disabled
```

```
Clock Class/ESMC QL     :  -
Slave Parameters:
  Sync Interval         : -
  Delay Request Interval: -6 (64 packets per second)
  Announce Interval     : -
  Announce Timeout      : 3
Master Parameters:
  Sync Interval         : -6 (64 packets per second)
  Delay Request Interval: -
  Announce Interval     : 1 (1 packet every 2 seconds)
  Clock Step            : one-step
```

Meaning

The output displays the parameters set in Synchronous Ethernet mode and the parameters set for the primary and the client.

RELATED DOCUMENTATION

Guidelines for Configuring Hybrid Mode on ACX Series Routers | 202

Hybrid Mode on ACX Series Routers Overview | 200

Configuring Hybrid Mode and ESMC Quality Level Mapping on ACX Series Routers | 204

Understanding Timing Defects and Event Management on ACX Series

Junos OS for ACX Universal Metro Routers supports defect and event management capabilities for timing features. Defects and events are notified in the form of SNMP traps and these SNMP traps are logged into the system log-file (var/log/snmpd). For each of the SNMP traps (timing defects and timing events) that are generated, a message is logged in the clksyncd file (var/log/clksyncd).

Table 6 on page 218 shows the list of SNMP trap notifications for timing defects and events supported in ACX Universal Metro Routers.

Table 6: SNMP trap notifications for timing defects and events

SNMP Trap	Notification Type	Description
jnxTimingFaultLOS	Defects	Denotes loss of signal
jnxTimingFaultEFD	Defects	Denotes exceeded frequency deviation
jnxTimingFaultLOESMC	Defects	Denotes loss of Ethernet Synchronization Message Channel (ESMC)
jnxTimingFaultQLFailed	Defects	Denotes failure in quality level
jnxTimingFaultLTI	Defects	Denotes loss of timing information
jnxTimingFaultPriSrcFailed	Defects	Denotes the failure of primary source
jnxTimingFaultSecSrcFailed	Defects	Denotes the failure of secondary source
jnxTimingFaultPtpUniNegRateReject	Defects	When acting as primary, this SNMP trap denotes failure or rejects clients for signaling messages. When acting as a client, this SNMP trap denotes failure or client stops receiving signaling messages
jnxTimingEventPriSrcRecovered	Events	Denotes the recovery of primary source
jnxTimingEventSecSrcRecovered	Events	Denotes the recovery of secondary source

Table 6: SNMP trap notifications for timing defects and events *(Continued)*

SNMP Trap	Notification Type	Description
jnxTimingEventPriRefChanged	Events	Denotes a change in primary reference such as a change in logical interface or a change from SyncE to BITS/external interface)
jnxTimingEventSecRefChanged	Events	Denotes a change in secondary reference such as a change in logical interface
jnxTimingEventQLChanged	Events	Denotes a change in quality level
jnxTimingEventDpllStatus	Events	Denotes the DPLL status (SyncE, BITS, Hybrid)
jnxTimingEventPtpServoStatus	Events	Denotes the following PTP Servo states: • INITIALIZING • ACQUIRING (Primary is elected and servo starts acquiring lock) • PHASE ALIGNED (Locked to Primary) • FREERUN (no PTP source available) • HOLDOVER (Member locked to PTP for more than 12 hours and then loses all the PTP sources)
jnxTimingEventPtpClockClassChange	Events	Denotes a change in PTP clock class
jnxTimingEventPtpClockAccuracyChange	Events	Denotes a change in PTP accuracy

Table 6: SNMP trap notifications for timing defects and events ***(Continued)***

SNMP Trap	Notification Type	Description
jnxTimingEventPtpGMChange	Events	Denotes a change in PTP reference clock
jnxTimingEventHybridStatus	Events	Denotes the following hybrid states: • INITIALIZING • ACQUIRING (Primary is elected and servo starts acquiring lock) • FREQUENCY LOCKED (Frequency locked but acquiring phase) • PHASE ALIGNED (Frequency and phase locked)

To configure and generate timing defects and events trap notifications, include the **timing-events** statement at the [**edit snmp trap-group** ***trap-group-name*** **categories**] hierarchy level as shown below:

```
[edit]
snmp {
    trap-group <group-name> {
       categories {
          timing-events;
        }
    }
}
```

The following is a sample configuration for SNMP timing in ACX Series routers:

```

snmp {
    trap-options {
        source-address 10.216.66.139;
    }
    trap-group timingGroup {
        version v2;
        destination-port 8999;
        categories {
            timing-events;
        }
        targets {
            192.168.120.129;
        }
    }
    traceoptions {
        flag all;
    }
}
```

RELATED DOCUMENTATION

- show chassis synchronization | 576
- source
- Understanding SNMP MIB for Timing on ACX Series | 221

Understanding SNMP MIB for Timing on ACX Series

Junos OS for ACX Universal Metro Routers supports SNMP get, get-next, and walk management capabilities for timing features. These capabilities are enabled through the PTP MIB, SyncE MIB and GPS MIB timing objects.

> **NOTE**: The PTP MIB and SyncE MIB timing objects are grouped under the **jnxTimingNotfObjects** SNMP MIB object.

Table 7 on page 222 shows the list of SNMP MIB objects supported for SNMP get, get-next, and walk management on ACX Universal Metro Routers.

Table 7: SNMP MIB Objects for get, get-next, and walk management

SNMP MIB	Object	Description
PTP MIB	jnxPtpServoState	Denotes the following PTP Servo states: • INITIALIZING • ACQUIRING • PHASE ALIGNED • FREERUN • HOLDOVER • FREQUENCY LOCKED
	jnxPtpServoStateStr	Denotes the PTP Servo state string: • INITIALIZING • ACQUIRING (Primary is elected and servo starts acquiring lock) • PHASE ALIGNED (Locked to Primary) • FREERUN (no PTP source available) • HOLDOVER (Member locked to PTP for more than 12 hours and then loses all the PTP sources)
	jnxPtpClass	Denotes the class of the PTP reference clock.
	jnxPtpGmId	Denotes the PTP reference clock identifier.
SyncE MIB	jnxClksyncQualityCode	Denotes the SSM/ESMC quality level of the locked source in decimal format.
	jnxClksyncQualityCodeStr	Denotes the SSM/ESMC quality level of the locked source in string format

Table 7: SNMP MIB Objects for get, get-next, and walk management *(Continued)*

SNMP MIB	Object	Description
	jnxClksyncIfIndex	Denotes the interface index of the locked source in decimal format.
	jnxClksyncIntfName	Denotes the interface name of the locked source in string format.
GPS MIB	jnxGpsRecvStatus	Displays the status of the GPS receiver.

NOTE:

- The SNMP get and walk management are supported only for scalar objects.
- For SyncE objects, the jnxClksyncQualityCode, jnxClksyncQualityCodeStr, jnxClksyncIfIndex, and jnxClksyncIntfName objects displays only for locked source.

You can use the **show chassis synchronization extensive**, **show ptp lock-status detail**, **show snmp mib get <*MIB-timing-objects*>**, and **show snmp mib walk jnxTimingNotfObjects** show commands for monitoring and troubleshooting purposes.

The following are the sample show command outputs for reference:

show chassis synchronization extensive

```
user@host> show chassis synchronization extensive

Current clock status   : Locked
Clock locked to        : Primary
SNMP trap status : Enabled

Configured sources:

Interface             : ge-0/0/7
Status                : Secondary      Index        : 136
Clock source state    : Clk qualified Priority     : Default(8)
Configured QL         : SEC            ESMC QL      : PRC
```

```
Clock source type   : ifd            Clock Event : Clock qualified
Interface State     : Up,sec,ESMC Rx(SSM 0x2),ESMC TX(QL SEC/SSM 0xb),

Interface           : ge-0/1/1
Status              : Primary        Index       : 138
Clock source state  : Clk qualified Priority     : Default(8)
Configured QL       : PRC            ESMC QL     : PRC
Clock source type   : ifd            Clock Event : Clock locked
Interface State     : Up,pri,ESMC Rx(SSM 0x2),ESMC TX(QL DNU/SSM 0xf)
```

show chassis synchronization extensive

```
user@host> show chassis synchronization extensive

Configured ports:

Name                : auxiliary
Rx status           : active
Rx message          : TL000001433759011353
Current ToD         : Mon Jun  8 10:23:31 2015
Last ToD update     : Mon Jun  8 10:23:30 2015
GPS receiver status : Lost Sync
UTC Pending         : FALSE
UTC Offset          : 35

One PPS status : Active

Configured sources:

Interface           : gps
Status              : Primary        Index       : 1
Clock source state  : Clk failed     Priority    : Default(6)
Configured QL       : PRC            ESMC QL     : DNU
Clock source type   : extern         Clock Event : Clock failed
Interface State     : Up,pri
```

show ptp lock-status detail

```
user@host> show ptp lock-status detail

Lock Status:

Lock State    : 1 (FREERUN)
Phase offset  : 0.000000000 sec
State since   : 2015-05-04 03:13:49 PDT (00:01:45 ago)

Selected Master Details:
Upstream Master address    : 61.1.1.2
Slave interface            : ge-0/1/1.0
Parent Id                  : 40:b4:f0:ff:fe:42:f5:00
GMC Id                     : 40:b4:f0:ff:fe:42:d5:00
```

show snmp mib get <MIB-timing-objects>

```
user@host> show snmp mib get jnxGpsRecvStatus.0

jnxGpsRecvStatus.0 = Lost Sync
```

show snmp mib walk jnxTimingNotfObjects

```
user@host> show snmp mib walk jnxTimingNotfObjects

jnxClksyncIfIndex.0 = 138
jnxClksyncIntfName.0 = ge-0/1/1
jnxClksyncQualityCode.0 = 2
jnxPtpServoState.0 = 1
jnxPtpClass.0 = 6
jnxPtpGmId.0  = 40:b4:f0:ff:fe:42:d5:00
jnxClksyncQualityCodeStr.0 = PRC
jnxPtpServoStateStr.0 = FREERUN
```

RELATED DOCUMENTATION

show chassis synchronization | 576

Understanding Timing Defects and Event Management on ACX Series | 217

Understanding IEEE 1588 Precision Timing Protocol (PTP) over IRB for Broadcast profiles

IN THIS SECTION

- CLI Configuration | 227
- CLI Commands | 228

The IEEE 1588 PTP boundary clock (BC) applications for broadcast media often requires many PTP streams to use a common local IP address. These packets are forwarded through L2 switching. In these use cases, there are no physical interface IFLs created for each PTP physical interface, as would be usually expected for PTP configurations on physical interfaces. Configuration over integrated routing and bridging (IRB) interfaces allows you to meet this requirement. Currently, there is an existing feature that supports multicast-mode with physical interfaces. PTP over IRB for broadcast profiles will extend this support for physical interfaces on IRB interfaces. PTP BC over IRB for broadcast profiles will support SMPTE/AES67/AES67-SMPTE profiles (multicast PTP over IP). This new interface type is added to the multicast profiles. The PTP multicast-mode supports IRB interfaces using the IPv4 transport type that is used with physical interfaces.

NOTE: PTP BC features developed for QFX5110 and QFX5200 are still available. Support is extended to IRB interfaces for PTP BC over multicast for broadcast profiles.

CLI Configuration

A new CLI configuration is added to this feature for multicast mode to identify the L2 interface that needs to be transported. This new interface type is supported in the example configuration statements below.

IPv4 Configuration Example

```
set protocols ptp clock-mode boundary
set protocols ptp profile-type smpte

set protocols ptp slave interface irb.100 multicast-mode transport ipv4
set protocols ptp slave interface irb.100 multicast-mode
                        local-ip-address 170.1.0.5 l2-ifl xe-0/0/2:0.0

set protocols ptp master interface irb.200 multicast-mode transport ipv4
set protocols ptp master interface irb.200 multicast-mode
                        local-ip-address 180.3.5.2 l2-ifl xe-0/0/8:2.0
```

Multiple IRB IPv4 Configuration Example

```
set interfaces xe-0/0/2:0 unit 0 family ethernet-switching vlan members V100
set interfaces xe-0/0/8:2 unit 0 family ethernet-switching vlan members V200
set interfaces et-0/0/20 unit 0 family ethernet-switching vlan members V100
set interfaces et-0/0/28 unit 0 family ethernet-switching vlan members V200
set interfaces irb unit 100 family inet address 170.1.0.5/24
set interfaces irb unit 200 family inet address 180.3.5.2/24

set protocols ptp clock-mode boundary
set protocols ptp profile-type smpte
set protocols ptp slave interface irb.100 multicast-mode transport ipv4
set protocols ptp slave interface irb.100 multicast-mode
                        local-ip-address 170.1.0.5 l2-ifl xe-0/0/2:0.0
set protocols ptp slave interface irb.100 multicast-mode
                        local-ip-address 170.1.0.5 l2-ifl et-0/0/20.0

set protocols ptp master interface irb.200 multicast-mode transport ipv4
set protocols ptp master interface irb.200 multicast-mode
                        local-ip-address 180.3.5.2 l2-ifl xe-0/0/8:0.0
set protocols ptp master interface irb.200 multicast-mode
```

```
                              local-ip-address 180.3.5.2 l2-ifl et-0/0/28.0
```

CLI Commands

There are no new operational commands being added. Areas in the display output that show an interface name will show the appropriate name for the IRB interface and will be expanded to include the L2 IFL name for IRB interfaces.

> **NOTE**: Available **vty** commands that are used to help diagnose the operation of the **clksyncd** and PTP protocol stack will not change, but will support the new interface types and information.

show ptp lock-status detail

```
{master:0}
regress@imax> show ptp lock-status detail
Lock Status:

Lock State     : 5 (PHASE ALIGNED)
Phase offset   : 0.000000180 sec
State since    : 2020-08-02 05:29:06 PDT (00:13:06 ago)

Selected Master Details:
Upstream Master address     : 224.0.1.129
Slave interface             : irb.5 (xe-0/0/29:1.0)
Parent Id                   : aa:00:00:00:00:00:11:11
GMC Id                      : aa:00:00:00:00:00:11:11
```

show ptp primary detail

```
{master:0}
regress@imax> show ptp master detail

PTP Master Interface Details:
Interface   :irb.10
Status      : Master, Active
Clock Info :
    Local Address: 20.0.0.1           Status: Configured, Master, Active
      l2-ifl: xe-0/0/29:0.0
        Remote Address: 20.0.0.2           Status: Learned, Slave, Active
        Remote Address: 224.0.1.129        Status: Configured, Slave, Active
    Total Remote Slaves: 2
```

show ptp slave detail

```
{master:0}
regress@imax> show ptp slave detail
PTP Slave Interface Details:

Interface         : irb.5
Status            : Slave, Active
Clock Info
    Local Address : 12.0.0.2                   Status: Configured, Slave, Active
      l2-ifl: xe-0/0/29:1.0
        Remote Master: 224.0.1.129      Status: Configured, Master, Active
    Total Remote Masters: 1
```

show ptp statistics

```
{master:0}
regress@imax> show ptp statistics
Local Clock       Remote Clock        Role  Stream      Received  Transmitted
irb.5             224.0.1.129        Slave       0         18255         7449
xe-0/0/29:1.0

irb.10            20.0.0.2          Master       5          7554         7554
xe-0/0/29:0.0

irb.10            224.0.1.129       Master       4             0        11682
xe-0/0/29:0.0
```

show ptp statistics detail

```
{master:0}
regress@imax> show ptp statistics detail
Local Clock       Remote Clock        Role  Stream      Received  Transmitted
irb.5             224.0.1.129        Slave       0         18255         7449
xe-0/0/29:1.0
```

```
         Signalling    Announce        Sync       Delay       Error
   Rx:            0        3725        7428        7102          27
   Tx:            0           0           0        7449           0
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
irb.10           20.0.0.2         Master       5          7554         7554
xe-0/0/29:0.0

         Signalling    Announce        Sync       Delay       Error
   Rx:            0           0           0        7554           0
   Tx:            0           0           0        7554           0
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
irb.10           224.0.1.129      Master       4             0        11682
xe-0/0/29:0.0

         Signalling    Announce        Sync       Delay       Error
   Rx:            0           0           0           0           0
   Tx:            0        3805        7877           0           0
```

RELATED DOCUMENTATION

- IEEE 1588v2 PTP Boundary Clock Overview | **99**
- IEEE 1588v2 Precision Timing Protocol (PTP) | **103**
- Understanding the PTP Media Profiles | **108**
- Configuring the PTP Media Profiles | **125**

5

CHAPTER

Configuring Synchronous Ethernet

Synchronous Ethernet Overview | 232

Ethernet Synchronization Message Channel Overview | 244

Synchronous Ethernet on 10-Gigabit Ethernet MIC Overview | 247

Understanding ESMC Quality Level Mapping | 251

Example: Configuring Synchronous Ethernet on MX Series Routers | 256

Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC | 263

Synchronous Ethernet Overview

IN THIS SECTION

- Understanding Synchronous Ethernet | 232
- Supported Platforms | 233
- Understanding Synchronous Ethernet on the ACX Series Universal Metro Routers | 239
- Understanding Clock Synchronization | 240
- Understanding Ingress Monitoring on MX Series Routers | 240
- Understanding Distributed Clocking Mode on MX Series Routers | 241
- Centralized Clocking Mode Overview | 241

Synchronous Ethernet (ITU-T G.8261 and ITU-T G.8264) is a physical layer technology that functions regardless of the network load and supports hop-by-hop frequency transfer, where all interfaces on the trail must support Synchronous Ethernet. It enables you to deliver synchronization services that meet the requirements of the present-day mobile network, as well as future Long Term Evolution (LTE)–based infrastructures.

The following sections explain Synchronous Ethernet in detail:

Understanding Synchronous Ethernet

Synchronization is a key requirement for circuit (emulation) services and mobile radio access technologies. Traditionally, mobile networks used SONET/SDH technologies to backhaul voice and data traffic, and the native support for frequency of SONET/SDH to synchronize their radio network. With the need for greater-capacity backhaul networks, packet-based technologies such as Carrier Ethernet (which do not support the transfer of frequency) and wireless technologies such as frequency division duplex and time-division duplex require not only frequency synchronization but also proper time and phase alignment. This requirement is fulfilled by Synchronous Ethernet, which is used for physical layer frequency synchronization of connected access devices (such as base stations, access nodes, and so on). Synchronous Ethernet supports sourcing and transfer of frequency for synchronization purposes for both wireless and wireline services and is primarily used for mobile backhaul and converged transport.

Synchronous Ethernet is used to transfer clock signals over Ethernet interfaces. The Synchronous Ethernet operation is described in three ITU recommendations:

- G.8261—Defines the architecture and wander performance of Synchronous Ethernet networks.
- G.8262—Specifies timing characteristics of synchronous Ethernet equipment clock (EEC).
- G.8264—Describes the Ethernet Synchronization Message Channel (ESMC).

Synchronous Ethernet is not supported in the following instances on an MX Series router:

- Slot 10 on an MX Series router with Switch Control Board (SCB).
- RJ45 ports

However, note that Synchronous Ethernet is supported on slot 10 on an MX Series router with SCBE and SCBE2.

NOTE: Unified in-service software upgrade (unified ISSU) is currently not supported when clock synchronization is configured for Synchronous Ethernet on MX80 Universal Routing Platforms and on the MICs and MPCEs on MX240, MX480, MX960, MX2010, and MX2020 routers.

Supported Platforms

Table 8 on page 233 summarizes the first Junos OS release that supports Synchronous Ethernet on the various Juniper Networks routers and their components:

Table 8: Synchronous Ethernet Support on Junos OS

Routers and Components	First Supported Junos OS Release
MX5, MX10, MX40, and MX80 Universal Routing Platforms with model numbers MX5-T, MX10-T, MX40-T, and MX80-T	11.2R4
10-Gigabit Ethernet MPC with SFP+ transceivers	11.2R4
10-Gigabit Ethernet MIC with XFP in WAN-PHY framing mode	11.2R4

Table 8: Synchronous Ethernet Support on Junos OS *(Continued)*

Routers and Components	First Supported Junos OS Release
On MX240, MX480, and MX960 routers, the following Enhanced MPCs (MPCEs) support Synchronous Ethernet: • MPC1E (MX-MPC1E-3D) • MPC1E Q (MX-MPC1E-3D-Q) • MPC2E (MX-MPC2E-3D) • MPC2E Q (MX-MPC2E-3D-Q) • MPC2E EQ (MX-MPC2E-3D-EQ)	11.2R4
10-Gigabit Ethernet MIC with XFP in LAN-PHY framing mode	11.4
Juniper Networks PTX Series Packet Transport Routers with 10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet interfaces	12.1
Juniper Networks ACX2000 Series Universal Metro Routers with Gigabit Ethernet and 10-Gigabit Ethernet SFP and SFP+ transceivers.	12.2
MPC-3D-16XGE-SFP	12.3
MPC4E-3D-32XGE-SFPP	15.1
MPC4E-3D-2CGE-8XGE	15.1
MX-MPC1-3D	12.3
MX-MPC1-3D-Q	12.3
MX-MPC2-3D	12.3

Table 8: Synchronous Ethernet Support on Junos OS ***(Continued)***

Routers and Components	First Supported Junos OS Release
MX-MPC2-3D-Q	12.3
MX-MPC2-3D-EQ	12.3
MPC3E (MX-MPC3E-3D) on MX240, MX480, and MX960 routers	13.2
MX104 router	13.2R2
MX104 router	13.2R2
On MX240, MX480, and MX960 routers with SCBE, the following MPCs support Synchronous Ethernet:	
MPC-3D-16XGE-SFP	12.3
MPC4E-3D-32XGE-SFPP	15.1
MPC4E-3D-2CGE-8XGE	15.1
MX-MPC1-3D	12.3
MX-MPC1-3D-Q	12.3
MX-MPC2-3D	12.3
MX-MPC2-3D-Q	12.3
MX-MPC2-3D-EQ	12.3

Table 8: Synchronous Ethernet Support on Junos OS *(Continued)*

Routers and Components	First Supported Junos OS Release
MPC3E (MX-MPC3E-3D) on MX240, MX480, and MX960 routers	13.2
MX104 router	13.2R2
MX104 router	13.2R2
On MX2010 and MX2020 routers, the following Enhanced MPCs (MPCEs) support Synchronous Ethernet: • MPC1E (MX-MPC1E-3D) • MPC1E Q (MX-MPC1E-3D-Q) • MPC2E (MX-MPC2E-3D) • MPC2E Q (MX-MPC2E-3D-Q) • MPC2E EQ (MX-MPC2E-3D-EQ) • MPC3E (MX-MPC3E-3D)	13.3
On MX240, MX480, and MX960 routers with SCBE2, and MX2010, MX2020 routers, the following MPCs support Synchronous Ethernet:	
MPC-3D-16XGE-SFP	13.3
MPC4E-3D-32XGE-SFPP	15.1
MPC4E-3D-2CGE-8XGE	15.1
MX-MPC1-3D	13.3
MX-MPC1-3D-Q	13.3

Table 8: Synchronous Ethernet Support on Junos OS *(Continued)*

Routers and Components	First Supported Junos OS Release
MX-MPC2-3D	13.3
MX-MPC2-3D-Q	13.3
MX-MPC2-3D-EQ	13.3
MPC7E-MRATE	16.1R1
MPC7E-10G	16.1R1
MX2K-MPC8E	16.1R1
MX2K-MPC9E	16.1R1
On MX240, MX480, and MX960 routers with SCBE or SCBE2, on MX2010 and on MX2020 routers with RE-CB, the following MPCs support Synchronous Ethernet: • MPC5E (MPC5E-40G10G) • MPC5EQ (MPC5EQ-40G10G) • MPC5E (MPC5E-100G10G) • MPC5EQ (MPC5EQ-100G10G) • MPC6E (MX2K-MPC6E)	13.3R3
On PTX3000, the following third-generation FPCs support Synchronous Ethernet: • FPC3-SFF-PTX-U0 • FPC3-SFF-PTX-U1	17.1R1

Table 8: Synchronous Ethernet Support on Junos OS ***(Continued)***

Routers and Components	First Supported Junos OS Release
MPC10E-15C-MRATE on MX240, MX480, and MX960 routers.	19.2R1
MPC11E on MX2020, MX2010, and MX2008 routers.	20.1R1

NOTE: Starting with Junos OS Release 12.1, Synchronous Ethernet is supported on Juniper Networks PTX Series Packet Transport Routers. On PTX Series routers, synchronous Ethernet is supported on 10-Gigabit Ethernet, 40-Gigabit Ethernet, and 100-Gigabit Ethernet interfaces and is compliant with ITU-T G.8261 and ITU-T G.8262 standards.

NOTE: Starting with Junos OS Release 14.2, Synchronous Ethernet supported on Juniper Networks PTX Series Packet Transport Routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.

NOTE: Starting with Junos OS Release 12.2, Synchronous Ethernet is supported on Juniper Networks ACX Series Universal Metro routers with Gigabit Ethernet and 10-Gigabit Ethernet SFP and SFP+ transceivers and is compliant with the ITU-T G.8261 and G.8264 standards.

NOTE: The 10-Gigabit Ethernet MIC with XFP supports Synchronous Ethernet, which requires both the MIC and the interface to be configured in LAN framing mode. In LAN mode, the LAN frequency is directly supplied by the MIC's on-board clocking circuitry.

NOTE: The 100-Gigabit Ethernet OTN MIC with CFP2 (MIC6-100G-CFP2) on MPC6E (MX2K-MPC6E) supports Synchronous Ethernet on 100-Gigabit Ethernet interfaces and is compliant with ITU-T G.872 standards. You can configure the primary and secondary clock sources on the 100-Gigabit Ethernet OTN MIC. Chassis line cards can be configured to recover network timing clocks at the physical layer via Synchronous Ethernet. The 100-Gigabit Ethernet OTN MIC supports recovery of clocks via the OTN overhead bytes and not from the configured clock sources.

NOTE: Starting with Junos OS Release 17.3, Synchronous Ethernet supported on fixed port PIC (6xQSFPP) and modular MIC (JNP-MIC1) on MX10003 routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.

Starting with Junos OS Release 17.4, Synchronous Ethernet supported on the fixed port PICs (4xQSFP28 PIC and 8xSFPP PIC) on MX204 routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.

Understanding Synchronous Ethernet on the ACX Series Universal Metro Routers

Synchronous Ethernet is supported on the ACX Series routers with Gigabit Ethernet and 10-Gigabit Ethernet SFP and SFP+ transceivers and is compliant with ITU-T Recommendation G.8261: *Timing and synchronization aspects in packet networks* and ITU-T Recommendation G8264: *Distribution of timing through packet networks.*Synchronous Ethernet is a physical layer frequency transfer technology modeled after synchronization in SONET/SDH. Traditional Ethernet nodes, which do not support Synchronous Ethernet, do not carry synchronization from one node link to another. Synchronous Ethernet–capable nodes however can synchronize their chassis clock to a clock recovered from an interface connected to an upstream clock primary. After this, the clock is used to time data sent to downstream clock slaves, forming a synchronization trail from a Primary Reference Clock (PRC) to Ethernet equipment clocks (EECs) and transferring frequency synchronization along the trail.

The ITU-T G.8264 specification defines the Synchronization Status Message (SSM) protocol and its format for Synchronous Ethernet to ensure interoperability between Synchronous Ethernet equipment used for frequency transfer—for example, SONET/SDH. Synchronous Ethernet provides stable frequency synchronization to a PRC and is not affected by load on the network. However, it requires that all the nodes from the PRC to the last downstream node are Synchronous Ethernet capable. Synchronous Ethernet is a recommended technology for mobile networks that require frequency-only synchronization—for example, 2G or 3G base stations.

Understanding Clock Synchronization

MX Series and PTX Series routers support external clock synchronization and automatic clock selection for Synchronous Ethernet and external inputs (T1 or E1 line timing sources).

Configuring external clock synchronization and automatic clock selection requires making clock selection, quality level, and priority considerations. The clock source selection algorithm is used to pick the two best upstream clock sources from among the various sources on the basis of system configuration and execution criteria such as quality level, priority, and hardware restrictions.

You can configure several options for external clock synchronization. For an overview about the configuration options, see "Configuring Clock Synchronization Interface on MX Series Routers" on page 303 and for information about configuring these options for MX Series routers, see "Understanding Clock Synchronization" on page 277.

Currently, two types of clocking modes are supported on MX Series routers, the distributing clocking mode and the centralized clocking mode. For information about distributed clocking mode, see "Understanding Distributed Clocking Mode on MX Series Routers" on page 241 and "Ethernet Synchronization Message Channel Overview" on page 244. For information about centralized clocking mode, see "Centralized Clocking Mode Overview" on page 241 and "Centralized Clocking Overview" on page 270.

Understanding Ingress Monitoring on MX Series Routers

The ingress clock monitoring feature is supported on all MX Series routers including the 16-port 10-Gigabit Ethernet MPC. On these routers, the incoming Synchronous Ethernet signals cannot be monitored on the 16-port 10-Gigabit Ethernet MPC but are monitored by other Modular Port Concentrators (MPCs) in the chassis. Therefore, you can use the 16-port 10-Gigabit Ethernet MPC for incoming Synchronous Ethernet signals if at least one other MPC with an Ethernet Equipment Clock (EEC) is present in the chassis. This behavior is referred to as *ingress clock monitoring*. Note that the 16-port 10-Gigabit Ethernet MPC does not have a built-in EEC or internal clock; therefore, it can only input (accept) a clock signal but cannot act as a clock source.

When an MX Series router is configured for Synchronous Ethernet on the 16-port 10-Gigabit Ethernet MPC and no other MPC with an EEC is present in the chassis, the Synchronous Ethernet feature cannot be supported by the system. The system notifies the user through log messages and CLI output and justifies its inability to support Synchronous Ethernet.

For information about Synchronous Ethernet support on the 10-Gigabit Ethernet MIC, see "Synchronous Ethernet on 10-Gigabit Ethernet MIC Overview" on page 247.

Understanding Distributed Clocking Mode on MX Series Routers

In the distributing clocking mode, the Switch Control Board (SCB) supports synchronizing the MX Series router's chassis to an internal Stratum 3 free-run oscillator. The Synchronous Ethernet timing messages are sent through the chassis to support the network timing trails that are traceable to a high-quality timing source. The timing messages are carried through the network by the Ethernet switches that were traditionally handled by time-division multiplexing (TDM) equipment over SONET/SDH interfaces. The distributing clocking mode is handled through ESMC messages. The ESMC support is based on the ITU-G.8264 specification. The ESMC messages transmit the clock quality of the line timing signal in the form of the (Synchronous Status Message) SSM TLV that is carried in the ESMC packet.For more information, see "Ethernet Synchronization Message Channel Overview" on page 244.

The distributed clocking mode has the following limitations:

- There is no SCB centralized clock module to synchronize the entire chassis.
- The recovered line timing is driven out only by the line interface of the 16-port 10-Gigabit Ethernet MPC.
- The distributed mode does not support external clock interface timing.

Centralized clocking mode overcomes these limitations by distributing and driving timing out on all the chassis line interfaces.

Centralized Clocking Mode Overview

Starting with Junos OS Release 12.2, the Enhanced SCB SCBE on the MX240, MX480, and MX960 routers supports a Stratum 3 clock module. This clock module functions as a centralized point within the chassis for clock monitoring, filtering, holdover, and selection. It has only one external clock interface. For more information, see "Centralized Clocking Overview" on page 270.

Starting from Junos OS Release 13.3, the Enhanced SCB SCBE2 on the MX240, MX480, and MX960 routers supports two external clock interfaces external-0/0 and external-1/0. The external-0/0 interface refers to the external interface on the SCB in slot 0 and the external 1/0 interface refers to the external interface on the SCB in slot 1.

In SONET/SDH networks, the routers use the best-quality clock available in the network. The quality level of various clock sources in the network is determined by monitoring the Synchronization Status Messages (SSMs) from the clock sources. An SSM occupies a fixed location in the SONET frame. On Ethernet networks that use Synchronous Ethernet for clock synchronization, the SSM is not a part of the timing signal. The SSM is carried in the Ethernet packets that flow in the Ethernet Synchronization Message Channel (ESMC). By interpreting the SSM values, the router determines the clock quality associated with the clock source, and performs its clock selection accordingly. The ESMC messages transmit the clock quality of the line timing signal in the form of the SSM TLV that is part of the ESMC packet.

Note that the clock in the router goes into holdover mode in the absence of any clock sources with best quality level and in turn uses the timing information stored in its buffer to synchronize itself.

The following processes play a crucial role during external synchronization of the clock sources in the control board. Note that PTX Series routers need two best clock sources that act as primary and secondary clock sources, whereas MX Series routers need only one best clock source.

- The clock sync process (clksyncd) performs the clock selection and participates in ESMC message exchange. For clock selection, in the absence of user-configured primary or secondary clock sources, the clksyncd runs a clock selection algorithm and selects the two best clocks available as the primary and secondary clock sources, respectively, for a PTX Series router or selects a best clock for an MX Series router. The clksyncd also sends out periodic ESMC packets to transmit its clock's quality level to the other routers in the network—this is specified in the SSM TLV in the ESMC packet—and receives ESMC packets from other clock sources and tracks the received clock signal quality level. ESMC packets are received on all the interfaces that are configured as clock sources. ESMC packets are also transmitted to the clock-source interfaces on other routers, as well as to the interfaces that are configured to receive ESMC packets on other routers.

- The chassis process (chassisd) is responsible for interfacing with the Enhanced Switch Control Board (SCBE) on MX Series routers and Centralized Clock Generator (CCG) on PTX Series routers. It monitors the clock quality and assists SCBE or the CCG to determine the clock source with the best quality level. When it detects clock quality deterioration, it informs clksyncd to select another primary clock source. After clock selection chassisd is updated with the latest clock source information. Note that in the absence of user-configured primary and secondary clock sources on PTX Series routers, the clock sources are selected through the clock algorithm and chassisd is updated with the latest clock information. Consequently, a new interprocess connection is established between chassisd and clksyncd.

- The periodic packet management process (ppmd) performs periodic transmission of ESMC packets to others routers in the network. It also receives incoming ESMC packets from other routers. The ppmd filters out repetitive ESMC packets to reduce packet flows between ppmd and clksyncd.

The following explains a simple clock selection process using ESMC packets:

- The Synchronous Ethernet (line timing) signal is an Ethernet physical layer signal that is received on the Ethernet interface. ESMC is a Layer 2 Ethernet packet. The Synchronous Ethernet signal and the ESMC packets are received on the Ethernet interface of the router.

- The received Synchronous Ethernet signal is sent to the clock hardware in the SCBE or in the CCG, whereas the ESMC packets—with the quality level—is directed to the clksyncd.

- The clock selection algorithm in clksyncd selects the best clock signal based on the quality level in the ESMC packet from one of the interfaces that is configured as a clock source. On PTX Series routers, the algorithm also selects the next best—when available—clock as the secondary clock.
- The best clock information is transmitted to the chassisd, which in turn generates a command to the clock hardware to use the best clock as the reference clock. On PTX Series routers, both primary and secondary clocks are used..
- The reference clock uses the best—primary in PTX Series routers—clock signal as the system clock that is used to generate Synchronous Ethernet signal to transmit on all its interfaces.
- The ESMC transmit module in clksyncd is notified of the quality level corresponding to the best—primary—clock. This quality level is used for ESMC packets that are transmitted out of the router.
- ESMC packets are transmitted on all the source interfaces and on those interfaces that are configured as esmc-transmit interfaces.

NOTE: On SCBE2, you can configure the external synchronization options only on the external interface on the active SCB. Therefore, if the active SCB is in slot 0, then you can configure the external-0/0 interface only. If the active SCB is in slot 1, then you can configure the external-1/0 interface only.

The centralized mode is applicable to mobile backhaul infrastructures and for network transition from traditional TDM to Ethernet network elements with the support of Synchronous Ethernet.

Release History Table

Release	Description
17.3	Starting with Junos OS Release 17.3, Synchronous Ethernet supported on fixed port PIC (6xQSFPP) and modular MIC (JNP-MIC1) on MX10003 routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.
17.3	Starting with Junos OS Release 17.4, Synchronous Ethernet supported on the fixed port PICs (4xQSFP28 PIC and 8xSFPP PIC) on MX204 routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.
14.2	Starting with Junos OS Release 14.2, Synchronous Ethernet supported on Juniper Networks PTX Series Packet Transport Routers is compliant with ITU-T G.8264 (Ethernet Synchronization Messaging Channel) standards.
13.3	Starting from Junos OS Release 13.3, the Enhanced SCB SCBE2 on the MX240, MX480, and MX960 routers supports two external clock interfaces external-0/0 and external-1/0.

12.2	Starting with Junos OS Release 12.2, Synchronous Ethernet is supported on Juniper Networks ACX Series Universal Metro routers with Gigabit Ethernet and 10-Gigabit Ethernet SFP and SFP+ transceivers and is compliant with the ITU-T G.8261 and G.8264 standards.
12.2	Starting with Junos OS Release 12.2, the Enhanced SCB SCBE on the MX240, MX480, and MX960 routers supports a Stratum 3 clock module.
12.1	Starting with Junos OS Release 12.1, Synchronous Ethernet is supported on Juniper Networks PTX Series Packet Transport Routers.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68
Centralized Clocking Overview | 270
Understanding Clock Synchronization | 277
Understanding Hybrid Mode | 357

Ethernet Synchronization Message Channel Overview

Ethernet Synchronization Message Channel (ESMC) is a logical communication channel. It transmits Synchronization Status Message (SSM) information, which is the quality level of the transmitting synchronous Ethernet equipment clock (EEC), by using ESMC protocol data units (PDUs). ESMC support is based on the ITU G.8264 specification.

Starting with Junos OS Release 17.3R1, Synchronized Ethernet with Ethernet synchronized Message Channel (ESMC) is supported on MX10003 routers

Starting with Junos OS Release 17.4R1, Synchronized Ethernet with Ethernet synchronized Message Channel (ESMC) is supported on MX204 routers

A Synchronous Ethernet interface is configured to operate in the following modes:

- Nonsynchronous mode—In this mode, the Synchronous Ethernet interface does not process the ESMC message and does not extract the quality level information.

- Synchronous mode—In this mode, the Synchronous Ethernet interface processes the ESMC message and extracts the quality level information. While operating in synchronous mode, the ESMC messages transmit the quality level.

You can enable ESMC on a Synchronous Ethernet port by adding the port to a list of ESMC interfaces. The ESMC messages are transmitted through the port indicating the quality level of the clock it is capable of driving and the ESMC messages are received (if the other endpoint supports ESMC) with the quality level of the transmitting clock. The MPC receiving the ESMC messages on its configured Synchronous Ethernet ports extracts the quality level and transmits it to the Routing Engine. The clock selection algorithm on the Routing Engine collects the ESMC data from each of the ESMC-enabled ports to select the clock sources.

The clock selection process supports revertive and nonrevertive modes. When the clock selection process has selected two clock sources—a primary and a secondary—and the active primary clock source degrades over a period of time and then improves again, this primary clock source again becomes the active clock source only if revertive mode is enabled. If nonrevertive mode is set and the secondary clock source is currently active (due to a previous degradation of primary clock source), the primary clock source is not reactivated even after its quality improves.

The clock selection is based on the following three operational modes:

- Forced free-run—In this mode, you can set the clock source either from a free-run local oscillator or from an external qualified clock. For MX80 routers, the free-run clock is provided by the local oscillator. For MX240, MX480, and MX960 routers, the free-run clock is provided by the Switching Control Board (SCB).

- Forced holdover—This mode is an internal state the synchronous Ethernet Equipment Clock (EEC) goes into, when an upstream clock source that the system locks on to is no longer available. You cannot configure this mode because it is an internal state.

- Automatic selection—In this mode, the system chooses up to two best upstream clock sources. The system then uses the clock recovered from one of the sources to generate a frequency of 19.44 MHz and clock the transmit side of the Ethernet interfaces. If no upstream clock with acceptable good quality is available or if the system is configured in free-run mode, the system uses the internal clock. Automatic clock selection is based on the quality level, priority, signal fail, and external commands.

For more information about clock selection, see "Configuring Clock Synchronization Interface on MX Series Routers" on page 303.

The synchronous EEC is in free-run mode when the chassis is switched on or restarted. When a synchronous EEC locks on to an upstream reference clock source at least once for a continuous period of 60 seconds, the EEC will have stored sufficient Synchronous Ethernet data in a replay holdover buffer. In case of failure of a reference clock source, the system goes to holdover mode and uses the replay data in the holdover buffer to service the downstream Synchronous Ethernet clients.

When a Modular Port Concentrator (MPC) with an EEC restarts (because of either a system crash or a manual restart), the holdover buffer data gets erased. Therefore, downstream Synchronous Ethernet clients cannot be serviced. This is also applicable when a new MPC containing an EEC is inserted into the system.

In a practical deployment scenario, the status display of holdover mode is invalid only when the chassis is switched on or restarted.

When an MPC containing an EEC is restarted or a new MPC containing an EEC is inserted into a system that is (already) in holdover mode, the EEC on this MPC cannot be considered to be in holdover mode because it does not have any Synchronous Ethernet replay information in its holdover data buffer. Therefore, you must first fix the system holdover issue before attempting to service the downstream Synchronous Ethernet clients on this MPC. To accomplish this, you must find a suitable upstream reference clock source and let the synchronous EEC lock on to this upstream reference clock source, and then service the downstream Synchronous Ethernet clients on this MPC.

Release History Table

Release	Description
17.3	Starting with Junos OS Release 17.3R1, Synchronized Ethernet with Ethernet synchronized Message Channel (ESMC) is supported on MX10003 routers
17.3	Starting with Junos OS Release 17.4R1, Synchronized Ethernet with Ethernet synchronized Message Channel (ESMC) is supported on MX204 routers

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Centralized Clocking Overview | 270

Understanding Clock Synchronization | 277

Understanding Hybrid Mode | 357

Synchronous Ethernet on 10-Gigabit Ethernet MIC Overview

Synchronous Ethernet (ITU-T G.8261) is a physical layer technology that functions regardless of the network load. Synchronous Ethernet supports hop-by-hop frequency transfer, where all interfaces on the trail must support Synchronous Ethernet.

Starting with Junos OS Release 11.4, the 10-Gigabit Ethernet MIC with XFP supports Synchronous Ethernet in LAN-PHY framing mode. This is possible only when all the Physical Interface Cards (PICs) under the given Modular Interface Card (MIC) and its ingress interfaces are configured in LAN framing mode. For more information about configuring LAN framing mode, see "Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC" on page 263. In this mode, the LAN frequency is directly supplied by the MIC's on-board clocking circuitry.

On MX80 Universal Routing Platforms, when the PIC-level framing type is changed, the pluggable MIC (2-port 10-Gigabit Ethernet MIC with XFP) is restarted and the Forwarding Engine Board with the built-in MIC (4-port 10-Gigabit Ethernet MIC with XFP) is restarted.

On MX240, MX480, and MX960 routers, when the PIC-level framing type is changed from LAN mode to non-LAN mode (on a MIC), the entire MPC restarts.

NOTE: The default interface framing mode is LAN-PHY framing mode. For WAN-PHY framing mode operation, interface framing needs to be set to the **wan-phy** framing option explicitly. For more information about the interface-level and PIC-level configuration combination, see "Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC" on page 263.

Synchronous Ethernet is not supported in the following instances:

- MX240, MX480, and MX960 routers with 10-Gigabit Ethernet MICs or 10-Gigabit Ethernet built-in interfaces do not support Synchronous Ethernet or Ethernet Synchronization Message Channel (ESMC) transmit in LAN physical layer device (LAN-PHY) framing mode. To configure Synchronous Ethernet or ESMC transmit interfaces on these routers with 10-Gigabit Ethernet Interfaces, you must configure all the 10-Gigabit Ethernet interfaces on the MIC in WAN physical layer device (WAN PHY) framing mode.

- Primary and secondary sources cannot be from the same MIC. Alternatively, only the port with the highest quality clock source from a given MIC is used for clock selection.

- Starting with Junos OS Release 11.4, Synchronous Ethernet is not supported on 10-Gigabit Ethernet ports in LAN-PHY mode except for the 10-Gigabit Ethernet MIC with XFP.

- Prior to Junos OS Release 11.4, Synchronous Ethernet was supported only in WAN-PHY framing mode on the 10-Gigabit Ethernet MICs with XFP.

> **NOTE**: On the MX Series 5G Universal Routing Platforms, the placement of MICs varies from router to router, the following key points has to be taken into consideration while configuring the MICs:
>
> - On the fixed MX80 chassis, the MICs (10-Gigabit Ethernet MIC) come preinstalled and cannot be replaced. The MIC is labeled as 0/MIC 0 and it consists of four 10-Gigabit Ethernet ports labeled 0 through 3, left to right.
> - On the modular MX5, MX10, MX40, and MX80 chassis, there are two MIC slots that are labeled as 1/MIC 0 and 1/MIC 1.
> - On the MX240, MX480, and MX960 Universal Routing Platforms, there are two slots for MICs which are labeled as PIC 0/1 and PIC 2/3 on the Modular Port Concentrators (MPCs).
>
> Note that hereon the term *PIC* is being used in synonymous with the term *MIC slot* or *Ethernet ports* (in the case of fixed MX80 chassis).

You can configure a MIC in LAN-PHY framing mode by configuring all the constituent logical PICs in the same LAN-PHY framing mode on MX80, MX240, MX480, and MX960 routers.

You can also alternatively configure a MIC in WAN-PHY framing mode on MX80, MX240, MX480, and MX960 routers by configuring all the constituent logical PICs in the same WAN-PHY framing mode in any one of the following configurations:

- No framing mode configured on all the constituent logical PICs of the MIC.
- Incompatible framing mode configured on constituent logical PICs of the MIC.
- No framing mode configured on some of the constituent logical PICs of the MIC.

> **NOTE**: All the logical PICs in a single MIC must be configured in the same framing mode.

You can also configure the framing mode at the interface level and at the PIC level. For more information about configuring the framing mode at the PIC level and at the interface level, see "Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC" on page 263.

When the PIC-level framing type is changed between LAN mode and non-LAN mode on a MIC:

- The Forwarding Engine Board (FEB) is restarted in the case of the built-in MIC (4-port 10-Gigabit Ethernet MIC with XFP) on MX80 routers.

- Only the corresponding MIC is restarted in the case of the pluggable MIC (2-port 10-Gigabit Ethernet MIC with XFP) on MX80 routers.
- The entire MPC restarts in the case of MX240, MX480, and MX960 routers.

NOTE: By default, the PIC-level framing mode is set to WAN framing type, that is, **e1 | e3 | sdh | sonet | t1 | t3**. Synchronous Ethernet works on the 10-Gigabit Ethernet MIC with XFP in LAN-PHY mode only when the PIC-level framing configuration is configured to the **lan** framing type explicitly.

By default, the interface-level framing mode is set to **lan-phy**. For WAN-PHY operation, interface framing needs to be set to **wan-phy** framing explicitly.

Table 9 on page 249 summarizes the possible configuration combination for Synchronous Ethernet on the 10-Gigabit Ethernet MIC with XFP that are available at the interface level and the PIC level:

Table 9: Configuration Options

Framing Configuration		Operation		
PIC Level	**Interface Level**	**Interface Status**	**Will Synchronous Ethernet Function?**	**Will Non-Synchronous Ethernet Functions Work?**
LAN	LAN-PHY (Default)	Up	Yes	Yes
LAN	WAN-PHY	Down (Framing Conflict)	No	No
WAN (Default)	LAN-PHY (Default)	Up	No	Yes
WAN (Default)	WAN-PHY	Up	Yes	Yes

The following cases and corresponding behaviors explain Table 9 on page 249 in detail.

- The PIC is being brought up online:

This case is applicable when either the MIC is restarted or when the MIC is being brought online by an operational command. In this case, the behavior can be presented as:

  - No framing mode is configured for any or all of the constituent logical PICs of the MIC—The MIC is configured to operate in WAN-PHY framing mode as the WAN mode is the default mode.

    Here, the WAN-PHY framing-based interfaces operate in normal state and provides Synchronous Ethernet services. However, the LAN-PHY framing-based interfaces operate normally but cannot provide Synchronous Ethernet services.

  - All the constituent logical PICs of a MIC are configured in LAN-PHY mode—The MIC is configured to operate in LAN-PHY framing mode.

    In this scenario, the WAN-PHY framing-based interfaces cannot operate in normal state. As a result, these interfaces are administratively brought down. The reason for the interface being in **admin-down** state is displayed as **Framing Conflict** in the output of the **show interfaces** operational command. This is because the interface framing configuration (WAN-PHY) is in conflict with the PIC-level framing configuration of LAN-PHY. Because the interfaces are in **admin-down** state, neither the Synchronous Ethernet services nor other services are provided.

    Alternatively, all the LAN-PHY framing-based interfaces can operate in normal state and can continue to provide any of the Synchronous Ethernet services.

- The PIC is already online:

  - In WAN-PHY framing mode—The interface framing configuration on the PIC has changed from WAN-PHY to LAN-PHY.

    The interface continues to be operational for data transceiving purposes. However, it cannot provide any of the Synchronous Ethernet services.

  - In WAN-PHY framing mode—The interface framing configuration on the PIC has changed from LAN-PHY to WAN-PHY.

    The interface continues to be operational for data transceiving purposes, and it can also provide Synchronous Ethernet services.

  - In LAN-PHY framing mode—The interface framing configuration on the PIC has changed from WAN-PHY to LAN-PHY.

    The interface is operational for data transceiving purposes, and it can also provide Synchronous Ethernet services.

  - In LAN-PHY framing mode—The interface framing configuration on the PIC has changed from LAN-PHY to WAN-PHY.

    The interface is down; therefore, it cannot provide any Synchronous Ethernet services.

Support for Synchronous Ethernet is limited in the following instances:

- Primary and secondary sources cannot be from the same MIC. Alternatively, only the port with the highest quality clock source from a given MIC is used for clock selection.
- Prior to Junos OS Release 11.4, Synchronous Ethernet was supported only in WAN-PHY framing mode on the 10-Gigabit Ethernet MICs with XFP.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68
Centralized Clocking Overview | 270
Understanding Clock Synchronization | 277
Understanding Hybrid Mode | 357

Understanding ESMC Quality Level Mapping

IN THIS SECTION

- Synchronous Ethernet Mode | 252
- Precision Time Protocol Mode | 253
- Hybrid Mode | 255
- Feature Mode Changes | 255

Ethernet Synchronization Message Channel (ESMC) is a logical communication channel. It transmits Synchronization Status Message (SSM) information, which is the quality level of the transmitting synchronous Ethernet equipment clock (EEC), by using ESMC protocol data units (PDUs). ESMC support is based on the ITU G.8264 specification. In order for an interface to receive or transmit ESMC messages, at least one *logical interface* must be configured on that interface. If the interface is currently not configured with a logical interface, you must configure a logical interface by using the **[set interfaces interface-name unit 0]** statement at the **[edit]** hierarchy level.

The following factors affect the ESMC quality level value that is transmitted out on the interfaces configured at the **[edit chassis synchronization esmc-transmit interfaces]** hierarchy level:

- Quality mode
- Selection mode
- Conversion of PTP clock class flag

Other than the aforementioned factors, the software phase lock loop (spll) state or the hybrid state impacts the transmitted ESMC quality level when the router is in PTP mode or hybrid mode, respectively.

The following sections explain how the ESMC quality level is handled in various situations:

Synchronous Ethernet Mode

In Synchronous Ethernet mode, the ESMC quality level is handled in the following way:

- In quality mode:
    - If the **quality-mode-enable** option at the **[show chassis synchronization]** hierarchy level is not set, then the configured quality and the priority set for the clock sources are used for the clock selection. The ESMC quality level is based on the configured quality level corresponding to the active clock source.
    - If the **quality-mode-enable** option at the **[show chassis synchronization]** hierarchy level is set, then only those clock sources that receive ESMC quality level is higher than or equal to the configured quality are considered for selection. The ESMC quality level value transmitted also depends on the selection mode option as discussed next.
- In selection mode:
    - If the **selection-mode** option at the **[show chassis synchronization]** hierarchy level is set to **configured-quality**, then the configured quality for the selected, active source is used as the system ESMC quality level value that is transmitted out.
    - If the **selection-mode** option at the **[show chassis synchronization]** hierarchy level is set to **received-quality**, then the received ESMC quality level value from the selected clock source is transmitted out.
- When no clock sources are locked:
    1. Do Not Use (DNU)/Don’t Use for Synchronization (DUS) quality level is transmitted.
    2. The ESMC quality level value sent out on the selected, active clock source interface is always DNU/DUS.

Precision Time Protocol Mode

In Precision Time Protocol (PTP) mode, you can transmit ESMC quality level values with the following parameters set:

- The **network-option** option must be configured at the **[edit chassis synchronization]** hierarchy level.
- Synchronous Ethernet sources must not be configured at the **[edit chassis synchronization]** hierarchy level.
- The **convert-clock-class-to-quality-level** option at the **[edit protocols ptp slave]** hierarchy level must be enabled so that the PTP clock class received from the selected primary is converted to the appropriate ESMC quality level.

Clock class is a value that ranges from 80 through 109 and is used to map the clock class to the set ESMC quality level. The ESMC quality level value is mapped to the clock class value by one of the following methods:

- Mapping of PTP clock class to ESMC quality level—By default, the standard mappings suggested by ITU-T G.781 specification are used as shown in Table 10 on page 253 and irrespective of the clock being configured in hybrid mode or pure PTP mode, the outgoing quality level is always based on the PTP clock class mapping. To map the PTP clock class to the ESMC quality level, you must set the **convert-clock-class-to-quality-level** option at the **[edit protocols ptp slave]** hierarchy level. For default mapping values, see Table 10 on page 253.

Table 10: Default Quality Level to PTP Clock-Class Mapping

SSM QL (Binary)	Standard Mappings Given in ITU-T G.781 Specification		PTP Clock Class
	Option I	**Option II**	
0001	-	QL-PRS	80
0000	-	QL-STU	82
0010	QL-PRC	-	84
0111	-	QL-ST2	86

Table 10: Default Quality Level to PTP Clock-Class Mapping *(Continued)*

SSM QL (Binary)	Standard Mappings Given in ITU-T G.781 Specification		PTP Clock Class
0011	-	-	88
0100	QL-SSU-A	QL-TNC	90
0101	-	-	92
0110	-	-	94
1000	QL-SSU-B	-	96
1001	-	-	98
1101	-	QL-ST3E	100
1010	-	QL-ST3/ QL-EEC2	102
1011	QL-SEC/ QL-EEC1		104
1100	-	QL-SMC	106
1110	-	QL-PROV	108
1111	QL-DNU	QL-DUS	110

- User-defined mapping of PTP clock class to ESMC quality level—You can manually override the clock class to ESMC mapping by setting the **clock-class** option at the **[edit protocols ptp slave clock-class-to-quality-level-mapping quality level *ql-value*]** hierarchy level.

Unlike Synchronous Ethernet, the DNU/DUS quality level value is not transmitted on the interface on which the PTP primary is configured. In PTP mode, an interface is configured as part of the **[edit chassis esmc-transmit interfaces]** hierarchy level, and an appropriate ESMC quality level value is transmitted through it. Note that when the PTP clock class value received from the primary changes, the ESMC quality level transmitted also changes appropriately. If there is no valid clock class value as input, then the DNU/DUS value is transmitted on the interfaces configured under the **esmc-transmit** option at the **[edit chassis synchronization]** hierarchy level.

To view the current mapping between the clock class and the ESMC quality level, run the **show ptp quality-level-mapping** *operational mode command*.

To display the ESMC quality level currently transmitted by the interface, run the **show ptp global-information** operational mode command in PTP or hybrid mode. Note that when the **convert-clock-class-to-quality-level** option is disabled or when there is no valid clock class as input, the **show ptp global information** command does not display the ESMC quality level value.

To view the ESMC quality level transmitted in all modes, run the **show synchronous-ethernet esmc transmit detail** operational mode command.

Hybrid Mode

Hybrid mode is a combination of PTP and Synchronous Ethernet modes.

The configuration required for transmitting the ESMC quality level in hybrid mode differs from that in PTP mode in the following ways:

- In hybrid mode, synchronous Ethernet source interfaces must be configured at the **[edit chassis synchronization]** hierarchy level.
- In hybrid mode, configuring the **convert-clock-class-to-quality-level** option is optional. When this option is configured, the outgoing ESMC quality level behavior is the same as that in PTP mode. When the **convert-clock-class-to-quality-level** option is not configured, the outgoing ESMC quality level behavior is the same as that in Synchronous Ethernet mode.

Feature Mode Changes

When the router configuration is changed from one feature mode to another mode—that is from or to Synchronous Ethernet, PTP, or hybrid mode—the following occurs:

1. The ESMC quality level is reset to DNU.

2. Based on the new feature mode, the ESMC quality level is decided:
   - When the reference clock qualifies for Synchronous Ethernet mode.
   - When PTP goes into phase-aligned state or hold-over state in PTP mode.
   - When the hybrid state reaches *frequency and phase aligned* state in hybrid mode.

Sometimes PTP is required to drive Synchronous Ethernet and ESMC. This scenario occurs when:

- After certain PTP hops, the network branches out, and one branch of the network requires only frequency synchronization while the other branch requires both phase and frequency synchronization.
- A packet-based distribution network is located between a time-division multiplexing (TDM), a SONET, and a Synchronous Ethernet network.

In such situations, the clock recovered by PTP is sent over the Ethernet physical transceiver for Synchronous Ethernet, and the ESMC quality level value mapping with the PTP clock class is sent over the interfaces.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68
Centralized Clocking Overview | 270
Understanding Clock Synchronization | 277
Understanding Hybrid Mode | 357

Example: Configuring Synchronous Ethernet on MX Series Routers

IN THIS SECTION

Requirements | 257
Overview | 257
Configuration | 257

- Verification | 260

Requirements

This example uses the following hardware and software components:

- One MX80-T, MX5-T, MX10-T, MX40-T, MX80, MX240, MX480, or MX960 router
- Junos OS Release 10.4 or later for MX80 Universal Routing Platforms and 11.2R4 or later for MX80-T, MX5, MX10, MX40, MX240, MX480, and MX960 routers.

Overview

You can configure Synchronous Ethernet on MX5-T, MX10-T, MX40-T, MX80, MX80-T, MX240, MX480, and MX960 routers, which enables you to synchronize clocks between nodes in a network through frequency synchronization.

NOTE: You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.

Configuration

IN THIS SECTION

- CLI Quick Configuration | 258
- Procedure | 258

CLI Quick Configuration

To quickly configure synchronization on the aforementioned routers, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

```
[edit]

set chassis synchronization clock-mode auto-select

set chassis synchronization network-type option-1

set chassis synchronization quality-mode-enable

set chassis synchronization selection-mode configured-quality

set chassis synchronization switchover-mode revertive

set chassis synchronization hold-interval configuration-change 1 restart 1 switchover 1

set chassis synchronization esmc-transmit interfaces ge-2/0/0

set chassis synchronization source external-a priority 2 quality-level prc request force-switch

set chassis synchronization interfaces ge-2/0/0 priority 1 quality-level prc request force-switch wait-to-restore 1
```

Procedure

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

For step-by-step configuration, see "Configuring Clock Synchronization Interface on MX Series Routers" on page 303.

To configure Synchronous Ethernet, perform the following tasks:

1. Configure the clock mode, network type, quality mode, selection mode, and switchover mode.

```
[edit chassis synchronization]
user@host# set clock-mode auto-select network-type option-1 quality-mode-enable selection-mode configured-quality switchover-mode revertive
```

2. Configure the hold interval for configuration change, restart interval, and the switchover interval in seconds.

```
[edit chassis synchronization]
user@host# set hold-interval configuration-change 1 restart 1 switchover 1
```

3. Configure the interfaces for transmitting ESMC.

```
[edit chassis synchronization]
user@host# set esmc-transmit interfaces ge-2/0/0
```

4. Configure the source node with its quality level, priority, and request type.

```
[edit chassis synchronization]
user@host# set source external-a priority 2 quality-level prc request force-switch
```

5. Configure the interfaces with priority, quality level, request type, and time to restore the interface to default.

```
[edit chassis synchronization]
user@host# set interfaces ge-2/0/0 priority 1 quality-level prc request force-switch wait-to-restore 1
```

Results

Display the results of the configuration:

```
user@host# show chassis
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | interface-name);
    }
    hold-interval {
        configuration-change seconds;
        restart seconds;
        switchover seconds;
    }
    network-type (option-1 | option-2);
    quality-mode-enable;
    selection-mode (configured-quality|received-quality);
    switchover-mode (revertive | non-revertive);
    source {
        (external-a | external-b) {
            priority number;
            quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            request (force-switch | lockout);
        }
        interfaces interface-name {
            priority number;
            quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            request (force-switch | lockout);
            wait-to-restore minutes;
        }
    }
}
```

Verification

IN THIS SECTION

- Verifying the Basic Parameters for Synchronization | 261
- Verifying All the Parameters for Synchronization | 261
- Verifying the Global Configuration | 262
- Verifying the ESMC Transmit Parameters | 262
- Verifying the ESMC Statistics Parameters | 262

- Verifying That the ESMC Statistics Are Cleared | 263

Confirm that the configuration is working properly.

Verifying the Basic Parameters for Synchronization

Purpose

Verify that the basic synchronization parameters such as the current clock status, clock locked to, and configured sources are working as expected.

Action

From operational mode, enter the **run show chassis synchronization** command to display the synchronization details.

Meaning

The output displays the basic synchronization parameters configured on the interface.

Verifying All the Parameters for Synchronization

Purpose

Verify that all the synchronization parameters are working as expected.

Action

From operational mode, enter the **run show chassis synchronization extensive** command to display all the synchronization details.

Meaning

The output displays all the synchronization parameters configured on the interface.

Verifying the Global Configuration

Purpose

Verify that all the global configuration parameters are working as expected.

Action

From operational mode, enter the **run show synchronous-ethernet global-information** command to display the set parameters for the global configuration.

Meaning

The output displays global information about the configured node.

Verifying the ESMC Transmit Parameters

Purpose

Verify that the transmission parameters of ESMC on the interface are working as expected.

Action

From operational mode, enter the **run show synchronous-ethernet esmc transmit detail** command to display the set parameters for the ESMC transmission.

Meaning

The output displays all the transmission details about the configured ESMC interface.

Verifying the ESMC Statistics Parameters

Purpose

Verify the statistics related to ESMC on the interface.

Action

From operational mode, enter the **run show synchronous-ethernet esmc statistics** command to display the statistics for the ESMC transmission.

Meaning

The output displays information about the ESMC statistics.

Verifying That the ESMC Statistics Are Cleared

Purpose

Clear the statistics related to ESMC on the interface.

Action

From operational mode, enter the **clear synchronous-ethernet esmc statistics** command to clear the statistics for the ESMC transmission.

Meaning

The output displays the message that the ESMC statistics have been cleared.

RELATED DOCUMENTATION

- Precision Time Protocol Overview | 68
- Centralized Clocking Overview | 270
- Understanding Clock Synchronization | 277
- Understanding Hybrid Mode | 357

Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC

IN THIS SECTION

- Requirements | 264

- Overview | 264
- Configuration | 265

Requirements

This example uses the following hardware and software components:

- Junos OS Release 11.4 or later for MX80-T, MX240, MX480, or MX960 routers
- One MX80-T, MX240, MX480, and MX960 router with 10-Gigabit Ethernet MIC with XFP

Overview

You can set the framing mode at the PIC level and at the interface level with various configuration combinations. For more information about the various configuration combinations, see "Synchronous Ethernet on 10-Gigabit Ethernet MIC Overview" on page 247.

This example provides information about configuring framing mode at the interface level and the PIC level for Synchronous Ethernet on the 10-Gigabit Ethernet MIC with XFP.

The 10-Gigabit Ethernet MIC with XFP supports Synchronous Ethernet in LAN-PHY framing mode. This is possible only when all the logical PICs under the given Modular Interface Card (MIC) and its ingress interfaces are configured in LAN framing mode.

You can also alternatively configure a MIC in WAN-PHY framing mode on MX80, MX240, MX480, and MX960 routers by configuring all the constituent logical PICs in the same WAN-PHY framing mode in any one of the following configurations:

- No framing mode configured on all the constituent logical PICs of the MIC.
- Incompatible framing mode configured on constituent logical PICs of the MIC.
- No framing mode configured on some of the constituent logical PICs of the MIC.

NOTE: By default, the PIC-level framing mode is set to WAN framing type, that is **e1** | **e3** | **sdh** | **sonet** | **t1** | **t3**. Synchronous Ethernet works on 10-Gigabit Ethernet MIC with XFP in LAN-PHY mode only when the PIC level framing configuration is configured to **lan** framing type explicitly.

By default, the interface-level framing mode is set to **lan-phy**. For WAN-PHY operation, interface framing needs to be set to **wan-phy** framing explicitly.

NOTE: You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.

Configuration

IN THIS SECTION

- CLI Quick Configuration | **265**
- Procedure | **266**
- Results | **267**

CLI Quick Configuration

To quickly configure PIC-level framing and interface-level framing on the 10-Gigabit Ethernet MIC with XFP, copy the following commands and paste it into the CLI.

```
[edit]

set chassis fpc 2 pic 0 framing lan


set chassis fpc 2 pic 1 framing lan


set interfaces xe-2/1/0 framing-mode lan-phy
```

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

For step-by-step configuration of Synchronous Ethernet, see "Configuring Clock Synchronization Interface on MX Series Routers" on page 303.

Procedure

Step-by-Step Procedure

To configure PIC-level framing on the 10-Gigabit Ethernet MIC with XFP, perform the following tasks:

1. In configuration mode, go to the **[edit chassis]** hierarchy level.

```
[edit]
user@host# edit chassis
```

2. Configure the FPC slot and the first PIC slot.

```
[edit chassis]
user@host# edit fpc 2 pic 0
```

3. Configure the framing type as LAN on the first PIC slot.

```
[edit chassis fpc2 pic 0]
user@host# set framing lan
```

4. Configure the FPC slot and the second PIC slot.

```
[edit chassis]
user@host# edit fpc 2 pic 1
```

5. Configure the framing type as LAN on the second PIC slot.

```
[edit chassis fpc2 pic 0]
user@host# set framing lan
```

Step-by-Step Procedure

To configure interface-level framing on the 10-Gigabit Ethernet MIC with XFP, perform the following tasks:

1. In configuration mode, go to the **[edit interfaces]** hierarchy level and set the interface as **xe-2/1/0**.

   ```
   [edit]
   user@host# edit interfaces xe-2/1/0
   ```

2. Configure the interface in LAN-PHY framing mode.

   ```
   [edit interfaces xe-2/1/0]
   user@host# set framing-mode lan-phy
   ```

Results

Display the results of the configuration at the PIC level:

```
[edit]
user@host# show
chassis {
    fpc 2 {
        pic 0 {
            framing lan;
        }
    }
    fpc 2 {
        pic 1 {
            framing lan;
        }
    }
}
```

Display the results of the configuration at the interface level:

```
[edit]
user@host# show
interfaces xe-2/1/0 {
    framing-mode lan-phy;
}
```

RELATED DOCUMENTATION

- Precision Time Protocol Overview | **68**
- Centralized Clocking Overview | **270**
- Understanding Clock Synchronization | **277**
- Understanding Hybrid Mode | **357**

6

CHAPTER

Configuring Clocking and Synchronization

Centralized Clocking Overview | 270

Understanding Clock Synchronization | 277

Getting Started Configuring Clock Synchronization on PTX Series Routers | 297

Interface and Router Clock Sources Overview | 298

Configuring Junos OS to Support an External Clock Synchronization Interface for M Series, MX Series, and T Series Routers | 301

Configuring Clock Synchronization Interface on MX Series Routers | 303

Clock Sources for PTX Series Packet Transport Routers | 321

Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers | 323

Example: Configuring Centralized Clocking on the Enhanced MX Switch Control Board | 328

Example: Configuring Centralized Clocking on an MX2020 | 341

Centralized Clocking Overview

IN THIS SECTION

- Stratum 3 Clock Module | **271**
- BITS and GPS Support | **272**
- External Clock Interface Input | **272**
- External Clock Interface Output | **275**
- Redundancy | **275**

Starting with Junos OS Release 12.2, the Enhanced SCB—SCBE—and from Junos OS Release 13.3, the Enhanced SCB—SCBE2—on the MX240, MX480, and MX960 routers support a Stratum 3 clock module that functions as a centralized point within the chassis for clock monitoring, filtering, holdover, and selection.

The Stratum 3 clock module produces a 19.44 MHz clock that is locked to a chassis synchronization clock source that is configured with the highest quality. The chassis clock signals are transmitted through the backplane to all the MPCs. The MPCs route the clock signals to their MICs, where the clock signals are driven out on all line interfaces thereby allowing the timing information to be distributed to the downstream routers.

You can configure external and line input synchronization sources at the **[edit chassis synchronization output]** hierarchy level, at the **[edit chassis synchronization source interfaces]** hierarchy level, and at the **[edit chassis synchronization interfaces]** hierarchy level, that become candidates to be selected by the chassis's clock selection algorithm. The clock selection algorithm selects the highest-quality candidate clock source, which is then used as the chassis's synchronization source.

The external clock interface on SCBE allows the building-integrated timing supply (*BITS*) clock source or the clock signals received from the global positioning system (GPS) receiver to act as an input clock source to the centralized timing circuit, or allows the centralized timing signals to act as an output clock source to the BITS source or to the GPS receiver.

The centralized mode is applicable to mobile backhaul infrastructures and for network transition from traditional TDM to Ethernet network elements with the support of Synchronous Ethernet.

Points to Remember

The following are the points to remember about centralized clocking:

- Before you begin configuring centralized clocking on an interface that uses Synchronous Ethernet, ensure that you have configured the interface as a chassis synchronization source to the router that provides a Synchronous Ethernet clock source.
- Before you remove the SCBE from the router, you must delete the configuration under the **[edit chassis synchronization]** hierarchy. Similarly, before you remove the SCBE2 from the router, you must delete the configuration under the **[edit chassis synchronization]** hierarchy.
- On SCBE2, the external-0/0 interface is located on **SCB0** and the external-1/0 interface is located on **SCB1**.

  When you configure the external clock interface for input, the BITS or GPS clock source—the source depends on how you configure the interface—sends the synchronized input clock signals to the centralized timing circuit in the SCBE. When you configure the external clock interface for output, the centralized timing circuit sends out the synchronized clock signal—BITS or GPS—to be transmitted to the downstream routers.

  For more information about SCBE hardware, see SCBE2-MX Description and SCBE2-MX LEDs.

The following sections explain centralized clocking and its features in detail:

NOTE: Hereafter, all features that are explained for SCBE are also applicable for SCBE2 unless otherwise specified.

Stratum 3 Clock Module

SCBE has a Stratum 3 centralized clock module that takes in synchronization sources on its reference input pins. When instructed by the clock selection algorithm, the clock module selects one of the reference inputs to lock its 19.44 MHz output clock. The MPCs select the chassis clock from the active SCBE to use it as a clock for their interface transmitters, thereby allowing the downstream routers to recover and synchronize to the chassis clock. A 20 MHz oscillator provides Stratum 3 free-run and holdover quality.

The clock module does not perform any automatic switching between the reference clocks, rather when Junos OS detects the loss of signal or clock, frequency inaccuracy, or phase irregularities, the clock module runs a clock selection algorithm and switches to the next highest-quality input reference.

The Stratum 3 clock modules—on the primary and the backup SCBE—are cross-wired to eliminate any phase transients during SCBE switchover. The backup SCBE locks to the primary's Stratum 3 clock module.

BITS and GPS Support

Table 11 on page 272 maps the Junos OS Release with the feature release of BITS and GPS on SCBE and SCBE2:

Table 11: BITS and GPS Support on SCBE and SCBE2

Feature	Switch Control Board	Junos OS Release
BITS	SCBE	12.3
GPS	SCBE	13.3
BITS	SCBE2	13.3

External Clock Interface Input

BITS and GPS can be configured on the external clock interface on the SCBE.

The following sections explain external clock interface input for BITS and GPS:

External Clock Interface Input for BITS

When the BITS clock is qualified by the Stratum 3 clock module, it becomes a candidate clock source to the clock selection algorithm. BITS can simultaneously support both input and output clocking.

The external clock interface for BITS can recover:

- A framed 1.544 Mbps (T1) clock or a framed 2.048 Mbps (E1) clock. The T1/E1 framer supports sending and receiving of SSM quality levels through SA bits.

- An unframed 2048 kHz (G.703 T12) clock. You must configure an input SSM quality level when the external clock interface is configured for a signal type that does not support SSM, such as an unframed 2048 kHz (T12) clock, or a T1 superframe (T1 SF) clock.

On T1/T12 interfaces that do not support SSM, you must configure the SSM quality levels. On E1 interfaces, the Sa bits receive and transmit the SSM quality level.

Starting with 17.3R1, MX10003 router supports T1/E1 framed and 2.048MHz unframed clock input.

Starting with 17.4R1, MX204 router supports T1/E1 framed and 2.048MHz unframed clock input.

External Clock Interface Input for GPS

The GPS external clock interface supports:

- 1 MHz, 5 MHz, and 10 MHz frequencies.
- Pulse per second (PPS) signals on BNC connectors—a special cable converts signals between the BNC connector and the RJ–45 port. These signals are fed into the Stratum 3 centralized clock module for qualification and monitoring. After qualification, the GPS source becomes a valid chassis clock source candidate.
- Time of day (TOD) over a serial link. Most GPS source TOD string formats are supported by Junos OS, thereby enabling you to configure a generic TOD format string. This format tells the Routing Engine how to interpret the incoming TOD character string.

You must also configure an input SSM quality level value, where the quality level is used by the chassis clock selection algorithm when the quality level mode is enabled.

For the GPS receiver to be qualified as a clock source, the frequency and the PPS signal from it must be qualified by the SCBE Stratum 3 module. The SCBE is synchronized with the GPS source TOD.

The 10MHz frequency and PPS are supported by an RJ–45 connector for SCBE/SCBE2. Figure 3 on page 274 illustrates the actual pinout of the connector.

Figure 3: RJ–45 Connector for SCBE/SCBE2

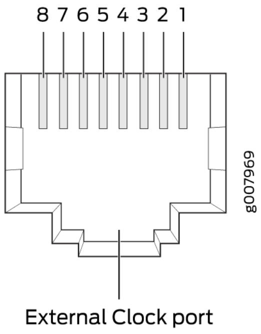

8 7 6 5 4 3 2 1
g007969
External Clock port

Table 12: RJ–45 Connector Pinout Information for SBE/SCBE2

Pin	Signal
1	RX
2	RX
3	1 PPS GND
4	TX
5	TX
6	10 MHz GND
7	1 PPS
8	10 MHz

NOTE: Note that the GPS receiver is configured to support 10 MHz, 1 PPS, and TOD by default when it acts as a primary reference time clock.

Starting with 17.3R1, MX10003 router supports one GPS port per SPM which can be configured with 1MHz, 5MHz, and 10MHz frequencies and 1PPS signal.

Starting with 17.4R1, MX204 router supports GPS with 1MHz, 5MHz, and 10MHz frequencies and 1PPS signal.

External Clock Interface Output

The external clock interface can be configured to drive BITS or GPS timing output (GPS timing output for frequency and PPS signal only). The BITS or GPS output is configured to select the output clock source but in the absence of an output configuration, the BITS or the GPS output is disabled. When the external clock interface is configured for output, it selects the clock source on the basis of the configured source mode.

Starting with Junos OS Release 14.1, the external clock interface can be configured to drive BITS timing output. When the external clock interface is configured as a BITS timing output, the following scenarios occur:

- The external clock interface drives the BITS timing output.

  The chassis clock or the line clock are used as the source on the basis of the source mode configuration.

  The best—configured—line source is transmitted out the BITS interface, when the output **source-mode** statement is configured as line.

  The central clock module is set to holdover and the output is suppressed when the BITS output is configured and there are no valid clock sources available.

Redundancy

On SCBE, the primary and the secondary SCBs monitor their respective clock sources, and the external clock interface source is accessible only to its local clocking hardware. Therefore, the clock signals cannot be routed between the primary and the secondary SCB. Redundancy is achieved after a Routing

Engine switchover. When a switchover occurs, the new primary SCB reruns the clock selection algorithm after the configured switchover time expires to select a new clock source.

Starting with Junos OS Release 14.1, on SCBE2, simultaneous BITS/BITS redundancy can be achieved because the external interfaces for BITS on the primary SCB and the secondary SCB are wired. Note that BITS redundancy is achieved without a Routing Engine switchover on SCBE2.

The following scenarios are supported for BITS/BITS redundancy:

- You can configure both the external interfaces for BITS input as reference clocks. Therefore, on the basis of the configured clock quality, one of the BITS inputs is considered as a primary clock source and the other as a secondary clock source.
- When the signal from the primary BITS input stops or degrades, the secondary BITS input takes over as primary, thereby providing redundancy across BITS interfaces.

GRES is supported on MX240, MX480, and MX960 routers with SCBE2.

Release History Table

Release	Description
17.3	Starting with 17.3R1, MX10003 router supports T1/E1 framed and 2.048MHz unframed clock input.
17.3	Starting with 17.4R1, MX204 router supports T1/E1 framed and 2.048MHz unframed clock input.
17.3	Starting with 17.3R1, MX10003 router supports one GPS port per SPM which can be configured with 1MHz, 5MHz, and 10MHz frequencies and 1PPS signal.
17.3	Starting with 17.4R1, MX204 router supports GPS with 1MHz, 5MHz, and 10MHz frequencies and 1PPS signal.
14.1	Starting with Junos OS Release 14.1, the external clock interface can be configured to drive BITS timing output.
14.1	Starting with Junos OS Release 14.1, on SCBE2, simultaneous BITS/BITS redundancy can be achieved because the external interfaces for BITS on the primary SCB and the secondary SCB are wired.
12.1	Starting with Junos OS Release 12.2, the Enhanced SCB—SCBE—and from Junos OS Release 13.3, the Enhanced SCB—SCBE2—on the MX240, MX480, and MX960 routers support a Stratum 3 clock module that functions as a centralized point within the chassis for clock monitoring, filtering, holdover, and selection.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232

Precision Time Protocol Overview | 68

Understanding Hybrid Mode | 357

Understanding Clock Synchronization

IN THIS SECTION

- Clock Selection | 278
- Network Option | 281
- Clock Mode | 282
- Quality Mode | 282
- Selection Mode | 283
- Hold Interval | 283
- Switchover Mode | 284
- Clock Source | 284
- ESMC Packet Transmit | 288
- Global Wait To Restore | 288
- Maximum Transmit Quality Level | 288
- Interfaces with Upstream Clock Source | 289
- External Output Interface | 291
- Clock Synchronization Ports | 293
- MIC-Level Framing Mode | 296

Starting with Junos OS Release 14.2, MX Series and PTX Series routers support external clock synchronization and automatic clock selection for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs.

Starting with Junos OS Release 17.3, MX 10003 routers support external clock synchronization and automatic clock selection for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs.

Configuring external clock synchronization and automatic clock selection requires making clock selection, quality level, and priority considerations. The clock source selection algorithm is used to pick the two best upstream clock sources from among the various sources on the basis of system configuration and execution criteria such as quality level, priority, and hardware restrictions.

MX5-T, MX10-T, MX40-T, MX80, MX80-T, MX240, MX480, MX960, MX2020, PTX3000, and PTX5000 routers support external clock synchronization using Synchronous Ethernet. Synchronous Ethernet is a physical layer technology that functions regardless of the network load and supports hop-by-hop frequency transfer, where all interfaces on the trail must support Synchronous Ethernet.

The Switch Control Board (SCB) supports distributed clocking mode. Starting from Junos OS Release 12.2, the Enhanced Switch Control Board—SCBE—supports centralized clocking mode and has one external clock interface.

Starting from Junos OS Release 13.3, the Enhanced Switch Control Board—SCBE2—supports centralized clocking mode and has two external clock interfaces external-0/0 and external-1/0. Note that the external-0/0 interface refers to the external interface on the SCB in slot 0 and the external 1/0 interface refers to the external interface on the SCB slot 1.

NOTE: On SCBE2, you can configure the external synchronization options only on the external interface on the active SCB. Therefore, if the active SCB is in slot 0, then you can configure the external-0/0 interface only. If the active SCB is in slot 1, then you can configure the external-1/0 interface only.

The PTX Series Packet Transport Routers support an external synchronization interface that can be configured to synchronize the internal Stratum 3 clock on the CCG to an external source, and then synchronize the chassis interface clock to that source.

The following sections explain external clock synchronization and its configuration parameters in detail:

Clock Selection

Configuring external clock synchronization requires making clock selection, quality level, and priority considerations. The clock selection algorithm is used to pick the two best clock sources—primary and secondary—from among the various sources.

The clock selection algorithm is on the basis of the system configuration and execution criteria such as quality level, priority, hardware restrictions, and so on, and is achieved using the following logic and restrictions:

- The following parameters must be configured irrespective of whether the quality level is enabled or not (You can set the quality level with the **set chassis synchronization source interfaces external quality-level *quality-level*** configuration command at the **[edit]** hierarchy level.):
  - Quality level must be configured for nonexternal clocks.
  - In the case of option-1, the quality level must be configured for the external clocks.
  - In the case of option-2, the default quality level for the external clocks is QL_STU.

  The synchronous Ethernet Equipment Clock (EEC) synchronization networking types option-1 and option-2 map to G.813 option 1 (EEC1) and G.812 type IV clock (EEC1) standards, respectively, and can be configured at the **[edit chassis synchronization]** hierarchy level.

- When the **quality-mode-enable** statement is included at the **[edit chassis synchronization]** hierarchy level, the received quality level must be equal to or better than the configured quality level for that particular source, otherwise that source is not considered for clock selection. This is so that a downstream client is guaranteed clock quality of a certain level. (Note that the term *certain level* here denotes the configured quality level.)

- Starting with Junos OS Release 12.2R1, configuring the quality level for a Synchronous Ethernet interface is optional when the **quality-mode-enable** and the **selection-mode received-quality** statements are included at the **[edit chassis synchronization]** hierarchy level.

  The default quality level value for a Synchronous Ethernet interface is:
  - **SEC** for the option-1 network type.
  - **ST3** for the option-2 network type.

- Configuring the **priority** statement is optional. When not specified, the external-a interface has a higher default priority than the external-b interface, and the external-b interface has a higher default priority than Ethernet-based sources such as ge or xe clock sources, which have the lowest default priority.

  NOTE: Configured priority is higher than any default priority.

- During clock selection:
  - The active source with the highest quality level is selected.
  - The configured (or default) quality level of the selected clock source is used for Ethernet Synchronization Message Channel (ESMC). In order to receive or transmit ESMC messages out of an interface, at least one logical interface must be configured on that interface.

- Table 13 on page 280 explains a few scenarios that must be taken into consideration during clock selection:

Table 13: Clock Selection Scenarios

If	Then
Two or more sources have the same quality level.	The source with highest priority is selected.
Two or more sources have the same quality level and priority.	The current active source, if any, among these sources is selected.
Two or more sources have the same quality level and priority, and none of these is currently active.	Any one of these sources is selected.
Primary clock source is ge|xe-*x*/ *y*/ *z*, where *y* is even (0 or 2).	The secondary clock source cannot be ge|xe-*x*/ *y*/* or ge|xe-*x*/ *y* + 1/*. For example, if ge-1/2/3 is the primary clock source, then the secondary clock source cannot be ge-1/2/* or ge-1/3/* for an MX80, MX240, MX480, or an MX960 router.
Primary clock source is ge|xe-*x*/ *y*/ *z*, where *y* is odd (1 or 3).	The secondary clock source cannot be ge|xe-*x*/ *y*/* or ge|xe-*x*/ *y* - 1/*. For example, if xe-2/3/4 is the primary clock source, then the secondary clock source cannot be xe-2/2/* or xe-2/3/* for an MX80, MX240, MX480, or an MX960 router.
Primary clock source is ge|xe-*x*/ *y*/ *z*.	The secondary clock source cannot be ge|xe-*x*/ *y*/* in the case of 12-port or 16-port 10-Gigabit Ethernet DPC on an MX Series router. For example, if ge-0/1/2 is the primary clock source, then ge-0/1/* cannot be the secondary clock source, but ge-0/0/* can be the secondary clock source.

Starting with Junos OS Release 14.2, note that on PTX Series routers, you can specify the primary and secondary clock sources provided the clock source meets the necessary qualification as set by the clock algorithm. However, in the absence of any user-selected clock source, the clock source with the best quality level is selected by the clock algorithm in the router. Note that the user selection is honored even when better quality level clock sources are available. You can select the clock source with the **request chassis synchronization switch *clock-source*** operational mode command. For more information, see "request chassis synchronization switch" on page 570.

NOTE: The clock sources used as primary or secondary clock sources cannot originate from the same FPC.

Network Option

The clock type or network option is the synchronous Ethernet Equipment Clock (EEC) synchronization networking type. You can set the network option to one of the following values:

- **option-1**—This option maps to G.813 option 1 (EEC1).
- **option-2**—This option maps to G.812 type IV clock (EEC1).

NOTE: On MX104 routers, to configure the OC-192, OC-3, OC-12, or OC-48 interfaces as clock sources, ensure that the *option-2* network option is configured.

NOTE: For SCB, this option is configured with the **set chassis synchronization network-type (option-1 | option-2)** configuration command at the **[edit]** hierarchy level.

To configure the clock type, execute the **set chassis synchronization network-option (option-1 | option-2)** configuration command at the **[edit]** hierarchy level.

NOTE: For Junos OS Releases 11.2R4 through 13.3R3 for MX240, MX480, MX960, MX2010, and MX2020 with SCB, SCBE or SCBE2, you must execute some specific commands after you change the network option at the **[edit chassis synchronization]** hierarchy level. This is because the loop bandwidth does not change automatically when you change the network option. These are the required commands:

```
user@host# deactivate chassis synchronization
user@host# activate chassis synchronization
```

Clock Mode

You can set the Synchronous Ethernet clock source to one of the following modes:

- **free-run**—In this mode, the free-running local oscillator is used as a clock source.

> **NOTE**: For MX80 routers, the free-run clock is provided by the local oscillator.
> For MX240, MX480, and MX960 routers with an SCB, the free-run clock is provided by the MPCs.
>
> For MX240, MX480, and MX960 routers with an SCBE or an SCBE2, the free-run clock is provided by the local oscillator.

- **auto-select**—In this mode, the best external clock source is selected.

By default, the auto-select option is selected.

To configure the clock mode, execute the **set chassis synchronization clock-mode (free-run | auto-select)** configuration command at the **[edit]** hierarchy level.

Quality Mode

When the **quality-mode-enable** statement is included at the **[edit chassis synchronization]** hierarchy level, the system ascertains that the clock selection algorithm uses both quality and priority of the clock sources to select the best clock source for clock synchronization. When the **quality-mode-enable** statement is not included, only the priority of the clock source is taken into account by the algorithm.

To enable the synchronization quality mode, include the **quality-mode-enable** statement at the **[edit chassis synchronization]** hierarchy level.

NOTE: The Synchronous Ethernet ESMC quality mode is disabled by default. The Synchronous Ethernet ESMC quality mode is disabled when the **quality-mode-enable** statement is not included.

Selection Mode

You can specify whether the clock source selection must use the configured or the received ESMC or SSM quality level for a qualifying interface. In both selection modes, the interface qualifies for clock source selection only when the received ESMC or SSM quality level on the interface is equal to or greater than the configured ESMC or SSM quality level for the interface.

The selection modes are:

- **configured-quality**—In this mode, the clock source selection algorithm uses the ESMC or SSM quality level configured for a qualifying interface.
- **received-quality**—In this mode, the clock source selection algorithm uses the ESMC or SSM quality level received on the qualifying interface.

To configure the clock source algorithm selection mode, execute the **set chassis synchronization selection-mode (configured-quality|received-quality)** configuration command at the **[edit]** hierarchy level.

NOTE: For the **selection-mode** statement to take effect, you must include the **quality-mode-enable** statement at the **[edit chassis synchronization]** hierarchy level.

Hold Interval

You can set the chassis synchronization wait time after a change in configuration, the clock selection wait time after reboot of the router, and the switchover wait time after a switchover of SCB before selecting the new clock source. The hold interval options are:

- **configuration-change**—In this mode, the wait time for clock selection after a change in configuration (clock synchronization configuration) can be set from 15 seconds through 60 seconds.

- **restart**—In this mode, the wait time for clock selection after reboot of the router can be set from 60 seconds through 180 seconds.

- **switchover**—In this mode, the switchover wait time after clock recovery can be set from 30 seconds through 60 seconds.

To set the hold interval, execute the **set chassis synchronization hold-interval (configuration-change | restart | switchover)** ***seconds*** configuration command at the **[edit]** hierarchy level.

NOTE: The default switchover wait time is 30 seconds and the default restart wait time is 120 seconds.

Switchover Mode

You can set the switchover mode to switch the clock from a lower quality source to higher quality source or to use the current clock source only. You can configure the switchover mode to one of the following:

- **non-revertive**—In this mode, the router uses the current clock source as long as it is valid.

- **revertive**—In this mode, the router automatically switches from a lower to a higher quality clock source whenever the higher clock source becomes available.

The default mode is revertive mode.

To configure the switching mode, execute the **set chassis synchronization switchover-mode (revertive | non-revertive)** configuration command at the **[edit]** hierarchy level.

Clock Source

You can specify the parameters that must be considered by the clock selection algorithm while selecting the best clock source. The parameters include the quality level value, the priority of the clock source, the request criteria, and the wait time to restore the interface signal to up state. You must specify these parameters on the external clock interfaces or other qualifying interfaces—which are connected to valid clock sources—to select the best clock source on the basis of the timing messages that are received on these interfaces.

For an SCBE, you can configure only one external interface and configure multiple Ethernet interfaces as needed.

On SCBE2, you can configure two external interfaces—external-0/0 and external-1/0—and configure multiple Ethernet interfaces as needed.

To configure the clock source, execute the **set chassis synchronization source interfaces *interface-name*** configuration command. You can also configure the clock source with the **set chassis synchronization source interfaces external** at the **[edit]** hierarchy level, where the external option refers to an external clock interface.

> **NOTE**: Incorporate the external option as needed on the basis of the SCB in your MX Series router.

To specify the clock source for an interface, you must set the following options:

- **priority**—You can set the user priority for the selected clock source from 1 through 5.

  To set the synchronization source priority for the selected clock source, execute the **set chassis synchronization source interfaces *interface-name* priority *number*** configuration command or the **set chassis synchronization source interfaces external priority *number*** configuration command at the **[edit]** hierarchy level.

- **request**—You can set the clock selection request criterion as one of the following:

  - **force-switch**—With this option, you can force the SCB to switch to a clock source you prefer on a particular interface (that is you can select a clock source on an interface overriding the algorithm), provided the source is enabled and not locked out. Only one configured source can be force-switched.

  - **lockout**—With this option configured, the clock source is not to be considered by the selection process. Lockout can be configured for any source.

  To configure these options, execute the **set chassis synchronization source interfaces *interface-name* request (force-switch|lockout)** configuration command or the **set chassis synchronization source interfaces external request (force-switch|lockout)** configuration command at the **[edit]** hierarchy level.

- **wait-to-restore**—You can set the wait-to-restore time for each interface. When an interface's signal transitions out of the signal fail state, it must be fault-free for the wait-to-restore time before it is again considered by the clock selection process. You can configure the interface signal upstate time—wait time before opening the interface to receive ESMC messages—from 0 through 12 minutes. The default time is 5 minutes. When the ESMC clock's EEC quality level (QL) mode is enabled, it sends a signal failure to the clock selection process during the wait-to-restore time. After the wait-to-restore time ends, a new quality level value is sent to the clock selection process.

  To configure the wait-to-restore time, execute the **set chassis synchronization source interfaces *interface-name* wait-to-restore *minutes*** configuration command or the **set chassis synchronization**

source interfaces external wait-to-restore *minutes* configuration command at the **[edit]** hierarchy level.

- **hold-off-time**—Starting with Junos OS Release 14.2, you can configure hold-off time for Synchronous Ethernet interfaces and external clock source interfaces to prevent rapid successive switching between signal fail states. If an interface goes down, hold-off time delays short signal failures from being sent to the clock selection process.

  > **NOTE**: During the hold-off time period, if the clock synchronization process restarts, hold-off time is not considered.

  If you configure hold-off time when the ESMC clock's EEC QL mode is enabled, the configured quality level is used in the clock selection process during the hold-off time period. During the hold-off time period, the external clock source appears in a locked state until the hold-off time period ends. After the hold-off time period ends, a signal failure is sent to the clock selection process.

  You can configure hold-off time for a range of 300 through 1800 milliseconds. The default hold-off time is 1000 milliseconds.

  To configure hold-off time, execute the **set chassis synchronization source interfaces *interface-name* hold-off-time** configuration command at the **[edit]** hierarchy level.

  > **NOTE**: When a link goes down and comes back up within the configured hold-off time in a clocking hybrid mode configuration (the combined operation of Synchronous Ethernet and Precision Time Protocol) that includes the **protocols ptp slave convert-clock-class-to-quality-level** configuration statement at the **[edit]** hierarchy level, the phase might not get locked before the timer expires. This might result in a degradation of clock quality level.

- **quality**—You can set the ESMC clock's EEC quality level as prc, prs, sec, smc, ssu-a, ssu-b, st2, st3, st3e, st4, stu, or tnc. Both option I and option II SSM quality levels are supported. Table 14 on page 286 explains the quality level values.

  Table 14: Quality Levels

Quality Level	Description
prc	Timing quality of a primary reference clock (option-1 only).
prs	Clock traceable to a primary reference source (option-2 only).

Table 14: Quality Levels *(Continued)*

Quality Level	Description
sec	Timing quality of an SDH equipment clock (option-1 only).
smc	Clock traceable to a self-timed SONET clock (option-2 only).
ssu-a	Timing quality of a type I or IV client clock (option-1 only).
ssu-b	Timing quality of a type VI client clock (option-1 only).
st2	Clock traceable to Stratum 2 (option-2 only).
st3	Clock traceable to Stratum 3 (option-2 only).
st3e	Clock traceable to Stratum 3E (option-2 only).
st4	Clock traceable to Stratum 4 free-run (option-2 only).
stu	Clock traceable to an unknown quality (option-2 only).
tnc	Clock traceable to a transit node clock (option-2 only).

NOTE: When the quality level is not configured and no ESMC messages are received by the clock source, then the quality level is set to DNU for option-1 and DUS for option-2. You can configure the network options, option-1 and option-2 at the **[edit chassis synchronization network-option]** hierarchy level.

To avoid source looping on the selected active source—primary or secondary source, whichever is active—even when ESMC transmit is not enabled, a DNU ESMC message is sent out when the **network-option** statement is configured as option-1, and a DUS ESMC message is sent out when the **network-option** statement is configured as option-2. This is applicable only for clock sources configured on the Ethernet interfaces.

To configure the quality level, execute the **set chassis synchronization source interfaces *interface-name*) quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 | stu | tnc)** configuration command or the **set chassis synchronization source interfaces external quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 | stu | tnc)** configuration command at the **[edit]** hierarchy level.

ESMC Packet Transmit

You can enable all the interfaces or configure one or more qualifying interfaces on which to permit ESMC transmit messages by executing the **set chassis synchronization esmc-transmit interfaces (all | *interface-name*)** configuration command at the **[edit]** hierarchy level.

Global Wait To Restore

Starting with Junos OS Release 14.2, you can globally configure the time in minutes for source ports to be up before opening the Ethernet Synchronization Message Channel (ESMC) for messages. When a port’s signal transitions out of the signal fail state, it must be fault-free for the global wait-to-restore time before it is again considered by the clock selection process.

To configure the global wait-to-restore time, include the `global-wait-to-restore` statement at the [edit chassis synchronization] hierarchy level.

To override the global wait-to-restore time on a specific interface, include the "wait-to-restore" on page 550 statement at the **[edit chassis source interfaces (external-a | external-b | interface *interface-name*)]** hierarchy level.

Maximum Transmit Quality Level

To configure the maximum transmit quality level for SCBE2 as prc, prs, sec, smc, ssu-a, ssu-b, st2, st3, st3e, st4, stu, or tnc, execute the **set chassis synchronization max-transmit-quality-level *quality-level*** configuration command at the **[edit]** hierarchy level.

NOTE: Starting from Junos OS Release 13.3, you can configure the **max-transmit-quality-level** statement on SCB and SCBE.

NOTE: Starting from Junos OS Release 13.3, for GPS external output, when you configure the maximum transmit quality level as PRC and router is rebooted, no valid output is obtained from SCBE. However, when the maximum transmit quality level is configured to any other quality level other than PRC and the router gets rebooted, then the SCBE works normally.

Interfaces with Upstream Clock Source

You can configure the external interface to operate with a connected router for a clock source. This external interface can be configured for a clock source, which then becomes a candidate for selection as the chassis clock source by the clock source selection algorithm. You can configure several options for the external clock source interface on the SCBE and for the two external clock source interfaces on the SCBE2.

The options include E1 interface options, pulse-per-second option, the signal type for the provided reference clocks, and the T1 interface options at the **[edit chassis synchronization interfaces external]** hierarchy level.

The following sections explain the clock source interface parameters in detail:

E1 Interface Options

You can set the E1 interface-specific options as:

- **framing**—Set the framing mode for the E1 interface as one of the following:
  - **g704**—G.704 framing format for E1 interfaces
  - **g704-no-crc4**—G.704 framing without CRC4 for E1 interfaces.

  To set the framing mode for the E1 interface, execute the **set chassis synchronization interfaces external e1-options framing (g704|g704-no-crc4)** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) e1-options framing (g704|g704-no-crc4)** configuration command at the **[edit]** hierarchy level for SCBE2.

  By default, the g704 framing format is selected.

- **line-encoding**—Set the **line-encoding** statement as automatic mark inversion or high-density bipolar 3 code. The line encoding technique converts signals to bipolar pulses. You can set the **line-encoding** option as one of the following:
  - **ami**—Automatic mark inversion

  - **hdb3**—High-density bipolar 3 code

  To configure the **line-encoding** statement on the E1 interface, execute the **set chassis synchronization interfaces external e1-options line-encoding (ami|hdb3)** configuration command for SCBE at the **[edit]** hierarchy level or the **set chassis synchronization interfaces (external-0/0 | external-1/0) e1-options line-encoding (ami|hdb3)** configuration command at the **[edit]** hierarchy level for SCBE2.

  By default, the hdb3 line encoding technique is selected.

- **sabit**—Set the SA bit to a value from 4 through 8. SA bits are used for exchanging the SSM quality between the clock source and the router on the E1 interface.

  To set the SA bit on the E1 interface, execute the **set chassis synchronization interfaces external e1-options sabit *sabit-value*** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) e1-options sabit *sabit-value*** configuration command at the **[edit]** hierarchy level for SCBE2.

Pulse Per Second

You can enable the **pulse-per-second-enable** option on the GPS interface to receive the pulse per second (PPS) signal by executing the **set chassis synchronization interfaces external pulse-per-second-enable** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) pulse-per-second-enable** configuration command at the **[edit]** hierarchy level for SCBE2.

Signal Type

You can set the frequency for the provided reference clock (GPS or BITS) as one of the following:

- **1mhz**—Set the signal with a clock frequency of 1 MHz.

- **5mhz**—Set the signal with a clock frequency of 5 MHz.

- **10mhz**—Set the signal with a clock frequency of 10 MHz.

- **2048khz**—Set the signal with a clock frequency of 2048 kHz.

- **e1**—Set the signal as an E1-coded 2048 kHz signal on a 120-ohm balanced line.

- **t1**—Set the signal as a T1-coded 1.544 MHz signal on a 100-ohm balanced line.

Configure the signal type by executing the **set chassis synchronization interfaces external signal-type (1mhz | 5mhz | 10mhz | 2048khz | e1 | t1)** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) signal-type (1hz | 5mhz | 10mhz | 2048khz | e1 | t1)** configuration command at the **[edit]** hierarchy level for SCBE2.

The 1mhz, 5mhz, and the 10mhz signals are traceable to a GPS-capable clock source, where the source can be an atomic clock. The e1 and t1 signals are traceable to a BITS clock source.

T1 Interface Options

You can set the T1 interface-specific options as:

- **framing**—Set the framing mode for the T1 interface as one of the following:
  - **esf**—Extended superframe
  - **sf**—Superframe

  To set the framing mode for the T1 interface, execute the **set chassis synchronization interfaces external t1-options framing (esf|sf)** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) t1-options framing (esf|sf)** configuration command at the **[edit]** hierarchy level for SCBE2.

  By default, the esf framing mode is selected.

- **line-encoding**—Set the **line-encoding** option on the T1 interface as one of the following:
  1. **ami**—Automatic mark inversion
  2. **b8zs**—8-bit zero suppression

  To configure the **line-encoding** option on the T1 interface, execute the **set chassis synchronization interfaces external t1-options line-encoding (ami|b8zs)** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization interfaces (external-0/0 | external-1/0) t1-options line-encoding (ami|b8zs)** configuration command at the **[edit]** hierarchy level for SCBE2.

  By default, the b8z3 line encoding technique is selected.

External Output Interface

You can set several options for the external clock output interface for SCBE or for the two external clock output interfaces for SCBE2.

The options include disabling the holdover mode; configuring a minimum quality threshold; configuring a mode to select a clock source; configuring the transmit quality level to DNU or DUS; and disabling wander filtering at the **[edit chassis synchronization output interfaces external]** hierarchy level for SCBE or at the **[edit chassis synchronization output interfaces (external0-0 | external-1/0)]** hierarchy level for SCBE2.

The following sections explain the external output interface parameters in detail:

Holdover Mode

You can disable the holdover mode on the external output interface by executing the **set chassis synchronization output interfaces external holdover-mode-disable** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization output interfaces (external-0/0 | external-1/0) holdover-mode-disable** configuration command at the **[edit]** hierarchy level for SCBE2.

Minimum Quality

When the quality of the source signal—used to derive the output—falls below a minimum quality level, the output of the external interface is placed in holdover mode. When the signal type supports the SSM quality level, the SSM quality level is set as the holdover quality level. The output interface remains in holdover mode until a source with the minimum quality level or higher is available. Note that when the **holdover-mode-disable** option is configured, the output is suppressed completely.

You can set the minimum quality on the external output interface as prc, prs, sec, smc, ssu-a, ssu-b, st2, st3, st3e, st4, stu, or tnc by executing the **set chassis synchronization output interfaces external minimum-quality *quality-level*** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization output interfaces (external-0/0 | external-1/0) minimum-quality *quality-level*** configuration command at the **[edit]** hierarchy level for SCBE2.

Source Mode

When the source mode is set to chassis, the source selected by the chassis clock module is used as the clock source. When the source mode is set to line, the best available line clock is selected.

You can set the source mode for selecting a clock source as either a chassis clock or the best line clock source as output by executing the **set chassis synchronization output interfaces external source-mode (chassis|line)** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization output interfaces (external-0/0 | external-1/0) source-mode (chassis|line)** configuration command at the **[edit]** hierarchy level for SCBE2.

Transmit Quality Level

You can configure the **tx-dnu-to-line-source-enable** statement to enable the transmit quality level to DNU or DUS when the chassis clock is the BITS input signal and when a valid line source signal is sent out through the BITS output.

You can set the transmitting quality level to DNU or DUS on the line source interface by executing the **set chassis synchronization output interfaces external tx-dnu-to-line-source-enable** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization output interfaces (external-0/0 | external-1/0) tx-dnu-to-line-source-enable** configuration command at the **[edit]** hierarchy level at SCBE2.

Wander Filter

You can disable the wander filter by executing the **set chassis synchronization output interfaces external wander-filter-disable** configuration command at the **[edit]** hierarchy level for SCBE or the **set chassis synchronization output interfaces (external-0/0 | external-1/0) wander-filter-disable** configuration command at the **[edit]** hierarchy level for SCBE2.

Clock Synchronization Ports

Starting with Junos OS Release 13.3, you can set the **time-of-day-format** statement as an ASCII string on SCBE and SCBE2 by executing the **set chassis synchronization port auxiliary client time-of-day-format ascii string** configuration command at the **[edit]** hierarchy level.

The time of day (TOD) format is specified as a string of ASCII characters. The TOD format string contains information that specifies which ASCII characters to match, which ASCII characters to ignore, and which ASCII characters to translate to particular time units (such as month, day, hour, minute, and so on).

The TOD format string specifies how the incoming string is to be parsed so that the information embedded can be extracted. The format of the TOD option can be executed with the **set chassis synchronization port auxiliary time-of-day-format ascii** *string* configuration command at the **[edit]** hierarchy level, where the format of the data string is **$GPRMC,%hh%mm%ss,^,^^^^.^^,^,^^^^^^^^^,^,^^^^^,^^^^^,%DD%MM%YY,^^^^^,^*^^**.

Table 15 on page 293 explains pattern-matching characters used in the TOD data string.

Table 15: Pattern-Matching Characters

Character construct	Number of characters	Description
-	1	The *DO NOT CARE* (DNC) character
%hh	2	Hours (00–23)
%mm	2	Minutes (00–59)
%ss	2	Seconds (00–59)

Table 15: Pattern-Matching Characters *(Continued)*

Character construct	Number of characters	Description
%DD	2	Day (01–31)
%MM	2	Month (01–12)
%YY	2	Year without century
%YYY	4	Year with century
%DDD	3	Day of year (001–366)
%MMM	3	Month of year (JAN, FEB, etc.)
%cc	2	NMEA message checksum
%Q	1	Time quality indicator (‘ ‘ = valid ‘*’ = error)

There are several patterns that can be received by a router. The following pattern shows an example of a received TOD data string (as defined in the National Marine Electronics Association (NMEA) 0183 standard. The data string is called the Recommended Minimum Specific GPS/Transit Data (RMC) message.) and Table 16 on page 294 explains it in detail.

```
$GPRMC,225446,A,4916.45,N,12311.12,W,000.5,054.7,191194,020.3,E*68<CR><LF>
```

Table 16: Received TOD Data String

Pattern	Description
$GPRMC	NMEA sentence ID
225446	UTC time of fix (22:54:46 UTC)

Table 16: Received TOD Data String *(Continued)*

Pattern	Description
A	Data status (A=Valid position, V=navigation receiver warning)
4916.45	Latitude of fix
N	N or S of longitude
12311.12	Longitude of fix
W	E or W of longitude
000.5	Speed over ground in knots
054.7	Track made good in degrees True
191194	UTC date of fix (19 November 1994)
020.3	Magnetic variation degrees
E	E or W of magnetic variation
*68	Checksum (XOR of all characters between $ and *)

NOTE: Whenever a TOD data string does not provide sufficient information, the router extracts it from Junos OS and generates a log message. The TOD data string that is either transmitted or received is always of fixed length and is delimited by a <CR><LF>character pair, where CR (carriage return) and LF (line feed) are the line break types used to end the ASCII format string.

MIC-Level Framing Mode

You can configure the LAN framing mode on the 10-Gigabit Ethernet MIC with XFP by executing the **set chassis fpc *fpc-slot* pic *pic-slot* framing lan** at the **[edit]** hierarchy level.

Note that to operate in LAN framing mode on the 10-Gigabit Ethernet MIC with XFP, you must configure the interface framing mode on the MIC interface. Execute the **set interfaces xe-*fpc*/*pic*/*port* framing-mode (lan-phy | wan-phy)** configuration command at the **[edit]** hierarchy level, where the lan-phy option denotes a 802.3ae 10-Gbps LAN-mode interface and the wan-phy option denotes a 802.3ae 10-Gbps WAN-mode interface.

Release History Table

Release	Description
17.3	Starting with Junos OS Release 17.3, MX 10003 routers support external clock synchronization and automatic clock selection for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs.
14.2	Starting with Junos OS Release 14.2, MX Series and PTX Series routers support external clock synchronization and automatic clock selection for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs.
14.2	Starting with Junos OS Release 14.2, note that on PTX Series routers, you can specify the primary and secondary clock sources provided the clock source meets the necessary qualification as set by the clock algorithm.
14.2	Starting with Junos OS Release 14.2, you can configure hold-off time for Synchronous Ethernet interfaces and external clock source interfaces to prevent rapid successive switching between signal fail states.
14.2	Starting with Junos OS Release 14.2, you can globally configure the time in minutes for source ports to be up before opening the Ethernet Synchronization Message Channel (ESMC) for messages.
13.3	Starting from Junos OS Release 13.3, the Enhanced Switch Control Board—SCBE2—supports centralized clocking mode and has two external clock interfaces external-0/0 and external-1/0.
13.3	Starting from Junos OS Release 13.3, you can configure the max-transmit-quality-level statement on SCB and SCBE.
13.3	Starting from Junos OS Release 13.3, for GPS external output, when you configure the maximum transmit quality level as PRC and router is rebooted, no valid output is obtained from SCBE.

13.3	Starting with Junos OS Release 13.3, you can set the time-of-day-format statement as an ASCII string on SCBE and SCBE2 by executing the set chassis synchronization port auxiliary client time-of-day-format ascii string configuration command at the [edit] hierarchy level.
12.2	Starting from Junos OS Release 12.2, the Enhanced Switch Control Board—SCBE—supports centralized clocking mode and has one external clock interface.
12.2	Starting with Junos OS Release 12.2R1, configuring the quality level for a Synchronous Ethernet interface is optional when the quality-mode-enable and the selection-mode received-quality statements are included at the [edit chassis synchronization] hierarchy level.
11.2-13.3	For Junos OS Releases 11.2R4 through 13.3R3 for MX240, MX480, MX960, MX2010, and MX2020 with SCB, SCBE or SCBE2, you must execute some specific commands after you change the network option at the [edit chassis synchronization] hierarchy level.

RELATED DOCUMENTATION

- Synchronous Ethernet Overview | **232**
- Precision Time Protocol Overview | **68**
- Understanding Hybrid Mode | **357**

Getting Started Configuring Clock Synchronization on PTX Series Routers

System clocking on PTX Series Packet Transport Routers is controlled by a Centralized Clock Generator (CCG). The CCG is capable of deriving a *primary clock* from a valid source and synchronizing all interfaces on the chassis to this primary clock.

To quickly access the information you need, click on the link in Table 17 on page 298.

Table 17: Locating the Information You Need to Configure Clock Synchronization on PTX Series Routers

Task You Need to Perform	Where The Information Is Located
Configure a clock source.	"Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers" on page 323 "synchronization (PTX Series)" on page 531
Identify clock sources.	"Clock Sources for PTX Series Packet Transport Routers" on page 321
Change the clock source.	"request chassis synchronization switch" on page 570
Configure the clock source mode to be revertive or non-revertive.	"switchover-mode" on page 515
Verify the clock source is operational.	"show chassis synchronization" on page 576

RELATED DOCUMENTATION

PTX5000 Centralized Clock Generator Description

Connecting the PTX5000 to an External Clocking Device

Understanding Clock Synchronization | 277

Interface and Router Clock Sources Overview

IN THIS SECTION

- Interface and Router Clock Sources Description | 299
- Configuring an External Synchronization Interface | 300

Interface and Router Clock Sources Description

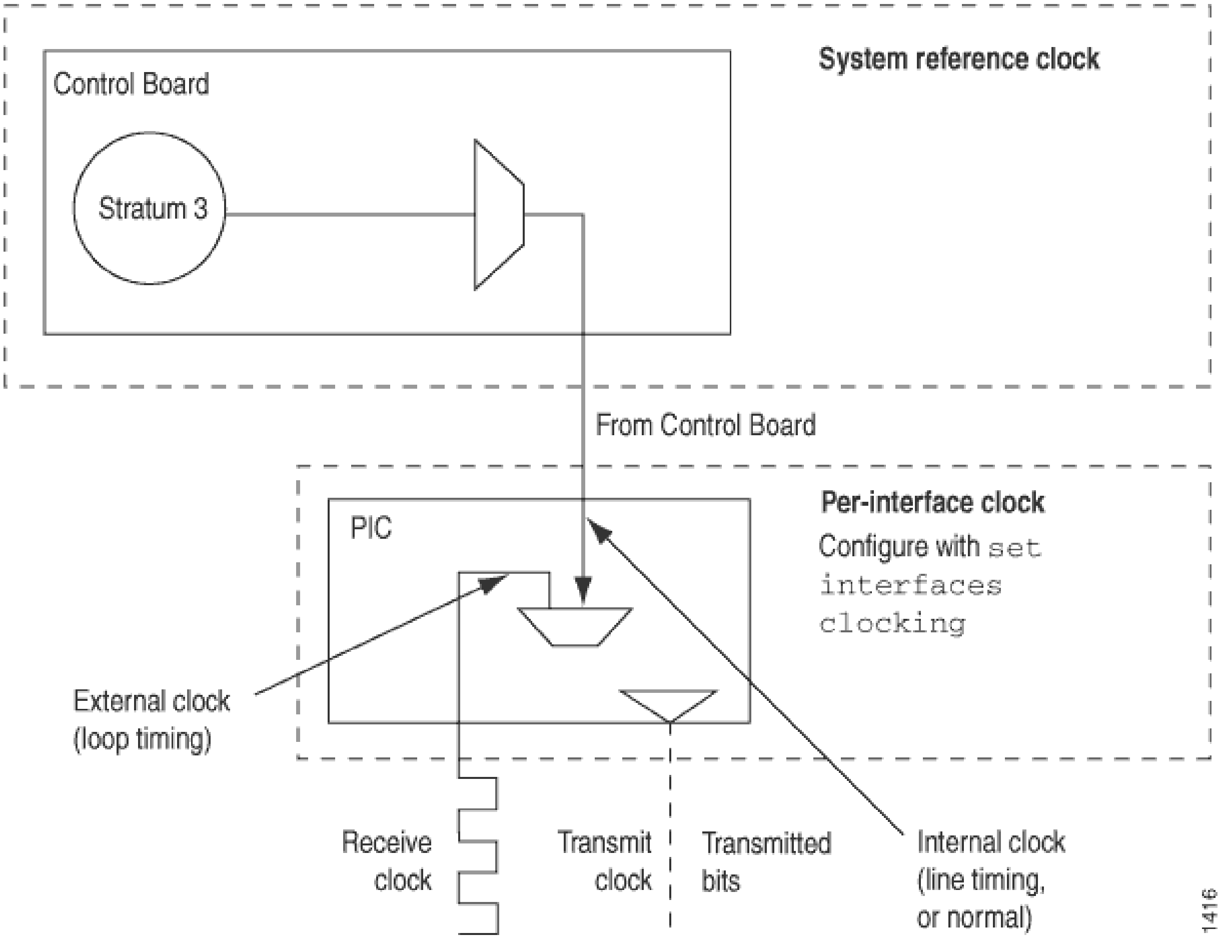
When configuring the router, you can configure the *transmit clock* on each interface; the transmit clock aligns each outgoing packet transmitted over the router's interfaces. For both the router and interfaces, the clock source can be the router's internal Stratum 3 clock, which resides on the control board, or an external clock that is received from the interface you are configuring. For example, interface A can transmit on interface A's received clock (external, loop timing) or the Stratum 3 clock (internal, line timing). Interface A cannot use a clock from any other source.

By default, each interface uses the router's internal Stratum 3 clock. To configure the clock source of each interface, include the **clocking** statement at the **[edit interfaces *interface-name*]** hierarchy level:

```
[edit interfaces interface-name]
clocking (internal | external);
```

System reference clocks can be generated from different system components, depending on the router type. For example, Figure 4 on page 300 illustrates the different clock sources on the M120 router.

Figure 4: M120 Router Clock Sources


System reference clock
Control Board
Stratum 3
From Control Board
Per-interface clock
Configure with set interfaces clocking
PIC
External clock (loop timing)
Receive clock
Transmit clock
Transmitted bits
Internal clock (line timing, or normal)
1416

Configuring an External Synchronization Interface

The M40e, M120, M320, T640, and T1600 routers support an external synchronization interface that can be configured to synchronize the internal Stratum 3 clock to an external source, and then synchronize the chassis interface clock to the external source.

This feature can be configured for external primary and secondary interfaces that use Building Integrated Timing System (BITS) or SDH Equipment Timing Source (SETS) timing sources. When internal timing is set for SONET/SDH, Plesiochronous Digital Hierarchy (PDH), and digital hierarchy (DS1) interfaces on the Physical Interface Cards (PICs), the transmit clock of the interface is synchronized to BITS/SETS timing and traceable to timing within the network.

To configure external synchronization on M40e, M120, M320, T640, and T1600 routers, include the **synchronization** statement at the **[edit chassis]** hierarchy level.

For more information about the external synchronization interface, see "Configuring Junos OS to Support an External Clock Synchronization Interface for M Series, MX Series, and T Series Routers" on page 301.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

Precision Time Protocol Overview | **68**

Understanding Hybrid Mode | **357**

Configuring Junos OS to Support an External Clock Synchronization Interface for M Series, MX Series, and T Series Routers

The M40e, M120, M320, T640, and T1600 routers support an external synchronization interface that can be configured to synchronize the internal Stratum 3 clock to an external source, and then synchronize the chassis interface clock to that source.

This feature can be configured for external primary and secondary interfaces that use building-integrated timing system (BITS), SDH Equipment Timing Source (SETS) timing sources, or an equivalent quality timing source. When internal timing is set for SONET/SDH, Plesiochronous Digital Hierarchy (PDH), or digital hierarchy (DS-1) interfaces on the Physical Interface Cards (PICs), the transmit clock of the interface is synchronized to BITS/SETS timing and is traceable to timing within the network.

Routers and switches that support an external clock synchronization interface include:

- M40e, M120, and M320 routers
- T640 and T1600 routers

To configure external synchronization on the router, include the **synchronization** statement at the **[edit chassis]** hierarchy level:

```
[edit chassis]
synchronization {
    signal-type (t1 | e1);
    switching--mode (revertive | non-revertive);
    y-cable-line-termination;
    transmitter-enable;
    validation-interval seconds;
    primary (external-a | external-b);
    secondary   (external-a | external-b);
}
```

Use the **synchronization** statement options to specify a primary and secondary timing source. To do this, configure the following options:

- For the M120 and M320 routers, specify a signal type mode for interfaces, either **t1** or **e1**. For the M40e, T640, and T1600 routers, only the **t1** signal type mode is supported. The default setting is **t1**.
- For the T640 and T1600 routers, external clock interfaces are supported on the SONET Clock Generators (SCG-T-EC). The external clock interfaces on the SONET Clock Generators (SCG-T) are not supported.
- Specify the switching mode as **revertive** if a lower-priority synchronization can be switched to a valid, higher-priority synchronization.
- For the M320 router, specify that a single signal should be wired to both Control Boards (CBs) using a Y-cable. For the M40e router, the signal is wired to the CIP and Y-cable functionality is embedded in this system.

  The **y-cable-line-termination** option is not available on the M40e, M120, T640, and T1600 routers.
- Control whether the diagnostic timing signal is transmitted.

  The **transmitter-enable** option is not available on the M120, T640, and T1600 routers.
- Set a validation interval. The **validation-interval** option validates the synchronized deviation of the synchronization source. If revertive switching is enabled and a higher-priority clock is validated, the clock module is directed to the higher-priority clock, and all configured and active synchronizations are validated. The validation timer resumes after the current validation interval expires. The validation interval can be a value from 90 through 86,400 seconds. The default value is 90 seconds. For the M120 router, the range for the **validation-interval** option is 30 through 86,400 and the default value is **30**.

- Specify the primary external timing source by using the **primary (external-a | external-b)** statement.
- Specify the secondary external timing source by using the **secondary (external-a | external-b)** statement.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232
Precision Time Protocol Overview | 68
Understanding Hybrid Mode | 357

Configuring Clock Synchronization Interface on MX Series Routers

IN THIS SECTION

- Configuring Clock Synchronization Options | 304
- Display the External Clock Synchronization Configuration for SCB | 313
- Display the External Clock Synchronization Configuration for SCBE | 315
- Display the External Clock Synchronization Configuration for SCBE2 | 317
- Displaying the External Clock Synchronization Configuration for MX2020 Control Board | 319

MX Series routers support external clock synchronization for Synchronous Ethernet, T1 or E1 line timing sources, and external inputs. Configuring external clock synchronization requires making clock selection, quality level, and priority considerations. The clock source selection algorithm is used to pick the two best upstream clock sources from among the various sources on the basis of system configuration and execution criteria such as quality level, priority, and hardware restrictions. For information about the clock synchronization options, see "Understanding Clock Synchronization" on page 277.

The following sections explain configuring clock synchronization options for MX Series routers:

NOTE: Starting with Junos OS Release 13.3, the following scenarios occur when you configure Synchronous Ethernet without the **clock-class-to-quality-level-mapping** statement at the **[edit protocols ptp slave]** hierarchy level:

- Qualified clock source quality level (that is the secondary clock source quality level) is transmitted out of the external interface and the Ethernet interface during clock reference switchover when two clock sources on different MICs of the same FPC exist or when two clock sources on two different FPCs exist.
- Lower quality level is transmitted out the external interface and the Ethernet interface during clock reference switchover when two clock sources on the same MIC of an FPC exist due to hardware limitation.

Before you remove the SCBE from the router, you must delete the configuration under the **[edit chassis synchronization]** hierarchy level. Similarly, before you remove the SCBE2 from the router, you must delete the configuration under the **[edit chassis synchronization]** hierarchy level.

On SCBE2, the external-0/0 interface is located on **SCB0** and the external-1/0 interface is located on **SCB1**.

Configuring Clock Synchronization Options

To configure the clock synchronization options.

1. In configuration mode, go to the **[edit chassis synchronization]** hierarchy level.

```
[edit]
user@host# edit chassis synchronization
```

2. Configure the Synchronous Ethernet clock selection mode as auto-select or free-run.

```
[edit chassis synchronization]
user@host# set clock-mode (auto-select | free-run)
```

3. Configure the ESMC transmit parameters on all the interfaces or on selected interfaces.

```
[edit chassis synchronization]
user@host# set esmc-transmit interfaces (all | interface-name)
```

4. Configure the hold interval as configuration-change, which is the wait time (from 15 seconds through 60 seconds) after a change in configuration; restart, which is the wait time (from 60 seconds through 180 seconds) after reboot of the router; and switchover, which is the switchover wait time (from 30 seconds through 60 seconds) after clock recovery.

```
[edit chassis synchronization]
user@host# set hold-interval configuration-change secs
user@host# set hold-interval restart secs
user@host# set hold-interval switchover secs
```

5. Configure the options for the external interfaces on the basis of the type of Enhanced Switch Control Board on your MX Series router.

   The SCBE has only one external interface. Configure the following options for SCBE:

   a. Go to the **[edit chassis synchronization interfaces external]** hierarchy level.

   ```
   [edit chassis synchronization]
   user@host# edit interfaces external
   ```

   b. Configure all the E1 interface-specific options—the **framing** statement as g704 or g704-no-crc, the **line-encoding** statement as ami or hdb3, and the **sabit** statement from 4 bits through 8 bits.

   ```
   [edit chassis synchronization interfaces external]
   user@host# set e1-options framing (g704 | g704-no-crc)
   user@host# set e1-options line-encoding (ami | hdb3)
   user@host# set e1-options sabit bit
   ```

   c. Configure the **pulse-per-second-enable** statement to enable the pulse per second (PPS) signal to be received on the GPS interface.

   ```
   [edit chassis synchronization interfaces external]
   user@host# set pulse-per-second-enable
   ```

d. Configure the frequency for the provided reference clock as 1 MHz, 5 MHz, 10 MHz, 2048 kHz, e1, or t1.

```
[edit chassis synchronization interfaces external]
user@host# set signal-type (1hz | 5mhz | 10mhz | 2048khz | e1 | t1)
```

e. Configure the T1 interface-specific options—the **framing** statement as esf or sf and the **line-encoding** statement as ami or b8zs.

```
[edit chassis synchronization interfaces external]
user@host# set t1-options framing (esf | sf)
user@host# set t1-options line-encoding (ami | b8zs)
```

The SCBE2 Control Board has two external interfaces—external-0/0 and external-1/0. Configure the following options for SCBE2 Control Board:

a. Go to the **[edit chassis synchronization interfaces external-0/0]** or **[edit chassis synchronization interfaces external-1/0]** hierarchy level.

```
[edit chassis synchronization]
user@host# edit interfaces external-0/0
```

OR

```
[edit chassis synchronization]
user@host# edit interfaces external-1/0
```

b. Configure all the E1 interface-specific options—the **framing** statement as g704 or g704-no-crc, the **line-encoding** statement as ami or hdb3, and the **sabit** statement from 4 bits through 8 bits—on the external-0/0 interface or the external-1/0 interface.

```
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
user@host# set e1-options framing (g704 | g704-no-crc)
user@host# set e1-options line-encoding (ami | hdb3)
user@host# set e1-options sabit bit
```

c. Configure the **pulse-per-second-enable** statement to enable the pulse per second (PPS) signal to be received on the GPS interface of the router.

```
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
user@host# set pulse-per-second-enable
```

d. Configure the frequency for the provided reference clock as 1 MHz, 5 MHz, 10 MHz, 2048 kHz, e1, or t1.

```
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
user@host# set signal-type (1hz | 5mhz | 10mhz | 2048khz | e1 | t1)
```

e. Configure the T1 interface-specific options—the **framing** statement as esf or sf and the **line-encoding** statement as ami or b8zs.

```
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
user@host# set t1-options framing (esf | sf)
user@host# set t1-options line-encoding (ami | b8zs)
```

The MX2020 Control Board has two external interfaces—external-a and external-b. Configure the following options for MX2020 Control Board:

a. Go to the **[edit chassis synchronization interfaces external-a]** or **[edit chassis synchronization interfaces external-b]** hierarchy level.

```
[edit chassis synchronization]
user@host# edit interfaces external-a
```

OR

```
[edit chassis synchronization]
user@host# edit interfaces external-b
```

b. For BITS interface, configure all the E1 interface-specific options—the **framing** statement as g704 or g704-no-crc, the **line-encoding** statement as ami or hdb3, and the **sabit** statement from 4 bits through 8 bits-—on the external-a interface or the external-b interface.

```
[edit chassis synchronization interfaces (external-a | external-b)]
user@host# set e1-options framing (g704 | g704-no-crc)
user@host# set e1-options line-encoding (ami | hdb3)
user@host# set e1-options sabit bit
```

c. Configure the **pulse-per-second-enable** statement to enable the pulse per second (PPS) signal to be received on the GPS interface of the router.

```
[edit chassis synchronization interfaces (external-a | external-b)]
user@host# set pulse-per-second-enable
```

d. Configure the frequency for the provided reference clock as 1 MHz, 5 MHz, or 10 MHz for GPS interface and 2048 kHz, e1, or t1 for BITS interface.

```
[edit chassis synchronization interfaces (external-a | external-b)]
user@host# set signal-type (1hz | 5mhz | 10mhz | 2048khz | e1 | t1)
```

e. For BITS interface, configure the T1 interface-specific options—the **framing** statement as esf or sf and the **line-encoding** statement as ami or b8zs.

```
[edit chassis synchronization interfaces (external-a | external-b)]
user@host# set t1-options framing (esf | sf)
user@host# set t1-options line-encoding (ami | b8zs)
```

6. Configure the maximum transmit quality level as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc.

```
[edit chassis synchronization]
user@host# set max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
```

7. Configure the EEC synchronization networking type as option-1 or option-2.

```
[edit chassis synchronization]
user@host# set network-option (option-1 | option-2)
```

8. Configure the options for the external clock interface output on the basis of the type of Enhanced Switch Control Board on your MX Series router.

   For SCBE:

   a. Go to the **[edit chassis synchronization output interfaces external]** hierarchy level.

      ```
      [edit chassis synchronization]
      user@host# edit output interfaces external
      ```

   b. Configure all the external clock interface output options. The options include the **holdover-mode-disable** statement; the **minimum-quality** statement, which can be set as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **source-mode** statement, which can be set as chassis or line; the **tx-dnu-to-line-source-enable** statement; and the **wander-filter-disable** statement.

      ```
      [edit chassis synchronization output interfaces external]
      user@host# set holdover-mode-disable
      user@host# set minimum-quality (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
      user@host# set source-mode (chassis | line)
      user@host# set tx-dnu-to-line-source-enable
      user@host# set wander-filter-disable
      ```

   For SCBE2:

   a. Go to the **[edit chassis synchronization output interfaces external-0/0]** hierarchy level or the **[edit chassis synchronization output interfaces external-1/0]** hierarchy level.

      ```
      [edit chassis synchronization]
      user@host# edit output interfaces (external-0/0 | external-1/0)
      ```

   b. Configure all the external clock interface output options on the external-0/0 interface or the external-1/0 interface. The options include the **holdover-mode-disable** statement; the **minimum-quality** statement, which can be set as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **source-mode** option, which can be set as chassis or line; the **tx-dnu-to-line-source-enable** statement; and the **wander-filter-disable** statement.

      ```
      [edit chassis synchronization output interfaces (external-0/0 |
      external-1/0)]
      user@host# set holdover-mode-disable
      user@host# set minimum-quality (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
      ```

```
user@host# set source-mode (chassis | line)
user@host# set tx-dnu-to-line-source-enable
user@host# set wander-filter-disable
```

For MX2020 Control Board:

a. Go to the **[edit chassis synchronization output interfaces external-a]** hierarchy level or the **[edit chassis synchronization output interfaces external-b]** hierarchy level.

```
[edit chassis synchronization]
user@host# edit output interfaces (external-a | external-b)
```

b. Configure all the external clock interface output options on the external-a interface or the external-b interface. The options include the **holdover-mode-disable** statement; the **minimum-quality** statement, which can be set as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **source-mode** option, which can be set as chassis or line; the **tx-dnu-to-line-source-enable** statement; and the **wander-filter-disable** statement.

```
[edit chassis synchronization output interfaces (external-a | external-b)]
user@host# set holdover-mode-disable
user@host# set minimum-quality (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
user@host# set source-mode (chassis | line)
user@host# set tx-dnu-to-line-source-enable
user@host# set wander-filter-disable
```

9. Configure the time-of-day message format as ASCII on the auxiliary port that receives the external clock signals.

```
[edit chassis synchronization]
user@host# set port auxiliary client time-of-day-format ascii string
```

10. Configure the **quality-mode-enable** statement to enable Synchronous Ethernet ESMC quality mode.

```
[edit chassis synchronization]
user@host# set quality-mode-enable
```

11. Configure the selection mode for the incoming ESMC quality as configured-quality or received-quality.

```
[edit chassis synchronization]
user@host#  set selection-mode (configured-quality | received-quality)
```

12. Configure the options for the ESMC source related external clock source interface on the basis of the type of Enhanced Switch Control Board on your MX Series router.

    For SCBE:

    a. Go to the **[edit chassis synchronization source interfaces external]** hierarchy level or the **[edit chassis synchronization source interfaces *ethernet-interface-name*]** hierarchy level.

    ```
    [edit chassis synchronization]
    user@host#  edit source interfaces external
    ```

    OR

    ```
    [edit chassis synchronization]
    user@host#  edit source interfaces ethernet-interface-name
    ```

    b. Configure the external clock interface and the Ethernet interface with their options. Configure the **priority** statement from 1 through 5; the **quality-level** statement as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **request** statement as force-switch or lockout; the **wait-to-restore** statement from 0 minutes to 12 minutes; and the **hold-off-time** statement from 300 through 1800 milliseconds. You can configure the same options for the Ethernet interfaces as well.

    ```
    [edit chassis synchronization source interfaces (external | ethernet-
    interface-name)]
    user@host#  set priority value
    user@host#  set quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
    user@host#  set request (force-switch | lockout)
    user@host#  set wait-to-restore minutes
    user@host#  set hold-off-time time
    ```

    For SCBE2 Control Board:

a. Go to the **[edit chassis synchronization source interfaces (external-0/0]** hierarchy level or the **[edit chassis synchronization source interfaces (external-1/0]** hierarchy level.

```
[edit chassis synchronization]
user@host# edit source interfaces external-0/0
```

OR

```
[edit chassis synchronization]
user@host# edit source interfaces external-1/0
```

b. Configure the options on the external-0/0 interface or the external-1/0 interface. Set the **priority** statement from 1 through 5; the **quality-level** statement as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **request** statement as force-switch or lockout; the **wait-to-restore** statement from 0 minutes to 12 minutes; and the **hold-off-time** statement from 300 through 1800 milliseconds.

```
[edit chassis synchronization source interfaces (external-0/0 |
external-1/0)]
user@host# set priority value
user@host# set quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
user@host# set request (force-switch | lockout)
user@host# set wait-to-restore minutes
user@host# set hold-off-time time
```

For MX2020 Control Board:

a. Go to the **[edit chassis synchronization source interfaces (external-a]** hierarchy level or the **[edit chassis synchronization source interfaces (external-b]** hierarchy level.

```
[edit chassis synchronization]
user@host# edit source interfaces external-a
```

OR

```
[edit chassis synchronization]
user@host# edit source interfaces external-b
```

b. Configure the options on the external-a interface or the external-b interface. Set the **priority** statement from 1 through 5; the **quality-level** statement as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **request** statement as force-switch or lockout; the **wait-to-restore** statement from 0 minutes to 12 minutes; and the **hold-off-time** statement from 300 through 1800 milliseconds.

```
[edit chassis synchronization source interfaces (external-a |external-b)]
user@host#  set priority value
user@host#  set quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
user@host#  set request (force-switch | lockout)
user@host#  set wait-to-restore minutes
user@host#  set hold-off-time time
```

13. Configure the switchover mode as revertive or non-revertive.

```
[edit chassis synchronization]
user@host#  set switchover-mode (non-revertive | revertive)
```

Display the External Clock Synchronization Configuration for SCB

IN THIS SECTION

- Purpose | 313
- Action | 314

Purpose

Display the options for external clock synchronization for SCB.

Action

Execute the **show** command at **[edit chassis]** hierarchy level.

```
[edit chassis]
user@host# show
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | <interface-name>);
    }
    hold-interval {
        configuration-change <seconds>;
        restart <seconds>;
        switchover <seconds>;
    }
    interfaces <interface-name> {
        hold-off-time <time>;
              priority <number>;
        quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e |
st4 | stu | tnc);
        request (force-switch | lockout);
        wait-to-restore <minutes>;
    }
}
    max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e |
stu | tnc);    # Applicable from 13.3 onwards
    network-type (option-1 | option-2);
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        (external-a | external-b) {
        priority <number>;
        quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e |
st4 | stu | tnc);
        request (force-switch | lockout);
    }
    switchover-mode (revertive | non-revertive);
}
```

Display the External Clock Synchronization Configuration for SCBE

IN THIS SECTION

- Purpose | 315
- Action | 315

Purpose

Display the options for external clock synchronization for SCBE. Note that the SCBE has only one external interface.

Action

Execute the show command at **[edit chassis]** hierarchy level.

```
[edit chassis]
user@host# show
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | <interface-name>);
    }
    hold-interval {
        configuration-change <seconds>;
        restart <seconds>;
        switchover <seconds>;
    }
    interfaces {
        external {
            e1-options {
                framing (g704 | g704-no-crc4);
                line-encoding (ami | hdb3);
                sabit <number>;
            }
            pulse-per-second-enable;
            signal-type (1mhz | 5mhz | 10mhz | 2048khz | t1 | e1);
            t1-options {
                framing (esf | sf);
                line-encoding (ami | b8zs);
            }
        }
    }
    max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e |
stu | tnc);   # Applicable from 13.3 onwards
    network-option (option-1 | option-2);
    output {
        interfaces {
            external {
                holdover-mode-disable;
                minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b |st2 |
st3 | st3e | st4 | stu | tnc);
                source-mode (chassis | line);
                tx-dnu-to-line-source-enable;
                wander-filter-disable;
            }
       }
    }
    port {
        auxiliary client {
           time-of-day-format {
               ascii <string>;
           }
        }
    }
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces (<interface-name> | external) {
                hold-off-time <time>;
                priority <number>;
               quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
               request (force-switch | lockout);
            wait-to-restore <minutes>;
        }
    }
    switchover-mode (revertive | non-revertive);
}
```

Display the External Clock Synchronization Configuration for SCBE2

IN THIS SECTION

- Purpose | 317
- Action | 317

Purpose

Display the options for external clock synchronization for SCBE2. SCBE2 has two external interfaces, external-0/0 and external-1/0.

Action

Execute the show command at **[edit chassis]** hierarchy level.

```
[edit chassis]
user@host# show
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | <interface-name>);
    }
    hold-interval {
        configuration-change <seconds>;
        restart <seconds>;
        switchover <seconds>;
    }
    interfaces {
        (external-0/0 | external-1/0) {
            signal-type (1mhz | 5mhz | 10mhz | 2048khz | t1 | e1);
            e1-options {
                framing (g704 | g704-no-crc4);
                line-encoding (ami | hdb3);
                sabit <number>;
            }
            pulse-per-second-enable;
            t1-options {
                framing (esf | sf);
                line-encoding (ami | b8zs);
            }
        }
    }
    max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e |
stu | tnc);
    network-option (option-1 | option-2);
    output {
        interfaces {
            (external-0/0 | external-1/0) {
                holdover-mode-disable;
                minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b |st2 |
st3 | st3e | st4 | stu | tnc);
                source-mode (chassis | line);
                tx-dnu-to-line-source-enable;
                wander-filter-disable;
            }
       }
    }
    port {
        auxiliary client {
           time-of-day-format {
               ascii <string>;
           }
        }
    }
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces {
            (external-0/0 | external-1/0 | <interface-name>) {
                hold-off-time <time>;
                                        priority <number>;
                quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3
| st3e | st4 | stu | tnc);
                request (force-switch | lockout);
                wait-to-restore <minutes>;
        }
    }
    switchover-mode (revertive | non-revertive);
}
```

Displaying the External Clock Synchronization Configuration for MX2020 Control Board

IN THIS SECTION

- Purpose | 319
- Action | 319

Purpose

Display the options for external clock synchronization for MX2020 Control Board. MX2020 Control Board has two external interfaces, external-a and external-b.

Action

Execute the show command at [**edit chassis**] hierarchy level.

```
[edit chassis]
user@host# show
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | <interface-name>);
    }
    hold-interval {
        configuration-change <seconds>;
        restart <seconds>;
        switchover <seconds>;
    }interfaces {
        (external-a | external-b) {
            signal-type (1mhz | 5mhz | 10mhz | 2048khz | t1 | e1);
            e1-options {
                framing (g704 | g704-no-crc4);
                line-encoding (ami | hdb3);
                sabit <number>;
            }
            pulse-per-second-enable;
            t1-options {
                framing (esf | sf);
                line-encoding (ami | b8zs);
            }
        }
    }max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e |
stu | tnc);
    network-option (option-1 | option-2);
    output {
        interfaces {
            (external-a | external-b) {
                holdover-mode-disable;
                minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b |st2 |
st3 | st3e | st4 | stu | tnc);
                source-mode (chassis | line);
                tx-dnu-to-line-source-enable;
                wander-filter-disable;
            }
       }
    }
    port {
        auxiliary client {
           time-of-day-format {
               ascii <string>;
           }
        }
    }
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces {
            (external-a | external-b | <interface-name>) {
                hold-off-time <time>;
                                       priority <number>;
                quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3
| st3e | st4 | stu | tnc);
                request (force-switch | lockout);
                wait-to-restore <minutes>;
            }
        }
        switchover-mode (revertive | non-revertive);
    }
```

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232

Precision Time Protocol Overview | 68

Understanding Hybrid Mode | 357

Clock Sources for PTX Series Packet Transport Routers

System clocking on PTX Series Packet Transport Routers is controlled by a Centralized Clock Generator (CCG). The CCG is capable of deriving a *primary clock* from a valid source and synchronizing all interfaces on the chassis to this primary clock. The CCG plugs into the rear of the chassis. A pair of CCGs installed in the chassis provide a redundant fallback option.

Synchronous Ethernet is configured on external primary and secondary interfaces that use building-integrated timing system (BITS), SDH Equipment Timing Source (SETS) timing sources, or an equivalent quality timing source such as GPS. On the PICs, the transmit clock of the interface is synchronized to a BITS or SETS timing source and is traceable to the timing source within the network.

PTX Series Packet Transport Routers can use an internal clock source or it can extract clocking from an external source.

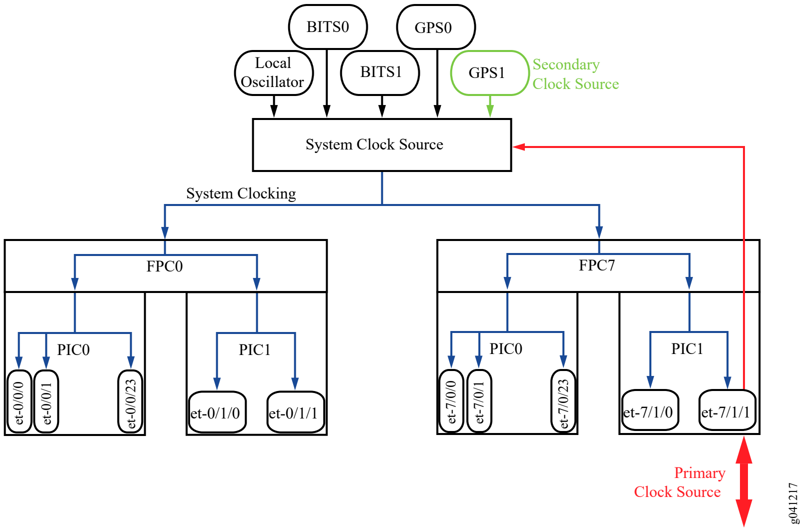
Clock sources and specifications include:

- The PTX Series Packet Transport Router clock is a Stratum 3E-compliant clock with Free Run +/- 4.6 ppm/20 years, Holdover +/- 0.01 ppm/24 hours, and Drift +/- 0.001 ppm/24 hours.
- The internal clock is based on Freerun OCXO with +/- 10 ppb accuracy.
- External clocking includes a choice of GPS-based clock recovery (5 MHz and 10 MHz) or BITS-T1/E1 Line synchronization (1.544 MHz and 2.048 MHz).

- Synchronous Ethernet is supported based on the ITU-T G.8261, ITU-T G.8262, and ITU-T G8264 specifications with line timing from the 10-Gigabit Ethernet, 40-Gigabit Ethernet, or 100-Gigabit Ethernet interface.

  Synchronous Ethernet is a key requirement for circuit (emulation) services and mobile radio access technologies. Synchronous Ethernet supports sourcing and transfer of frequency for synchronization purposes for both wireless and wireline services and is primarily used for mobile backhaul and converged transport.

Figure 5: Clocking Example for PTX Series Packet Transport Routers


BITS0
GPS0
Local Oscillator
BITS1
GPS1
Secondary Clock Source
System Clock Source
System Clocking
FPC0
PIC0
PIC1
et-0/0/0
et-0/0/1
et-0/0/23
et-0/1/0
et-0/1/1
FPC7
PIC0
PIC1
et-7/0/0
et-7/0/1
et-7/0/23
et-7/1/0
et-7/1/1
Primary Clock Source
g041217

In this example, the interface et-7/1/1 is configured as the primary clock source and GPS1 as the secondary clock source.

Note that you can specify the primary and secondary clock sources provided that the clock source meets the necessary qualification as set by the clock algorithm. However, in the absence of any user-selected clock source, the clock source with the best quality level is selected by the clock algorithm in the router. Note that the user selection is honored even when better quality level clock sources are available. You can select the clock source with the **request chassis synchronization switch *clock-source*** operational mode command. For more information, see "request chassis synchronization switch" on page 570.

NOTE: The clock sources used as primary or secondary clock sources cannot originate from the same FPC.

For more information about clock source ports, see PTX3000 Clocking Port Cable Specifications and Pinouts, PTX5000 Centralized Clock Generator Description, and Connecting the PTX5000 to an External Clocking Device.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232
Precision Time Protocol Overview | 68
Understanding Hybrid Mode | 357

Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers

IN THIS SECTION

- Configuring a Recovered Clock for an FPC | 323
- Configuring External Clock Synchronization Options | 324

The PTX Series Packet Transport Routers support an external synchronization interface that can be configured to synchronize the internal Stratum 3 clock to an external source, and then synchronize the chassis interface clock to that source. You can also configure a primary and a secondary clock source.

The following tasks explain how to configure a recovered clock for an FPC and to configure the clock synchronization options:

Configuring a Recovered Clock for an FPC

To configure a recovered clock for an FPC on PTX Series routers:

1. Go to the **[edit chassis fpc *slot-number* pic *pic-number*]** hierarchy level.

```
[edit]
user@host# edit chassis fpc slot-number pic pic-number
```

2. Configure a port from 0 through 47 through which the clock is recovered.

```
[edit]
user@host# set recovered-clock port port-number
```

Configuring External Clock Synchronization Options

NOTE: Starting with Junos OS Release 15.1F3, you must configure a recovered clock (**recovered-clock port** *port-number*) for an interface before configuring clock synchronization options for the same interface.

Use the **synchronization** statement options to specify a primary and a secondary timing source. To do this, you must configure the following options:

- Specify the switching mode as **revertive** when a lower-priority synchronization source is to be switched to a valid, higher-priority synchronization source.
- Specify the primary external timing source with the **primary (fpc-*slot-number* | gps-0 | gps-1 | bits-a | bits-b)** statement.
- Specify the secondary external timing source with the **secondary (fpc-*slot-number* | gps-0 | gps-1 | bits-a | bits-b)** statement.

NOTE: For more information about clock synchronization options, see "Understanding Clock Synchronization" on page 277.

To configure the clock synchronization options:

1. In configuration mode, go to the **[edit chassis synchronization]** hierarchy level.

```
[edit]
user@host# edit chassis synchronization
```

2. Configure the Synchronous Ethernet clock selection mode as *auto-select* to select the best external clock source or *free-run* to use the free-running local oscillator as a clock source.

```
[edit chassis synchronization]
user@host# set clock-mode (auto-select | free-run)
```

3. Configure the ESMC transmit parameters on all the interfaces or on selected interfaces.

```
[edit chassis synchronization]
user@host# set esmc-transmit interfaces (all | interface-name)
```

4. Configure the hold interval as configuration-change, which is the wait time (from 15 seconds through 60 seconds) after a change in configuration; restart, which is the wait time (from 60 seconds through 180 seconds) after reboot of the router; and switchover, which is the switchover wait time (from 30 seconds through 60 seconds) after clock recovery.

```
[edit chassis synchronization]
user@host# set hold-interval configuration-change secs
user@host# set hold-interval restart secs
user@host# set hold-interval switchover secs
```

5. Configure the interface with an available upstream clock source where the clock source is bits-a, bits-b, gps-0, or gps-1. Configure the **pulse-per-second-enable** statement to enable the pulse per second (PPS) signal to be received on the GPS interface and configure the frequency for the provided reference clock as 5 MHz, 10 MHz, e1, or t1.

```
[edit chassis synchronization]
user@host# set interfaces (bits-a | bits-b | gps-0 | gps-1) (pulse-per-second-enable | signal-type (5mhz
| 10mhz |e1 | t1))
```

6. Configure the maximum transmit quality level as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc.

```
[edit chassis synchronization]
user@host# set max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e | stu | tnc)
```

7. Configure the EEC synchronization networking type as option-1 to map to G.813 option 1 (EEC1)or option-2 to map to G.812 type IV clock (EEC1).

```
[edit chassis synchronization]
user@host# set network-option (option-1 | option-2)
```

8. Configure the primary synchronization reference source as bits-a, bits-b, gps-0, gps-1, fpc-0, fpc-1, fpc-2, fpc-3, fpc-4, fpc-5, fpc-6, or fpc-7. The selected source is considered to be the best choice among the available sources.

```
[edit chassis synchronization]
user@host# set primary (fpc-slot-number | gps-0 | gps-1 | bits-a | bits-b)
```

9. Configure the **quality-mode-enable** statement to enable Synchronous Ethernet ESMC quality mode.

```
[edit chassis synchronization]
user@host# set quality-mode-enable
```

10. Configure the secondary synchronization reference source as bits-a, bits-b, gps-0, gps-1, fpc-0, fpc-1, fpc-2, fpc-3, fpc-4, fpc-5, fpc-6, or fpc-7. The selected source is considered to be the best alternative among the available sources.

```
[edit chassis synchronization]
user@host# set secondary (fpc-slot-number | gps-0 | gps-1 | bits-a | bits-b)
```

11. Configure the quality selection mode for the incoming ESMC packets as configured-quality or received-quality.

```
[edit chassis synchronization]
user@host# set selection-mode (configured-quality | received-quality)
```

12. Configure the ESMC source as bits-a, bits-b, gps-0, or gps-1. For the configured source, configure the **priority** statement from 1 through 5; the **quality-level** statement as prc, prs, sec, ssu-a, ssu-b, st2, st3e, stu, or tnc; the **request** statement as force-switch or lockout.

```
[edit chassis synchronization]
user@host# source (bits-a | bits-b | gps-0 | gps-1) (priority number | quality-level (prc | prs |sec | smc |
ssu-a | ssu-b | st2 | st3 | st3e | st4 | stu | tnc) | request (force-switch | lockout)
```

13. Configure the switchover mode as revertive or non-revertive.

```
[edit chassis synchronization]
user@host# set switchover-mode (non-revertive | revertive)
```

NOTE: To configure the Synchronous Ethernet clock sources, you must configure **network-option** *option*, **quality-mode-enable**, and **source interfaces** *interface-name* **priority** *value* **quality-level** *level* along with other parameters as needed at the **[edit chassis synchronization]** hierarchy level.

To configure ESMC transmit interface, you must configure **esmc-transmit interface** *interface-name* along with other parameters as needed at the **[edit chassis synchronization]** hierarchy level.

Release History Table

Release	Description
15.1F3	Starting with Junos OS Release 15.1F3, you must configure a recovered clock (recovered-clock port port-number) for an interface before configuring clock synchronization options for the same interface.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232

Precision Time Protocol Overview | 68

Understanding Hybrid Mode | 357

Example: Configuring Centralized Clocking on the Enhanced MX Switch Control Board

IN THIS SECTION

- Requirements | 328
- Overview | 329
- Configuration | 330
- Verification | 337

These examples show how to configure the following clock sources and features on an Enhanced MX Switch Control Board (SCBE): Synchronous Ethernet, ordinary Precision Time Protocol (PTP) client, hybrid PTP client, and retiming through the building-integrated timing supply (BITS) external interface.

Requirements

These examples use the following hardware and software components:

- One MX240, MX480, or MX960 router with MPC 16x10GE or MPC2Es (see MPCs Supported by MX Series Routers) for Synchronous Ethernet clock sources, or MPC2E-P for PTP clock sources
- One Synchronous Ethernet clock source device (may be an MX240, MX480, or MX960 router)
- One PTP reference clock device
- One BITS device (may be the same as the PTP reference clock device)
- Junos OS Release 12.2 or later for MX240, MX480, or MX960 routers
- Junos OS Release 12.3 or later to configure a BITS interface as an input, output, or I/O clock source for MX240, MX480, or MX960 routers

Before you begin configuring centralized clocking on an interface that uses Synchronous Ethernet, ensure that you have configured the MX Series interface as a chassis synchronization source to the device that provides a Synchronous Ethernet clock source.

- Configure the MX Series interface as a chassis synchronization source to the device that provides a Synchronous Ethernet clock source.

Overview

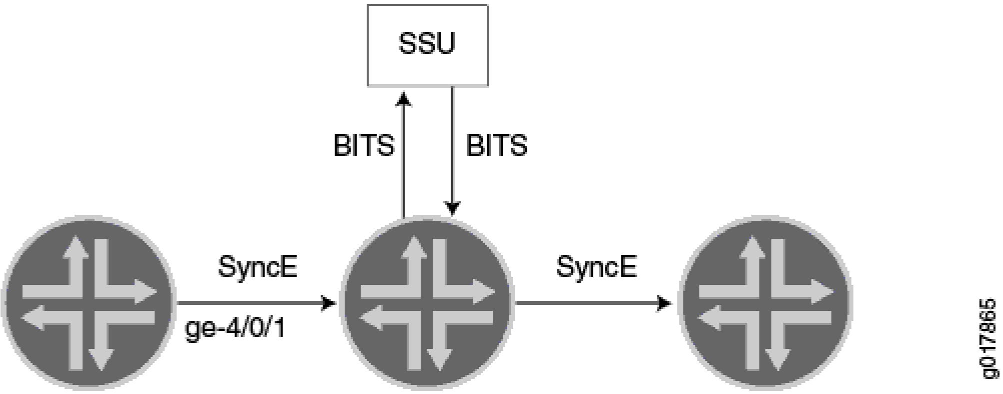
With the addition of a Stratum 3 clock module to the SCBE, an MX240, MX480, or MX960 chassis can perform clock monitoring, filtering, and holdover in a centralized chassis location. Chassis line cards can be configured to recover network timing clocks at the physical layer via Synchronous Ethernet or by a packet-based PTP implementation. These recovered clocks are routed to the SCBE Stratum 3 clock module via the chassis backplane. A clock selection algorithm is run that selects the best quality recovered clock from the list of configured clock sources. The Stratum 3 clock module locks to the selected clock source and fans it out to the chassis line cards. 16x10GE 3D and MPC2Es (see MPCs Supported by MX Series Routers) can distribute this clock to downstream network elements via Synchronous Ethernet.

The Stratum 3 clock module acquires holdover data while locked to the selected clock source. If the clock fails, the Stratum 3 clock module enters holdover mode and replays collected holdover data to maintain its output clock. The Stratum 3 holdover performance depends on the drift of the SCBE OCXO device.

In Junos 12.3, support was added for synchronizing an MX240, MX480, or MX960 chassis with an SCBE to a BITS timing source through an RJ-48 port on the SCBE. The BITS external clock interface supports the sending and receiving of Synchronization Status Message (SSM) quality levels. The quality level is used by the chassis clock-selection algorithm. When BITS output is configured, the source-mode default is the selected line clock source.

The BITS external interface can be connected to a retiming device, which cleans up the clock and sends it back in the external BITS interface. The conditioned input BITS clock is selected as the chassis clock and distributed downstream via Synchronous Ethernet interfaces. The **tx-dnu-to-line-source-enable** option is used to prevent a timing loop. Figure 6 on page 330 shows the BITS retiming functionality using a Synchronization Supply Unit (SSU). For instructions on how to configure retiming through the BITS external interface, see "Configuring Retiming through the BITS External Interface" on page 334.

Figure 6: BITS Retiming with Synchronization Supply Unit (SSU)



Prior to the SCBE, clock monitoring, filtering, and holdover functions were distributed throughout the chassis and performed on MPC2E line cards. This distributed clocking mode limits the distribution of timing to downstream network elements on MPC2E interfaces only. Centralized clocking mode removes this limitation by supporting the distribution of timing on MPC 16x 10GE line interfaces as well.

Configuration

IN THIS SECTION

- Configuring Centralized Clocking from a Synchronous Ethernet Clock Source | 331
- Configuring Centralized Clocking from an Ordinary PTP Clock Source | 332
- Configuring Centralized Clocking from a Hybrid PTP Clock Source | 332
- Configuring Retiming through the BITS External Interface | 334

To configure centralized clocking, perform one or more of these tasks:

Configuring Centralized Clocking from a Synchronous Ethernet Clock Source

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization source interfaces ge-4/1/0 priority 1
set chassis synchronization source interfaces ge-4/1/0 quality-level st3
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a Synchronous Ethernet clock source:

1. Configure the network option:

   ```
   [edit chassis synchronization]
   user@host# set network-option option-2
   ```

2. Configure the priority and quality level of the clock source on this interface:

   ```
   [edit chassis synchronization source interfaces ge-4/1/0]
   user@host# set priority 1
   user@host# set quality-level st3
   ```

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
```

```
network-option option-2;
source {
     interfaces ge-4/1/0 {
          priority 1;
          quality-level st3;
     }
}
```

After you configure the device, enter **commit** from configuration mode.

Configuring Centralized Clocking from an Ordinary PTP Clock Source

Step-by-Step Procedure

To configure a PTP clock source:

1. Configure ordinary mode PTP on the ge-4/1/9 interface to the PTP reference clock device. See "Example: Configuring Precision Time Protocol" on page 82.

Configuring Centralized Clocking from a Hybrid PTP Clock Source

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization source interfaces ge-4/1/0 priority 1
set chassis synchronization source interfaces ge-4/1/0 quality-level st3
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a hybrid PTP clock source:

1. Configure the network option:

   ```
   [edit chassis synchronization]
   user@host# set network-option option-2
   ```

2. Configure the priority and quality level of the clock source on this interface:

   ```
   [edit chassis synchronization source interfaces ge-4/1/0]
   user@host# set priority 1
   user@host# set quality-level st3
   ```

3. Configure hybrid mode PTP on the ge-4/1/9 interface to the PTP reference clock device. For the **synchronous-ethernet-mapping** interface, specify the Synchronous Ethernet interface used in Step 2.

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
network-option option-2;
source {
     interfaces ge-4/1/0 {
          priority 1;
          quality-level st3;
     }
}
```

After you configure the device, enter **commit** from configuration mode.

Configuring Retiming through the BITS External Interface

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization interfaces external signal-type t1
set chassis synchronization interfaces external t1-options line-encoding b8zs
set chassis synchronization interfaces external t1-options framing sf
set chassis synchronization output interfaces external wander-filter-disable
set chassis synchronization output interfaces external holdover-mode-disable
set chassis synchronization output interfaces external source-mode line
set chassis synchronization output interfaces external tx-dnu-to-line-source-enable
set chassis synchronization output interfaces external minimum-quality st3
set chassis synchronization source interfaces ge-4/0/1 quality-level st3
set chassis synchronization source interfaces external quality-level prs
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure retiming through the BITS external interface using an SSU:

1. Configure the network option (G.812 type IV clock):

   ```
   [edit chassis synchronization]
   user@host# set network-option option-2
   ```

2. Configure the external BITS signal type (T1-coded 1.544-MHz signal on 100-ohm balanced line):

   ```
   [edit chassis synchronization interfaces external]
   set signal-type t1
   ```

3. Configure the external BITS signal line-encoding (B8ZS) and framing (superframe) options:

   ```
   [edit chassis synchronization interfaces external]
   user@host# set t1-options line-encoding b8zs
   user@host# set t1-options framing sf
   ```

4. Configure the output external BITS signal properties:

   - Disable wander filtering:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set wander-filter-disable
     ```

   - Disable holdover:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set holdover-mode-disable
     ```

   - Select the best line clock source for output:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set source-mode line
     ```

   - Set Tx QL to DNU/DUS on the line source interface to prevent a timing loop:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set tx-dnu-to-line-source-enable
     ```

   - Set minimum quality level:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set minimum-quality st3
     ```

5. Configure the incoming clock source and quality level:

   ```
   [edit chassis synchronization source interfaces ge-4/0/1]
   user@host# set quality-level st3
   ```

6. Configure the external clock source and quality level:

   ```
   [edit chassis synchronization source interfaces external]
   user@host# set quality-level prs
   ```

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
network-option option-2;
interfaces external {
    signal-type t1;
    t1-options {
        line-encoding b8zs;
        framing sf;
    }
}
output {
    interfaces external {
        wander-filter-disable;
        holdover-mode-disable;
        source-mode line;
        tx-dnu-to-line-source-enable;
        minimum-quality st3;
    }
}
source {
    interfaces ge-4/0/1 {
        quality-level st3;
    }
```

```
    interfaces external {
        quality-level prs;
    }
}
```

After you configure the device, enter **commit** from configuration mode.

Verification

IN THIS SECTION

- Verifying the Synchronous Ethernet Clock Source | 337
- Verifying the Ordinary PTP Clock Source | 338
- Verifying the Hybrid PTP Clock Source | 339
- Verifying the Retiming through the BITS External Interface | 340

Confirm that the configuration is working properly.

Verifying the Synchronous Ethernet Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured Synchronous Ethernet clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role      : master
  Current state     : locked to ge-4/1/0
    State for       : 0 days, 00 hrs, 00 mins, 15 secs
    State since     : Mon Jun  6 07:28:47 2011
  Monitored clock sources
    Interface      Type          Status
    ge-4/1/0       syncE         qualified-selected
```

Meaning

The Monitored clock sources field shows that the ge-4/1/0 interface has the Synchronous Ethernet type and is the qualified and selected centralized clock source.

Verifying the Ordinary PTP Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured PTP clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role      : master
  Current state     : locked to ge-4/1/9
    State for       : 0 days, 00 hrs, 00 mins, 45 secs
    State since     : Wed Jun 29 10:52:05 2011
  Monitored clock sources
    Interface      Type          Status
    ge-4/1/9       ptp           qualified-selected
```

Meaning

The Monitored clock sources field shows that the ge-4/1/9 interface has the ptp type and is the qualified and selected centralized clock source.

Verifying the Hybrid PTP Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured hybrid PTP clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role      : master
  Current state     : locked to ge-4/1/9
    State for       : 0 days, 00 hrs, 00 mins, 15 secs
    State since     : Wed Jun 29 11:19:25 2011
  Monitored clock sources
    Interface       Type          Status
    ge-4/1/9        ptp-hybrid    qualified-selected

Configured sources:

Interface            : ge-4/1/0
Status               : Primary       Index        : 218
Clock source state   : Clk qualified Priority     : 1
Configured QL        : ST3           ESMC QL      : DUS
Clock source type    : ifd           Clock Event  : Clock locked
Kernel flags         : Up,sec,
```

Meaning

The Monitored clock sources field shows that the ge-4/1/9 interface has the ptp-hybrid type and is the qualified and selected centralized clock source. The Configured sources field shows that the ge-4/1/0 interface has the Clock locked Clock Event .

Verifying the Retiming through the BITS External Interface

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured clock source, and that the external clock is locked to the configured clock source.

Action

From operational mode, enter the **show chassis synchronization extensive** command.

```
user@host> show chassis synchronization extensive

Current clock status   : Locked
Clock locked to        : Primary

Configured interfaces:

Name          : external
Signal type   : t1 (sf b8zs)
Rx status     : active
Tx status     : active
LED color     : green

Configured outputs:

Interface       : external
Tx status       : active
Minimum QL      : ST3               Tx QL         : ST3
Holdover mode   : disabled          Wander filter : disabled
Source mode     : line              Source Tx DNU : enabled
Holdover data   : valid
Current state   : locked to ge-4/0/1
  State for     : 0 days, 00 hrs, 24 mins, 47 secs
  State since   : Thu Sep  6 13:01:07 2012

Configured sources:

Interface            : external
Status               : Primary       Index        : 0
Clock source state   : Clk qualified Priority     : Default(6)
```

```
Configured QL        : PRS            ESMC QL      : PRS
Clock source type    : extern         Clock Event : Clock locked
Interface State      : Up,pri,

Interface            : ge-4/0/1
Status               : Secondary      Index        : 152
Clock source state   : Clk qualified Priority     : Default(8)
Configured QL        : ST3            ESMC QL      : DUS
Clock source type    : ifd            Clock Event : Clock qualified
Interface State      : Up,sec,ESMC TX(QL DUS/SSM 0xf),
```

Meaning

The Configured interfaces field shows that the external interface receive and transmit statuses are active. The Configured outputs field shows that the current state is locked to ge-4/0/1. The Configured sources field shows that the external interface is the qualified and selected centralized clock source, and has the Clock locked Clock Event. The Configured sources field shows that the ge-4/0/1 interface is the secondary clock source, and has the Clock qualified Clock Event.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232
Precision Time Protocol Overview | 68
Understanding Hybrid Mode | 357

Example: Configuring Centralized Clocking on an MX2020

IN THIS SECTION

- Requirements | 342
- Overview | 342
- Configuration | 343

- Verification | 351

These examples show how to configure the following clock sources and features on an MX2020 router: Synchronous Ethernet, Precision Time Protocol (PTP) client, hybrid PTP client, and retiming through the building-integrated timing supply (BITS) external interface.

Requirements

These examples use the following hardware and software components:

- One MX2020, with MPC 16x10GE or MPC2Es (see MPCs Supported by MX Series Routers) for Synchronous Ethernet clock sources, or MPC2E-P for PTP clock sources
- One Synchronous Ethernet clock source device
- One PTP reference clock device
- One BITS device (may be the same as the PTP reference clock device)
- Junos OS Release 13.3 for MX2020 routers
- Junos OS Release 13.3 or later to configure a BITS interface as an input, output, or I/O clock source for MX2020 router
- Configure the MX Series interface as a chassis synchronization source to the device that provides a Synchronous Ethernet clock source.

Overview

With the addition of a Stratum 3 (ST3) clock module the MX2020 chassis can perform clock monitoring, filtering, and holdover in a centralized chassis location. Chassis line cards can be configured to recover network timing clocks at the physical layer via Synchronous Ethernet or by a packet-based PTP implementation. These recovered clocks are routed to MX2020 SCB ST3 clock module via the chassis backplane. A clock selection algorithm is run that selects the best quality recovered clock from the list of configured clock sources. The ST3 clock module locks to the selected clock source and fans it out to the chassis line cards. 16x10GE 3D and MPC2Es (see MPCs Supported by MX Series Routers) can distribute this clock to downstream network elements via Synchronous Ethernet.

The ST3 clock module acquires holdover data while locked to the selected clock source. If the clock fails, the ST3 clock module enters holdover mode and replays collected holdover data to maintain its output clock. The ST3 holdover performance depends on the drift of the MX SCB OCXO device.

In Junos 13.3, support was added for synchronizing an MX2020 chassis to a BITS timing source using any of the two BITS interfaces. The quality level is used by the chassis clock-selection algorithm. When BITS output is configured, the source-mode can be configured as either **chassis** or **line**.

The BITS external interface can be connected to a retiming device, which cleans up the clock and sends it back in the external BITS interface. The conditioned input BITS clock is selected as the chassis clock and distributed downstream via Synchronous Ethernet interfaces. The **tx-dnu-to-line-source-enable** option is used to prevent a timing loop. For instructions on how to configure retiming through the BITS external interface, see "Configuring Retiming through the BITS External Interface" on page 348.

Prior to 13.3, clock monitoring, filtering, and holdover functions were distributed throughout the chassis and performed on MPC2E line cards. This distributed clocking mode limits the distribution of timing to downstream network elements on MPC2E interfaces only. Centralized clocking mode removes this limitation by supporting the distribution of timing on MPC 16x 10GE line interfaces as well.

Configuration

IN THIS SECTION

- Configuring Centralized Clocking from a Synchronous Ethernet Clock Source | 344
- Configuring an ordinary PTP Clock Source | 345
- Configuring Centralized Clocking from a Hybrid Mode PTP Clock Source | 345
- Configuring Hybrid Mode PTP | 346
- Configuring Retiming through the BITS External Interface | 348

To configure centralized clocking, perform one or more of these tasks:

Configuring Centralized Clocking from a Synchronous Ethernet Clock Source

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization source interfaces ge-4/1/0 priority 1
set chassis synchronization source interfaces ge-4/1/0 quality-level st3
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a Synchronous Ethernet clock source:

1. Configure the network option:

   ```
   [edit chassis synchronization]
   user@host# set network-option option-2
   ```

2. Configure the priority and quality level of the clock source on this interface:

   ```
   [edit chassis synchronization source interfaces ge-4/1/0]
   user@host# set priority 1
   user@host# set quality-level st3
   ```

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
```

```
network-option option-2;
source {
     interfaces ge-4/1/0 {
          priority 1;
          quality-level st3;
     }
}
```

After you configure the device, enter **commit** from configuration mode.

Configuring an ordinary PTP Clock Source

Step-by-Step Procedure

To configure a PTP clock source:

1. Configure ordinary mode PTP on the ge-4/1/9 interface to the PTP reference clock device. See "Example: Configuring Precision Time Protocol" on page 82.

Configuring Centralized Clocking from a Hybrid Mode PTP Clock Source

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization source interfaces ge-4/1/0 priority 1
set chassis synchronization source interfaces ge-4/1/0 quality-level st3
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure a hybrid mode PTP clock source:

1. Configure the network option:

```
[edit chassis synchronization]
user@host# set network-option option-2
```

2. Configure the priority and quality level of the clock source on this interface:

```
[edit chassis synchronization source interfaces ge-4/1/0]
user@host# set priority 1
user@host# set quality-level st3
```

3. To configure hybrid mode PTP on the ge-4/1/9 interface to the PTP reference clock device, see "Configuring Hybrid Mode PTP" on page 346.

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
network-option option-2;
source {
     interfaces ge-4/1/0 {
          priority 1;
          quality-level st3;
     }
}
```

After you configure the device, enter **commit** from configuration mode.

Configuring Hybrid Mode PTP

CLI Quick Configuration

To quickly configure hybrid mode on the ge-4/1/0 interface with the clock source IP address as 2.2.2.2, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

[edit]

set protocols ptp slave hybrid

set protocols ptp slave hybrid synchronous-ethernet-mapping

set protocols ptp slave hybrid synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-4/1/0

set protocols ptp slave convert-clock-class-to-quality-level

Step-by-Step Procedure

To configure hybrid mode on an MX240 router with mapping of the PTP clock class perform the following steps:

1. Configure the **convert-clock-class-to-quality-level** option on the client at the **[edit protocols ptp slave]** hierarchy level.

   ```
   [edit protocols ptp slave]
   user@host# set convert-clock-class-to-quality-level
   ```

2. Configure hybrid mode on the client.

   ```
   [edit protocols ptp slave]
   user@host# edit hybrid
   ```

3. Configure the Synchronous Ethernet mapping option, IP address of the primary clock as 2.2.2.2, and the interface ge-4/1/0 for hybrid mode on the client.

   ```
   [edit protocols ptp slave hybrid]
   user@host# set synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-4/1/0
   ```

Results

Display the results of the configuration of hybrid mode with the mapping of the PTP clock class to the ESMC quality level:

```
[edit protocols ptp slave]
user@host# show
```

```
convert-clock-class-to-quality-level
hybrid {
    synchronous-ethernet-mapping {
        clock-source 2.2.2.2 {
        interface  ge-4/1/0;
        }
    }
}
```

Configuring Retiming through the BITS External Interface

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set chassis synchronization network-option option-2
set chassis synchronization interfaces external signal-type t1
set chassis synchronization interfaces external t1-options line-encoding b8zs
set chassis synchronization interfaces external t1-options framing sf
set chassis synchronization output interfaces external wander-filter-disable
set chassis synchronization output interfaces external holdover-mode-disable
set chassis synchronization output interfaces external source-mode line
set chassis synchronization output interfaces external tx-dnu-to-line-source-enable
set chassis synchronization output interfaces external minimum-quality st3
set chassis synchronization source interfaces ge-4/0/1 quality-level st3
set chassis synchronization source interfaces external quality-level prs
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the CLI User Guide.

To configure retiming through the BITS external interface using an SSU:

1. Configure the network option (G.812 type IV clock):

   ```
   [edit chassis synchronization]
   user@host# set network-option option-2
   ```

2. Configure the external BITS signal type (T1-coded 1.544-MHz signal on 100-ohm balanced line):

   ```
   [edit chassis synchronization interfaces external]
   set signal-type t1
   ```

3. Configure the external BITS signal line-encoding (B8ZS) and framing (superframe) options:

   ```
   [edit chassis synchronization interfaces external]
   user@host# set t1-options line-encoding b8zs
   user@host# set t1-options framing sf
   ```

4. Configure the output external BITS signal properties:

   - Disable wander filtering:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set wander-filter-disable
     ```

   - Disable holdover:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set holdover-mode-disable
     ```

   - Select the best line clock source for output:

     ```
     [edit chassis synchronization output interfaces external]
     user@host# set source-mode line
     ```

- Set Tx QL to DNU/DUS on the line source interface to prevent a timing loop:

  ```
  [edit chassis synchronization output interfaces external]
  user@host# set tx-dnu-to-line-source-enable
  ```

- Set minimum quality level:

  ```
  [edit chassis synchronization output interfaces external]
  user@host# set minimum-quality st3
  ```

5. Configure the incoming clock source and quality level:

   ```
   [edit chassis synchronization source interfaces ge-4/0/1]
   user@host# set quality-level st3
   ```

6. Configure the external clock source and quality level:

   ```
   [edit chassis synchronization source interfaces external]
   user@host# set quality-level prs
   ```

Results

From configuration mode, confirm your configuration by entering the **show chassis synchronization** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
[edit]
user@host# show chassis synchronization
network-option option-2;
interfaces external {
    signal-type t1;
    t1-options {
        line-encoding b8zs;
        framing sf;
    }
}
output {
```

```
    interfaces external {
        wander-filter-disable;
        holdover-mode-disable;
        source-mode line;
        tx-dnu-to-line-source-enable;
        minimum-quality st3;
    }
}
source {
    interfaces ge-4/0/1 {
        quality-level st3;
    }
    interfaces external {
        quality-level prs;
    }
}
```

After you configure the device, enter **commit** from configuration mode.

Verification

IN THIS SECTION

- Verifying the Synchronous Ethernet Clock Source | 351
- Verifying the Ordinary PTP Clock Source | 352
- Verifying the Hybrid PTP Clock Source | 353
- Verifying the Retiming through the BITS External Interface | 354

Confirm that the configuration is working properly.

Verifying the Synchronous Ethernet Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured Synchronous Ethernet clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role     : master
  Current state    : locked to ge-4/1/0
    State for      : 0 days, 00 hrs, 00 mins, 15 secs
    State since    : Mon Jun  6 07:28:47 2011
  Monitored clock sources
    Interface      Type         Status
    ge-4/1/0       syncE        qualified-selected
```

Meaning

The Monitored clock sources field shows that the ge-4/1/0 interface has the Synchronous Ethernet type and is the qualified and selected centralized clock source.

Verifying the Ordinary PTP Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured PTP clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role     : master
  Current state    : locked to ge-4/1/9
    State for      : 0 days, 00 hrs, 00 mins, 45 secs
    State since    : Wed Jun 29 10:52:05 2011
  Monitored clock sources
```

```
    Interface      Type          Status
    ge-4/1/9       ptp           qualified-selected
```

Meaning

The Monitored clock sources field shows that the ge-4/1/9 interface has the ptp type and is the qualified and selected centralized clock source.

Verifying the Hybrid PTP Clock Source

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured hybrid PTP clock source.

Action

From operational mode, enter the **show chassis synchronization clock-module** command.

```
user@host> show chassis synchronization clock-module

Clock module on SCB0
  Current role      : master
  Current state     : locked to ge-4/1/9
    State for       : 0 days, 00 hrs, 00 mins, 15 secs
    State since     : Wed Jun 29 11:19:25 2011
  Monitored clock sources
    Interface      Type          Status
    ge-4/1/9       ptp-hybrid    qualified-selected

Configured sources:

Interface          : ge-4/1/0
Status             : Primary       Index       : 218
Clock source state : Clk qualified Priority    : 1
Configured QL      : ST3           ESMC QL     : DUS
Clock source type  : ifd           Clock Event : Clock locked
Kernel flags       : Up,sec,
```

Meaning

The Monitored clock sources field shows that the ge-4/1/9 interface has the ptp-hybrid type and is the qualified and selected centralized clock source. The Configured sources field shows that the ge-4/1/0 interface has the Clock locked Clock Event .

Verifying the Retiming through the BITS External Interface

Purpose

Verify that the MX Series router recovers, selects, qualifies, and locks to the configured clock source, and that the external clock is locked to the configured clock source.

Action

From operational mode, enter the **show chassis synchronization extensive** command.

```
user@host> show chassis synchronization extensive

Current clock status   : Locked
Clock locked to        : Primary

Configured interfaces:

Name          : external
Signal type   : t1 (sf b8zs)
Rx status     : active
Tx status     : active
LED color     : green

Configured outputs:

Interface       : external
Tx status       : active
Minimum QL      : ST3               Tx QL         : ST3
Holdover mode   : disabled          Wander filter : disabled
Source mode     : line              Source Tx DNU : enabled
Holdover data   : valid
Current state   : locked to ge-4/0/1
  State for     : 0 days, 00 hrs, 24 mins, 47 secs
  State since   : Thu Sep  6 13:01:07 2012
```

```
Configured sources:

Interface            : external
Status               : Primary       Index        : 0
Clock source state   : Clk qualified Priority     : Default(6)
Configured QL        : PRS           ESMC QL      : PRS
Clock source type    : extern        Clock Event : Clock locked
Interface State      : Up,pri,

Interface            : ge-4/0/1
Status               : Secondary     Index        : 152
Clock source state   : Clk qualified Priority     : Default(8)
Configured QL        : ST3           ESMC QL      : DUS
Clock source type    : ifd           Clock Event : Clock qualified
Interface State      : Up,sec,ESMC TX(QL DUS/SSM 0xf),
```

Meaning

The Configured interfaces field shows that the external interface receive and transmit statuses are active. The Configured outputs field shows that the current state is locked to ge-4/0/1. The Configured sources field shows that the external interface is the qualified and selected centralized clock source, and has the Clock locked Clock Event. The Configured sources field shows that the ge-4/0/1 interface is the secondary clock source, and has the Clock qualified Clock Event.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232

Precision Time Protocol Overview | 68

Understanding Hybrid Mode | 357

7

CHAPTER

Configuring Hybrid Mode

Understanding Hybrid Mode | 357

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping | 365

Understanding Hybrid Mode

IN THIS SECTION

- Hybrid Mode Overview | 357
- Supporting Platforms | 359

The combined operation of Synchronous Ethernet and Precision Time Protocol (PTP) is also known as hybrid mode.

The following sections explain hybrid mode in detail:

Hybrid Mode Overview

In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the Modular Port Concentrator (MPC) derives the frequency from Synchronous Ethernet and the phase and time of day from PTP. Time synchronization includes both phase synchronization and frequency synchronization.

Synchronous Ethernet is a physical layer–based technology that functions regardless of the network load. Synchronous Ethernet supports hop-by-hop frequency transfer, where all interfaces on the trail must support Synchronous Ethernet. PTP (also known as IEEE 1588v2) synchronizes clocks between nodes in a network, thereby enabling the distribution of an accurate clock over a packet-switched network. This synchronization is achieved through packets that are transmitted and received in a session between a *primary clock* (commonly called the primary) and a *client clock* (also known as the client in PTP terminology).

> **NOTE**: Router clocks are categorized based on the role of the router in the network. They are broadly categorized into ordinary clocks and boundary clocks. The primary clock and the client clock are known as ordinary clocks. The boundary clock can operate as either a primary or a client.

Synchronous Ethernet works on the principle of frequency synchronization, whereby the frequencies of all the clocks (intermediate primary and client clocks) in the network are synchronized to the frequency of the primary clock at the starting end of the network trail. PTP works on the principle of phase synchronization and frequency synchronization—it synchronizes both frequency and phase, including time of day. Phase synchronization is achieved either by adjusting the phase of the client clock (the router's internal clock oscillator) discontinuously by receiving clock signals from the primary clock at irregular periods of time or by adjusting the phase-locked loop of the client internal clock at regular intervals. The accuracy of clock synchronization depends on factors such as packet delay variation, quality of oscillator used, network asymmetry, and so on.

Synchronous Ethernet and PTP provide frequency and phase synchronization; however, accuracy in the order of nanoseconds is difficult to achieve through PTP or Synchronous Ethernet and these technologies do not support a large number of network hops. Hybrid mode resolves these issues by extending the number of network hops and also provides clock synchronization accuracy in the order of tens of nanoseconds. Hybrid mode is configured on the client. On the client, you can configure one or more interfaces as Synchronous Ethernet source interfaces.

Hybrid mode has an internal threshold value of 100 nanoseconds for the PTP phase difference before the PTP phase adjustment can initiate. To understand PTP phase difference and adjustment, consider a scenario involving two PTP sources—PTP1 and PTP2—and one Synchronous Ethernet source. Assume that initially the PTP1 source and the Synchronous Ethernet source are up and the PTP2 source is down. Also, assume that the router clock (client) is synchronized to the available PTP source—PTP1—and the Synchronous Ethernet source. Suppose that after sometime the PTP1 source goes down because of technical issues—during which time the PTP2 source has come up—which, in turn, triggers the best primary clock algorithm to run automatically, latching the router clock to the next available PTP source—that is, the PTP2 source—and the Synchronous Ethernet source. Note that a PTP phase adjustment is triggered when the phase difference between the current actual time of day (TOD) and the TOD as calculated by the algorithm as a result of the communication with the PTP2 source is at least 100 nanoseconds. Although this phase difference can occur anytime during the operation of the router in hybrid mode, this phase difference is more likely to occur only during PTP source switchover. You must always add a measurement error of 10 through 20 nanoseconds to the original internal threshold value. This error adjustment results in a phase difference threshold value of 110–120 nanoseconds.

For information about configuring hybrid mode, see "Configuring Hybrid Mode and ESMC Quality Level Mapping" on page 361. You can use the **show ptp hybrid status** operational command to find the current operating mode.

NOTE: Starting in Junos OS Release 14.2R1, in hybrid mode, the EEC in the MPC derives frequency synchronization from Synchronous Ethernet and the phase and time of day from PTP. However, the **show chassis synchronization extensive** operational mode command output displays the lock status that is derived from the EEC located on the SCB.

Supporting Platforms

Hybrid mode is supported on the Juniper Networks MX104, MX240, MX480, and MX960 Universal Routing Platforms and on the Juniper Networks MX80 Universal Routing Platforms with precision timing support (MX80-P) and with timing support (MX80-T).

Starting in Junos OS Release 17.4R1, the 10GE, 40G, and 100GE WAN ports on MX10003 and MX204 routers support the hybrid mode feature.

On the MX240, MX480, MX960, MX2008, MX2010, and MX2020 routers, the combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same enhanced MPC and are traceable to the same primary reference clock (PRC). On MX10003, the Synchronous Ethernet source can be from any MPC for the combined operation.

Junos OS supports hybrid mode over link aggregation group(LAG) for MPC2E NG, MPC3E NG, MPC5E, MPC6E, MPC7E-10G, MPC7E–MRATE, MPC8E, MPC9E, and MPC10E line cards. The hybrid operation over LAG is supported only when primary and secondary Synchronous Ethernet interfaces are present on the same line card. The MPC2E NG and MPC3E NG line cards support PTP over IPv4 in hybrid mode over LAG. The MPC5E, MPC6E, MPC7E-10G, MPC7E–MRATE, MPC8E, and MPC9E line cards support both PTP over IPv4 and PTP over Ethernet in hybrid mode over LAG. The MPC10E line cards support PTP over Ethernet in hybrid mode over LAG

This table summarizes the first Junos OS release that supports hybrid mode over LAG on various Juniper Networks devices:

Table 18: Hybrid mode over LAG Support

Juniper Network Devices	PTP over IPv4 in hybrid mode over LAG	PTP over Ethernet in hybrid mode over LAG
MPC2E NG	17.2R1	–
MPC3E NG	17.2R1	–
MPC5E	17.2R1	18.2R1
MPC6E	17.2R1	18.2R1
MPC7E-10G	18.1R1	18.3R1

MPC7E–MRATE	18.1R1	18.3R1
MPC8E	18.1R1	18.3R1
MPC9E	18.1R1	18.3R1
MPC10E	–	21.1R1

When acting as PTP slaves, MX80-P routers can accept any external Synchronous Ethernet clock as reference and do not support building-integrated timing supply (BITS) input as frequency source in hybrid mode of operation. Only Synchronous Ethernet sources are allowed in hybrid mode. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

Unified in-service software upgrade (unified ISSU) is not supported when clock synchronization is configured for hybrid mode on MX80-P, MX80-T, MX10003, MX2008, MX2010, MX2020 routers, and on the MICs and enhanced MPCs on MX240, MX480, and MX960 routers.

NOTE: To switch between PTP and Synchronous Ethernet modes, you must first deactivate the configuration for the current mode and then commit the configuration. Wait for 30 seconds, configure the new mode and its related parameters, and then commit the configuration.

Release History Table

Release	Description
17.4R1	Starting in Junos OS Release 17.4R1, the 10GE, 40G, and 100GE WAN ports on MX10003 and MX204 routers support the hybrid mode feature.
14.2R1	Starting in Junos OS Release 14.2R1, in hybrid mode, the EEC in the MPC derives frequency synchronization from Synchronous Ethernet and the phase and time of day from PTP.

RELATED DOCUMENTATION

- Precision Time Protocol Overview | 68
- Synchronous Ethernet Overview | 232
- Centralized Clocking Overview | 270
- Understanding Clock Synchronization | 277

Configuring Hybrid Mode and ESMC Quality Level Mapping

IN THIS SECTION

- Configuring the Router in Hybrid Mode | **361**
- Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | **362**
- Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | **363**

You can configure hybrid mode (that is, the combined operation of Synchronous Ethernet and Precision Time Protocol (PTP)) on MX240, MX480, and MX960 Universal Routing Platforms and on MX80 Universal Routing Platforms with precision timing support (MX80-P) and with timing support (MX80-T). On the MX240, MX480, and MX960 routers, the combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same enhanced Modular Port Concentrator (MPC) and are traceable to the same primary. When acting as a PTP client, an MX80-P or MX80-T router can accept any external Synchronous Ethernet clock as reference. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the MPC derives the frequency from Synchronous Ethernet and the phase and time of day from PTP.

The hybrid mode is configured on the client. On the client, one or more interfaces are configured as Synchronous Ethernet source interfaces.

The ESMC quality level value is mapped to the clock class value either by mapping the PTP clock class to the ESMC quality level or by configuring a user-defined mapping of PTP clock class to ESMC quality level. For more information , see "Understanding ESMC Quality Level Mapping" on page 251. The following procedures explain configuring hybrid mode with either of the modes in detail.

Configuring the Router in Hybrid Mode

To configure the router in hybrid mode, you must:

1. Configure Synchronous Ethernet options at the **[edit chassis synchronization]** hierarchy level:

- Configure the **auto-select** mode of operation. You can select the clock source either from a free-run local oscillator or from an external qualified clock.

  When the router is configured with the **auto-select** option, the router chooses up to two best upstream clock sources. It then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable quality is not available or if the router is configured in free-run mode, the router uses the internal oscillator.

- Configure the **esmc-transmit** and **network-option** options at the **[edit chassis synchronization** hierarchy level.

- Configure one or more interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources as needed.

2. Configure PTP options at the **[edit protocols ptp]** hierarchy level.
3. Configure hybrid mode options at the **[edit protocols ptp slave]** hierarchy level.

Configuring Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level

To configure hybrid mode options with mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. In configuration mode, go to the **[edit protocols ptp slave]** hierarchy level:

```
[edit]
user@host# edit protocols ptp slave
```

2. Configure the **convert-clock-class-to-quality-level** option to set the default mapping between the ESMC SSM quality level and the PTP clock class.

```
[edit protocols ptp slave]
user@host# set convert-clock-class-to-quality-level
```

3. Configure the hybrid mode option on the client.

```
[edit protocols ptp slave]
user@host# edit hybrid
```

4. Configure the Synchronous Ethernet mapping option in hybrid mode.

```
[edit protocols ptp slave hybrid]
user@host# edit synchronous-ethernet-mapping
```

5. Configure the IP address of the clock source.

```
[edit protocols ptp slave hybrid synchronous-ethernet-mapping]
user@host# edit clock-source ip-address
```

6. Configure one or more Synchronous Ethernet source interfaces for the client as needed.

```
[edit protocols ptp slave hybrid synchronous-ethernet-mapping clock-source ip-
address]
user@host# set interface interface1-name
user@host# set interface interface2-name
```

NOTE: You must first configure these interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources. For information about configuring these interfaces, see "synchronization (MX Series)" on page 524.

Configuring Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level

To configure hybrid mode options with a user-defined mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. In configuration mode, go to the **[edit protocols ptp slave]** hierarchy level:

```
[edit]
user@host# edit protocols ptp slave
```

2. To override the default mapping option, perform the following steps:

a. Configure the **clock-class-to-quality-level-mapping** option with one of the quality level values. The quality level values are prc, prs, sec, smc, ssu-a, ssu-b, st2, st3, st3e, st4, stu, and tnc.

```
[edit protocols ptp slave]
user@host# edit clock-class-to-quality-level-mapping quality-level prc | prs | sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 | stu | tnc
```

b. Configure the **clock-class** option for the set quality level. The clock class value ranges from 80 through 109.

```
[edit protocols ptp slave clock-class-to-quality-level-mapping quality-level quality-level-value]
user@host# set clock-class clock-class
```

NOTE: In hybrid mode, the boundary node advertises the reference clock class value only after phase lock is achieved.

3. Configure the hybrid mode option on the client.

```
[edit protocols ptp slave]
user@host# edit hybrid
```

4. Configure the Synchronous Ethernet mapping option in hybrid mode.

```
[edit protocols ptp slave hybrid]
user@host# edit synchronous-ethernet-mapping
```

5. Configure the IP address of the clock source.

```
[edit protocols ptp slave hybrid synchronous-ethernet-mapping]
user@host# edit clock-source ip-address
```

6. Configure one or more Synchronous Ethernet source interfaces for the client as needed.

```
[edit protocols ptp slave hybrid synchronous-ethernet-mapping clock-source ip-address]
```

```
user@host# set interface interface1-name
user@host# set interface interface2-name
```

NOTE: You must first configure these interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources. For information about configuring these interfaces, see "synchronization (MX Series)" on page 524.

For information about verifying the aforementioned procedure, see "Example: Configuring Hybrid Mode and ESMC Quality Level Mapping" on page 361.

RELATED DOCUMENTATION

Precision Time Protocol Overview | **68**

Synchronous Ethernet Overview | **232**

Centralized Clocking Overview | **270**

Understanding Clock Synchronization | **277**

Example: Configuring Hybrid Mode and ESMC Quality Level Mapping

IN THIS SECTION

- Requirements for Hybrid Mode Configuration | **366**
- Overview | **366**
- Configuration | **367**
- Verification | **371**

This example shows the configuration of hybrid mode by mapping the PTP clock class to the ESMC quality level and also by configuring a user-defined mapping of the PTP clock class to the ESMC quality level on MX240 Universal Routing Platforms.

Requirements for Hybrid Mode Configuration

This example uses the following hardware and software components:

- One MX240 router.
- Junos OS Release 12.2R2 or later.

Overview

The combined operation of Synchronous Ethernet and Precision Time Protocol (PTP) is also known as hybrid mode. In hybrid mode, the synchronous Ethernet equipment clock (EEC) on the Modular Port Concentrator (MPC) derives the frequency from Synchronous Ethernet and the phase and time of day from PTP.

You can configure hybrid mode on MX240, MX480, and MX960 Universal Routing Platforms and on MX80 Universal Routing Platforms with precision timing support (MX80-P) and with timing support (MX80-T). On the MX240, MX480, and MX960 routers, the combined operation is possible only when the PTP client and the Synchronous Ethernet source are on the same enhanced MPC and are traceable to the same primary. When acting as a PTP client, an MX80-P or MX80-T router can accept any external Synchronous Ethernet clock as reference. Note that when the selected Synchronous Ethernet reference fails, the router continues to work in PTP mode.

Hybrid mode is configured on the client. On the client, one or more interfaces are configured as Synchronous Ethernet source interfaces.

> **NOTE**: You can set the values for each parameter according to your requirement. The values given in this example are for illustration purposes only.
>
> The ESMC quality level value is mapped to the clock class value either by mapping the PTP clock class to the ESMC quality level or by configuring a user-defined mapping of the PTP clock class to the ESMC quality level. For more information, see "Understanding ESMC Quality Level Mapping" on page 251. The following examples explain configuring hybrid mode with either of the modes in detail.

To configure the router in hybrid mode, you must:

1. Configure Synchronous Ethernet options at the **[edit chassis synchronization]** hierarchy level:
   - Configure the **auto-select** mode of operation. You can select the clock source either from a free-run local oscillator or from an external qualified clock.

When the router is configured with the **auto-select** option, the router chooses up to two best upstream clock sources. It then uses the clock recovered from one of the sources to lock the chassis clock. If an upstream clock with acceptable quality is not available or if the router is configured in free-run mode, the router uses the internal oscillator.

- Configure the **esmc-transmit** and **network-option** options at the **[edit chassis synchronization]** hierarchy level.
- Configure one or more interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources as needed.

2. Configure PTP options at the **[edit protocols ptp]** hierarchy level.
3. Configure hybrid mode options at the **[edit protocols ptp slave]** hierarchy level.

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode*. For step-by-step configuration of hybrid mode, see "Configuring Hybrid Mode and ESMC Quality Level Mapping" on page 361.

Configuration

IN THIS SECTION

- Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level | **367**
- Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level | **369**

Hybrid Mode with Mapping of the PTP Clock Class to the ESMC Quality Level

CLI Quick Configuration

To quickly configure hybrid mode on the ge-1/2/3.0 interface with the clock source IP address as 2.2.2.2, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

[edit]

set protocols ptp slave hybrid

set protocols ptp slave hybrid synchronous-ethernet-mapping

set protocols ptp slave hybrid synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-1/2/3.0

set protocols ptp slave convert-clock-class-to-quality-level

Step-by-Step Procedure

To configure hybrid mode on an MX240 router with mapping of the PTP clock class to the ESMC quality level, perform the following steps:

1. Configure the **convert-clock-class-to-quality-level** option on the client at the **[edit protocols ptp slave]** hierarchy level.

   ```
   [edit protocols ptp slave]
   user@host# set convert-clock-class-to-quality-level
   ```

2. Configure hybrid mode on the client.

   ```
   [edit protocols ptp slave]
   user@host# edit hybrid
   ```

3. Configure the Synchronous Ethernet mapping option, IP address of the primary clock as 2.2.2.2, and the interface ge-1/2/3.0 for hybrid mode on the client.

   ```
   [edit protocols ptp slave hybrid]
   user@host# set synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-1/2/3.0
   ```

Results

Display the results of the configuration of hybrid mode with the mapping of the PTP clock class to the ESMC quality level:

```
[edit protocols ptp slave]
user@host# show
convert-clock-class-to-quality-level
hybrid {
```

```
     synchronous-ethernet-mapping {
         clock-source 2.2.2.2 {
         interface  ge-1/2/3.0;
         }
     }
}
```

Hybrid Mode with a User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level

CLI Quick Configuration

To quickly configure hybrid mode on the interface ge-1/2/3.0, copy the following commands, paste them in a text file, remove any line breaks, and then copy and paste the commands into the CLI.

[edit]

set protocols ptp slave hybrid

set protocols ptp slave hybrid synchronous-ethernet-mapping

set protocols ptp slave hybrid synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-1/2/3.0

set protocols ptp slave clock-class-to-quality-level-mapping quality-level prc clock-class 80

Step-by-Step Procedure

To configure hybrid mode with a user-defined mapping of the PTP clock class to the ESMC quality level on an MX240 router, perform the following steps:

1. Configure the **quality-level** option for the **clock-class-to-quality-level-mapping** statement on the client at the **[edit protocols ptp slave]** hierarchy level and then configure the **clock-class** option for the set quality level if you want to manually override the mapping of the ESMC quality level to the clock class.

   ```
   [edit protocols ptp slave]
   user@host# set clock-class-to-quality-level-mapping quality-level prc clock-class 80
   ```

2. Configure hybrid mode on the client.

```
[edit protocols ptp slave]
user@host# edit hybrid
```

3. Configure the Synchronous Ethernet mapping option, IP address of the primary clock as 2.2.2.2 , and the interface ge-1/2/3.0 for hybrid mode on the client.

```
[edit protocols ptp slave hybrid]
user@host# set synchronous-ethernet-mapping clock-source 2.2.2.2 interface ge-1/2/3.0
```

Results

Display the results of the configuration of hybrid mode with a user-defined mapping of the PTP clock class to the ESMC quality level:

```
[edit protocols ptp slave]
user@host# show
clock-class-to-quality-level-mapping {
    quality-level prc {
        clock-class 80;
    }
}
hybrid {
    synchronous-ethernet-mapping {
        clock-source 2.2.2.2 {
        interface ge-1/2/3.0;
        }
    }
}
```

Verification

IN THIS SECTION

- Verifying That the Router Is Operating in Hybrid Mode | 371
- Verifying the Quality Level Change on the Transmit Side | 371
- Verifying Global Information Parameters After Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode | 372
- Verifying Global Information Parameters After Configuring User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode | 373

Verifying That the Router Is Operating in Hybrid Mode

Purpose

Verify the current mode of operation of the client.

Action

In operational mode, enter the **run show ptp hybrid** command to display the current configuration and current mode of operation of the client.

In operational mode, enter the **run show ptp hybrid config** command to display the PTP source to Synchronous Ethernet interface mappings.

In operational mode, enter the **run show ptp hybrid status** command to display the current hybrid mode operational status.

Meaning

The output displays the current configuration and current mode of operation of the client. For information about the **run show ptp hybrid** operational command, see "show ptp hybrid" on page 624.

Verifying the Quality Level Change on the Transmit Side

Purpose

Verify the quality level change on the transmit side of the router.

Action

In operational mode, enter the **run show synchronous-ethernet esmc transmit detail** command to display the ESMC transmit interface details.

Meaning

The output displays the ESMC SSM quality level transmitted out of various Ethernet interfaces. For information about the **run show synchronous-ethernet esmc transmit detail** operational command, see "show synchronous-ethernet esmc transmit" on page 669.

Verifying Global Information Parameters After Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode

Purpose

Verify the global information parameters after mapping of the PTP clock class to the ESMC quality level in hybrid mode by enabling the **convert-clock-class-to-quality-level** option.

Action

In operational mode, enter the **run show ptp global-information** command to display the following output:

```
user@host> run show ptp global-information
PTP Global Configuration:
Domain number            : 0
Transport Encapsulation : IPv4
Clock mode               : Ordinary
Priority Level1          : 128
Priority Level2          : 128
Unicast Negotiation      : Disabled
ESMC QL From Clock Class: Enabled
Clock Class/ESMC QL      : 84 / (QL SSU-A/SSM 0x4)
Slave Parameters:
  Sync Interval          : -
  Delay Request Interval: -6 (64 packets per second)
  Announce Interval      : -
  Announce Timeout       : 3
Master Parameters:
  Sync Interval          : -6 (64 packets per second)
```

```
    Delay Request Interval: -
    Announce Interval     : 1 (1 packet every 2 seconds)
    Clock Step            : one-step
  Number of Slaves       : 1
  Number of Masters      : 0
```

In operational mode, enter the **run show ptp quality-level-mapping** command to display the following output:

```
user@host> run show ptp quality-level-mapping
quality level         ptp clock class
PRC                         84
SSU-A                       92
SSU-B                       96
SEC                         104
```

Meaning

The output for **run show ptp global-information** displays the parameters set in Synchronous Ethernet mode and the parameters set for the primary and the client.

The output of **run show ptp quality-level-mapping** displays the default mapping of the clock class to the ESMC quality level.

Verifying Global Information Parameters After Configuring User-Defined Mapping of the PTP Clock Class to the ESMC Quality Level in Hybrid Mode

Purpose

Verify the global information parameters after configuring a user-defined mapping of the PTP clock class to the ESMC quality level in hybrid mode by disabling the **convert-clock-class-to-quality-level** option.

Action

In operational mode, enter the **run show ptp global-information** command to display the following output:

```
user@host> run show ptp global-information
PTP Global Configuration:
Domain number            : 0
```

```
Transport Encapsulation : IPv4
Clock mode              : Ordinary
Priority Level1         : 128
Priority Level2         : 128
Unicast Negotiation     : Disabled
ESMC QL From Clock Class: Disabled
Clock Class/ESMC QL     :  -
Slave Parameters:
  Sync Interval         : -
  Delay Request Interval: -6 (64 packets per second)
  Announce Interval     : -
  Announce Timeout      : 3
Master Parameters:
  Sync Interval         : -6 (64 packets per second)
  Delay Request Interval: -
  Announce Interval     : 1 (1 packet every 2 seconds)
  Clock Step            : one-step
```

Meaning

The output displays the parameters set in Synchronous Ethernet mode and the parameters set for the primary and the client.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Synchronous Ethernet Overview | 232

Centralized Clocking Overview | 270

Understanding Clock Synchronization | 277

8

CHAPTER

Configuration Statements

aggregated-ether | 378

acquiring-state-announce-grandmaster | 379

bits (Chassis Synchronization) | 381

clock-class | 384

clock-class-to-quality-level-mapping | 385

clock-ipv6-source | 387

clock-source (hybrid) | 389

clock-mode | 391

clock-mode (Clock Synchronization) | 392

clock-ipv6-client | 394

convert-clock-class-to-quality-level | 396

domain | 398

e1-options (BITS Interfaces Signal Type) | 399

e1-options (Clock Synchronization) | 401

e2e-transparent | 403

esmc-transmit (Chassis Synchronization) | 405

force-switch | 407

framing (E1 Options) | 408

framing (T1 Options) | 410

framing (E1 Options for BITS Interfaces) | 411 framing (T1 Options for BITS Interfaces) | 413

global-wait-to-restore | 415

hold-interval (Clock Synchronization) | 417

holdover-mode-disable | 419

holdover-time-error-budget | 420

hold off time | 422

hybrid | 423

interface | 425

interfaces external | 427

ipv4-dscp | 429

line-encoding (E1 Options) | 430

line-encoding (E1 Options) | 432

line-encoding (T1 Options) | 433

local-priority | 435

master | 436

max-transmit-quality-level | 440

minimum-quality | 443

network-option | 445

ntp | 447

ntp (QFabric) | 454

output interfaces (Chassis Synchronization) | 455

phy-timestamping | 458

port (Chassis Synchronization) | 459

primary | 461

priority1 | 463

priority2 | 465

priority (Clock Synchronization) | 466

profile-type | 468

pulse-per-second-enable | 472

quality-level (Clock Synchronization) | 474

quality-level (hybrid) | 476

quality-mode-enable (MX) | 478

quality-mode-enable (PTX) | 480

recovered-clock | 482

remote-ip-address | 483

request (Clock Synchronization) | 486

sabit | 487

secondary | 489

selection-mode | 491

signal-type | 492

signal-type (BITS Interfaces) | 494

server (NTP) | 496

slave | 498

source-address (RADIUS, System Logging, or TACACS+) | 503

source-mode | 505

source interfaces | 507

stateful | 510

squelch | 512

switchover-mode | 515

synchronization (ACX Series) | 517

synchronization (M Series and T Series) | 521

synchronization (MX Series) | 524

synchronization (PTX Series) | 531

synchronous-ethernet-mapping | 534

t1-options | 535

t1-options (BITS Interfaces Signal Type) | 537

time-zone | 539

tx-dnu-to-line-source-enable | 543

unicast-mode | 544

unicast-negotiation | 547

use-imported-time-zones | 549

wait-to-restore | 550

wander-filter-disable | 552

aggregated-ether

IN THIS SECTION

- Syntax | 378
- Hierarchy Level | 378
- Description | 378
- Options | 379
- Required Privilege Level | 379
- Release Information | 379

Syntax

```
aggregated ether aggregated-ether-group-name;
```

Hierarchy Level

```
[edit chassis synchronization source interfaces ]
```

Description

Specify an aggregated Ethernet group while configuring a member of the group as the clock source. This is an optional setting. Any number of interfaces from an aggregated Ethernet group can be configured as the clock source. If a member from the aggregated Ethernet group is selected as the locked clock source, then all the members of the group will transmit the Do not Use (DNU) ESMC quality level.

Options

aggregated-ether-group-name	aggregated ethernet group name

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.2R1.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

show chassis synchronization | **576**

acquiring-state-announce-grandmaster

IN THIS SECTION

- Syntax | **380**
- Hierarchy Level | **380**
- Description | **380**
- Options | **380**
- Required Privilege Level | **380**
- Release Information | **380**

Syntax

```
acquiring-state-announce-grandmaster {
    default-ts;
}
```

Hierarchy Level

```
[edit logical-systems name   protocols ptp]
[edit protocols ptp]
```

Description

Use grandmaster data set for announce messages when in acquiring state.

Options

default-ts	Local data set for announce messages when in acquiring state.

Required Privilege Level

routing

Release Information

Statement introduced in Junos OS Release 20.4R1.

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | 103

Precision Time Protocol Overview | 68

bits (Chassis Synchronization)

IN THIS SECTION

- Syntax | 381
- Syntax (ACX710: Interfaces Hierarchy) | 382
- Syntax (ACX710: Output Interfaces Hierarchy) | 382
- Hierarchy Level | 382
- Description | 382
- Options | 383
- Required Privilege Level | 383
- Release Information | 383

Syntax

```
bits {
    signal-type (e1 | t1);
    e1-options {
        framing (g704 | g704-no-cro4);
    }
    t1-options {
        framing (esf | sf);
    }
}
```

Syntax (ACX710: Interfaces Hierarchy)

```
bits {
    signal-type (e1 | t1);
    e1-options {
        framing (g704 | g704-no-cro4);
    }
    t1-options {
        framing (esf | sf);
    }
}
```

Syntax (ACX710: Output Interfaces Hierarchy)

```
bits {
    source-mode (chassis | ptp-clock);
    squelch {
        method (ais | ql-dnu | rai | shut);
    }
    ssm option-2  (GEN-1 | GEN-2);
}
```

Hierarchy Level

```
[edit chassis synchronization interfaces]
[edit chassis synchronization output interfaces]
```

Description

Configure the parameters of the building-integrated timing supply (BITS) interface.

NOTE: **bits** is not supported on the ACX1000 router.

Options

ssm option-2 (GEN-1 | GEN-2)	(ACX710 only) Specify the type of synchronization status message (SSM). Choose message type Generation 1 or Generation 2.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

source-mode, **squelch**, and **ssm** options introduced in Junos OS Release 20.2R1.

RELATED DOCUMENTATION

- External Clock Synchronization Overview for ACX Series Routers | **23**
- Configuring External Clock Synchronization for ACX Series Routers | **26**
- Synchronous Ethernet Overview | **232**
- show chassis synchronization | **576**

clock-class

IN THIS SECTION

- Syntax | 384
- Hierarchy Level | 384
- Description | 384
- Default | 384
- Required Privilege Level | 385
- Release Information | 385

Syntax

```
clock-class clock-class-value;
```

Hierarchy Level

```
[edit protocols ptp client clock-class-to-quality-level-mapping ]
```

Description

Configure the clock class to the set ESMC quality level.

Default

Following are the default clock class values for various clocks:

- Boundary clock–248
- Ordinary clock (primary)–52
- Ordinary clock (client)–255

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Understanding Hybrid Mode | 357
Precision Time Protocol Overview | 68
Synchronous Ethernet Overview | 232

clock-class-to-quality-level-mapping

IN THIS SECTION

Syntax | 386
Hierarchy Level | 386
Description | 386

- Required Privilege Level | 386
- Release Information | 387

Syntax

```
clock-class-to-quality-level-mapping {
    clock-class clock-class-value;
    {
        quality-level ql-value;
    }
}
```

Hierarchy Level

```
[edit protocols ptp slave]
```

Description

Configure the client to override the default Precision Time Protocol (PTP) clock class to Ethernet Synchronization Message Channel (ESMC) mapping.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Understanding Hybrid Mode | 357
Precision Time Protocol Overview | 68
Synchronous Ethernet Overview | 232

clock-ipv6-source

IN THIS SECTION

- Syntax | 387
- Hierarchy Level | 388
- Description | 388
- Options | 388
- Required Privilege Level | 388
- Release Information | 388

Syntax

```
clock-ipv6-source master-ipv6-address {
    local-ip-address local-ip-address;
}
```

Hierarchy Level

```
[edit protocols ptp client interface interface-name unicast-mode transport]
```

Description

Configure the IPv6 address of the primary.

Options

master-ipv6-address—IPv6 address for the primary.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 16.1.

RELATED DOCUMENTATION

- Configuring Precision Time Protocol | **82**
- Configuring Precision Time Protocol | **82**
- Precision Time Protocol Overview | **68**

clock-source (hybrid)

IN THIS SECTION

- Syntax | **389**
- Hierarchy Level | **389**
- Description | **389**
- Options | **390**
- Required Privilege Level | **390**
- Release Information | **390**

Syntax

```
clock-source ip-address {
    interface interface1-name;
    interface interface2-name;
}
```

Hierarchy Level

```
[edit protocols ptp slave hybrid synchronous-ethernet-mapping]
```

Description

Configure the IP address of the PTP primary and its possible Synchronous Ethernet source interfaces.

Options

interface *interface1-name*—Synchronous Ethernet interface traceable to the same PTP primary clock.

interface *interface2-name*—Synchronous Ethernet interface traceable to the same PTP primary clock.

NOTE: You must first configure these interfaces at the **[edit chassis synchronization]** hierarchy level as Synchronous Ethernet sources. For information about configuring the interfaces, see "synchronization (MX Series)" on page 524.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

- Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**
- Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**
- Understanding Hybrid Mode | **357**
- Precision Time Protocol Overview | **68**
- Synchronous Ethernet Overview | **232**

clock-mode

IN THIS SECTION

- Syntax | 391
- Hierarchy Level | 391
- Description | 391
- Options | 392
- Required Privilege Level | 392
- Release Information | 392

Syntax

```
clock-mode (boundary | ordinary);
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the clock mode as either boundary clock or ordinary clock. The clock mode determines whether the node is going to act as a client, primary, or both. This attribute is mandatory and has no default value.

Options

boundary—The clock mode of the node is a boundary clock where the clock acts as both primary and client.

ordinary—The clock mode of the node is a system clock where the clock acts either as a primary or as a client. The **ordinary** option is not supported on ACX710 devices.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | 82

Configuring Precision Time Protocol | 82

Precision Time Protocol Overview | 68

IEEE 1588v2 Precision Timing Protocol (PTP) | 103

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

clock-mode (Clock Synchronization)

IN THIS SECTION

- Syntax | 393

- Hierarchy Level | 393
- Description | 393
- Default | 393
- Options | 394
- Required Privilege Level | 394
- Release Information | 394

Syntax

```
clock-mode (auto-select | free-run);
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the mode of operation to select the clock source from a free-run local oscillator or from an external qualified clock. On MX240, MX480, and MX960 routers with enhanced MPCs, the free-run clock is provided by a local oscillator. On other MX Series routers, the free-run clock is provided by the SCB.

Default

auto-select

Options

auto-select	Select the best external clock source as a clock source.
free-run	Select the free-run local oscillator as a clock source.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

clock-ipv6-client

IN THIS SECTION

- Syntax | 395
- Hierarchy Level | 395
- Description | 395
- Options | 395
- Required Privilege Level | 395
- Release Information | 395

Syntax

```
clock-ipv6-client  slave-ip-address;
```

Hierarchy Level

```
[edit protocols ptp master interface interface-name unicast-mode transport ipv4]
```

Description

Configure the IPv6 address of the client.

Options

slave-ip-address—The IPv6 address for the client.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 16.1.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | 82
Configuring Precision Time Protocol | 82
Precision Time Protocol Overview | 68

convert-clock-class-to-quality-level

IN THIS SECTION

- Syntax | 396
- Hierarchy Level | 396
- Description | 397
- Required Privilege Level | 397
- Release Information | 397

Syntax

```
convert-clock-class-to-quality-level;
```

Hierarchy Level

```
[edit protocols ptp slave]
```

Description

Configure the client to enable it to retrieve Ethernet Synchronization Message Channel (ESMC) information from the Precision Time Protocol (PTP) clock class.

When this option is set, the outgoing quality level depends on the PTP clock class mapping, irrespective of the clock being configured in hybrid mode or pure PTP mode. This is the default mapping mode of the ESMC quality level value to the clock class.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**

Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**

Precision Time Protocol Overview | **68**

Synchronous Ethernet Overview | **232**

Understanding ESMC Quality Level Mapping | **251**

Understanding Hybrid Mode | **357**

domain

IN THIS SECTION

- Syntax | 398
- Hierarchy Level | 398
- Description | 398
- Options | 399
- Required Privilege Level | 399
- Release Information | 399

Syntax

```
domain domain-value;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure multiple independent Precision Time Protocol (PTP) domains.

> **NOTE**: Only one PTP domain is supported at any given point in time.

Options

domain-value—The PTP domain value. The range depends on the selected profile type.

- **Range:** 0 through 127
- **Default:** 0
- **Range:** 44 to 63 for profile type g.8275.2
- **Default:** 44 for profile type g.8275.2

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | **82**

Configuring Precision Time Protocol | **82**

Precision Time Protocol Overview | **68**

e1-options (BITS Interfaces Signal Type)

IN THIS SECTION

Syntax | **400**

- Hierarchy Level | 400
- Description | 400
- Options | 400
- Required Privilege Level | 401
- Release Information | 401

Syntax

```
e1-options {
    framing (g704 | g704-no-cro4);
}
```

Hierarchy Level

```
[edit chassis synchronization interfaces bits ]
```

Description

Specify options for the E1 signal type for the building-integrated timing supply (BITS) interface. Valid only if **e1** is the `signal-type` configured at the [**edit chassis synchronization source interfaces *interface-name* bits signal-type**] hierarchy.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**

Configuring External Clock Synchronization for ACX Series Routers | **26**

Synchronous Ethernet Overview | **232**

show chassis synchronization | **576**

e1-options (Clock Synchronization)

IN THIS SECTION

- Syntax | **402**
- Hierarchy Level | **402**
- Description | **402**
- Options | **402**
- Required Privilege Level | **402**
- Release Information | **403**

Syntax

```
e1-options {
     framing (g704 | g704-no-crc4);
    line-encoding (ami | hdb3);
    sabit bit;
}
```

Hierarchy Level

```
[edit chassis synchronization interfaces external]
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
```

Description

Configure the E1 interface options.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

e2e-transparent

IN THIS SECTION

- Syntax | 403
- Hierarchy Level | 403
- Description | 404
- Options | 404
- Required Privilege Level | 404
- Release Information | 404

Syntax

```
e2e-transparent;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the end-to-end (E2E) transparent clock for Precision Time Protocol (PTP). With an end-to-end transparent clock, only the residence time is included in the timestamp in the packet. Transparent clock functionality is supported on PTP over Ethernet, IPv4, IPv6, unicast, and multicast. With PTP over Ethernet, one or two VLANs are supported. Transparent clock functionality is enabled globally and might be required in scenarios in which the interface on which packets are received and transmitted is unknown.

NOTE: ACX5048 and ACX5096 routers do not support PTP over IPv6 for transparent clocks.

Options

There are no options.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 14.1X53-D25.

Statement introduced in Junos OS Release 20.1R1 EVO for QFX5220 devices

RELATED DOCUMENTATION

Configuring Transparent Clock Mode for Precision Time Protocol | **117**

esmc-transmit (Chassis Synchronization)

IN THIS SECTION

- Syntax | 405
- ACX710 | 405
- Hierarchy Level | 406
- Description | 406
- Options | 406
- Required Privilege Level | 406
- Release Information | 406

Syntax

```
esmc-transmit {
    interfaces (all | interface-name);
}
```

ACX710

```
esmc-transmit {
    interfaces {
        (all | interface-name) {
            squelch {
                method ql-dnu;
                quality-level quality-level;
            }
        }
    }
}
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Enable Ethernet Synchronization Message Channel (ESMC) packet transmission on all interfaces or on a specific interface.

Options

interfaces (all | *interface-name*)	Specify the interface. To enable ESMC packet transmission on all interfaces, use **all**. To enable ESMC packet transmission on one interface, use the name of the interface.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

bits option introduced in Junos OS Release 20.2R1.

RELATED DOCUMENTATION

Interfaces Fundamentals

synchronization (ACX Series) | 517
synchronization (MX Series) | 524
synchronization (PTX Series) | 531
show chassis synchronization | 576

force-switch

IN THIS SECTION

- Syntax | 407
- Hierarchy Level | 407
- Description | 408
- Required Privilege Level | 408
- Release Information | 408

Syntax

```
force-switch;
```

Hierarchy Level

```
[edit chassis synchronization source  (external | interface-name)]
```

Description

For MX Series routers operating with Synchronous Ethernet, force a router to use the clock source. provided that the source is enabled and not locked out. Only one configured source may be force-switched.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

framing (E1 Options)

IN THIS SECTION

- Syntax | 409
- Hierarchy Level | 409
- Description | 409
- Options | 409
- Required Privilege Level | 409
- Release Information | 409

Syntax

```
framing (g704 | g704-no-crc4);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external e1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) e1-
options]
```

Description

Configure the framing format for the E1 interface.

Options

g704	Set the G.704 framing format for E1 interfaces.
g704-no-crc4	Set the G.704 framing without CRC4 for E1 interfaces.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

framing (T1 Options)

IN THIS SECTION

- Syntax | 410
- Hierarchy Level | 410
- Description | 410
- Options | 411
- Required Privilege Level | 411
- Release Information | 411

Syntax

```
framing (esf | sf);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external t1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) t1-
options]
```

Description

Configure the framing format for the T1 interface.

Options

esf	Set the framing format as extended super frame.
sf	Set the framing format as super frame.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

framing (E1 Options for BITS Interfaces)

IN THIS SECTION

- Syntax | 412
- Hierarchy Level | 412
- Description | 412
- Options | 412
- Required Privilege Level | 412
- Release Information | 413

Syntax

```
framing (g704 | g704-no-cro4);
```

Hierarchy Level

```
[edit chassis synchronization interfaces bits e1-options]
```

Description

Configure the framing format for the building-integrated timing supply (BITS) interface when the signal type is E1. Valid only when **e1** is the `signal-type` configured at the [**edit chassis synchronization source interfaces *interface-name* bits signal-type**] hierarchy.

Options

g704	G.704 framing format for E1 interfaces.
g704-no-crc4	G.704 framing with no cyclic redundancy check 4 (CRC4) for E1 interfaces.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | 23
Configuring External Clock Synchronization for ACX Series Routers | 26
Synchronous Ethernet Overview | 232
show chassis synchronization | 576

framing (T1 Options for BITS Interfaces)

IN THIS SECTION

- Syntax | 413
- Hierarchy Level | 414
- Description | 414
- Options | 414
- Required Privilege Level | 414
- Release Information | 414

Syntax

```
framing (esf | sf);
```

Hierarchy Level

```
[edit chassis synchronization interfaces bits t1-options]
```

Description

Configure the framing format for the building-integrated timing supply (BITS) interface when the signal type is T1 . Valid only when **t1** is the `signal-type` configured at the [**edit chassis synchronization source interfaces *interface-name* bits signal-type**] hierarchy.

Options

esf	Extended superframe (ESF) mode for T1 interfaces.
sf	Superframe (SF) mode for T1 interfaces.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**

Configuring External Clock Synchronization for ACX Series Routers | **26**

Synchronous Ethernet Overview | 232
show chassis synchronization | 576

global-wait-to-restore

IN THIS SECTION

- Syntax | 415
- Hierarchy Level | 415
- Description | 415
- Options | 416
- Required Privilege Level | 416
- Release Information | 416

Syntax

```
global-wait-to-restore minutes;
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Use this statement to configure the global time to wait before opening the interface to receive ESMC messages.

When an interface's signal transitions out of the signal fail state, it must be fault-free for the global-wait-to-restore time before it is again considered by the clock selection process.

When the ESMC clock's EEC quality level (QL) mode is enabled, it sends a signal failure to the clock selection process during the global wait-to-restore time. After the global wait-to-restore time ends, a new quality level value is sent to the clock selection process.

To override the global wait-to-restore time on a specific interface, include the "wait-to-restore" on page 550 statement at the **[edit chassis source interfaces (external-a | external-b | interface *interface-name*)]** hierarchy level.

Options

minutes Set the time for the port signal to be up before the port is opened to receive and transmit ESMC messages.

- **Range:** 0 through 12 minutes
- **Default:** 5 minutes

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 14.2.

RELATED DOCUMENTATION

synchronization (ACX Series) | **517**

synchronization (MX Series) | **524**

synchronization (PTX Series) | **531**

wait-to-restore | **550**

hold-interval (Clock Synchronization)

IN THIS SECTION

- Syntax | 417
- Hierarchy Level | 417
- Description | 417
- Options | 418
- Required Privilege Level | 418
- Release Information | 418

Syntax

```
hold-interval {
    configuration-change seconds;
    restart seconds;
    switchover seconds;
}
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the wait time for clock selection after a change in configuration and after a reboot of the router, and configure the switchover wait time after clock recovery.

Options

configuration-change	Set the wait time for clock selection after a change in configuration. • **Range:** 15 seconds through 60 seconds
restart	Set the wait time for clock selection after reboot of the router. • **Range:** 60 seconds through 180 seconds • **Default:** 120 seconds
switchover	Set the switchover wait time after clock recovery. • **Range:** 30 seconds through 60 seconds. • **Default:** 30 seconds

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

holdover-mode-disable

IN THIS SECTION

- Syntax | 419
- Hierarchy Level | 419
- Description | 419
- Required Privilege Level | 419
- Release Information | 420

Syntax

```
holdover-mode-disable;
```

Hierarchy Level

```
[edit chassis synchronization output interfaces external]
[edit chassis synchronization output interfaces (external-0/0 | external-1/0)]
```

Description

Disable the holdover mode on the external output interface—external—on SCBE or on the external output interfaces—external-0/0 and external-1/0—on SCBE2.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

holdover-time-error-budget

IN THIS SECTION

- Syntax | 420
- Hierarchy Level | 421
- Description | 421
- Default | 421
- Required Privilege Level | 421
- Release Information | 421

Syntax

```
holdover-time-error-budget holdover-time-error-budget;
```

Hierarchy Level

```
[edit logical-systems name   protocols ptp]
[edit protocols ptp]
```

Description

Configure the PTP clock hold-over-in-specification time error budget. The range supported is 0 to 10000 nano seconds.

Default

400 nanoseconds

Required Privilege Level

routing

Release Information

Statement introduced in Junos OS Release 20.4R1.

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

Precision Time Protocol Overview | **68**

hold off time

IN THIS SECTION

- Syntax | 422
- Hierarchy Level | 422
- Description | 422
- Options | 422
- Required Privilege Level | 423
- Release Information | 423

Syntax

hold-off-time *time*;

Hierarchy Level

[**set chassis synchronization** `source interfaces`]

Description

Enable hold-off time for Synchronous Ethernet interfaces and external clock source interfaces. If an interface goes down, hold-off time delays short signal failures from being sent to the clock selection process to prevent rapid successive switching.

Options

time	Amount of time in milliseconds that a signal is held before being passed to the clock selection process.

Range: 300–1800 milliseconds

Default: 1000 milliseconds

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 14.2.

RELATED DOCUMENTATION

Configuring Clock Synchronization Interface on MX Series Routers | 303
Ethernet Synchronization Message Channel Overview | 244

hybrid

IN THIS SECTION

- Syntax | 424
- Hierarchy Level | 424
- Description | 424
- Required Privilege Level | 424
- Release Information | 424

Syntax

```
hybrid {
    synchronous-ethernet-mapping {
        clock-source ip-address {
            interface interface1-name;
            interface interface2-name;
        }
    }
}
```

Hierarchy Level

```
[edit protocols ptp slave]
```

Description

Configure hybrid mode.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**

Configuring Hybrid Mode and ESMC Quality Level Mapping | **361**

Understanding Hybrid Mode | **357**

Precision Time Protocol Overview | **68**

Synchronous Ethernet Overview | **232**

interface

IN THIS SECTION

- Syntax | **425**
- Hierarchy Level | **426**
- Description | **426**
- Options | **426**
- Required Privilege Level | **426**

Syntax

```
interface interface-name {
    unicast-mode {
        clock-source ip-address {
            local-ip-address local-ip-address;
            }
        }
        transport ipv4;
    }
}
```

Hierarchy Level

```
[edit protocols ptp slave]
```

Description

The interface on which to respond to the upstream PTP primary.

Options

unicast-mode	Configure upstream unicast PTP primary clock sources
clock-source	Configure the parameters of the PTP.
local-ip-address	Configure the IP address of the local interface acting as the client.
asymmetry	Specify the asymmetry value between the primary and the client.
transport	Configure the encapsulation type for PTP packet transport.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

Precision Time Protocol Overview | **68**

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | **119**

interfaces external

IN THIS SECTION

- Syntax | 427
- Hierarchy Level | 428
- Description | 428
- Options | 428
- Required Privilege Level | 428
- Release Information | 428

Syntax

```
interfaces {
external/external-0-0/external-1/0 {
    e1-options {
        framing (g704 | g704-no-crc4);
        line-encoding (ami | hdb3);
        sabit bit;
    }
    signal-type (1mhz | 5mhz | 10mhz | 2048khz | t1 | e1);
    t1-options {
        framing (esf | sf);
        line-encoding (ami | b8zs);
    }
    pulse-per-second-enable;
    }
}
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Starting from Junos OS Release 12.3, configure options for the external clock source interface—external—for SCBE.

Starting from Junos OS Release 13.3, configure options for the two external clock source interfaces—external-0/0 and external-1/0—for SCBE2.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

ipv4-dscp

IN THIS SECTION

- Syntax | 429
- Hierarchy Level | 429
- Description | 429
- Options | 429
- Required Privilege Level | 430

Syntax

```
ipv4-dscp number
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Specify the value used as the DiffServ code point (DSCP) value for all Precision Time Protocol (PTP) IPv4 packets originated by the router.

Options

number—DiffServ code point (DSCP) value for all PTP IPv4 packets originated by the router.

- **Range:** 0 through 63
- **Default:** 56

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

RELATED DOCUMENTATION

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

Precision Time Protocol Overview | **68**

line-encoding (E1 Options)

IN THIS SECTION

- Syntax | **430**
- Hierarchy Level | **431**
- Description | **431**
- Options | **431**
- Required Privilege Level | **431**
- Release Information | **431**

Syntax

```
line-encoding (ami | hdb3);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external e1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) e1-
options]
```

Description

Configure the line encoding format on the E1 interface.

Options

ami	Set the line encoding format as automatic mark inversion.
hdb3	Set the line encoding format as high-density bipolar 3 code.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

line-encoding (E1 Options)

IN THIS SECTION

- Syntax | 432
- Hierarchy Level | 432
- Description | 432
- Options | 433
- Required Privilege Level | 433
- Release Information | 433

Syntax

```
line-encoding (ami | hdb3);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external e1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) e1-
options]
```

Description

Configure the line encoding format on the E1 interface.

Options

ami	Set the line encoding format as automatic mark inversion.
hdb3	Set the line encoding format as high-density bipolar 3 code.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

line-encoding (T1 Options)

IN THIS SECTION

- Syntax | 434
- Hierarchy Level | 434
- Description | 434
- Options | 434
- Required Privilege Level | 434
- Release Information | 434

Syntax

```
line-encoding (ami | b8zs);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external t1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) t1-
options]
```

Description

Configure the line encoding format on the T1 interface.

Options

ami	Set the line encoding format as automatic mark inversion.
b8zs	Set the line encoding format as 8-bit zero suppression.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

local-priority

IN THIS SECTION

- Syntax | 435
- Hierarchy Level | 435
- Description | 435
- Options | 436
- Required Privilege Level | 436
- Release Information | 436

Syntax

```
local-priority local-priority;
```

Hierarchy Level

```
[edit logical-systems name                protocols ptp],
[edit protocols ptp]
```

Description

Priority assigned to the local clock.

Options

local-priority *value*	The priority value of the clock. **Range:** 1 through 255 **Default:** 128

Required Privilege Level

routing

Release Information

Statement introduced in Junos OS Release 20.4

master

IN THIS SECTION

- MX Series | 437
- QFX Series | 437
- ACX Series (ACX5448, ACX5448-D, and ACX5448-M) | 438
- Hierarchy Level | 438
- Description | 438
- Options | 439
- Required Privilege Level | 439
- Release Information | 440

MX Series

```
master {
    announce-interval announce-interval-value;
    clock-step (one-step | two-step);
    sync-interval sync-interval-value;
    interface interface-name {
        unicast-mode {
            transport ipv4;
            clock-client ip-address {
                local-ip-address local-ip-address;
            }
        }
    }
    multicast-mode {
        local-priority
        transport 802.3 link-local;
    }
}
```

QFX Series

```
master {
    interface interface-name {
        unicast-mode {
            transport ipv4;
            clock-client ip-address {
                local-ip-address local-ip-address;
            }
        }
    }
    multicast-mode {
        transport (ipv4 | ieee-802.3)
        local-ip-address local-ip-address;
        local-priority local-ip-address;
    }
max-announce-interval max-announce-interval;
max-delay-response-interval max-delay-response-interval;
max-sync-interval max-sync-interval;
min-announce-interval min-announce-interval;
min-delay-response-interval min-delay-response-interval;
min-sync-interval min-sync-interval;
sync-interval sync-interval;
}
```

ACX Series (ACX5448, ACX5448-D, and ACX5448-M)

```
master {
    announce-interval announce-interval-value;
    interface interface-name {
        unicast-mode {
            clock-client ip-address local-ip-address local-ip-address {
                transport (ipv4 | ipv6)
            }
        }
    }
    sync-interval sync-interval;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the primary with parameters.

Options

master	Configure the primary with parameers
announce-interval	Configure the mean interval for the announce messages from the primary.
clock-step	Configures the clock-step that determines timing information on messages
sync-interval	Configure the mean interval for sync interval messages from the primary.
unicast-mode	Configure upstream unicast PTP primary clock sources. IPv4 and IPv6 support is available.
clock-client	Configure the IP address of the client.
local-priority	Configure a clock's local priority to be used as a tie-breaker in the dataset comparison algorithm.
transport 802.3	Configure Ethernet as the encapsulation type for transport of PTP packets.
transport	Configure the encapsulation type for PTP packet transport.
local-ip-address	Configure the IP address of the interface acting as the client or the primary.
max-announce-interval	Configure the maximum log mean interval between announce messages.
max-delay-response-interval	Configure the maximum log mean interval between delay-response messages.
max-sync-interval	Configure the maximum log mean interval between synchronization messages.
min-announce-interval	Configure the minimum log mean interval between announce messages.
min-delay-response-interval	Configure the minimum log mean interval between delay-response messages.
min-sync-interval	Configure the minimum log mean interval between synchronization messages.
sync-interval	Configure the log mean interval between synchronization messages.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

- Configuring Precision Time Protocol | 82
- Configuring Precision Time Protocol | 82
- Precision Time Protocol Overview | 68
- Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

max-transmit-quality-level

IN THIS SECTION

- Syntax | 440
- Hierarchy Level | 441
- Description | 441
- Options | 441
- Required Privilege Level | 442
- Release Information | 442

Syntax

```
max-transmit-quality-level;
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the threshold quality level for the router. If the received quality level is below the threshold quality level, then the router will send out a received quality level of SEC. The available quality levels are listed in Table 19 on page 441.

NOTE: For GPS external output, when you configure the maximum transmit quality level as PRC and the router is rebooted, no valid output is obtained from SCBE. However, when the maximum transmit quality level is configured to any other quality level other than PRC and the router gets rebooted, then the SCBE works normally.

Options

quality-level The available quality levels are as given in Table 19 on page 441.

Table 19: Quality Levels

Quality Level	Description
prc	Timing quality of a primary reference clock (option-1 only).
prs	Clock traceable to a primary reference source (option-2 only).
sec	Timing quality of an SDH equipment clock (option-1 only).
smc	Clock traceable to a self-timed SONET (option-2 only).

Table 19: Quality Levels *(Continued)*

Quality Level	Description
ssu-a	Timing quality of a type I or IV client clock (option-1 only).
ssu-b	Timing quality of a type VI client clock (option-1 only).
st2	Clock traceable to Stratum 2 (option-2 only).
st3	Clock traceable to Stratum 3 (option-2 only).
st3e	Clock traceable to Stratum 3E (option-2 only).
st4	Clock traceable to Stratum 4 free-run (option-2 only).
stu	Clock traceable to an unknown quality (option-2 only).
tnc	Clock traceable to a transit node clock (option-2 only).

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (ACX Series) | 517
synchronization (MX Series) | 524
synchronization (PTX Series) | 531

minimum-quality

IN THIS SECTION

- Syntax | 443
- Hierarchy Level | 443
- Description | 444
- Required Privilege Level | 445
- Release Information | 445

Syntax

```
minimum-quality;
```

Hierarchy Level

```
[edit chassis synchronization output interfaces external]
[edit chassis synchronization output interfaces (external-0/0 | external-1/0)]
[edit chassis synchronization]
```

Hierarchy level **[edit chassis synchronization]** added for ACX710 in Junos OS Release 20.2R1.

Description

Configure the minimum quality level threshold to select a clock source (see Table 20 on page 444). If the quality level of the output clock source drops below the configured minimum quality level threshold, the external output clock is suppressed on the external output interface—external—on SCBE and on the external output interfaces—external-0/0 and external-1/0—on SCBE2.

Table 20: Quality Levels

Quality Level	Description
prc	Timing quality of a primary reference clock (option-1 only).
prs	Clock traceable to a primary reference source (option-2 only).
sec	Timing quality of an SDH equipment clock (option-1 only).
smc	Clock traceable to a self-timed SONET (option-2 only).
ssu-a	Timing quality of a type I or IV client clock (option-1 only).
ssu-b	Timing quality of a type VI client clock (option-1 only).
st2	Clock traceable to Stratum 2 (option-2 only).
st3	Clock traceable to Stratum 3 (option-2 only).
st3e	Clock traceable to Stratum 3E (option-2 only).
st4	Clock traceable to Stratum 4 free-run (option-2 only).
stu	Clock traceable to an unknown quality (option-2 only).
tnc	Clock traceable to a transit node clock (option-2 only).

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (ACX Series) | 517

synchronization (MX Series) | 524

network-option

IN THIS SECTION

- Syntax | 445
- Hierarchy Level | 446
- Description | 446
- Options | 446
- Required Privilege Level | 447
- Release Information | 447

Syntax

```
network-option (option-1 | option-2);
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the Ethernet equipment clock (EEC) synchronization networking type.

NOTE: For SCB, this option is set with the **set chassis synchronization network-type (option-1 | option-2)** configuration command at the **[edit]** hierarchy level.

NOTE: For Junos OS releases 11.2R4 through 13.3R3 for MX240, MX480, and MX960 with SCB, SCBE, and SCBE2; and MX2010 and MX2020 with SCB or SCBE; you must execute the following commands after you change the network option at the **[edit chassis synchronization]** hierarchy level. This is because the loop bandwidth does not change automatically when you change the network option.

```
user@host# deactivate chassis synchronization
user@host# activate chassis synchronization
```

Options

Depending on the configuration of the Synchronization Status Messages (SSM) quality level, the network option functions in the following ways:

- **option-1**—Maps to the G.813 option 1 (EEC1).
- **option-2**—Maps to the G.812 type IV clock (EEC1).

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

ntp

IN THIS SECTION

- Syntax | 447
- Hierarchy Level | 448
- Description | 448
- Options | 448
- Required Privilege Level | 453
- Release Information | 453

Syntax

```
ntp {
    authentication-key key-number type (md5 | sha1 | sha256) value password;
    boot-server  (address | hostname);
    broadcast <address> <key key-number> <routing-instance-name routing-instance-
name> <ttl value>  <version value>;
    broadcast-client;
    interval-range value;
    multicast-client <address>;
    peer address <key key-number> <prefer> <version value>;
    restrict address {
        mask network-mask;
        noquery;
    }
    server address <key key-number> <prefer> <routing-instance routing-instance>
<version value>;
    source-address source-address <routing-instance routing-instance-name>;
    threshold value action (accept | reject);
    trusted-key [ key-numbers ];
}
```

Hierarchy Level

```
[edit system]
```

Description

Configure NTP on the device. In both standalone and chassis cluster modes, the primary Routing Engine runs the NTP process to get the time from the external NTP server. Although the secondary Routing Engine runs the NTP process in an attempt to get the time from the external NTP server, this attempt fails because of network issues. For this reason, the secondary Routing Engine uses NTP to get the time from the primary Routing Engine.

Options

authentication-key ***key_number***	Configure key (key ID, key type, and key value) to authenticate NTP packets with the devices (servers and clients). The authentication key has two fields:

- **type**—When authentication is specified, the key identifier (key ID) followed by the message digest is appended to the NTP packet header. The supported message digest formats are md5, sha1, sha256.

- **value**—If the key value is available in ASCII format and without special characters, it can be entered directly. If the key value contains special characters or is available in hex format, consider the following:

  For specifying the keys in hex format, prepend a "\x" for each two characters. For hex key example, af60112f...39af4ced,

  set system ntp authentication-key <ID> value "\xaf\x60\x11\x2f\....\x39\xaf\x4c\xed".

  If the key contains one of the characters from **(null) 0x00, (space) 0x20, " 0x22, & 0x26, (0x28) 0x29** prepend a "\\x" . For example, **\\x22**.

- **Range:** 1 to 65534

boot-server (*address* | *hostname*)

Configure the server that NTP queries when the device boots to determine the local date and time.

When you boot the device, it issues an ntpdate request, which polls a network server to determine the local date and time. You must configure an NTP boot server that the device uses to determine the time when the device boots. Otherwise, NTP cannot synchronize to a time server if the server time significantly differs from the local device's time.

If you configure an NTP boot server, then when the device boots, it immediately synchronizes with the boot server even if the NTP process is explicitly disabled or if the time difference between the client and the boot server exceeds the threshold value of 1000 seconds.

- **Values:** Configure one of the following:
  - *address*—IP address of an NTP boot server.
  - *hostname*—Hostname of an NTP boot server. If you configure a hostname instead of an IP address, the ntpdate request resolves the hostname to an IP address when the device boots up.

broadcast <*address*> <key *key-number*> <routing-instance-name *routing-instance-name*>

Configure the device to operate in broadcast mode with the remote system at the specified address. In this mode, the device sends periodic broadcast messages to a client population at the specified broadcast or multicast address. Normally, you include this statement only when the device is operating as a transmitter.

<ttl *value*> <version *value*>	*address*	Configure the broadcast address on one of the local networks or a multicast address assigned to NTP. You must specify an address, not a hostname. If the multicast address is used, it must be **224.0.1.1**.
	key *key-number*	(Optional) All packets sent to the address include authentication fields that are encrypted using the specified key number (any unsigned 32-bit integer except 0). The key corresponds to the key number you specified in the authentication-key statement.
	routing-instance-name *routing-instance-name*	(Optional) Configure the routing instance name in which the interface has an address in the broadcast subnet. • **Default:** The default routing instance is used to broadcast packets.
	ttl *value*	(Optional) Configure the time-to-live (TTL) value. • **Range:** 1 through 255 • **Default:** 1
	version *value*	(Optional) Specify the version number to be used in outgoing NTP packets. • **Range:** 1 through 4 • **Default:** 4

broadcast-client	Configure the local device to listen for broadcast messages on the local network to discover other servers on the same subnet. To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier.
interval-range *value*	Configure the poll interval range. • **Range:** 0 through 3
multicast-client <*address*>	Configure the local device to listen for multicast messages on the local network. To avoid accidental or malicious disruption in this mode, both the local and remote systems must use authentication and the same trusted key and key identifier. • **Syntax:** <*address*>—(Optional) Specify one or more IP addresses. If you specify addresses, the device joins those multicast groups.

- **Default:** 224.0.1.1

peer *address* <key *key-number*> <prefer> <version *value*>

Configure the local device to operate in symmetric active mode with the remote system at the specified address. In this mode, the local device and the remote system can synchronize with each other. This configuration is useful in a network in which either the local device or the remote system might be a better source of time.

address	Address of the remote system. You must specify an address, not a hostname.
key *key-number*	(Optional) All packets sent to the address include authentication fields that are encrypted using the specified key number (any unsigned 32-bit integer except 0). The key corresponds to the key number you specified in the authentication-key statement.
prefer	(Optional) Mark the remote system as the preferred host, which means that if all other factors are equal, this remote system is chosen for synchronization among a set of correctly operating systems.
version *value*	(Optional) Specify the NTP version number to be used in outgoing NTP packets. • **Range:** 1 through 4 • **Default:** 4

restrict *address* mask *network-mask* noquery

Restrict packets from hosts (including remote time servers) and subnets.

- **Syntax:**
  - *address*—Specify the IP address for a host or network.
  - mask *network-mask*—Specify the network mask for a host or network.
  - noquery—Deny ntpq and ntpdc queries from hosts and subnets. These queries can be used in amplification attacks.

server

Configure the local device to operate in client mode with the remote system at the specified address. In this mode, the device can be synchronized with the remote system, but the remote system can never be synchronized with the device.

If the NTP client time drifts so that the difference in time from the NTP server exceeds 128 milliseconds, the client is automatically stepped back into synchronization. If the offset between the NTP client and server exceeds the

1000-second threshold, the client still synchronizes with the server, but it also generates a system log message noting that the threshold was exceeded.

address	Address of the remote system. You must specify an address, not a hostname.
key *key-number*	(Optional) All packets sent to the address include authentication fields that are encrypted using the specified key number (any unsigned 32-bit integer except 0). The key corresponds to the key number you specified in the authentication-key statement.
prefer	(Optional) Mark the remote system as the preferred host, which means that if all other factors are equal, this remote system is chosen for synchronization among a set of correctly operating systems.
routing-instance *routing-instance*	(Optional) Routing instance through which the server is reachable.
version *value*	(Optional) Specify the NTP version number to be used in outgoing NTP packets. • **Range:** 1 through 4 • **Default:** 4

source-address*source-address* <routing-instance *[routing-instance-name]*>	A valid IP address configured on one of the device's interfaces to be used as the source address for messages sent to the NTP server, and optionally, the routing instance in which the source address is configured. • **Default:** The primary address of the interface

threshold *seconds* action (accept | reject)	Configure the maximum threshold in seconds allowed for NTP adjustment and specify the mode for NTP abnormal adjustment.
	• **Range:** 1 through 600 seconds
	• **Values:** Configure one of the following:
	  • accept—Enable log mode for abnormal NTP adjustment.
	  • reject—Enable reject mode for abnormal NTP adjustment.

trusted-key [*key-numbers*]	Configure one or more keys you are allowed to use to authenticate other time servers, when you configure the local device to synchronize its time with other

systems on the network. Each key can be any 32-bit unsigned integer except 0. The key corresponds to the key number you specify in the authentication-key statement.

By default, network time synchronization is unauthenticated. The device synchronizes to whatever system appears to have the most accurate time. We strongly encourage you to configure authentication of network time services.

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced before Junos OS Release 7.4.

routing-instance option for the **server** statement introduced in Junos OS Release 18.1.

restrict statement introduced in Junos OS Release 20.1.

RELATED DOCUMENTATION

- Synchronizing and Coordinating Time Distribution Using NTP
- Understanding NTP Time Servers
- Configuring NTP Authentication Keys
- *NTP Time Synchronization on SRX Series Devices*
- Configuring the NTP Time Server and Time Services
- Configuring the Switch to Listen for Broadcast Messages Using NTP
- Configuring the Switch to Listen for Multicast Messages Using NTP

ntp (QFabric)

IN THIS SECTION

- Syntax | 454
- Hierarchy Level | 454
- Description | 454
- Options | 455
- Required Privilege Level | 455
- Release Information | 455

Syntax

```
ntp {
    authentication-key number type type value password;
     server address <key key-number> <version value> <prefer>;
}
```

Hierarchy Level

```
[edit system]
```

Description

Configure Network Time Protocol (NTP) on the switch.

Options

authentication-key	Configure NTP authentication keys so authenticated packets can be sent.
server	Configure the switch to operate in client mode with the remote system at the specified server address.

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.1.

RELATED DOCUMENTATION

Configuring NTP Authentication Keys (QFabric System) | 48

Configuring the NTP Time Server and Time Services (QFabric System) | 53

output interfaces (Chassis Synchronization)

IN THIS SECTION

- Syntax (ACX710) | 456
- Syntax (MX Series) | 456
- Hierarchy Level | 457
- Description | 457

- Options | 457
- Required Privilege Level | 457
- Release Information | 457

Syntax (ACX710)

```
output {
    interfaces {
        bits {
            source-mode (chassis | ptp-clock);
            squelch {
                method (ais | ql-dnu | rai | shut);
            }
            ssm option-2  (GEN-1 | GEN-2);
        }
    }
}
```

Syntax (MX Series)

```
output {
    interfaces {
        external {
            holdover-mode-disable;
            minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b  | st2 | st3
| st3e | st4 | stu | tnc);
            source-mode (chassis | line);
            tx-dnu-to-line-source-enable;
            wander-filter-disable;
        }
    }
}
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the options for clock output interfaces.

Options

external (SCBE only) Specify the properties of the external output interface.

(external-0/0 | external-1/0)	(SCBE2 only) Specify the properties of the external output interface.
holdover-mode-disable	Disable holdover.
tx-dnu-to-line-source-enable	Set Tx quality level to DNU/DUS on line source interface that has been selected as the external output source.
wander-filter-disable	Disable wander filtering.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (ACX Series) | 517

synchronization (MX Series) | 524

phy-timestamping

IN THIS SECTION

- Syntax | 458
- Hierarchy Level | 458
- Description | 458
- Required Privilege Level | 459
- Release Information | 459

Syntax

```
phy-timestamping
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure timestamping of the IEEE 1588 event packets at the physical layer. Timestamping the packet at the physical layer, also known as PHY timestamping, eliminates the noise or the packet delay variation (PDV) that is introduced by the Packet Forwarding Engine.

By default PHY timestamping is disabled.

NOTE: MX104 routers and the MPC5E and MPC6E line cards do not support PHY timestamping in WAN PHY mode. If the interface framing is changed from LAN PHY mode to WAN PHY mode or WAN PHY mode to LAN PHY mode on MX104, MPC5E, or MPC6E, you must reboot the MX104 router or the MPC5E and MPC6E line cards. For PHY timestamping to work for MX104 routers and the MPC5E and MPC6E line cards, the packet forwarding engine must come up in LAN PHY mode after a reboot.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.1R1.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

port (Chassis Synchronization)

IN THIS SECTION

- Syntax (MX Series) | 460
- Hierarchy Level | 460
- Description | 460

- Options | 461
- Required Privilege Level | 461
- Release Information | 461

Syntax (MX Series)

```
port {
    auxiliary {
        client {
            time-of-day-format {
                ascii string;
            }
        }
    }
}
```

Hierarchy Level

```
[edit chassis synchronization]
[edit chassis synchronization source interfaces (external-a | external-b |
interface interface-name)]
[edit chassis synchronization source interfaces (external | interface interface-
name)]
[edit chassis synchronization source interfaces (external-0/0 | external-1/0 |
interface interface-name)]
```

Description

Configure the clock synchronization ports.

Options

time-of-day-format	Specify the time of day (TOD) message format. • ascii—Configure the TOD message format in ASCII characters on the auxiliary port that receives the external clock signals.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 13.3.

RELATED DOCUMENTATION

Integrated Global Navigation Satellite System (GNSS) on ACX500 Series Routers | 35

synchronization (MX Series) | 524

primary

IN THIS SECTION

- Syntax | 462
- Hierarchy Level | 462
- Description | 462
- Required Privilege Level | 462

- Release Information | **462**

Syntax

```
primary interface name;
```

Hierarchy Level

```
[edit protocols ptp client interface interface-name],
[edit protocols ptp master interface interface-name]
```

Description

Configure the primary member link in an aggregated Ethernet bundle to enable Precision Time Protocol (PTP) over a link aggregation group. PTP primary streams are created on the FPC on which the primary interface is present. Announce and sync packets are transmitted on this primary PTP Aggregated Ethernet link.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.2R1.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | 82

Configuring Precision Time Protocol | 82

Precision Time Protocol Overview | 68

priority1

IN THIS SECTION

- Syntax | 463
- Hierarchy Level | 463
- Description | 464
- Options | 464
- Required Privilege Level | 464
- Release Information | 464

Syntax

```
priority1 priority1-value;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the priority as one of the following:

- In the client, the priority value is set to select the best primary clock. Note that in order to select a particular primary clock, the priority value in the primary clock's announce message must be equal to or lower than the configured *priority1-value*.
- In the primary, the priority value is set to represent itself in the announce message to other slaves.
- In the boundary node, the client uses this value to determine the best primary clock, whereas the primary uses this value from the announce message of the selected primary clock.

Note that the lower value takes precedence.

Options

priority1-value—The priority value of the clock.

- **Range:** 0 through 255
- **Default:** 128

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | **82**

Precision Time Protocol Overview | **68**

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

priority2

IN THIS SECTION

- Syntax | **465**
- Hierarchy Level | **465**
- Description | **465**
- Options | **466**
- Required Privilege Level | **466**
- Release Information | **466**

Syntax

```
priority2 priority2-value;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the **priority2** value. This value is used to differentiate and prioritize the primary clocks to avoid confusion when the ***priority1-value*** is the same for different primary clocks in a network.

Note that the lower value takes precedence.

Options

priority2-value—The priority value of the clock.

- **Range:** 0 through 255
- **Default:** 128

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | **82**

Configuring Precision Time Protocol | **82**

Precision Time Protocol Overview | **68**

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

priority (Clock Synchronization)

IN THIS SECTION

- Syntax | **467**
- Hierarchy Level | **467**

- Description | 467
- Options | 468
- Required Privilege Level | 468
- Release Information | 468

Syntax

```
priority number;
```

Hierarchy Level

```
[edit chassis synchronization source interfaces (external-a | external-b |
interface interface-name)]
[edit chassis synchronization source interfaces (external | interface interface-
name)]
[edit chassis synchronization source interfaces (external-0/0 | external-1/0 |
interface interface-name)]
```

Description

Configure the priority of a clock source in relationship to other clock sources to define a network synchronization flow and to help prevent timing loops.

When the priority is not specified, the external-a interface has higher default priority than the external-b interface, and the external-b interface has higher default priority than other Gigabit Ethernet or 10-Gigabit Ethernet clock sources, which have the lowest default priority. Any priority you configure is higher than any default priority.

Options

number	Set the priority level of the clock source. • **Range:** 1 through 5

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

profile-type

IN THIS SECTION

- QFX Series (AES67 Profile) | **469**
- QFX Series (AES67+SMPTE Profile) | **469**
- MX Series | **469**
- QFX Series (Enterprise Profile) | **469**
- QFX Series (G.8275.2 Enhanced Profile) | **470**
- ACX Series (G.8275.2) for ACX710) | **470**

- ACX Series (G.8275.2 Enhanced Profile for ACX5448, ACX5448-D, and ACX5448-M) | **470**
- QFX Series (SMPTE Profile) | **470**
- Hierarchy Level | **470**
- Description | **471**
- Options | **471**
- Required Privilege Level | **472**
- Release Information | **472**

QFX Series (AES67 Profile)

```
profile-type aes67
```

QFX Series (AES67+SMPTE Profile)

```
profile-type aes67-smpte
```

MX Series

```
profile-type (g.8275.1 | g.8275.1.enh)
```

QFX Series (Enterprise Profile)

```
profile-type enterprise-profile
```

QFX Series (G.8275.2 Enhanced Profile)

```
profile-type g.8275.1.enh
```

ACX Series (G.8275.2) for ACX710)

```
profile-type g.8275.2
```

ACX Series (G.8275.2 Enhanced Profile for ACX5448, ACX5448-D, and ACX5448-M)

```
profile-type g.8275.2.enh
```

QFX Series (SMPTE Profile)

```
profile-type smpte
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

On the MX Series, configure the G.8275.1 or the enhanced G.8275.1 PTP profile for applications that require accurate phase and time synchronization. This profile supports the architecture defined in ITU-T G.8275 to enable the distribution of phase and time with full timing support and is based on the second version of PTP defined in IEEE 1588.

On QFX Series switches that support the enterprise-profile feature, you can configure the enterprise profile, which supports IEEE 1588 PTPv2 transport over multicast IPv4. If you do not specify a profile, the IEEE 1588 default profile is enabled by default.

On QFX Series switches that support the G.8275.2 enhanced profile feature, you can configure the G.8275.2 enhanced profile, which supports telecom applications that require accurate phase and time synchronization for phase alignment and time of day synchronization over a wide area network. This profile supports PTP over IPv4 unicast, ordinary and boundary clocks, and unicast negotiation.

On QFX Series switches that support the media profile, you can configure the SMPTE, AES67, and the AES67+SMPTE profiles to support video applications for capture (for example, cameras), video edit, and playback to be used in professional broadcast environments. The standard allows multiple video sources to stay in synchronization across various equipment by providing time and frequency synchronization to all devices. This profile supports PTP over IPv4 multicast and ordinary and boundary clocks.

ACX 710 devices support G.8275.2 profile with node type T-BC-P (BC).

ACX5448, ACX5448-D, and ACX5448-M devices support ACX G.8275.2 enhanced profile. Yyou can configure the G.8275.2 enhanced profile, which supports telecom applications that require accurate phase and time synchronization for phase alignment and time of day synchronization over a wide area network. This profile supports PTP over IPv4 and IPV6 unicast traffic.

Options

aes67	Enable the AES67 PTP profile.
aes67-smpte	Enable the AES67+SMPTE PTP profile.
enterprise-profile	Enable the enterprise profile. The enterprise profile supports IEEE 1588 PTPv2 transport over multicast IPv4. When the enterprise profile is enabled, no other profiles can be enabled. Also, unicast negotiation is disabled when you enable the enterprise profile.
g.8275.1	Enable the G.8275.1 PTP profile.

g.8275.1.enh	Enable the enhanced G.8275.1 PTP profile. This profile supports PTP over IPv4.
g.8275.2	Enable the G.8275.2 PTP profile.
g.8275.2.enh	Enable the enhanced G.8275.2 PTP profile.
smpte	Enable the SMPTE PTP profile.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.1R1.

RELATED DOCUMENTATION

- Precision Time Protocol Overview | 68
- Configuring the Precision Time Protocol Enterprise Profile | 137
- Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

pulse-per-second-enable

IN THIS SECTION

- Syntax | 473
- Hierarchy Level | 473
- Description | 473

- Required Privilege Level | 473
- Release Information | 473

Syntax

```
pulse-per-second-enable;
```

Hierarchy Level

```
[edit chassis synchronization interfaces external]
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
```

Description

Configure the external interface to receive the pulse per second (PPS) signal on the GPS interface of the router.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

quality-level (Clock Synchronization)

IN THIS SECTION

- Syntax | 474
- Hierarchy Level | 474
- Description | 475
- Options | 475
- Required Privilege Level | 475
- Release Information | 476

Syntax

```
quality-level (prc | prs | sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 |
stu | tnc);
```

Hierarchy Level

```
[edit chassis synchronization source interfaces (external-a | external-b |
interface interface-name)]
[edit chassis synchronization source interfaces (external | interface interface-
name)]
[edit chassis synchronization source interfaces (external-0/0 | external-1/0 |
interface interface-name)]
```

Description

Configure the quality level for a timing source so that the router knows the best available source with which to synchronize. The quality level specifies the accuracy level of the clock and is transmitted across the network through Synchronization Status Messages (SSMs) over the Ethernet Synchronization Messaging Channel (ESMC), or through SSMs contained in SONET/SDH frames.

SONET SSM messages are either Generation 1 or Generation 2. Generation 1 is the first and most widely deployed SSM message set. Generation 2 is a newer version. Quality level options are available for both Generation 1 and Generation 2.

Options

prs—Primary reference source—Stratum 1

st2—Stratum 2

tnc—Transit node clock

st3e—Stratum 3E

st3—Stratum 3

smc—SONET minimum clock

st4—Stratum 4

prc—Primary reference clock

ssu-a—Synchronization supply unit A

ssu-b—Synchronization supply unit B

sec—SDH equipment clock

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

quality-level (hybrid)

IN THIS SECTION

- Syntax | **476**
- Hierarchy Level | **476**
- Description | **477**
- Options | **477**
- Required Privilege Level | **477**
- Release Information | **477**

Syntax

```
quality-level (prs | st2 | tnc | st3e | st3 | smc | st4) | (prc | ssu-a | ssu-b
| sec);
```

Hierarchy Level

```
[edit protocols ptp slave clock-class-to-quality-level-mapping]
```

Description

Configure the quality level for the timing source so that the router knows the best available source with which to synchronize. The quality level specifies the accuracy level of the clock.

Options

prs —Primary reference source—Stratum 1

st2—Stratum 2

tnc—Transit node clock

st3e—Stratum 3E

st3—Stratum 3

smc—SONET minimum clock

st4—Stratum 4

prc—Primary reference clock

ssu-a—Synchronization supply unit A

ssu-b—Synchronization supply unit B

sec—SDH equipment clock

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361

Understanding Hybrid Mode | 357

Precision Time Protocol Overview | 68

Synchronous Ethernet Overview | 232

quality-mode-enable (MX)

IN THIS SECTION

- Syntax | 478
- Hierarchy Level | 478
- Description | 479
- Default | 479
- Required Privilege Level | 479
- Release Information | 480

Syntax

```
quality-mode-enable;
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Enable Synchronous Ethernet ESMC quality mode. The quality level parameter for a Synchronous Ethernet interface is optional when the **quality-mode-enable** and the **selection-mode received-quality** statements are included at the **[edit chassis synchronization]** hierarchy level.

The default quality level for a Synchronous Ethernet interface is based on the value of network option: The **option-1** statement, when set, selects the **sec** quality level; and the **option-2** statement, when set, selects the **st3** quality level.

Table 21 on page 479 shows whether SSM quality level is supported for a given external interface signal type and framing. The default setting is disabled.

- **Table 21: SSM-Quality LevelSupport by Signal Type and Framing**

Signal Type	Framing	SSM Quality Level Supported
E1	G.704	yes
E1	G.704 no CRC4	no
T1	ESF	yes
T1	SF	no
2048 KHz	Not applicable	no

Default

By default, this statement is disabled.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

show chassis synchronization | 576

quality-mode-enable (PTX)

IN THIS SECTION

- Syntax | 480
- Hierarchy Level | 481
- Description | 481
- Default | 481
- Required Privilege Level | 481
- Release Information | 481

Syntax

```
quality-mode-enable;
```

Hierarchy Level

```
[edit chassis synchronization (PTX Series)]
```

Description

Enable Synchronous Ethernet ESMC quality mode. The quality level parameter for a Synchronous Ethernet interface is optional when the **quality-mode-enable** and the **selection-mode received-quality** statements are included at the **[edit chassis synchronization]** hierarchy level.

The default quality level for a Synchronous Ethernet interface is based on the value of the network option: The **option-1** statement, when included, selects the **sec** quality level; and the **option-2** statement, when included, selects the **st3** quality level.

Default

By default, this statement is not included.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 14.2R1.

RELATED DOCUMENTATION

synchronization (PTX Series) | **531**

Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers | **323**

show chassis synchronization | 576

recovered-clock

IN THIS SECTION

- Syntax | 482
- Hierarchy Level | 482
- Description | 482
- Options | 483
- Required Privilege Level | 483
- Release Information | 483

Syntax

```
recovered-clock {
    port port-number;
}
```

Hierarchy Level

```
[edit chassis fpc slot-number pic pic-number]
```

Description

Select the port where the synchronous clock may be recovered.

Options

port-number—Port number where the synchronous clock may be recovered.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.1X48.

RELATED DOCUMENTATION

Clock Sources for PTX Series Packet Transport Routers | **321**
Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers | **323**
synchronization (PTX Series) | **531**

remote-ip-address

IN THIS SECTION

- Syntax | **484**
- Hierarchy Level | **484**
- Description | **484**
- Options | **484**
- Required Privilege Level | **485**
- Release Information | **485**

Syntax

```
remote-ip-address ip-address {
    local-ip-address;
    announce-interval announce-interval;
    asymmetry asymmetry;
    delay-request delay-request;
    dscp dscp;
    grant-duration grant-duration;
    sync-interval sync-interval;
}
```

Hierarchy Level

```
[edit logical-systems name             protocols ptp stateful interface name
unicast-mode],
[edit protocols ptp stateful interface name unicast-mode]
```

Description

Configure remote IP address for PTP stateful parameters

Options

ip-address	IP address of remote PTP partner.
local-ip-address	IP address on local interface.
announce-interval	Log mean interval between announce messages. • **Range:** -3 through 0
asymmetry	Adjust the slave-to-master delay by value specified in nanoseconds.

	- **Range:** -100000000 through 100000000
delay-request	Log mean interval between delay requests. - **Range:** -7 through 0
dscp	IP DSCP value for the stream. - **Default:** 56 - **Range:** 0 through 63
grant-duration	Length of grants in seconds requested during unicast-negotiation - **Default:** 300 - **Range:** 60 through 1000
sync-interval	Requested log mean interval between sync messages - **Range:** -7 through 0

Required Privilege Level

routing

Release Information

Statement introduced in Junos OS Release 20.4R1.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | **82**

request (Clock Synchronization)

IN THIS SECTION

- Syntax | 486
- Hierarchy Level | 486
- Description | 486
- Options | 487
- Required Privilege Level | 487
- Release Information | 487

Syntax

```
request (force-switch lockout);
```

Hierarchy Level

```
[edit chassis synchronization source interfaces (external-a | external-b |
interface interface-name)]
[edit chassis synchronization source interfaces (external | interface interface-
name)]
[edit chassis synchronization source interfaces (external-0/0 | external-1/0 |
interface interface-name)]
```

Description

Specify the clock selection request criterion.

Options

force-switch	Force switching to a clock source, provided the clock source is enabled and not locked out. Only one configured source may be force-switched.
lockout	Clock source is not considered by the selection process. Lockout may be configured for any source.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2 R4.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

sabit

IN THIS SECTION

- Syntax | **488**
- Hierarchy Level | **488**
- Description | **488**
- Options | **488**

- Required Privilege Level | **488**
- Release Information | **489**

Syntax

```
sabit bit;
```

Hierarchy Level

```
[edit chassis synchronization interfaces external e1-options]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) e1-
options]
[edit chassis synchronization interfaces bits e1-options]
```

Description

Configure the SA bit for exchanging the SSM quality on the E1 interface.

Options

bit	SA bit value.

- **Range:** 4 through 8.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

secondary

IN THIS SECTION

- Syntax | 489
- Hierarchy Level | 490
- Description | 490
- Required Privilege Level | 490
- Release Information | 490

Syntax

```
secondary interface name;
```

Hierarchy Level

```
[edit protocols ptp client interface interface-name],
[edit protocols ptp master interface interface-name]
```

Description

Configure the secondary member link in an aggregated Ethernet bundle to enable Precision Time Protocol (PTP) over a link aggregation group. PTP switches over to the secondary member in the aggregated Ethernet bundle when the primary aggregated Ethernet link is down.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.2R1.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | 82

Configuring Precision Time Protocol | 82

Precision Time Protocol Overview | 68

selection-mode

IN THIS SECTION

- Syntax | 491
- Hierarchy Level | 491
- Description | 491
- Options | 492
- Required Privilege Level | 492
- Release Information | 492

Syntax

```
selection-mode (configured-quality | received-quality);
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Specify whether the clock source selection must use the configured or the received ESMC or SSM quality level for a qualifying interface. In both the selection modes, the interface qualifies for clock source selection only when the received ESMC or SSM quality level on the interface is equal to or greater than the configured ESMC or SSM quality level for the interface.

Options

configured-quality	Set this option to let the clock source selection algorithm to use the ESMC or SSM quality level that is configured for a qualifying interface.
received-quality	Set this option to let the clock source selection algorithm to use the ESMC or SSM quality level that is received on the qualifying interface.

NOTE: For the **selection-mode** statement configuration to take effect, you must set the **quality-mode-enable** statement at the [**edit chassis synchronization**] hierarchy level.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

signal-type

IN THIS SECTION

Syntax | 493

- Hierarchy Level | 493
- Description | 493
- Options | 493
- Required Privilege Level | 494
- Release Information | 494

Syntax

```
signal-type (1hz | 5mhz | 10mhz | 2048mhz | e1 | t1);
```

Hierarchy Level

```
[edit chassis synchronization interfaces external]
[edit chassis synchronization interfaces (external-0/0 | external-1/0)]
```

Description

Configure the frequency for the provided reference clock.

Options

1mhz	Set the signal with a clock frequency of 1 MHz.
5mhz	Set the signal with a clock frequency of 5 MHz.
10mhz	Set the signal with a clock frequency of 10 MHz.
2048khz	Set the signal as an E1 unframed 2048 kHz G.703 signal.

e1	Set the signal as an E1-coded 2048-kHz signal on a 120-ohm balanced line.
t1	Set the signal as a T1-coded 1.544-MHz signal on a 100-ohm balanced line.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

signal-type (BITS Interfaces)

IN THIS SECTION

- Syntax | 495
- Hierarchy Level | 495
- Description | 495
- Options | 495
- Required Privilege Level | 495
- Release Information | 496

Syntax

```
signal-type (2048KHZ | e1 | t1)
```

Hierarchy Level

```
[edit chassis synchronization interfaces bits]
```

Description

Configure the input and output signal type to the same value for the building-integrated timing supply (BITS) interface.

Options

2048khz	Configure the BITS interface to output or accept as input the 2.048 MHz square wave.
e1	Configure the BITS interface to output or accept as input the E1 framed signal.
t1	Configure the BITS interface to output or accept as input the T1 framed signal.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | 23
Configuring External Clock Synchronization for ACX Series Routers | 26
Synchronous Ethernet Overview | 232
show chassis synchronization | 576
e1-options (BITS Interfaces Signal Type) | 399
t1-options (BITS Interfaces Signal Type) | 537

server (NTP)

IN THIS SECTION

- Syntax | 496
- Hierarchy Level | 497
- Description | 497
- Options | 497
- Required Privilege Level | 498
- Release Information | 498

Syntax

```
server address {
    key key;
    prefer;
    routing-instance routing-instance;
    version version;
}
```

Hierarchy Level

```
[edit system ntp]
```

Description

For NTP, configure the local router or switch to operate in client mode with the remote system at the specified ***address***. In this mode, the local router or switch can be synchronized with the remote system, but the remote system can never be synchronized with the local router or switch.

If the NTP client time drifts so that the difference in time from the NTP server exceeds 128 milliseconds, the client is automatically stepped back into synchronization. If the offset between the NTP client and server exceeds the 1000-second threshold, the client still synchronizes with the server, but it also generates a system log message noting that the threshold was exceeded.

Options

address—Address of the remote system. You must specify an address, not a hostname.

key *key-number*—(Optional) Use the specified key number to encrypt authentication fields in all packets sent to the specified address.

- **Range:** Any unsigned 32-bit integer

prefer—(Optional) Mark the remote system as preferred host, which means that if all other things are equal, this remote system is chosen for synchronization among a set of correctly operating systems.

routing-instance *routing-instance*—(Optional) Routing instance through which the server is reachable.

NOTE: You can use the routing instance name **mgmt_junos** to enable access to NTP servers through the management interface.

version ***value***—(Optional) Specify the version number to be used in outgoing NTP packets.

- **Range:** 1 through 4
- **Default:** 4

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

Configuring the NTP Time Server and Time Services | **14**

slave

IN THIS SECTION

- MX Series | **499**
- QFX Series | **499**
- ACX Series (ACX5448, ACX5448-D, and ACX5448-M) | **500**

- Hierarchy Level | 501
- Description | 501
- Options | 501
- Required Privilege Level | 502
- Release Information | 503

MX Series

```
slave {
    announce-interval announce-interval-value
    announce-timeout announce-timeout-value;
    delay-request delay-request-value;
    frequency-only;
    hybrid
    interface interface-name {
        unicast-mode {
            transport ipv4;
            clock-source ip-address {
                local-ip-address local-ip-address {
            }
        }
        multicast-mode {
            hybrid
            transport 802.3 link-local;
        }
    }
    sync-interval interval;
}
```

QFX Series

```
slave {
    interface interface-name {
        unicast-mode {
            transport ipv4;
            clock-client ip-address {
                local-ip-address local-ip-address;
            }
        }
    }
    multicast-mode {
        transport (ipv4 | ieee-802.3)
        local-ip-address local-ip-address;
        local-priority local-ip-address;
    }
max-announce-interval max-announce-interval;
max-delay-response-interval max-delay-response-interval;
max-sync-interval max-sync-interval;
min-announce-interval min-announce-interval;
min-delay-response-interval min-delay-response-interval;
min-sync-interval min-sync-interval;
sync-interval sync-interval;
}
```

ACX Series (ACX5448, ACX5448-D, and ACX5448-M)

```
slave {
    announce-interval announce-interval-value
    announce-timeout announce-timeout-value;
    delay-request delay-request-value;
    grant-duration;
    interface interface-name {
        unicast-mode {
            transport [ipv4 | ipv6];
            clock-source ip-address {
                local-ip-address local-ip-address {
            }
        }
    }
    sync-interval interval;
}
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the client with parameters.

> **NOTE**: Multicast mode is not supported on the QFX Series, ACX5448, ACX5448-D, and ACX5448-M devices.

Options

announce-interval	Configure the logarithmic mean interval for the announce messages to be sent by the primary. • **Range:** 0 through 3 seconds • **Default:** 1
announce-timeout	Specify the number of announce messages a client must miss before an announce-timeout is declared. • **Range:** 2 through 10 seconds • **Default:**
delay-request	Configure the logarithmic mean interval in seconds between the delay request messages sent by the client to the primary. Specify the grant duration value for the announce messages. • **Range:** 60 through 7200 seconds • **Default:** 300 seconds
frequency-only	Configure frequency synchronization.

hybrid	Configure the timing and synchronization feature to operate in Sync-E assisted PTP mode of operation.
unicast-mode	Configure the client in unicast mode.
clock-source	Configure the IP address of the primary.
multicast-mode	Configure multicast transmission of PTP packets between the primary node and the client node.
transport 802.3	Configure Ethernet as the encapsulation type for transport of PTP packets.
sync-interval	Configure the logarithmic mean interval for sync interval messages to be sent by the primary.
unicast-mode	Configure the primary in unicast mode.
clock-client	Configure the IP address of the client
transport	Configure the encapsulation type for PTP packet transport.
local-ip-address	Configure the IP address of the interface acting as the client or the primary.
local-priority	Configure a clock's local priority to be used as a tie-breaker in the dataset comparison algorithm, if all other attributes of the datasets being compared are equal.
max-announce-interval	Configure the maximum log mean interval between announce messages.
max-delay-response-interval	Configure the maximum log mean interval between delay-response messages.
max-sync-interval	Configure the maximum log mean interval between synchronization messages.
min-announce-interval	Configure the minimum log mean interval between announce messages.
min-delay-response-interval	Configure the minimum log mean interval between delay-response messages.
min-sync-interval	Configure the minimum log mean interval between synchronization messages.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

- Configuring Precision Time Protocol | **82**
- Configuring Precision Time Protocol | **82**
- Precision Time Protocol Overview | **68**
- Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | **119**

source-address (RADIUS, System Logging, or TACACS+)

IN THIS SECTION

- Syntax | **503**
- Hierarchy Level | **504**
- Description | **504**
- Options | **504**
- Required Privilege Level | **504**
- Release Information | **504**

Syntax

```
source-address source-address;
```

Hierarchy Level

```
[edit system accounting destination radius server server-address],
[edit system accounting destination tacplus server server-address],
[edit system radius-server server-address],
[edit system syslog],
[edit system tacplus-server server-address]
```

Description

Specify a source address for each configured TACACS+ server, RADIUS server, or the source address to record in system log messages that are directed to a remote machine.

Options

source-address—Valid IP address configured on one of the switch interfaces. For system logging, the address is recorded as the message source in messages sent to the remote machines specified in all **host *hostname*** statements at the **[edit system syslog]** hierarchy level.

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.1.

RELATED DOCUMENTATION

Configuring RADIUS Authentication (QFX Series or OCX Series)

Synchronizing and Coordinating Time Distribution Using NTP | 57

Specifying an Alternative Source Address for System Log Messages Directed to a Remote Destination

source-mode

IN THIS SECTION

- Syntax | 505
- Syntax (ACX710) | 505
- Hierarchy Level | 506
- Description | 506
- Options | 506
- Required Privilege Level | 506
- Release Information | 506

Syntax

```
source-mode (chassis | line);
```

Syntax (ACX710)

```
source-mode (chassis | ptp-clock);
```

Hierarchy Level

```
[edit chassis synchronization output interfaces external]
[edit chassis synchronization output interfaces (external-0/0 | external-1/0)]
[edit chassis synchronization interfaces bits]
```

[edit chassis synchronization interfaces bits] hierarchy added for ACX710 in Junos OS Release 20.2R1.

Description

Configure a clock source for output for the configured BITS interface.

Options

chassis	Set the chassis clock for output.
line	Set the best line clock source for output.
ptp-clock	(ACX710 only) Set the PTP clock for output.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

ptp-clock option introduced in Junos OS Release 20.2R1.

RELATED DOCUMENTATION

synchronization (ACX Series) | 517

synchronization (MX Series) | 524

source interfaces

IN THIS SECTION

- Syntax | 507
- Hierarchy Level | 508
- Description | 508
- Options | 508
- Required Privilege Level | 509
- Release Information | 509

Syntax

```
source interfaces (external | interface-name)
    hold-off-time time;
    priority number;
    quality-level (prc | prs | sec | smc | ssu-a | ssu-b | st2 | st3 | st3e |
st4 | stu | tnc);
    request (force-switch | lockout);
    wait-to-restore minutes;
    aggregated-ether aggregated-ether-group-name;
}
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Configure the clock source that is used by the clock selection process on an interface.

- (SCB only) Specify the primary clock source as the external-a interface and the secondary clock source as the external-b interface. The clock source is chosen using the clock selection process.
- (SCBE only) Specify the external interface to select the external clock source.
- (SCBE2 only) Specify the external-0/0 interface or the external-1/0 interface to select the external clock source.

Options

time Amount of time in milliseconds that a signal is held before being passed to the clock selection process.

Range: 300–1800 milliseconds

Default: 1000 milliseconds

number Set the priority level of the clock source.

Range: 1 through 5

prc—Primary reference clock

prs —Primary reference source—Stratum 1

sec—SDH equipment clock

smc—SONET minimum clock

ssu-a—Synchronization supply unit A

ssu-b—Synchronization supply unit B

st2—Stratum 2

st3—Stratum 3

st3e—Stratum 3E

st4—Stratum 4

force-switch	Force switching to a clock source, provided the clock source is enabled and not locked out. Only one configured source may be force-switched.
lockout	Clock source is not considered by the selection process. Lockout may be configured for any source.

minutes	Set the time for the port signal to be up before the port is opened to receive and transmit ESMC messages. **Range:** 0 through 12 minutes **Default:** 5 minutes
aggregated-ether-group-name	aggregated ethernet group name

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

stateful

IN THIS SECTION

- Syntax | **510**
- Hierarchy Level | **510**
- Description | **511**
- Options | **511**
- Required Privilege Level | **511**
- Release Information | **511**

Syntax

```
stateful {
    interface interface-name {
        multicast-mode

                local-priority
                transport 802.3 ( link-local ) ;
                asymmetry number;
            }
    }
    }
}
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure the stateful port or bidirectional port with parameters. A stateful port is useful when you configure PTP over Ethernet for multicast mode of transmission of PTP traffic.

For PTP over Ethernet, you can configure a port to function as both a client port and a primary port. This type of port is called a dynamic port, a stateful port, or a bidirectional port. Such a dynamic port enables the transfer of frequency for synchronization services, in addition to time and phase alignment, when PTP functionality is not hop-by-hop and you have provisioned primary and client roles or interfaces.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 17.1R1.

RELATED DOCUMENTATION

- Precision Time Protocol Overview | **68**
- Guidelines for Configuring PTP over Ethernet | **112**
- Configuring PTP Multicast Primary and Member Ports for Ethernet Encapsulation | **181**
- Configuring PTP Dynamic Ports for Ethernet Encapsulation | **187**

squelch

IN THIS SECTION

- Syntax (ACX710: ESMC Hierarchy Level) | 512
- Syntax (ACX710: Output Hierarchy Level) | 512
- Hierarchy Level | 513
- Description | 513
- Options | 513
- Required Privilege Level | 514
- Release Information | 514

Syntax (ACX710: ESMC Hierarchy Level)

```
squelch {
    method ql-dnu;
    quality-level quality-level;
}
```

Syntax (ACX710: Output Hierarchy Level)

```
squelch {
    method (ais | ql-dnu | rai | shut);
}
```

Hierarchy Level

```
[edit chassis synchronization esmc-transmit interfaces]
[edit chassis synchronization output interfaces bits]
```

Description

Squelch the transmitting signal.

Options

method Specify the method to squelch the transmitting signal. Choose from the following options:

- ais—Transmits an alarm indication signal (AIS).
- ql-dnu—Transmits a Synchronous Digital Hierarchy (SDH) synchronization status message (SSM) or a Synchronous Optical Networks (SONET) SSM.
- rai—Transmits a remote alarm indication (RAI).
- shut—Shuts down the output.

quality-level Specify the quality level below which **squelch** is activated. The available quality levels are given in Table 22 on page 513.

Table 22: Quality Levels

Quality Level	Description
prc	Timing quality of a primary reference clock (option-1 only).
prs	Clock traceable to a primary reference source (option-2 only).
sec	Timing quality of an SDH equipment clock (option-1 only).

Table 22: Quality Levels *(Continued)*

Quality Level	Description
smc	Clock traceable to a self-timed SONET (option-2 only).
ssu-a	Timing quality of a type I or IV client clock (option-1 only).
ssu-b	Timing quality of a type VI client clock (option-1 only).
st2	Clock traceable to Stratum 2 (option-2 only).
st3	Clock traceable to Stratum 3 (option-2 only).
st3e	Clock traceable to Stratum 3E (option-2 only).
st4	Clock traceable to Stratum 4 free-run (option-2 only).
stu	Clock traceable to an unknown quality (option-2 only).
tnc	Clock traceable to a transit node clock (option-2 only).

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 20.2R1.

RELATED DOCUMENTATION

show chassis synchronization | 576

switchover-mode

IN THIS SECTION

- Syntax | 515
- Hierarchy Level | 515
- Description | 516
- Default | 516
- Options | 516
- Required Privilege Level | 516
- Release Information | 516

Syntax

```
switchover-mode (revertive | non-revertive);
```

Hierarchy Level

```
[edit chassis synchronization]
```

Description

Specify whether the device should switch to a higher-quality clock source or use the current clock source only.

Default

The default is revertive mode.

Options

revertive	In revertive mode (the default), the system automatically switches from a lower to a higher quality clock source whenever the higher clock source becomes available.
non-revertive	Set this option so that the router continues to use the current clock source as long as it is valid.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

synchronization (ACX Series) | **517**

synchronization (MX Series) | **524**

synchronization (PTX Series) | **531**

quality-level

show chassis synchronization | 576

synchronization (ACX Series)

IN THIS SECTION

- Syntax | 517
- Syntax (ACX710) | 518
- Hierarchy Level | 520
- Description | 520
- Options | 520
- Required Privilege Level | 520
- Release Information | 520

Syntax

```
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces {
            (all | interface-name);
        }
    }
    global-wait-to-restore minutes;
    hold-interval {
        configuration-change seconds;
        restart seconds;
        switchover seconds;
    }
    interfaces bits {
        signal-type (e1 | t1);
        e1-options {
            framing (g704 | g704-no-cro4);
        }
        t1-options {
            framing (esf | sf);
        }
    }
    network-option (option-1 | option-2);
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces interface-name {
            priority number;
            quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            request (force-switch | lockout);
            wait-to-restore minutes;
        }
    }
    switchover-mode (revertive | non-revertive);
}
```

Syntax (ACX710)

```
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces {
            (all | interface-name) {
                squelch {
                    method ql-dnu;
                    quality-level quality-level;
                }
            }
        }
    }
    global-wait-to-restore minutes;
    hold-interval {
        configuration-change seconds;
        restart seconds;
        switchover seconds;
    }
    interfaces bits {
        signal-type (e1 | t1);
        e1-options {
            framing (g704 | g704-no-cro4);
        }
        t1-options {
            framing (esf | sf);
        }
    }
    minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b | st2 | st3 | st3e |
st4 | stu | tnc);
    network-option (option-1 | option-2);
    output interfaces {
        bits {
            source-mode (chassis | ptp-clock);
            squelch {
                method (ais | ql-dnu | rai | shut);
            }
            ssm option-2  (GEN-1 | GEN-2);
        }
    }
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces interface-name {
            priority number;
            quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            request (force-switch | lockout);
            wait-to-restore minutes;
        }
    }
    switchover-mode (revertive | non-revertive);
}
```

Hierarchy Level

```
[edit chassis]
```

Description

Configure Synchronous Ethernet parameters.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**
Configuring External Clock Synchronization for ACX Series Routers | **26**
Synchronous Ethernet Overview | **232**
show chassis synchronization | **576**

synchronization (M Series and T Series)

IN THIS SECTION

- Syntax | 521
- Hierarchy Level | 521
- Description | 522
- Options | 522
- Required Privilege Level | 523
- Release Information | 523

Syntax

```
synchronization {
    primary (external-a | external-b | fpc-slot-number | gps-0-10mhz |
gps-0-5mhz | gps-1-10mhz | gps-1-5mhz | bits-a | bits-b);
    secondary (external-a | external-b | fpc-slot-number | gps-0-10mhz |
gps-0-5mhz | gps-1-10mhz | gps-1-5mhz | bits-a | bits-b );
    signal-type (t1 | e1);
    switching-mode (revertive | non-revertive);
    transmitter-enable;
    validation-interval seconds;
    y-cable-line-termination;
}
```

Hierarchy Level

```
[edit chassis]
```

Description

(M320, M40e, M120, T320, T640, and T1600 routers and PTX Series Packet Transport Routers only) Configure an external synchronization interface to synchronize the internal Stratum 3 clock to an external source, and then synchronize the chassis interface clock to that source.

Options

primary—First external timing source specified in the configuration hierarchy. This statement has the following suboptions:

- **external-a**—Use **external-a** as the primary clock synchronization source.
- **external-b**—Use **external-b** as the primary clock synchronization source.
- **fpc-*slot-number***—Use **fpc-*slot-number*** as the primary clock synchronization source. For the PTX5000 Packet Transport Router, replace *slot-number* with a value from **0** through **7**.
- **gps-0-10mhz**—Use **gps-0-10mhz** as the primary clock synchronization source.
- **gps-0-5mhz**—Use **gps-0-5mhz** as the primary clock synchronization source.
- **gps-1-10mhz**—Use **gps-1-10mhz** as the primary clock synchronization source.
- **gps-1-5mhz**—Use **gps-1-5mhz** as the primary clock synchronization source.
- **bits-a**—Use **bits-a** as the primary clock synchronization source.
- **bits-b**—Use **bits-b** as the primary clock synchronization source.

secondary—Second external timing source specified in the configuration hierarchy.

- **external-a**—Use **external-a** as the secondary clock synchronization source.
- **external-b**—Use **external-b** as the secondary clock synchronization source.
- **fpc-*slot-number***—Use **fpc-*slot-number*** as the secondary clock synchronization source. For the PTX5000 Packet Transport Router, replace *slot-number* with a value from **0** to **7**.
- **gps-0-10mhz**—Use**gps-0-10mhz** as the secondary clock synchronization source.
- **gps-0-5mhz**—Use **gps-0-5mhz** as the secondary clock synchronization source.
- **gps-1-10mhz**—Use **gps-1-10mhz** as the secondary clock synchronization source.
- **gps-1-5mhz**—Use **gps-1-5mhz** as the secondary clock synchronization source.

- **bits-a**—Use **bits-a** as the secondary clock synchronization source.
- **bits-b**—Use **bits-b** as the secondary clock synchronization source.

signal-type—Specify the line encoding mode for interfaces: either **t1** or **e1**. For the M40e router, only the **t1 signal-type** mode is supported.

- Default: **t1**

switching-mode—Specify **revertive** if a lower-priority synchronization can be switched to a valid, higher-priority synchronization.

- Default: **non-revertive**

transmitter-enable—(M320 routers only) Control whether the diagnostic timing signal is transmitted.

validation-interval—Validate the synchronized deviation. If revertive switching is enabled and a higher-priority clock is validated, the clock module is directed to the higher-priority clock, and all configured and active synchronizations are validated. The validation timer resumes after the current validation interval expires. This feature is not supported on PTX Series Packet Transport Routers.

- **Range:** (M320, M40e, T320, T640, T1600 routers) 90 through 86,400 seconds.

  (M120 routers) 30 through 86,400 seconds.
- **Default:** (M320, M40e, T320, T640, T1600 routers) 90 seconds. (M120 routers) 30 seconds

y-cable-line-termination—(M320 routers only) Specify that a single signal be wired to both Control Boards (CBs) using a Y-cable.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 7.6.

RELATED DOCUMENTATION

Configuring Junos OS to Support an External Clock Synchronization Interface for M Series, MX Series, and T Series Routers | **301**

synchronization (MX Series)

IN THIS SECTION

- Syntax | **524**
- Hierarchy Level | **526**
- Description | **526**
- Options | **527**
- Required Privilege Level | **530**
- Release Information | **531**

Syntax

```
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | interface-name);
    }
    hold-interval {
        configuration-change seconds;
        restart seconds;
        switchover seconds;
    }
    interfaces {
        external | (external-0/0 | external-1/0) {
            e1-options {
                framing (g704 | g704-no-crc4);
                line-encoding (ami | hdb3);
                sabit number;
            }
            pulse-per-second-enable;
            signal-type (2048khz | e1 | t1);
            t1-options {
                framing (esf | sf);
                line-encoding (ami | b8zs);
            }
        }
        bits {
            e1-options {
                framing (g704 | g704-no-crc4);
                sabit number;
                }
            }
        }
    }
    max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
    network-option (option-1 | option-2);
    output interfaces {
         (external | (external-0/0 | external-1/0)) {
            holdover-mode-disable;
            minimum-quality (prc | prs | sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            source-mode (chassis | line);
            tx-dnu-to-line-source-enable;
            wander-filter-disable;
        }
    }
    port {
        auxiliary {
            client {
                time-of-day-format {
                    ascii string;
                }
            }
        }
    }
    quality-mode-enable;
    selection-mode (configured-quality | received-quality);
    source {
        interfaces (interface-name | (bits |external | (external-0/0 |
external-1/0)) {
```

```
            priority number;
            quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 |
st3e | st4 | stu | tnc);
            request (force-switch | lockout);
        }
    }
    switchover-mode (revertive | non-revertive);
}
```

Hierarchy Level

```
[edit chassis]
```

Description

(MX5-T, MX10-T, MX40-T, MX80-T, MX240, MX480, MX960 , and MX10003 routers) Configure Synchronous Ethernet parameters. For configuration details, see "Configuring Clock Synchronization Interface on MX Series Routers" on page 303.

(MX240, MX480, MX960, and MX2020 routers with SCBE or SCBE2) Configure centralized clocking parameters.

- Starting in Junos 12.2, configure distribution of the selected chassis clock source to downstream network elements through supported line interfaces.
- Starting in Junos 12.3, configure an external building-integrated timing supply (BITS) timing source. You can also configure the selected chassis clock, or an incoming Synchronous Ethernet or PTP line source for transmission out the external interface.
- Starting in Junos 16.1 for the MX104 routers, SSM is supported on the BITS interface and can be configured at the **[edit chassis** `synchronization` **interfaces bits e1-options]** hierarchy level.

For configuration details, see "Example: Configuring Centralized Clocking on the Enhanced MX Switch Control Board" on page 328.

NOTE:

- Unified ISSU is not supported when clock synchronization is configured for Synchronous Ethernet.
- The commit operation fails if you configure bits as source, without first configuring bits interface.

Options

clock-mode (auto-select | free-run)—Specify the mode of operation to select the clock source either from a free-run local oscillator or from an external qualified clock. On MX240, MX480, and MX960 routers with enhanced MPCs, the free-run clock is provided by a local oscillator. On other MX Series routers, the free-run clock is provided by the SCB. The default setting is auto-select mode.

hold-interval (configuration-change | restart | switchover) *seconds*—Specify the chassis synchronization hold interval type and clock selection wait time:

- **configuration-change**—Clock select wait time after change in configuration. The range is 15 through 60 seconds.
- **restart**— Clock select wait time after reboot. The range is 60 through 180 seconds. The default is 120 seconds.
- **switchover**— Switchover wait time after clock recovery. The range is 30 to 60 seconds. The default is 30 seconds.

interfaces (external | (external-0/0 | external-1/0))—Configure the external interface for operating with a connected external device. This interface can be configured as a clock source, which then becomes a candidate for selection as the chassis clock source by the clock source selection algorithm.

- **signal-type (1mhz | 5mhz | 10mhz | 2048khz | e1 | t1)**—Specify the external interface signal type:
    1. **1mhz**—Set the signal with a clock frequency of 1 MHz.
    2. **5mhz**—Set the signal with a clock frequency of 5 MHz.
    3. **10mhz**—Set the signal with a clock frequency of 10 MHz.
    4. **2048khz**—Set the signal with a clock frequency of 2048 kHz.
    5. **e1**—Set the signal as an E1-coded 2048 kHz signal on a 120-ohm balanced line.
    6. **t1**—Set the signal as a T1-coded 1.544 MHz signal on a 100-ohm balanced line.
- **e1-options**—Specify the E1 options:

1. **framing (g704 | g704-no-crc4)**—Specify the framing format:
    - **g704**—G.704 framing format for E1 interfaces
    - **g704-no-crc4**—G.704 framing with no CRC4 for E1 interfaces
2. **line-encoding (ami | hdb3)**—Specify the line encoding:
    - **ami**— Alternate mark inversion (AMI)
    - **hdb3**—High-d Density bipolar 3 code (HDB3)
3. **sabit *number***—Specify the San synchronization status bit used for exchanging SSN quality. The value can be 4, 5, 6, 7, or 8. The default is 4.

- **t1-options**—Specify the T1 options:
    1. **framing (esf | sf)**—Specify the framing format:
        - **esf**—Extended superframe (ESF)
        - **sf**—Superframe (SF)
    2. **line-encoding (ami | b8zs)**—Specify the line encoding:
        - **ami**— Alternate mark inversion (AMI)
        - **b8zs**—8-bit zero suppression, bipolar with 8-zero substitution (B8ZS)

network-option (option-1 | option-2)—Specify the synchronization networking:

- **option-1**— EEC-1 maps to G.813 option 1 clock
- **option-2**—EEC-2 maps to G.812 type IV clock

quality-mode-enable—Specify the clock selection, quality level, and priority setting. The quality level parameter for a Synchronous Ethernet interface is optional when quality mode is enabled and the selection mode is set to **received-quality**. The default quality level for a Synchronous Ethernet interface is based on the value of **network-option**: **option-1** selects **SEC** and **option-2** selects **ST3**. Table 23 on page 528 shows whether SSM quality level is supported for a given external interface signal type and framing. The default setting is disabled.

Table 23: SSM-Quality Level Support by Signal Type and Framing

Signal Type	Framing	SSM Quality Level Supported
E1	G.704	yes

Table 23: SSM-Quality Level Support by Signal Type and Framing ***(Continued)***

Signal Type	Framing	SSM Quality Level Supported
E1	G.704 no CRC4	no
T1	ESF	yes
T1	SF	no
2048 KHz	Not applicable	no

selection-mode (configured-quality | received-quality)—Specify whether the clock source selection should use the configured or received ESMC or SSM quality level for a qualifying interface. In both selection modes, the interface qualifies for clock source selection only when the received ESMC or SSM quality level on the interface is equal to or greater than the configured ESMC or SSM quality level for the interface.

> **NOTE**: For the **selection-mode** statement configuration to take effect, you must set the **quality-mode-enable** statement at the **[edit chassis synchronization]** hierarchy level.

1. **configured-quality**—The clock source selection algorithm uses the ESMC or SSM quality level configured for a qualifying interface.

2. **received-quality**—The clock source selection algorithm uses the ESMC or SSM quality level received on the qualifying interface.

source (external-a | external-b | interfaces (*interface-name*) | external | (external-0/0 | external-1/0))—Specify clock sources.

(SCB only) The primary clock source is external-a interface, the secondary clock source is external-b interface. The clock source is chosen using the clock selection process.

(SCBE only) Specify the external interface to select the external clock source.

(SCBE2 only) Specify the external-0/0 interface or external-1/0 interface to select the external clock source.

- **priority** ***number***—Specify a priority level from 1 to 5. When not specified, **external-a** has higher default priority than external-b interface , and external-b interface has higher default priority than other Gigabit Ethernet or 10-Gigabit Ethernet clock sources, which have the lowest default priority. Any priority you configure is higher than any default priority.

- **quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e | st4 | stu | tnc)**—Specify the **quality-level** option based on the configured **network-option**. For quality level details, see "quality-level" on page 474.

> **NOTE**: Starting with Junos OS Release 12.2R1, the **quality-level** parameter for a Synchronous Ethernet interface is optional when quality mode is enabled and the selection mode is set to received quality. The default quality level for a Synchronous Ethernet interface is **SEC** for the **option-1** network type and **ST3** for the **option-2** network type.
>
> Both option I and option II SSM quality levels are supported:
>
> - For option-1, quality level must be configured for external clocks (**external-a** or **external-b**) whether or not quality level is enabled.
> - For option-2, the default quality level for external clocks is QL_STU whether or not quality level is enabled.
> - Quality level is set to DNU for network-option 1 and set to DUS for network-option 2, if quality-level is not configured and no ESMC messages are received.
> - On the selected active source (primary or secondary, whichever is active), even if ESMC transmit is not enabled, a DNU ESMC will be sent out if **network-option** is 1, and DUS ESMC will be sent out if **network-option** is 2. This is applicable only for sources of Ethernet interface type to avoid source looping.

- **request force-switch**—Force a switch to this source if the source is enabled and not locked out. You can configure only one source to be force-switched.
- **request lockout**—You can configure lockout for any source. When configured, this source is not considered by the clock selection process.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 10.4.

Statement introduced in Junos OS Release 17.3R1 for MX10003 router.

Options **interfaces**, **output**, and **source interfaces external** introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

- Synchronous Ethernet Overview | **232**
- show chassis synchronization (MX Series Routers) | **590**
- Configuring Clock Synchronization Interface on MX Series Routers | **303**
- Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC | **263**
- Example: Configuring Centralized Clocking on the Enhanced MX Switch Control Board | **328**
- Example: Configuring Centralized Clocking on an MX2020 | **341**
- request chassis synchronization mode | **568**
- Clock Sources for PTX Series Packet Transport Routers | **321**

synchronization (PTX Series)

IN THIS SECTION

- Syntax | **532**
- Hierarchy Level | **532**
- Description | **533**
- Options | **533**
- Required Privilege Level | **533**
- Release Information | **533**

Syntax

```
synchronization {
    clock-mode (auto-select | free-run);
    esmc-transmit {
        interfaces (all | interface-name);
    }
    global-wait-to-restore minutes;
    hold-interval {
        configuration-change seconds;
        restart seconds;
        switchover seconds;
    }
    interfaces (bits-a | bits-b | gps-0 | gps-1) (pulse-per-second-enable |
signal-type (5mhz|10mhz|e1|t1));
    max-transmit-quality-level (prc | prs | sec | ssu-a | ssu-b | st2 | st3e |
stu | tnc);
    network-option (option-1 | option-2);
    primary (fpc-slot-number | gps-0 | gps-1 | bits-a | bits-b);
    quality-mode-enable;
    secondary (fpc-slot-number | gps-0 | gps-1 | bits-a | bits-b);
    selection-mode (configured-quality | received-quality);
    source (bits-a | bits-b | gps-0 | gps-1) {
        priority number;
        quality-level (prc | prs |sec | smc | ssu-a | ssu-b | st2 | st3 | st3e |
st4 | stu | tnc);
        request (force-switch | lockout);
    }
    switchover-mode (revertive | non-revertive);
}
```

Hierarchy Level

```
[edit chassis]
```

Description

Configure Synchronous Ethernet parameters.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.1X48.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

Synchronizing Internal Stratum 3 Clock to External Clock Sources on PTX Series Routers | **323**

request chassis synchronization switch | **570**

Clock Sources for PTX Series Packet Transport Routers | **321**

Understanding Clock Synchronization | **277**

synchronous-ethernet-mapping

IN THIS SECTION

- Syntax | 534
- Hierarchy Level | 534
- Description | 534
- Required Privilege Level | 535
- Release Information | 535

Syntax

```
synchronous-ethernet-mapping {
    clock-source ip-address {
        interface interface1-name;
        interface interface2-name;
    }
}
```

Hierarchy Level

```
[edit protocols ptp slave hybrid]
```

Description

Configure the Synchronous Ethernet mapping for hybrid mode.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Configuring Hybrid Mode and ESMC Quality Level Mapping | 361
Understanding Hybrid Mode | 357
Precision Time Protocol Overview | 68
Synchronous Ethernet Overview | 232

t1-options

IN THIS SECTION

- Syntax | 536
- Hierarchy Level | 536
- Description | 536
- Options | 536
- Required Privilege Level | 536
- Release Information | 537

Syntax

```
t1-options {
    framing (esf | sf);
    line-encoding (ami | b8zs);
}
```

Hierarchy Level

```
[edit chassis synchronization interfaces external]
[edit chassis synchronization interfaces (external-0/0 | external-1/0) e1-
options]
```

Description

Configure the T1 interface options.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

t1-options (BITS Interfaces Signal Type)

IN THIS SECTION

- Syntax | **537**
- Hierarchy Level | **537**
- Description | **538**
- Options | **538**
- Required Privilege Level | **538**
- Release Information | **538**

Syntax

```
t1-options {
    framing (esf | sf);
}
```

Hierarchy Level

```
[edit chassis synchronization interfaces bits]
```

Description

Specify options for the T1 signal type for the building-integrated timing supply (BITS) interface. Valid only if **t1** is the `signal-type` configured at the [**edit chassis synchronization source interfaces *interface-name* bits signal-type**] hierarchy.

Options

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

External Clock Synchronization Overview for ACX Series Routers | **23**

Configuring External Clock Synchronization for ACX Series Routers | **26**

Synchronous Ethernet Overview | **232**

show chassis synchronization | **576**

time-zone

IN THIS SECTION

- Syntax | 539
- Hierarchy Level | 539
- Description | 539
- Default | 540
- Options | 540
- Required Privilege Level | 542
- Release Information | 542

Syntax

```
time-zone (GMT hour-offset | time-zone);
```

Hierarchy Level

```
[edit system]
```

Description

Set the local time zone. To have the time zone change take effect for all processes running on the router or switch, you must reboot the router or switch.

Default

UTC

Options

GMT *hour-offset*—Set the time zone relative to UTC time.

- **Range:** –14 through +12
- **Default:** 0

time-zone—Specify the time zone as **UTC**, which is the default time zone, or as a string such as PDT (Pacific Daylight Time), or use one of the following continents and major cities:

```
Africa/Abidjan, Africa/Accra, Africa/Addis_Ababa, Africa/Algiers, Africa/Asmera,
Africa/Bamako, Africa/Bangui, Africa/Banjul, Africa/Bissau, Africa/Blantyre,
Africa/Brazzaville, Africa/Bujumbura, Africa/Cairo, Africa/Casablanca, Africa/
Ceuta, Africa/Conakry, Africa/Dakar, Africa/Dar_es_Salaam, Africa/Djibouti,
Africa/Douala, Africa/El_Aaiun, Africa/Freetown, Africa/Gaborone, Africa/Harare,
Africa/Johannesburg, Africa/Kampala, Africa/Khartoum, Africa/Kigali, Africa/
Kinshasa, Africa/Lagos, Africa/Libreville, Africa/Lome, Africa/Luanda, Africa/
Lubumbashi, Africa/Lusaka, Africa/Malabo, Africa/Maputo, Africa/Maseru, Africa/
Mbabane, Africa/Mogadishu, Africa/Monrovia, Africa/Nairobi, Africa/Ndjamena,
Africa/Niamey, Africa/Nouakchott, Africa/Ouagadougou, Africa/Porto-Novo, Africa/
Sao_Tome, Africa/Timbuktu, Africa/Tripoli, Africa/Tunis, Africa/Windhoek
America/Adak, America/Anchorage, America/Anguilla, America/Antigua, America/
Aruba, America/Asuncion, America/Barbados, America/Belize, America/Bogota,
America/Boise, America/Buenos_Aires, America/Caracas, America/Catamarca, America/
Cayenne, America/Cayman, America/Chicago, America/Cordoba, America/Costa_Rica,
America/Cuiaba, America/Curacao, America/Dawson, America/Dawson_Creek, America/
Denver, America/Detroit, America/Dominica, America/Edmonton, America/
El_Salvador, America/Ensenada, America/Fortaleza, America/Glace_Bay, America/
Godthab, America/Goose_Bay, America/Grand_Turk, America/Grenada, America/
Guadeloupe, America/Guatemala, America/Guayaquil, America/Guyana, America/
Halifax, America/Havana, America/Indiana/Knox, America/Indiana/Marengo, America/
Indiana/Vevay, America/Indianapolis, America/Inuvik, America/Iqaluit, America/
Jamaica, America/Jujuy, America/Juneau, America/La_Paz, America/Lima, America/
Los_Angeles, America/Louisville, America/Maceio, America/Managua, America/
Manaus, America/Martinique, America/Mazatlan, America/Mendoza, America/
```

```
Menominee, America/Mexico_City, America/Miquelon, America/Montevideo, America/
Montreal, America/Montserrat, America/Nassau, America/New_York, America/Nipigon,
America/Nome, America/Noronha, America/Panama, America/Pangnirtung, America/
Paramaribo, America/Phoenix, America/Port-au-Prince, America/Port_of_Spain,
America/Porto_Acre, America/Puerto_Rico, America/Rainy_River, America/
Rankin_Inlet, America/Regina, America/Rosario, America/Santiago, America/
Santo_Domingo, America/Sao_Paulo, America/Scoresbysund, America/Shiprock,
America/St_Johns, America/St_Kitts, America/St_Lucia, America/St_Thomas, America/
St_Vincent, America/Swift_Current, America/Tegucigalpa, America/Thule, America/
Thunder_Bay, America/Tijuana, America/Tortola, America/Vancouver, America/
Whitehorse, America/Winnipeg, America/Yakutat, America/Yellowknife
Antarctica/Casey, Antarctica/DumontDUrville, Antarctica/Mawson, Antarctica/
McMurdo, Antarctica/Palmer, Antarctica/South_Pole
Arctic/Longyearbyen
Asia/Aden, Asia/Alma-Ata, Asia/Amman, Asia/Anadyr, Asia/Aqtau, Asia/Aqtobe, Asia/
Ashkhabad, Asia/Baghdad, Asia/Bahrain, Asia/Baku, Asia/Bangkok, Asia/Beirut,
Asia/Bishkek, Asia/Brunei, Asia/Chungking, Asia/Colombo, Asia/Dacca, Asia/
Damascus, Asia/Dubai, Asia/Dushanbe, Asia/Gaza, Asia/Harbin, Asia/Hong_Kong,
Asia/Irkutsk, Asia/Ishigaki, Asia/Jakarta, Asia/Jayapura, Asia/Jerusalem, Asia/
Kabul, Asia/Kamchatka, Asia/Karachi, Asia/Kashgar, Asia/Katmandu, Asia/Kolkata ,
Asia/Krasnoyarsk, Asia/Kuala_Lumpur, Asia/Kuching, Asia/Kuwait, Asia/Macao, Asia/
Magadan, Asia/Manila, Asia/Muscat, Asia/Nicosia, Asia/Novosibirsk, Asia/Omsk,
Asia/Phnom_Penh, Asia/Pyongyang, Asia/Qatar, Asia/Rangoon, Asia/Riyadh, Asia/
Saigon, Asia/Seoul, Asia/Shanghai, Asia/Singapore, Asia/Taipei, Asia/Tashkent,
Asia/Tbilisi, Asia/Tehran, Asia/Thimbu, Asia/Tokyo, Asia/Ujung_Pandang, Asia/
Ulan_Bator, Asia/Urumqi, Asia/Vientiane, Asia/Vladivostok, Asia/Yakutsk, Asia/
Yekaterinburg, Asia/Yerevan
Atlantic/Azores, Atlantic/Bermuda, Atlantic/Canary, Atlantic/Cape_Verde,
Atlantic/Faeroe, Atlantic/Jan_Mayen, Atlantic/Madeira, Atlantic/Reykjavik,
Atlantic/South_Georgia, Atlantic/St_Helena, Atlantic/Stanley
Australia/Adelaide, Australia/Brisbane, Australia/Broken_Hill, Australia/Darwin,
Australia/Hobart, Australia/Lindeman, Australia/Lord_Howe, Australia/Melbourne,
Australia/Perth, Australia/Sydney
Europe/Amsterdam, Europe/Andorra, Europe/Athens, Europe/Belfast, Europe/
Belgrade, Europe/Berlin, Europe/Bratislava, Europe/Brussels, Europe/Bucharest,
Europe/Budapest, Europe/Chisinau, Europe/Copenhagen, Europe/Dublin, Europe/
Gibraltar, Europe/Helsinki, Europe/Istanbul, Europe/Kaliningrad, Europe/Kiev,
Europe/Lisbon, Europe/Ljubljana, Europe/London, Europe/Luxembourg, Europe/
Madrid, Europe/Malta, Europe/Minsk, Europe/Monaco, Europe/Moscow, Europe/Oslo,
Europe/Paris, Europe/Prague, Europe/Riga, Europe/Rome, Europe/Samara, Europe/
San_Marino, Europe/Sarajevo, Europe/Simferopol, Europe/Skopje, Europe/Sofia,
Europe/Stockholm, Europe/Tallinn, Europe/Tirane, Europe/Vaduz, Europe/Vatican,
Europe/Vienna, Europe/Vilnius, Europe/Warsaw, Europe/Zagreb, Europe/Zurich
```

```
Indian/Antananarivo, Indian/Chagos, Indian/Christmas, Indian/Cocos, Indian/
Comoro, Indian/Kerguelen, Indian/Mahe, Indian/Maldives, Indian/Mauritius, Indian/
Mayotte, Indian/Reunion
Pacific/Apia, Pacific/Auckland, Pacific/Chatham, Pacific/Easter, Pacific/Efate,
Pacific/Enderbury, Pacific/Fakaofo, Pacific/Fiji, Pacific/Funafuti, Pacific/
Galapagos, Pacific/Gambier, Pacific/Guadalcanal, Pacific/Guam, Pacific/Honolulu,
Pacific/Johnston, Pacific/Kiritimati, Pacific/Kosrae, Pacific/Kwajalein, Pacific/
Majuro, Pacific/Marquesas, Pacific/Midway, Pacific/Nauru, Pacific/Niue, Pacific/
Norfolk, Pacific/Noumea, Pacific/Pago_Pago, Pacific/Palau, Pacific/Pitcairn,
Pacific/Ponape, Pacific/Port_Moresby, Pacific/Rarotonga, Pacific/Saipan, Pacific/
Tahiti, Pacific/Tarawa, Pacific/Tongatapu, Pacific/Truk, Pacific/Wake, Pacific/
Wallis, Pacific/Yap
```

Required Privilege Level

system—To view this statement in the configuration.

system-control—To add this statement to the configuration.

Release Information

Statement introduced before Junos OS Release 7.4.

GMT ***hour-offset*** option added in Junos OS Release 7.4.

RELATED DOCUMENTATION

Modifying the Default Time Zone for a Router or Switch Running Junos OS | 40

tx-dnu-to-line-source-enable

IN THIS SECTION

- Syntax | 543
- Hierarchy Level | 543
- Description | 543
- Required Privilege Level | 543
- Release Information | 544

Syntax

```
tx-dnu-to-line-source-enable;
```

Hierarchy Level

```
[edit chassis synchronization output interfaces external]
[edit chassis synchronization output interfaces (external-0/0 | external-1/0)]
```

Description

Configure the transmitting quality level to DNU or DUS on the line source interface that has been selected as the external output source.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | 524

unicast-mode

IN THIS SECTION

- Syntax | 544
- ACX710 | 545
- Hierarchy Level | 545
- Description | 545
- Options | 546
- Required Privilege Level | 546
- Release Information | 546

Syntax

```
unicast-mode {
    clock-source ip-address {
        local-ip-address local-ip-address;
            asymmetry  number;
        }
    transport ipv4;
    clock-ipv6-source  master-ipv6-address {
        local-ip-address local-ip-address;
        }
    transport ipv6;
}
```

ACX710

```
unicast-mode {
    announce-timeout announce-timeout;
    grantor;
    local-priority local-priority;
    master-only;
    remote-ip-address ip-address {
        local-ip-address;
        announce-interval announce-interval;
        asymmetry asymmetry;
        delay-request delay-request;
        dscp dscp;
        grant-duration grant-duration;
        sync-interval sync-interval;
    }
    transport (ipv4 | ipv6);
}
```

Hierarchy Level

```
[edit protocols ptp client interface interface-name]
```

Description

Configure the slave in unicast mode. You can set this option when PTP unicast mode of messaging is needed.

Options

announce-timeout-value	The announce timeout value for announce interval messages. • **Range:** 3 through 10 • **Default:** 3
grantor	Specify that the selected interface port can be grantor. The grantor attribute enables the port to allow for the grant-port property and can provide PTP message services. It allows the port to accept and handle unicast negotiation requests.
Priority value	Priority value. • **Range:** 1 through 255 • **Default:** 128
master-only	Specify master only option. When you set master-only option, it is not possible to set the interface port as client clock.

transport	Encapsulation for PTP packet transport
	• Values:
	  • ipv4—Use IPv4 as transport
	  • ipv6—Use IPv6 as transport

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Precision Time Protocol | 82

Configuring Precision Time Protocol | 82

Precision Time Protocol Overview | 68

IEEE 1588v2 Precision Timing Protocol (PTP) | 103

unicast-negotiation

IN THIS SECTION

- Syntax | 547
- Hierarchy Level | 547
- Description | 548
- Required Privilege Level | 548
- Release Information | 548

Syntax

```
unicast-negotiation;
```

Hierarchy Level

```
[edit protocols ptp]
```

Description

Configure unicast negotiation. Unicast negotiation is a method by which the announce, synchronization, and delay response packet rates are negotiated between the primary and the client before a PTP session is established.

> **NOTE:**
> When unicast negotiation is enabled, you cannot commit any packet rate–related configuration.

Required Privilege Level

routing—To view this statement in the configuration.

routing-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

- Configuring Precision Time Protocol | **82**
- Configuring Precision Time Protocol | **82**
- Precision Time Protocol Overview | **68**
- IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

use-imported-time-zones

IN THIS SECTION

- Syntax | 549
- Hierarchy Level | 549
- Description | 549
- Required Privilege Level | 549
- Release Information | 550

Syntax

```
use-imported-time-zones;
```

Hierarchy Level

```
[edit system]
```

Description

Configure a custom time zone from a locally generated time-zone database.

Required Privilege Level

admin—To view this statement in the configuration.

admin-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 9.0.

RELATED DOCUMENTATION

Updating the IANA Time Zone Database on Junos OS Devices | 41

wait-to-restore

IN THIS SECTION

- Syntax | 550
- Hierarchy Level | 550
- Description | 551
- Options | 551
- Required Privilege Level | 551
- Release Information | 552

Syntax

```
wait-to-restore minutes;
```

Hierarchy Level

```
[edit chassis source interfaces (external-a | external-b | interface interface-name)]
[edit chassis source interfaces (external | interface interface-name)]
```

```
[edit chassis source interfaces (external-0/0 | external-1/0 | interface
interface-name)]
```

Description

Configure the time in minutes for each port to be up before opening the Ethernet Synchronization Message Channel (ESMC) for messages. When a port’s signal transitions out of the signal fail state, it must be fault-free for the wait-to-restore time before it is again considered by the clock selection process.

> **NOTE**: When you perform GRES on MX Series routers, you must execute the **clear synchronous-ethernet wait-to-restore** operational mode command on the new primary Routing Engine to clear the wait-to-restore timer on it. This is because the **clear synchronous-ethernet wait-to-restore** operational mode command clears the wait-to-restore timer only on the local Routing Engine.

Options

minutes	Set the time for the port signal to be up before the port is opened to receive and transmit ESMC messages.

- **Range:** 0 through 12 minutes
- **Default:** 5 minutes

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 14.2.

RELATED DOCUMENTATION

synchronization (MX Series) | 524
synchronization (PTX Series) | 531
global-wait-to-restore | 415

wander-filter-disable

IN THIS SECTION

- Syntax | 552
- Hierarchy Level | 553
- Description | 553
- Required Privilege Level | 553
- Release Information | 553

Syntax

```
wander-filter-disable;
```

Hierarchy Level

```
[edit chassis synchronization output interfaces external]
[edit chassis synchronization output interfaces (external-0/0 | external-1/0)]
```

Description

Disable the wander filter on the output interface.

Required Privilege Level

interface—To view this statement in the configuration.

interface-control—To add this statement to the configuration.

Release Information

Statement introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

synchronization (MX Series) | **524**

9

CHAPTER

Operational Commands

clear synchronous-ethernet esmc statistics | 556

clear synchronous-ethernet wait-to-restore | 557

request chassis ccg | 559

request chassis clock master switch | 561

request chassis pcg | 563

request chassis scg | 565

request chassis synchronization mode | 568

request chassis synchronization switch | 570

set date | 573

show chassis synchronization | 576

show chassis synchronization (MX Series Routers) | 590

show ntp associations | 608

show ntp status | 612

show ptp clock | 616

show ptp aggregated-ethernet interfaces | 621

show ptp hybrid | 624

show ptp global-information | 627

show ptp lock-status | 632

show ptp master | 637

show ptp path-trace detail | 642

show ptp phy-timestamping-interfaces | 645

show ptp port | 647

show ptp quality-level-mapping | 651

show ptp slave | 653

show ptp stateful detail | 658

show ptp statistics | 660

show synchronous-ethernet esmc statistics | 666

show synchronous-ethernet esmc transmit | 669

show synchronous-ethernet global-information | 672

clear synchronous-ethernet esmc statistics

IN THIS SECTION

- Syntax | 556
- Description | 556
- Options | 556
- Required Privilege Level | 556
- Sample Output | 557
- Release Information | 557

Syntax

```
clear synchronous-ethernet esmc statistics <interface-name>
```

Description

Clear the ESMC statistics for all the interfaces.

Options

interface-name	(Optional) Clear ESMC statistics for the specified interface.

Required Privilege Level

clear

Sample Output

clear synchronous-ethernet esmc statistics

The following example displays the message after the **clear synchronous-ethernet esmc statistics** command is entered:

```
user@host> clear synchronous-ethernet esmc statistics
Cleared ESMC statistics for all interfaces
```

Release Information

Command introduced before Junos OS Release 10.4.

RELATED DOCUMENTATION

- Example: Configuring Synchronous Ethernet on MX Series Routers | 256
- Synchronous Ethernet Overview | 232
- show synchronous-ethernet esmc statistics | 666

clear synchronous-ethernet wait-to-restore

IN THIS SECTION

- Syntax | 558
- Description | 558
- Options | 558
- Required Privilege Level | 558
- Sample Output | 559
- Release Information | 559

Syntax

```
clear synchronous-ethernet wait-to-restore
<interface interface-name>
```

Description

Clear the wait-to-restore timer for all the interfaces in an MX Series router.

> **NOTE**: When you perform GRES on MX Series routers, you must execute the **clear synchronous-ethernet wait-to-restore** operational mode command on the new primary Routing Engine to clear the wait-to-restore timer on it. This is because the **clear synchronous-ethernet wait-to-restore** operational mode command clears the wait-to-restore timer only on the local Routing Engine.

Options

interface *interface-name*	(Optional) Clear wait to restore timer for the specified interface.

Required Privilege Level

clear

Sample Output

clear synchronous-ethernet wait-to-restore interface <interface-name>

The following example displays the message after the **clear synchronous-ethernet wait-to-restore interface ge-2/1/6** command is entered in operational mode command:

```
user@host> clear synchronous-ethernet wait-to-restore interface ge-2/1/6
Cleared wait-to-restore timer for interface ge-2/1/6
```

Release Information

Command introduced in Junos OS Release 14.2.

RELATED DOCUMENTATION

Example: Configuring Synchronous Ethernet on MX Series Routers | **256**

Synchronous Ethernet Overview | **232**

request chassis ccg

IN THIS SECTION

- Syntax | **560**
- Description | **560**
- Options | **560**
- Required Privilege Level | **560**
- Output Fields | **560**
- Sample Output | **561**
- Release Information | **561**

Syntax

```
request chassis ccg (offline | online) slot slot-number
```

Description

(PTX5000 Packet Transport Routers) Control the operation of the Centralized Clock Generator (CCG).

Options

offline	Take the CCG offline.
online	Bring the CCG online.
slot *slot-number*	CCG slot number. Replace *slot-number* with a value from 0 through 1.

Required Privilege Level

maintenance

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis ccg

```
user@host> request chassis ccg offline slot 1
CCG 1 is  offline, Backup CCG 0 is now online.
```

Release Information

Command introduced in Junos OS 12.1x48 .

RELATED DOCUMENTATION

Clock Sources for PTX Series Packet Transport Routers | 321

show chassis environment ccg

request chassis clock master switch

IN THIS SECTION

- Syntax | 562
- Description | 562
- Options | 562
- Additional Information | 562
- Required Privilege Level | 562
- Output Fields | 563
- Sample Output | 563
- Release Information | 563

Syntax

```
request chassis clock master switch
```

Description

(PTX Series Packet Transport Routers only) Control which Centralized Clock Generator (CCG) is the primary.

Options

This command has no options.

Additional Information

By default, the CCG in slot 0 (CCG0) is the primary and the CCG in slot 1 (CCG1) is the backup. If you use this command to change the primary, and then restart the chassis software for any reason, the primary reverts to the default setting. To change the default primary CCG, include the **ccg** statement at the [**edit chassis redundancy**] hierarchy level in the configuration. For more information, see the Junos OS Administration Library.

The configurations on the two CCGs do not have to be the same, and they are not automatically synchronized. If you configure both CCGs as primaries, when the chassis software restarts for any reason, the CCG in slot 0 becomes the primary and the one in slot 1 becomes the backup.

The switchover from the primary CCG to the backup CCG is immediate.

Required Privilege Level

maintenance

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis clock primary switch

```
user@host> request chassis clock master switch
CCG master switch initiated, use “show chassis environment ccg” to verify
```

Release Information

Command introduced in Junos OS Release 12.1.

RELATED DOCUMENTATION

show chassis environment

request chassis pcg

IN THIS SECTION

- Syntax | **564**
- Description | **564**
- Options | **564**
- Required Privilege Level | **564**
- Output Fields | **564**
- Sample Output | **565**

- Release Information | 565

Syntax

```
request chassis pcg (offline | online) slot slot-number
```

Description

(M40e and M160 routers) Control the operation of the Packet Forwarding Engine (PFE) clock generator (PCG).

Options

offline	Take the PCG offline.
online	Bring the PCG online.
slot *slot-number*	PCG slot number. Replace *slot-number* with 0 or 1.

Required Privilege Level

maintenance

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis pcg

```
user@host> request chassis pcg online slot 0
PCG 1 appears to be already online
```

Release Information

Command introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

show chassis environment pcg

request chassis scg

IN THIS SECTION

- Syntax | 566
- Syntax (TX Matrix and TX Matrix Plus Routers) | 566
- Description | 566
- Options | 566
- Required Privilege Level | 567
- Output Fields | 567
- Sample Output | 567
- Release Information | 567

Syntax

```
request chassis scg (offline | online) slot slot-number
```

Syntax (TX Matrix and TX Matrix Plus Routers)

```
request chassis scg lcc number   (offline | online) slot slot-number
```

Description

(T Series routers only) Control the operation of the specified SONET Clock Generator (SCG).

Options

lcc *number* (TX Matrix router and TX Matrix Plus router only) (Optional) Line-card chassis number.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

offline Take the SCG offline. When you change the SCG status to offline, the unit is not powered down.

online Bring the SCG online.

slot *slot-number*	SCG slot number. Replace *slot-number* with 0 or 1.

Required Privilege Level

maintenance

Output Fields

When you enter this command, you are provided feedback on the status of your request.

Sample Output

request chassis scg

```
user@host> request chassis scg online slot 0
Online initiated, use "show chassis environment scg" to verify
```

Release Information

Command introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

show chassis environment scg

Configuring the Clock Source

T320 SONET Clock Generator (SCG) Description

request chassis synchronization mode

IN THIS SECTION

- Syntax | 568
- Description | 568
- Options | 568
- Required Privilege Level | 569
- Output Fields | 569
- Sample Output | 569
- Sample Output | 569
- Sample Output | 570
- Release Information | 570

Syntax

```
request chassis synchronization mode (free-run | holdover | auto-select)
```

Description

(MX5-T, MX10-T, MX40-T, MX80, MX80-T, MX240, MX480, and MX960 routers only) Change the chassis synchronization source used for Synchronous Ethernet configuration.

Options

freerun	Change chassis synchronization to free-run mode.
holdover	Change chassis synchronization to holdover mode.

auto-select	Change chassis synchronization to auto-select mode.

Required Privilege Level

maintenance

Output Fields

When you enter this command, the current status of your request is displayed.

- **Not configured**—Indicates that the source is not configured.
- **Present**—Indicates that the source is configured and present.
- **Qualified**—Indicates that the source is being used for synchronization.

Sample Output

request chassis synchronization mode freerun

```
user@host> request chassis synchronization mode freerun
mode is freerun, status: qualified
```

Sample Output

request chassis synchronization mode holdover

```
user@host> request chassis synchronization mode holdover
mode is holdover, status: qualified
```

Sample Output

request chassis synchronization mode auto-select

```
user@host> request chassis synchronization mode auto-select
mode is auto-select, status: qualified
```

Release Information

Command introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

Configuring Clock Synchronization Interface on MX Series Routers | **303**

request chassis synchronization switch

IN THIS SECTION

- Syntax | **571**
- Syntax (M Series, T Series) | **571**
- Syntax (PTX Series) | **571**
- Description | **571**
- Options | **571**
- Required Privilege Level | **572**
- Output Fields | **572**
- Sample Output | **572**
- Release Information | **573**

Syntax

```
request chassis synchronization switch
```

Syntax (M Series, T Series)

```
request chassis synchronization switch (external-a | external-b)
```

Syntax (PTX Series)

```
request chassis synchronization switch (bits-a | bits-b | fpc-slot-number |
gps-0 | gps-1 )
```

Description

(M320, M40e, M120, T320, T640, and T1600 routers and PTX Packet Transport Routers only) Change the external clock source used for chassis synchronization.

Options

external-a	(Routing matrix only) Change the synchronization source to external source A.
external-b	(Routing matrix only) Change the synchronization source to external source B.
bits-a	(PTX Series only) Change the synchronization source to the BITS external source A.
bits-b	(PTX Series only) Change the synchronization source to the BITS external source B.

fpc-*slot-number*	(PTX Series only) Change the synchronization source to an FPC in the slot specified. For the PTX5000 Packet Transport Router, replace *slot-number* with a value from 0 through 7.
gps-0-10mhz	(PTX Series only) Change the synchronization source to the 10 MHz GPS source on CCG port 0.
gps-0-5mhz	(PTX Series only) Change the synchronization source to the 5 MHz GPS source on CCG port 0.
gps-1-10mhz	(PTX Series only) Change the synchronization source to the 10 MHz GPS source on CCG port 1.
gps-1-5mhz	(PTX Series only) Change the synchronization source to the 5 MHz GPS source on CCG port 1.

Required Privilege Level

maintenance

Output Fields

When you enter this command, you are provided feedback on the status of your request. **Not configured** indicates that the source is not configured. **Present** indicates that the source is configured and present. **Qualified** indicates that the source is being used for synchronization.

Sample Output

request chassis synchronization switch (M Series, T Series)

```
user@host> request chassis synchronization switch external-a
switching to external-a, status: qualified
```

request chassis synchronization switch (PTX Series)

```
user@host> request chassis synchronization switch fpc-2
switching to fpc-2, status: qualified
```

Release Information

Command introduced in Junos OS Release 7.6.

RELATED DOCUMENTATION

show chassis synchronization | 576

Configuring Clock Synchronization Interface on MX Series Routers | 303

Supported Time Synchronization Standard

set date

IN THIS SECTION

- Syntax | 574
- Description | 574
- Options | 574
- Required Privilege Level | 575
- Sample Output | 575
- Release Information | 575

Syntax

```
set date (date-time | ntp <ntp-server> <key key> <source-address    source-
address>)
```

Description

Set the date and time.

```
user@host> set date ntp
21 Apr 17:22:02 ntpdate[3867]: step time server 172.17.27.46 offset 8.759252 sec
```

Options

- *date-time*—Specify date and time in one of the following formats:
  - *YYYYMMDDHHMM.SS*
  - "*month DD, YYYY HH:MM***(am | pm)"**
- **ntp**—Configure the router to synchronize the current date and time setting with a Network Time Protocol (NTP) server.

  NOTE: In Junos OS Evolved, if the ntpd server is running, the **set date ntp** command fails with the following error message: **error: ntpd is already running**. To use this command, you must first stop the ntpd server

- *ntp-server*—(Optional) Specify the IP address of one or more NTP servers.
- **key** *key*—Configure the key to authenticate the NTP server.
- **source-address** *source-address*—(Optional) Specify the source address that is used by the router to contact the remote NTP server.

Required Privilege Level

view

Sample Output

set date ntp (Junos OS)

```
user@host> set date ntp
22 Jun 10:07:48 ntpdate[51123]: step time server 66.129.255.62 offset -0.013200
sec
```

set date ntp (Junos OS Evolved)

```
user@host> set date ntp
-------------------------------
node: re0
-------------------------------
error: ntpd is already running
```

Release Information

Command introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

Setting the Date and Time Locally

show chassis synchronization

IN THIS SECTION

- Syntax | 576
- Syntax (on ACX500 Series) | 576
- Syntax (on EX9251 Switches) | 577
- Description | 577
- Options | 577
- Required Privilege Level | 578
- Output Fields | 578
- Sample Output | 580
- Release Information | 589

Syntax

```
show chassis synchronization
<clock-module> <(re0 | re1 | routing-engine (backup | both | local | master |
other))>>
<extensive>
<backup | master>
<interface interface-name>
```

Syntax (on ACX500 Series)

```
show chassis synchronization
<gnss>
<extensive>
<backup | master>
```

Syntax (on EX9251 Switches)

```
show chassis synchronization
<clock-module
<extensive>
<interface interface-name>
```

Description

(ACX Series, M320, M40e,M120, T320, T640, and T1600 routers and PTX Series Packet Transport Routers only) Display information about the external clock source currently used for chassis synchronization.

Options

clock-module	Display clock module information. You can optionally specify one of these Routing Engine qualifiers:	
	re0	Routing Engine 0
	re1	Routing Engine 1
	routing-engine (backup | both | local | master | other)	Routing Engine type
extensive	(Optional) Display clock synchronization information in detail.	
interface *interface-name*	(Optional) Display clock synchronization information for the specified interface.	
backup	(Optional) Display clock synchronization information about the backup clock.	
master	(Optional) Display clock synchronization information about the primary clock.	

Required Privilege Level

maintenance

Output Fields

Table 24 on page 578 lists the output fields for the **show chassis synchronization** command. Output fields are listed in the approximate order in which they appear."show chassis synchronization" on page 576"show chassis synchronization" on page 576"show chassis synchronization" on page 576

Table 24: show chassis synchronization Output Fields

Field Name	Field Description
Current state	Indicates current status of external clock sources: • backup—Source is currently the backup clock source. • primary—Source is currently the primary clock source. • Online-Primary—(PTX Series Packet Transport Routers) Source is the primary clock. Source is online. • Online-Standby—(PTX Series Packet Transport Routers) Source is the standby (backup) clock. Source is online.
Current clock state	Indicates current source of external synchronization: • internal—Source is providing its own clocking. • locked to primary CB—(M320, M40e, and M120 routers) Source is locked to primary clock source. • locked to primary SCG—(T320, T640, and T1600 routers) Source is locked to primary clock source. • locked to primary CCG—(PTX Series Packet Transport Routers) Source is locked to primary clock source.

Table 24: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description
SNMP trap status	Denotes the SNMP trap generation status (Enabled or Disabled) on ACX Series routers.
Selected for	Number of seconds this clock has been the primary or backup clock source.
Selected since	Timestamp for establishment as primary or backup clock source.
Deviation (in ppm)	Difference in clock timing, in parts per million (ppm). **NOTE**: Starting in Junos OS Release 16.1R2, if the clock source is locked and the deviation exceeds 10 ppm, the status of the configured source is displayed in the command output as **in-use**. This status indicates that the clock source is locked even though the clock has significant deviation.
Last deviation (in ppm)	Previous difference in clock timing, if any, in ppm.
Configured sources	Information about clock sources eligible for selection as primary clock.
Source	Information about external clock sources.
Priority	Indicates priority of external clock sources: • primary—Source is a primary reference. • secondary—Source is a secondary reference.
Deviation (in ppm)	Current difference in clock timing, in ppm: • measuring—Establishing source deviation. • *number*—Deviation in ppm.

Table 24: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description
Last deviation (in ppm)	Previous difference in clock timing, in ppm: • *number*—Deviation in ppm.
Status	Indicates status of external sources: • present—Source is configured and present. • qualified—Source is eligible for synchronization source.

Sample Output

show chassis synchronization

```
user@host> show chassis synchronization
Clock Synchronization Status :
  Clock module on CB 0
    Current state              : master
    Current clock state        : internal
      Selected for             : 18 hours, 12 minutes, 43 seconds
      Selected since           : 2008-09-10 03:27:47 PDT
      Deviation (in ppm)       : +0.00
      Last deviation (in ppm): +0.00
Clock Synchronization Status :
  Clock module on CB 1
    Current state              : backup
    Current clock state        : locked to master CB
      Selected for             : 1 day, 12 hours, 49 minutes, 20 seconds
      Selected since           : 2008-09-09 08:51:10 PDT
```

show chassis synchronization primary

```
user@host> show chassis synchronization master
Clock Synchronization Status :
  Clock module on CB 0
    Current state              : master
    Current clock state        : internal
      Selected for             : 8 days, 21 minutes, 12 seconds
      Selected since           : 2008-08-27 21:05:40 PDT
      Deviation (in ppm)       : +0.00
      Last deviation (in ppm): +0.00
```

show chassis synchronization backup

```
user@host> show chassis synchronization backup
Clock Synchronization Status :
  Clock module on CB 1
    Current state              : backup
    Current clock state        : locked to master CB
      Selected for             : 34 days, 20 hours, 17 minutes, 8 seconds
      Selected since           : 2008-08-01 01:22:16 PDT
```

show chassis synchronization extensive

```
user@host> show chassis synchronization extensive
Clock Synchronization Status :
  Clock module on CB 0
    Current state              : master
    Current clock state        : internal
      Selected for             : 8 days, 36 minutes, 29 seconds
      Selected since           : 2008-08-27 21:05:40 PDT
      Deviation (in ppm)       : +0.00
      Last deviation (in ppm): +0.00
Clock Synchronization Status :
  Clock module on CB 1
    Current state              : backup
    Current clock state        : locked to master CB
```

```
      Selected for           : 34 days, 20 hours, 19 minutes, 53 seconds
      Selected since         : 2008-08-01 01:22:16 PDT
```

show chassis synchronization (T320, T640, and T1600 Routers)

```
user@host> show chassis synchronization
    Clock Synchronization Status :
      Clock module on SCG 0
        Current state             : master
        Current clock state       : locked to external-a
          Selected for            : 2 hours, 28 minutes, 4 seconds
          Selected since          : 2006-02-17 01:12:58 PST
        Configured sources
          Source      Priority   Deviation    Last deviation   Status
                                  (in ppm)     (in ppm)
          external-a  primary    measuring    -0.10            in-use
          external-b  secondary  -0.10        -0.10            qualified
    Clock Synchronization Status :
      Clock module on SCG 1
        Current state             : backup
        Current clock state       : locked to master SCG
          Selected for            : 19 hours, 49 minutes, 14 seconds
          Selected since          : 2006-02-16 07:51:48 PST
        Configured sources
          Source      Priority   Deviation    Last deviation   Status
                                  (in ppm)     (in ppm)
          external-a  primary    -0.25        -0.25            qualified
          external-b  secondary  -0.25        -0.25            qualified
```

show chassis synchronization (PTX Series Packet Transport Routers)

```
user@host> show chassis synchronization
Clock Synchronization Status :
  Clock module on CCG 0
    Current state             : Online - Master
    Current clock state       : internal
      Selected for            : 1 hour, 24 minutes, 21 seconds
      Selected since          : 2011-03-21 15:59:37 PDT
      Deviation (in ppm)      : +0.51
      Last deviation (in ppm): +0.51
Clock Synchronization Status :
  Clock module on CCG 1
    Current state             : Online - Standby
    Current clock state       : locked to master CCG
      Selected for            : 1 hour, 39 minutes, 12 seconds
      Selected since          : 2011-03-21 15:44:46 PDT
```

show chassis synchronization clock-module (PTX Series Packet Transport Routers)

```
user@host> show chassis synchronization clock-module
re0:
--------------------------------------------------------------------------
Clock Synchronization Status :
  Clock module on CCG 0
    Current state             : Online - Master
    Current clock state       : locked to bits-a
      Selected for            : 1 minute, 24 seconds
      Selected since          : 2015-06-22 15:01:33 PDT
      Deviation (in ppm)      : unknown
      Last deviation (in ppm): unknown
    Configured sources
      Source      Priority   Deviation    Last deviation   Status
ro                              (in ppm)     (in ppm)
      bits-a      primary    unknown      unknown          unknown
      fpc-2       secondary  unknown      unknown          unknown
Clock Synchronization Status :
  Clock module on CCG 1
    Current state             : Online - Standby
    Current clock state       : locked to master CCG
      Selected for            : 1 hour, 39 minutes, 52 seconds
      Selected since          : 2015-06-22 13:23:05 PDT
      Deviation (in ppm)      : unknown
      Last deviation (in ppm): unknown
    Configured sources
      Source      Priority   Deviation    Last deviation   Status
                             (in ppm)     (in ppm)
      bits-a      primary    unknown      unknown          unknown
      fpc-2       secondary  unknown      unknown          unknown
```

This following sample output displays the status of configured sources as **in-use#**. This status indicates that the clock source is locked even though the clock has significant deviation in timing.

```
user@host> show chassis synchronization clock-module
re0:
--------------------------------------------------------------------------
Clock Synchronization Status :
  Clock module on CB 0
    Current state            : Online - Master
    Current clock state      : locked to fpc-12
      Selected for           : 7 seconds
      Selected since         : 2016-08-16 09:39:07 PDT
      Deviation (in ppm)     : 10.00
      Last deviation (in ppm): 8.75
    Configured sources
      Source      Priority   Deviation    Last deviation   Status
                             (in ppm)     (in ppm)
      fpc-12      primary    10.00        8.75             in-use#
```

show chassis synchronization extensive (ACX Series Routers)

```
user@host> show chassis synchronization extensive

Current clock status   : Locked
Clock locked to        : Primary
SNMP trap status : Enabled

Configured sources:

Interface            : ge-0/0/7
Status               : Secondary     Index       : 136
Clock source state   : Clk qualified Priority    : 3
Configured QL        : SEC           ESMC QL     : PRC
Clock source type    : ifd           Clock Event : Clock qualified
Interface State      : Up,sec,ESMC Rx(SSM 0x2),ESMC TX(QL PRC/SSM 0x2),

Interface            : ge-0/1/1
Status               : Primary       Index       : 138
Clock source state   : Clk qualified Priority    : 2
```

```
Configured QL       : SEC          ESMC QL     : PRC
Clock source type   : ifd          Clock Event : Clock locked
Interface State     : Up,pri,ESMC Rx(SSM 0x2),ESMC TX(QL DNU/SSM 0xf)
```

show chassis synchronization extensive (ACX500 Series Routers)

```
user@host> show chassis synchronization extensive
Current clock status  : Locked
Clock locked to           : Primary

Configured ports:

Name                : gnss
Current ToD         : Mon Aug 10 08:50:52 2015
Last ToD update     : Mon Aug 10 08:50:51 2015
GPS receiver status : Synchronized
UTC Pending         : FALSE
UTC Offset          : 36

One PPS status : Active
```

show chassis synchronization gnss (ACX500 Series Routers)

```
user@host> show chassis synchronization gnss

Receiver Status          : Good
Constellation            : GPS & GLONASS
Cable delay compensation : 0
Antenna Status           : GPS Antenna Good
```

show chassis synchronization gnss extensive (ACX500 Series Routers)

```
user@host> show chassis synchronization gnss extensive

Receiver Status          : Good
Constellation            : GPS & GLONASS
Cable delay compensation : 0
```

```
Antenna Status           : GPS Antenna Good
Position                 : 12 56' 35.740410'' N   : 77 41' 32.228191'' E
Altitude                 : 841 meters
Number of satellites     : 17
Satellite List:

Sat No    Signal Level     Status        Type          Mode(T=Timing/P=Position)
17        34    dBHZ       Acquired      GPS           T,P
24        38    dBHZ       Acquired      GPS           T,P
12        31    dBHZ       Acquired      GPS           T,P
2         37    dBHZ       Acquired      GPS           T,P
5         48    dBHZ       Acquired      GPS           T,P
20        35    dBHZ       Acquired      GPS           T,P
28        42    dBHZ       Acquired      GPS           T,P
6         40    dBHZ       Acquired      GPS           T,P
71        41    dBHZ       Acquired      GLONASS       T,P
70        46    dBHZ       Acquired      GLONASS       T,P
76        36    dBHZ       Acquired      GLONASS       T,P
75        45    dBHZ       Acquired      GLONASS       T,P
72        40    dBHZ       Acquired      GLONASS       T,P
15        18    dBHZ       Acquired      GPS           NONE
13        36    dBHZ       Acquired      GPS           NONE
74        41    dBHZ       Acquired      GLONASS       NONE
77        19    dBHZ       Acquired      GLONASS       NONE
```

show chassis synchronization clock-module (EX9251 Switches)

```
user@switch> show chassis synchronization clock-module
re0:
--------------------------------------------------------------------------


Clock module on SCB0
  Current role     : master
```

Show chassis synchronization (external 1pps) (ACX710 Router)

```
user@switch> show chassis synchronization extensive
Current clock status   : Locked
Clock locked to        : Primary
```

```
SNMP trap status : Enabled

Configured sources:

Interface           : ge-0/1/1
Status              : Primary       Index       : 138
Clock source state  : Clk qualified Priority    : 2
Configured QL       : SEC           ESMC QL     : PRC
Clock source type   : ifd           Clock Event : Clock locked
Interface State     : Up,pri,ESMC Rx(SSM 0x2),ESMC TX(QL DNU/SSM 0xf)

```

Show chassis synchronization gru extensive (ACX710 Router)

```
user@switch> Show chassis synchronization gru extensive
Receiver Status           : Good
Constellation             : GPS & GLONASS
Cable delay compensation : 0
+ 1PPS Loopback           : {Enabled|Not enabled}
+ 1PPS Counts             : 42
+ One PPS status          : Active
+ ToD Protocol            : {No-protocol|ericsson-combined}
+ Reset counts            : 1
+ Status                  : {Free running|1PPS Not synchronized|GPS locked}
+ Status last received    : 21:05:02 21 May 2019
+ Antenna DC Status       : 2 (Nominal current detected)
+ GPS Quality             : {Positioning not started|Standalone|Differential}
+ Self Survey Length      : 2000 sec
+ Antenna Cable Delay     : 0 ns
+ Current ToD             : Mon Aug 10 08:50:52 2015
+ Current TAI             : Mon Aug 10 08:55:52 2015
+ Current UTC             : Mon Aug 10 08:50:52 2015
+ Client                  : D821713120/2 R6K (In Control)
+ Client in control       : D821713120 R6K
+ Pps SM mode             : 2 (Position Hold)
+ Product designation     : GRU 04 01
+ Product No.             : NCD 901 65/1
+ Product Rev.            : R1C
+ Additional Information : E640000065.1851
+ GRM hardware ID         : 3052
+ GRM serial number       : 0
+ GRM manf date          : 12.19.2018
+ GRM firmware version   : 0.08.00
+  Received sentences:
+    PERC, GPppr : 2811
+    PERC, GPsts : 2811
+    PERC, GPver : 47
+    PERC, GPrst : 0
+    PERC, GPssl : 14
+    PERC, GPdly : 14
+    PERC, GPavp : 47
+    PERC, GPtsp : 42
+    GPGSV       : 141
+    GPGSA       : 47
+    BDGSV       : 0
+    BDGSA       : 0
+    GLGSV       : 130
+    GLGSA       : 47
+    GAGSV       : 0
+    GAGSA       : 0
+    QZGSV       : 0
+    QZGSA       : 0
+    GPGGA       : 47
+    GPCTR       : 57
+    Other       : 2886
+Protocol Errors:
+  Unexpected character   : 0
+  Checksum error         : 0
+  Format error           : 0
+  Other error            : 0
Number of satellites     : 17
Satellite List:
Sat No    Signal Level     Status        Type          Mode(T=Timing/P=Position)
17        34    dBHZ       Acquired      GPS           T,P
24        38    dBHZ       Acquired      GPS           T,P
12        31    dBHZ       Acquired      GPS           T,P
2         37    dBHZ       Acquired      GPS           T,P
5         48    dBHZ       Acquired      GPS           T,P
20        35    dBHZ       Acquired      GPS           T,P
28        42    dBHZ       Acquired      GPS           T,P
6         40    dBHZ       Acquired      GPS           T,P
71        41    dBHZ       Acquired      GLONASS       T,P
70        46    dBHZ       Acquired      GLONASS       T,P
76        36    dBHZ       Acquired      GLONASS       T,P
```

```
75          45     dBHZ        Acquired       GLONASS        T,P
72          40     dBHZ        Acquired       GLONASS        T,P
15          18     dBHZ        Acquired       GPS            NONE
13          36     dBHZ        Acquired       GPS            NONE
74          41     dBHZ        Acquired       GLONASS        NONE
77          19     dBHZ        Acquired       GLONASS        NONE
```

Show chassis synchronization gru (ACX710 Router)

```
user@switch> Show chassis synchronization gru
Current ToD           : Mon Aug 10 08:50:52 2015
Current TAI           : Mon Aug 10 08:55:52 2015
Current UTC           : Mon Aug 10 08:50:52 2015

One PPS status : Active
```

Release Information

Command introduced in Junos OS Release 7.6.

RELATED DOCUMENTATION

request chassis synchronization switch | 570

Configuring Clock Synchronization Interface on MX Series Routers | 303

Supported Time Synchronization Standard

Configuring External Clock Synchronization for ACX Series Routers | 26

show chassis synchronization (MX Series Routers)

IN THIS SECTION

- Syntax | 590
- Description | 591
- Options | 591
- Required Privilege Level | 592
- Output Fields | 592
- Sample Output | 599
- Sample Output | 600
- Sample Output | 600
- Sample Output | 601
- Sample Output | 602
- Sample Output | 602
- Sample Output | 603
- Sample Output | 604
- Sample Output | 604
- Sample Output | 605
- Release Information | 607

Syntax

```
show chassis synchronization
<clock-module <(re0 | re1 | routing-engine (backup | both | local | master |
other))>>
<extensive>
<interface interface-name>
```

Description

Display information about clocks used for chassis synchronization.

NOTE: In hybrid mode, the EEC in the MPC derives frequency synchronization from Synchronous Ethernet and the phase and time of day from PTP; however, the **show chassis synchronization extensive** operational mode command output displays the lock status that is derived from the EEC located on the SCB.

NOTE: The Switch Control Board (SCB) framer in MX Series routers supports only the first-generation Synchronization Status Message (SSM) format. Therefore, whenever the router needs to transmit an SSM value of st3e or tnc via an external interface, an SSM value of st3 is transmitted. However, on a Synchronous Ethernet interface, an ESMC packet with the unadjusted SSM is transmitted. The term *unadjusted* here means:

- If the **receive-quality** statement at the **[edit chassis synchronization selection-mode]** hierarchy level is configured, the originally received SSM value st3e or tnc (corresponding to the currently active Synchronous Ethernet clock interface) is transmitted.
- If the **configured quality** statement at the **[edit chassis synchronization selection-mode]** hierarchy level is configured, the originally configured SSM value of st3e or tnc (corresponding to the currently active Synchronous Ethernet clock interface) is transmitted.

Note that when the external interface receives an SSM value of either st3e or tnc, the SCB framer does not recognize either of these SSM codes, and therefore, it reports that the Do Not Use (DNU) quality value has been received.

SCBE2 does not support SSM when you configure the following framing format values on the external interface at the **[edit chassis synchronization interfaces external]** hierarchy level:

- sf for the **t1-options** statement
- g704-no-crc for the **e1-options** statement

Options

clock-module	(MX240, MX480, MX960, MX10003, MX204, MX2010, MX2020, and MX2008 routers with Enhanced MX Switch Control Board;) (Optional) Display clock module information. You can optionally specify one of these Routing Engine qualifiers:

	re0	Routing Engine 0
	re1	Routing Engine 1
	routing-engine (backup | both | local | master | other)	Routing Engine type
extensive	(Optional) Display clock synchronization information in detail.	
interface *interface-name*	(Optional) Display clock synchronization information for the specified interface.	

Required Privilege Level

maintenance

Output Fields

Table 25 on page 592 lists the output fields for the **show chassis synchronization** command. Output fields are listed in the approximate order in which they appear.

Table 25: show chassis synchronization Output Fields

Field Name	Field Description	Level of Output
Current clock status	Indicates the current status of chassis synchronization: • **Locked**—Clock is operational. • **Holdover**—Clock is not operational. • **Freerun**—Clock is locked to the free-run local oscillator.	none
Clock locked to	Indicates whether the clock is locked to either the **primary** source or the **secondary** source.	none

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Configured sources	Heading for the list of interfaces configured for chassis synchronization and their subsequent status indicators.	none
Source name	Indicates the configured interface that is the source. The **external** source name indicates the external clock interface.	none
Configured Priority	Indicates the priority configured for the interface.	none
Interface Status	Indicates the status of the interface as **primary**, **secondary**, or **n/a** (external).	none
Configured quality	Indicates the configured quality of the interface. • **prs** —Primary reference source—Stratum 1 • **st2**—Stratum 2 • **tnc**—Transit node clock • **st3e**—Stratum 3E • **st3**—Stratum 3 • **smc**—SONET minimum clock • **st4**—Stratum 4 • **prc**—Primary reference clock • **ssu-a**—Synchronization supply unit A • **ssu-b**—Synchronization supply unit B • **sec**—SDH equipment clock	none

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Interface	Indicates the configured interface: - **ge-*fpc*/*pic*/*port***—Indicates the interface type and which FPC, PIC, and port are configured.	**extensive**
Status	Indicates the synchronization status of the indicated interface, as follows: - **Primary**—This interface is the selected primary chassis clock source. - **Secondary**—This interface is the selected secondary chassis clock source. - **n/a**—This interface is not a selected clock source.	**extensive**
Index	Unique numeric identifier for the established Synchronous Ethernet configuration.	**extensive**
Clock source state	Indicates the status of the Synchronous Ethernet clock source: - **Clk qualified**—The Synchronous Ethernet clock source is qualified. - **n/a**—The Synchronous Ethernet clock source is not qualified.	**extensive**
Priority	Indicates the configured priority. The range is from 1 through 5. The following values indicate whether the parameter is not specified or undefined: - **Default(8)**—The parameter is not specified. - **-** —The parameter is undefined or out of range.	**extensive**

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Configured QL	Indicates the configured source interface quality level (QL), which is dependent on the source interface and option. The following quality levels are supported and the configured QL is indicated: • **prc | ssu-a | ssu-b | sec**—Network option-1 QLs • **prs | st2 | tnc | st3e | st3 | smc | st4**—Network option-2 QLs	**extensive**
ESMC QL	Indicates the configured Ethernet Synchronization Message Channel (ESMC) quality level: • **DNU**—Network option-1 source • **DSU**—Network option-2 source	**extensive**
Clock source type	Indicates that the configured chassis synchronization clock source is one of the following types: • **ifd**—Uses the free-run local oscillator. • **extern**—Uses a configured qualified clock source.	**extensive**
Clock Event	Indicates the event clock status: • **Clock locked**—Clock is established. • **n/a**—Clock is not established.	**extensive**
Configuration flags	Indicates **Ext** for external interface configuration	
Wait-to-restore time	Indicates the amount of time in minutes for the port signal to be up before the port is opened to receive and transmit Ethernet Synchronization messages.	**extensive**

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Hold-off time	Indicates the amount of time in milliseconds for hold off time for Synchronous Ethernet interfaces and external clock source interfaces to prevent rapid successive switching. If an interface goes down, hold-off time delays short signal failures from being sent to the clock selection process.	**extensive**
Kernel flags	Indicates the Synchronous Ethernet software operational status: • **Up**—The Synchronous Ethernet software is operational for the configured interface. • **pri**—The source is the selected primary clock source. • **Dn**—The Synchronous Ethernet software is not operational for the configured interface.	**extensive**

Table 25: show chassis synchronization Output Fields ***(Continued)***

Field Name	Field Description	Level of Output
Ineligibility reason	Indicates the reason the interface is ineligible for the Synchronous Ethernet operation, including the following: • **Link Down**—The link between the Synchronous Ethernet interfaces is not operational. • **Not restored**—The Synchronous Ethernet link has not yet been restored because it is waiting for the specified **wait-to-restore** time to elapse. • **Forbidden slot**—Slot 10 is not supported. • **Interface unit missing**—The unit parameter is not set or is invalid. • **Locked**—The paired interface is not available. • **No cfg**—Synchronous Ethernet is not configured. • **RX Disabled**—The receiving interface is disabled. • **Undefined/invalid QL**—The QL mode is not specified in the configuration or, if specified, is not supported. **NOTE**: When GPS is configured as the clock source and the **quality-mode-enable** statement is configured, the **Current Lock Status** is displayed as **Locked** but **Undefined/invalid QL** is displayed as the Ineligibility reason. As a workaround, configure the **no-ssm-support** statement at the **[edit chassis synchronization source interfaces interface-name]** hierarchy level. • **System initialization in progress**—The remote system is performing initialization and not currently available for synchronization. • **Unsupported interface**—The configured interface does not support Synchronous Ethernet.	**extensive**
Clock module on	Indicates whether the clock module is on the Switch Control Board **SCB0** or **SCB1**.	**clock-module**

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Current role	Indicates the role of the clock module: • **master**—The clock module is on the primary SCB, which is the active chassis clock source. • **backup**—The clock module is on the backup SCB, which mirrors the state of the active clock.	**clock-module**
Current state	Indicates the state of the clock module: • **freerun**—The clock module is in free-run mode. When the system starts up, the default clock module state is free-run. • **acquiring-lock on**—The clock module is attempting to acquire a lock on the specified clock source. • **locked to**—The clock module is locked to the specified clock source. • **holdover on**—The clock module is in holdover mode on the specified clock source. Prior to the specified clock source becoming invalid, the clock module was locked on the source and holdover data was collected. • **holdover**—The clock module has transitioned into holdover prior to locking on a valid clock source and collecting holdover data.	**clock-module**
Monitored clock sources	Displays information about monitored clock sources.	**clock-module**
Interface	Indicates the interface type and which FPC, PIC, and port are configured: • **external**—External clock source • **ge-*fpc*/*pic*/*port***—Line Synchronous Ethernet or PTP client • **xe-*fpc*/*pic*/*port***—Line Synchronous Ethernet or PTP client	**clock-module**

Table 25: show chassis synchronization Output Fields *(Continued)*

Field Name	Field Description	Level of Output
Type	Indicates the type of clock source: • **t1**—BITS T1 framed • **e1**—BITS E1 framed • **2048khz**—BITS unframed 2048 KHz frequency source • **syncE**—Synchronous Ethernet frequency source • **ptp**—PTP client source • **ptp-hybrid**—PTP client source using Synchronous Ethernet for frequency	**clock-module**
Status	Indicates the status of the clock source: • **failed**—The clock source is in the failed state. • **qualifying**—The clock source is being qualified. • **qualified**—The clock source is qualified and can be selected as the chassis clock source. • **qualified-selected**—The clock source is qualified and selected as the chassis clock source.	**clock-module**

Sample Output

show chassis synchronization

```
user@host> show chassis synchronization
Current clock status: Locked
Clock locked to : Primary

Configured sources
```

```
Source       Configured        Interface       Configured
Name         Priority          Status          Quality

ge-1/0/0        -              Primary         PRC
```

Sample Output

show chassis synchronization extensive

```
user@host> show chassis synchronization extensive
Current clock status: Locked
Clock locked to             : Primary

Configured sources:
Interface            : ge-1/0/0
Status               : Primary         Index : 143
Clock source state   : Clk qualified   Priority : -
Configured QL        : PRC             ESMC QL : DNU
Clock source type    : ifd             Clock Event : Clock locked
Kernel flags         : Up,pri,
Wait-to-restore time            : 1
Hold-off time              :  1200
Interface State            : Up,ESMC TX(QL SEC/SSM 0xb),
```

Sample Output

show chassis synchronization extensive (Synchronous Ethernet with link down)

```
user@host> show chassis synchronization extensive
Current clock status   : Holdover
Configured sources:

Interface            : ge-1/0/2
Status               : n/a           Index       : 142
```

```
Clock source state  : n/a           Priority    : Default(8)
Configured QL       : SSU-B         ESMC QL     : DNU
Clock source type   : ifd           Clock Event : n/a
Kernel flags        : Dn,
Ineligibility reason: Link Down,
Wait-to-restore time            : 1
Hold-off time             :  1200
Interface State           : Up,ESMC TX(QL SEC/SSM 0xb),
```

Sample Output

show chassis synchronization extensive (Synchronous Ethernet with physical interface not restored)

```
user@host> show chassis synchronization extensive
Current clock status  : Holdover
Configured sources:

Interface           : ge-1/0/2
Status              : n/a           Index       : 142
Clock source state  : n/a           Priority    : Default(8)
Configured QL       : SSU-B         ESMC QL     : DNU
Clock source type   : ifd           Clock Event : n/a
Kernel flags        : Restoring in 13s,ESMC TX(QL DNU/SSM 0xf),
Ineligibility reason: Not restored,
Wait-to-restore time            : 1
Hold-off time             :  1200
Interface State           : Up,ESMC TX(QL SEC/SSM 0xb),
```

Sample Output

show chassis synchronization extensive (Synchronous Ethernet configured on ineligible slot 10)

```
user@host> show chassis synchronization extensive
Current clock status  : Holdover
Configured sources:

Interface           : ge-10/0/2  # Note: configuration 10/x/y (slot 10), which
does not support Synchronous Ethernet
Status              : n/a          Index       : 142
Clock source state  : n/a          Priority    : Default(8)
Configured QL       : SSU-B        ESMC QL     : DNU
Clock source type   : ifd          Clock Event : n/a
Kernel flags        : Up,
Ineligibility reason: Forbidden slot,
Wait-to-restore time            : 1
Hold-off time             :  1200
Interface State           : Up,ESMC TX(QL SEC/SSM 0xb),
```

Sample Output

show chassis synchronization extensive (on MX104 Router)

```
user@host> show chassis synchronization extensive
Current clock status  : Locked
Clock locked to       : Primary

Configured interfaces:

Name          : bits
Signal type   : e1 (g704 hdb3 sa4)
Rx status     : active
Tx status     : active

Configured sources:
```

```
Interface            : bits
Status               : Primary       Index       : 2
Clock source state   : Clk qualified Priority    : Default(7)
Configured QL        : SEC           ESMC QL     : SEC
Clock source type    : extern        Clock Event : Clock locked
Wait-to-restore      : 5  min        Hold-off    : 1000 ms
Interface State      : Up,pri,ESMC Rx(SSM 0xb)
```

Sample Output

show chassis synchronization clock-module (MX10003 Router)

```
user@host> show chassis synchronization extensive

Current clock status : Locked
Clock locked to : Primary
SNMP trap status : Disabled

Configured sources:

Interface : et-0/1/3
Status : Secondary Index : 563
Clock source state : Clk qualified Priority : 1
Configured QL : PRC ESMC QL : DNU
Clock source type : ifd Clock Event : Clock qualified
Wait-to-restore : 0 min Hold-off : 1000 ms
Interface State : Up,sec,ESMC TX(QL PRC/SSM 0x2),

Interface : et-0/1/7
Status : n/a Index : 567
Clock source state : n/a Priority : 3
Configured QL : PRC ESMC QL : DNU
Clock source type : ifd Clock Event : n/a
Wait-to-restore : 0 min Hold-off : 1000 ms
Interface State : Up,ESMC TX(QL PRC/SSM 0x2),

Interface : et-0/1/8
Status : Primary Index : 568
Clock source state : Clk qualified Priority : 1
```

```
Configured QL : PRC ESMC QL : DNU
Clock source type : ifd Clock Event : Clock locked
Wait-to-restore : 0 min Hold-off : 1000 ms
Interface State : Up,pri,ESMC TX(QL DNU/SSM 0xf),

Interface : et-1/1/1
Status : n/a Index : 555
Clock source state : n/a Priority : 5
Configured QL : PRC ESMC QL : DNU
Clock source type : ifd Clock Event : n/a
Wait-to-restore : 0 min Hold-off : 1000 ms
Interface State : Dn,
Ineligibility reason: Link Down
```

Sample Output

show chassis synchronization clock-module (MX204 Router)

```
user@host> show chassis synchronization clock-module

re0:
--------------------------------------------------------------------------

Clock module on SCB0
  Current role      : master
```

Sample Output

show chassis synchronization interface

```
user@host> show chassis synchronization interface ge-1/0/2
Current clock status   : Locked
Clock locked to        : Primary
```

Sample Output

show chassis synchronization clock-module

```
user@host> show chassis synchronization clock-module
Clock module on SCB0
  Current role      : master
  Current state     : locked to ge-4/1/0
    State for       : 0 days, 00 hrs, 00 mins, 15 secs
    State since     : Mon Jun  6 07:29:40 2011
  Monitored clock sources
    Interface      Type          Status
    ge-4/1/0       syncE         qualified-selected
    ge-4/3/0       syncE         qualified
```

show chassis synchronization (configured external clock interface)

```
user@host> show chassis synchronization
Current clock status  : Free-run

Configured interfaces:
Name            Signal type                Rx status      Tx status
external        e1 (g704 ami sa4)          loss of signal squelched

Configured outputs:
Interface       Tx status    Minimum QL   Tx QL
external        squelched    SEC          DNU

Configured sources:
Source         Configured    Interface    Configured
 Name           Priority     Status       Quality
external       Default(6)    n/a          SSU-A
```

show chassis synchronization clock-module (configured external clock interface)

```
user@host> show chassis synchronization clock-module
re0:
```

```
--------------------------------------------------------------------------

Clock module on SCB0
  Current role     : master
  Current state    : freerun
    State for      : 2 days, 06 hrs, 16 mins, 57 secs
    State since    : Wed Nov 14 08:02:07 2012
  Monitored clock sources
    Interface      Type         Status
    external       e1           failed
```

show chassis synchronization extensive (configured external clock interface)

```
user@host> show chassis synchronization extensive
Current clock status: Locked
Clock locked to              : Primary

Configured sources:
Interface            : xe-2/0/10
Status               : Primary         Index : 227
Clock source state   : Clk qualified   Priority : Default (8)
Configured QL        : SEC             ESMC QL : SEC
Clock source type    : ifd             Clock Event : Clock locked
Kernel flags         : Up,pri, ESMC Rx(SSM 0xb),ESMC TX(QL DNU/SSM 0xf),
```

show chassis synchronization clock-module(configured external clock interfaces)

```
user@host> show chassis synchronization clock-module
re0:
--------------------------------------------------------------------------

Clock module on SCB0
  Current role     : master
  Current state    : locked to xe-2/0/10
    State for      : 29 days, 10 hrs, 06 mins, 23 secs
    State since    : Wed Jun 7 21:55:23 2014
  Monitored clock sources
    Interface      Type         Status
    xe-2/0/10      syncE        qualified-selected
```

show chassis synchronization extensive (configured external clock interface)

```
user@host> show chassis synchronization extensive
Current clock status  : Free-run

Configured interfaces:

Name          : external
Signal type   : e1 (g704 ami sa4)
Rx status     : loss of signal
Tx status     : squelched
LED color     : red

Configured outputs:

Interface       : external
Tx status       : squelched (holdover data invalid)
Minimum QL      : SEC              Tx QL         : DNU
Holdover mode   : enabled          Wander filter : disabled
Source mode     : chassis          Source Tx DNU : disabled
Holdover data   : invalid
Current state   : holdover
  State for     : 2 days, 06 hrs, 03 mins, 46 secs
  State since   : Wed Nov 14 08:02:09 2012

Configured sources:

Interface            : external
Status               : n/a            Index        : 0
Clock source state   : n/a            Priority     : Default(6)
Configured QL        : SSU-A          ESMC QL      : DNU
Clock source type    : extern         Clock Event : n/a
Interface State      : Dn,ESMC Rx(SSM 0xf),
Ineligibility reason: Link Down,
```

Release Information

Command introduced in Junos OS Release 10.4.

clock-module option introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Configuring Clock Synchronization Interface on MX Series Routers | **303**

Configuring External Clock Synchronization for ACX Series Routers | **26**

Example: Configuring Framing Mode for Synchronous Ethernet on MX Series Routers with 10-Gigabit Ethernet MIC | **263**

request chassis synchronization mode | **568**

show chassis synchronization | **576**

synchronization (MX Series) | **524**

Synchronous Ethernet Overview | **232**

show ntp associations

IN THIS SECTION

- Syntax | **608**
- Description | **609**
- Options | **609**
- Required Privilege Level | **609**
- Output Fields | **609**
- Sample Output | **611**
- Release Information | **611**

Syntax

```
show ntp associations
<no-resolve>
```

Description

Display Network Time Protocol (NTP) peers and their state.

Options

none	Display NTP peers and their state.
no-resolve	(Optional) Suppress symbolic addressing.

Required Privilege Level

view

Output Fields

Table 26 on page 610 describes the output fields for the **show ntp associations** command. Output fields are listed in the approximate order in which they appear.

Table 26: show ntp associations Output Fields

Field Name	Field Description
remote	Address or name of the remote NTP peer. Status of the peer in the clock selection process: • space—Discarded because of a high stratum value or failed sanity checks. • **x**—Designated "falseticker" by the intersection algorithm. • **.**—Culled from the end of the candidate list. • **–** —Discarded by the clustering algorithm. • **+**—Included in the final selection set. • **#**—Selected for synchronization, but the distance exceeds the maximum. • *—Selected for synchronization. • **o**—Selected for synchronization, but the packets-per-second (pps) signal is in use.
refid	Reference identifier of the remote peer. If the reference identifier is not known, this field shows a value of **0.0.0.0**.
st	Stratum of the remote peer.
t	Type of peer: **b** (broadcast), **l** (local), **m** (multicast), or **u** (unicast).
when	When the last packet from the peer was received.
poll	Polling interval, in seconds.
reach	Reachability register, in octal.
delay	Current estimated delay of the peer, in milliseconds.

Table 26: show ntp associations Output Fields *(Continued)*

Field Name	Field Description
offset	Current estimated offset of the peer, in milliseconds.
disp	Current estimated dispersion of the peer, in milliseconds.

Sample Output

show ntp associations

```
<user@host>show ntp associations
   remote         refid           st t when poll reach   delay   offset  jitter
===============================================================================
*@device1@example.com   .STEP.           3 -   41   64    1    0.484    0.567
2.906
```

Release Information

Command introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

show ntp status | 612

show ntp status

IN THIS SECTION

- Syntax | 612
- Description | 612
- Options | 612
- Required Privilege Level | 613
- Output Fields | 613
- Sample Output | 615
- Release Information | 615

Syntax

```
show ntp status
<no-resolve>
```

Description

Display the values of internal variables returned by Network Time Protocol (NTP) peers.

Options

none	Display the values of internal variables returned by NTP peers.
no-resolve	(Optional) Suppress symbolic addressing.

Required Privilege Level

view

Output Fields

Table 27 on page 613 describes the output fields for the **show ntp status** command. Output fields are listed in the approximate order in which they appear.

Table 27: show ntp status Output Fields

Field Name	Field Description
status	System status word, a code representing the status items listed.
leap_none	Indicates a normal synchronized state with no leap seconds imminent. Other options could be **leap_add_sec**, **leap_del_sec**, or **leap_alarm**, indicating a leap second will be added, deleted, or a leap second requirement is upcoming.
sync_ntp	Indicates the current synchronization source, in this case, an NTP server. Other options include **sync_alarm** and **sync_unspec**, both indicating that the router has not been synched.
x events	Indicates the number of events that have occurred since that last code change. An event is often the receipt of an NTP polling message.
event_peer/ strat_chg	Describes the most recent event, in this case, the stratum of the peer server changed.
version	A detailed description of the version of NTP being used.
processor	Indicates the current hardware platform and version of the processor.
system	Detailed description of the name and version of the operating system in use.

Table 27: show ntp status Output Fields *(Continued)*

Field Name	Field Description
leap	The number of leap seconds in use.
stratum	The stratum of the peer server. Anything greater than 1 is a secondary reference source, and the number roughly represents the number of hops away from the stratum 1 server.. Stratum 1 is a primary reference, such as an atomic clock.
precision	The precision of the peer clock, how precisely the frequency and time can be maintained with this particular timekeeping system.
rootdelay	The total roundtrip delay to the primary reference source, in seconds.
rootdispersion	The maximum error relative to the primary reference source, in seconds.
peer	An identification number of the peer in use.
refid	Reference identifier of the remote peer. If the reference identifier is not known, this field shows a value of **0.0.0.0**.
reftime	The local time, in timestamp format, when the local clock was last updated. If the local clock has never been synchronized, the value is zero.
poll	The NTP broadcast message polling interval, in seconds.
clock	The current time on the local router clock.
state	The current mode of NTP operation, where 1 is symmetric active, 2 is symmetric passive, 3 is client, 4 is server, and 5 is broadcast.
offset	Current estimated offset of the peer, in milliseconds. Indicates the time difference between the reference clock and the local clock.

Table 27: show ntp status Output Fields *(Continued)*

Field Name	Field Description
frequency	The frequency of the clock.
jitter	Indicates the magnitude of jitter, in milliseconds, between several time queries.
stability	A measure of how well this clock can maintain a constant frequency.

Sample Output

show ntp status

```
user@host> show ntp status
assID=0 status=0544 leap_none, sync_local_proto, 4 events, event_peer/strat_chg,
version="ntpd 4.2.2p1@1.1570-o Tue May 19 13:57:55 UTC 2009 (1)",
processor="x86_64", system="Linux/2.6.18-164.el5", leap=00, stratum=4,
precision=-10, rootdelay=0.000, rootdispersion=11.974, peer=59475,
refid=LOCAL(0),
reftime=d495c32c.0e71eaf2  Mon, Jan  7 2013 13:57:00.056, poll=10,
clock=d495c32c.cebd43bd  Mon, Jan  7 2013 13:57:00.807, state=4,
offset=0.000, frequency=0.000, jitter=0.977, noise=0.977,
stability=0.000, tai=0
```

Release Information

Command introduced before Junos OS Release 7.4.

RELATED DOCUMENTATION

show ntp associations | 608

show ptp clock

IN THIS SECTION

- Syntax | 616
- Description | 616
- Options | 616
- Required Privilege Level | 617
- Output Fields | 617
- Sample Output | 619
- Release Information | 621

Syntax

```
show ptp clock
```

Description

(ACX Series, MX80, MX240, MX480, MX960 routers, and QFX Series switches) Display the details of the clock configured on the node.

Options

This command has no options.

Required Privilege Level

view

Output Fields

Table 28 on page 617 lists the output fields for the **show ptp clock** command. Output fields are listed in the approximate order in which they appear.

Table 28: show ptp clock Output Fields

Field Name	Field Description
Slot Number	Number of the FPC or MIC slot.
Two-step Clock	Whether the clock provides time information which is a combination of an event message and a subsequent general message: **True** or **False**.
Clock Identity	Clock identity of the client or client as defined in IEEE 1588.
Total Ports on Device	Total number of PTP ports on the router.
Clock Class	Attribute of an ordinary or boundary clock that denotes the traceability of the time or frequency distributed by the reference clock.
Clock Accuracy	Indicates the expected accuracy of a clock when it is the reference clock, or in the event it becomes the reference.
Log Variance	Represents an estimate of the variations of the local clock when it is not synchronized via PTP to another clock.
Clock Priority1	Priority value of the clock. Lower value takes precedence.

Table 28: show ptp clock Output Fields *(Continued)*

Field Name	Field Description
Clock Priority2	Prioritize the primaries to avoid confusion when the **Clock Priority1** value is the same for different primaries in a network.
UTC Offset	Offset between International Atomic Time (TAI) and Coordinated Universal Time (UTC) times. The value is 34 seconds as of January 2012.
Leap59	When **TRUE**, the last minute of the current UTC day has only 59 seconds (instead of the 60 SI seconds).
Leap61	When **TRUE**, the last minute of the current UTC day has 61 seconds (instead of the 60 SI seconds).
Time Traceable	When **TRUE**, the timescale and the UTC offset are traceable to a primary reference.
Frequency Traceable	When **TRUE**, frequency determining the timescale is traceable to a primary reference.
Time Source	Time source external to the Precision Time Protocol (PTP), which provides time and/or frequency as appropriate. The time source is traceable to the international standards laboratories maintaining clocks that form the basis for the International Atomic Time (TAI) and Universal Coordinated Time (UTC) timescales. Examples of these are Global Positioning System (GPS), NTP, and National Institute of Standards and Technology (NIST) timeservers.
Delay Req Sending Time	Interval in seconds between the delay-request messages sent by the client to the primary.
Steps Removed	Number of boundary clocks between the local clock and the foreign primary clock.
Slave-only	Set to **TRUE**, when the system is used in ordinary client clock mode; otherwise, **FALSE**.

Table 28: show ptp clock Output Fields *(Continued)*

Field Name	Field Description
Parent Id	EUI-64 clock identifier of the immediate upstream primary clock.
GMC Id	EUI-64 clock identifier of the reference clock.
GMC Class	Denotes the reference clock’s traceability of the distributed time or frequency.
GMC Accuracy	Indicates the expected accuracy of the reference clock.
GMC Variance	Represents an estimate of the variations of the reference clock.
GMC Priority1	**Priority1-value** of the reference clock.
GMC Priority2	**Priority2-value** of the reference clock.

Sample Output

show ptp clock

```
user@host> run show ptp clock
Clock Details:

Slot Number           : 7
Default Data:
Two-step Clock        : FALSE                     Clock Identity :
00:05:85:ff:fe:73:ef:d0
Total Ports on Device : 0                         Clock Class     : 255
Clock Accuracy        : 49                        Log Variance    : -12944
Clock Priority1       : 128                       Clock Priority2: 128
UTC Offset            : 33                        Leap59          : FALSE
Leap61                : FALSE                     Time Traceable  : FALSE
Frequency Traceable   : FALSE                     Time master     : 0
```

```
Delay Req Sending Time: 0                          Steps Removed  : 1
Slave-only            : NA
Parent Data:
Parent Id             : 00:18:0b:ff:ff:20:01:62
GMC Id                : 00:18:0b:ff:ff:20:01:62   GMC Class        : 52
GMC Accuracy          : 254                       GMC Variance     : 11952
GMC Priority1         : 0                         GMC Priority2    : 0
Global Data:
UTC Offset            : 34                        Leap-59          : FALSE
Leap-61               : FALSE                     Time traceable    : FALSE
Freq Traceable        : FALSE                     Time Scale       : FALSE
Time master           : 160
```

show ptp clock (ACX Series Routers)

```
user@host> run show ptp clock
Clock Details:
Slot Number           : 0
Default Data:
Two-step Clock        : FALSE                      Clock Identity :
84:18:88:ff:fe:c0:7a:00
Total Ports on Device : 0                          Clock Class    : 255
Clock Accuracy        : 34                         Log Variance   : 15353
Clock Priority1       : 128                        Clock Priority2: 128
UTC Offset            : 0                          Leap59         : FALSE
Leap61                : FALSE                      Time Traceable : FALSE
Frequency Traceable   : FALSE                      Time Source    : 0
Delay Req Sending Time: 0                          Steps Removed  : 0
Slave-only            : NA
Parent Data:
Parent Id             : 00:00:64:ff:fe:01:01:02
GMC Id                : 00:00:64:ff:fe:01:01:02   GMC Class        : 80
GMC Accuracy          : 35                        GMC Variance     : 0
GMC Priority1         : 128                       GMC Priority2    : 128
Global Data:
UTC Offset            : 0                         Leap-59          : FALSE
Leap-61               : FALSE                     Time tracable    : FALSE
Freq Traceable        : FALSE                     Time Scale       : FALSE
Time source           : 16
```

Release Information

Command introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

- IEEE 1588v2 PTP Boundary Clock Overview | 99
- IEEE 1588v2 Precision Timing Protocol (PTP) | 103
- Precision Time Protocol Overview | 68

show ptp aggregated-ethernet interfaces

IN THIS SECTION

- Syntax | 621
- Description | 622
- Options | 622
- Required Privilege Level | 622
- Output Fields | 622
- Sample Output | 623
- Release Information | 623

Syntax

```
show ptp aggregated-ethernet interfaces
```

Description

Display the information related to aggregated Ethernet bundles.

Options

This command has no options.

Required Privilege Level

View

Output Fields

Table 29 on page 622 lists the output fields for the **show ptp aggregated-ethernet interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 29: show ptp aggregated-ethernet interfaces

Field Name	Field Description
Bundle	Name of the aggregated Ethernet bundle.
Primary	Primary interface in an aggregated Ethernet bundle. • **active**—Indicates that the link is actively receiving ptp packets. • **down**—Indicates that the link is down.
Secondary	Secondary interface in an aggregated Ethernet bundle. • **active**—Indicates that the link is actively receiving ptp packets. • **ready**—Indicates that the link is ready to take over if the primary link fails.

Table 29: show ptp aggregated-ethernet interfaces *(Continued)*

Field Name	Field Description
Role	Role of the aggregated Ethernet bundle: - **Master**, **Slave**, or **Stateful**

Sample Output

show ptp aggregated-ethernet interfaces

```
user@host> show ptp aggregated-ethernet interfaces

bundle        primary                    secondary                  role
ae0.0         ge-1/0/1  (active)       ge-5/0/5  (ready)          slave
ae2.0         ge-5/0/1  (down)         ge-6/1/1  (active)    master
```

show ptp aggregated-ethernet interfaces (stateful ports)

```
user@host> show ptp aggregated-ethernet interfaces

AE Bundle          Ifstate  Primary                Secondary              Role
ae0.0                Up       et-11/0/5(active)      et-11/1/2(secondary)
Stateful
```

Release Information

Command introduced in Junos OS Release 17.2R1.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

show ptp hybrid

IN THIS SECTION

- Syntax | 624
- Description | 624
- Options | 624
- Required Privilege Level | 625
- Output Fields | 625
- Sample Output | 626
- Release Information | 627

Syntax

```
show ptp hybrid
<config | status>
```

Description

Display the current configuration and current operation mode of the client.

Options

config	Display the PTP source to Synchronous Ethernet interface mappings.
status	Display the current hybrid mode operational status.

Required Privilege Level

View

Output Fields

Table 30 on page 625 lists the output fields for the **show ptp hybrid** command. Output fields are listed in the approximate order in which they appear.

Table 30: show ptp hybrid Output Fields

Field Name	Field Description
ptp source	Displays the IP address of the PTP source.
synce source	Displays the interface name of the Synchronous Ethernet source through which the PTP source is traceable.
Configured Mode	Displays the current configured mode of the router as **Hybrid**.
Operating Mode	Displays the current operation mode: **Hybrid** or **None**.
PTP Reference	Displays the IP address and the interface name of the PTP reference clock.
Synchronous Ethernet Reference	Displays the interface name of the Synchronous Ethernet reference clock.
Lock state	Displays the current lock state of the router: **Locked**, **Initializing**, or **Acquiring**.

Table 30: show ptp hybrid Output Fields *(Continued)*

Field Name	Field Description
Lock state description	Displays the description for the current lock state of the router: • **Initializing**—Hybrid mode is being initialized. • **Acquiring Frequency**—Synchronous Ethernet source identified for frequency synchronization, acquiring frequency-related data from primary clock. • **Frequency Locked, Acquiring Phase**—Frequency locked from the Synchronous Ethernet source, acquiring phase-related data from primary clock. • **Frequency and Phase Locked**—Member clock is frequency and phase synchronized with primary clock.

Sample Output

show ptp hybrid config

```
user@host> show ptp hybrid config
ptp source          synce source
100.1.1.2              ge-1/1/2
```

show ptp hybrid status

```
user@host> show ptp hybrid status
Hybrid Mode Status:
Configured Mode                  : Hybrid
Operating  Mode                  : Hybrid
PTP Reference                    : 100.1.1.2, ge-1/0/0.0
Synchronous Ethernet Reference : ge-1/1/2
Lock state                       : Locked
Lock state description           : Frequency and Phase Locked
```

Release Information

Command introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Understanding Hybrid Mode | 357

show ptp global-information

IN THIS SECTION

- Syntax | 627
- Description | 627
- Options | 628
- Required Privilege Level | 628
- Output Fields | 628
- Sample Output | 630
- Release Information | 632

Syntax

```
show ptp global-information
```

Description

Show Precision Time Protocol (PTP)–related global information.

Options

This command has no options.

Required Privilege Level

view

Output Fields

Table 31 on page 628 lists the output fields for the **show ptp global-information** command. Output fields are listed in the approximate order in which they appear.

Table 31: show ptp global-information Output Fields

Field Name	Field Description
PTP Global Configuration	Displays if PTP is configured globally.
Domain Number	PTP domain with values from 0 through 127. The default value is 0. Only one PTP domain is supported at any given point in time.
Clock mode	Clock mode is either boundary or ordinary.
Profile Type	IEEE-2008, Enterprise, or G.8275.1.
Priority Level1	Priority value of the clock: 0 through 255. The default is 128. The lower value takes precedence.
Priority Level2	Priority value of the clock: 0 through 255. The default is 128. This value is used to differentiate and prioritize the primary clocks when the ***priority1-value*** is the same for different primary clocks in a network. The lower value takes precedence.

Table 31: show ptp global-information Output Fields *(Continued)*

Field Name	Field Description
Unicast Negotiation	Method by which the announce, synchronization, and delay-response packet rates are negotiated between the primary and the client before a PTP session is established. Unicast negotiation is enabled or disabled.
ESMC QL From Clock Class	Denotes whether the conversion from clock class to QL is enabled or disabled.
Clock Class/ESMC QLl	Denotes the user defined clock class to QL conversion.
SNMP Trap Status	Denotes the SNMP trap generation status (Enabled or Disabled).
Master Parameters	**Delay Request Timeout** The default value is 30 seconds. The range is from 30 to 300 seconds.
Transparent-clock-config	Displays if transparent clock mode is enabled or disabled.
Transparent-clock-status	Display the status of the transparent clock operation. The following status would be displayed: • **N/A**—Transparent clock is not configured. • **Active**—Transparent clock is configured and working properly. • **sync-in-progress**—This is a temporary state. During startup, all the PHYs are synchronized with each other. This status can also occur when a new PIC is plugged in to the switch and all the PHYs go through the synchronization cycle again. **NOTE**: Transparent clock operation is disabled during the synchronization of PHYs. • **Inactive**—Transparent clock is configured but not working properly. This would indicate a hardware error in PHY timestamping logic.

Table 31: show ptp global-information Output Fields *(Continued)*

Field Name	Field Description
UTC Leap Seconds	The number of UTC leap seconds is 37 seconds by default. You can, however, configure a different value.

Sample Output

show ptp global-information (Transparent Clock Configured)

```
user@switch> show ptp global-information
PTP Global Configuration:
Transparent-clock-config : ENABLED
Transparent-clock-status : ACTIVE
```

show ptp global-information (Default Profile)

```
user@switch> show ptp global-information
PTP Global Configuration:
Domain number            : 0
Clock mode               : Ordinary
Profile type             : IEEE-2008
Priority Level1          : 128
Priority Level2          : 128
Path Trace               : Disabled
Unicast Negotiation      : Disabled
ESMC QL From Clock Class: Disabled
Clock Class/ESMC QL      :  -
SNMP Trap Status         : Disabled
PHY Time Stamping        : Disabled
UTC Leap Seconds         : 37
```

show ptp global-information (Enterprise Profile)

```
user@switch> show ptp global-information
PTP Global Configuration:
Domain number            : 0
Clock mode               : Boundary
Profile type             : Enterprise
Priority Level1          : 128
Priority Level2          : 128
…


…
```

show ptp global-information (G.8275.1 Profile)

```
user@host> show ptp global-information
PTP Global Configuration:
Domain number            : 0
Clock mode               : Boundary
Profile type             : G.8275.1
Priority Level1          : 128
Priority Level2          : 128
Local Priority           : 128
Path Trace               : Disabled
Unicast Negotiation      : Disabled
ESMC QL From Clock Class: Disabled
Clock Class/ESMC QL      : -
SNMP Trap Status         : Disabled
PHY Time Stamping        : Enabled
UTC Leap Seconds         : 37
Transparent-clock-config : Disabled
Transparent-clock-status : N/A
  Sync Interval          : -
  Delay Request Interval: -4 (16 packets per second)
  Announce Interval      : -
  Announce Timeout       : 3
Grant Duration         : -
Master Parameters:
    Sync Interval           : -4 (16 packets per second)
    Delay Request Interval: -
    Announce Interval       : -3 (8 packets per second)
    Delay Request Timeout : -
    Clock Step              : one-step
    Arbitrary Mode          : FALSE
  Number of Slaves        : 1
  Number of Masters       : 0
  Number of Stateful      : 0
```

Release Information

Command introduced in Junos OS Release 14.1X53-D25.

RELATED DOCUMENTATION

Understanding Transparent Clocks in Precision Time Protocol | 97

Configuring Transparent Clock Mode for Precision Time Protocol | 117

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

show ptp lock-status

IN THIS SECTION

- Syntax | 633
- Description | 633
- Options | 633
- Required Privilege Level | 633
- Output Fields | 633
- Sample Output | 635
- Release Information | 637

Syntax

```
show ptp lock-status
```

Description

(ACX Series, MX80, MX240, MX480, MX960 routers, and QFX Series switches) Display information about the lock status of the client. The output verifies whether the client is aligned to the reference (primary clock) or not.

Options

detail	Display detailed information about the lock status of the client.

Required Privilege Level

view

Output Fields

Table 32 on page 634 lists the output fields for the **show ptp lock-status** command. Output fields are listed in the approximate order in which they appear.

Table 32: show ptp lock-status Output Fields

Field Name	Field Description
Lock State	State of the client clock with respect to its primary clock: • Freerun • Holdover • Phase Aligned • Acquiring • Initializing • Freq locked
Phase offset	Time offset information of a client clock with respect to its primary clock. Precision of this time offset is 1 nanosecond.
State since	Date, time, and how long ago the lock status of the PTP client or client clock changed. The format is **State since: year-month-day hour:minute:second:timezone (hour:minute:second ago)**. For example, **State since: 2002-04-26 10:52:40 PDT (04:33:20 ago)**. On ACX Series routers, this field is displayed in Junos OS Release 15.1 and later.
Selected Master Details	Details include the following: • **Upstream Master address**—The address of the remote primary from which the salve acquires the clock. • **Slave interface**—The client interface on this router corresponding to the Primary above. **NOTE**: On ACX Series router, if the PTP lock state is **FREERUN**, then the **Selected Master Details** field is not shown.

Sample Output

show ptp lock-status

```
user@host> run show ptp lock-status
Lock Status:

Lock State     : 5 (PHASE ALIGNED)
Phase offset   : 0.000000001 sec
```

show ptp lock-status

```
user@host> show ptp lock-status
Lock Status:

Lock State     : 1 (FREERUN)
Phase offset   : 0.000000869 sec
```

show ptp lock-status detail

```
user@host> show ptp lock-status detail
Lock Status:

Lock State     : 5 (PHASE ALIGNED)
State since    : 2014-09-10 11:24:11 PDT (00:02:51 ago)

Phase offset   : 0.000000030 sec

Selected Master Details:
Upstream Master address     : 13.13.13.1
Slave interface             : ge-0/1/5.0
```

show ptp lock-status detail

```
user@host> show ptp lock-status detail
Lock Status:
```

```
Lock State    : 5 (PHASE ALIGNED)
Phase offset  : -0.000000010 sec

Selected Master Details:
Upstream Master address    : 2001:cdba:0000:0000:0000:0000:3257:9652
Slave interface            : ge-0/2/0.0
Parent Id                  : 84:18:88:ff:fe:c0:34:00
GMC Id                     : 00:18:0b:ff:fe:20:03:14
```

show ptp lock-status detail

```
user@host> show ptp lock-status detail
Lock Status:

Lock State    : 5 (PHASE ALIGNED)
Phase offset  : -0.000000016 sec
State since   : 2018-10-17 01:53:29 UTC (01:09:37 ago)

Selected Master Details:
Upstream Master address    : 2003::a
Slave interface            : ae0.0
Parent Id                  : 12:34:56:78:9a:bc:de:01
GMC Id                     : 12:34:56:78:9a:bc:de:01
```

show ptp lock-status detail

```
user@host> show ptp lock-status detail
Lock Status:

Lock State    : 5 (PHASE ALIGNED)
Phase offset  : -0.000000016 sec
State since   : 2018-10-17 01:53:29 UTC (01:09:37 ago)

Selected Master Details:
Upstream Master address    : 2003::a
Slave interface            : lo0.0
Parent Id                  : 12:34:56:78:9a:bc:de:01
GMC Id                     : 12:34:56:78:9a:bc:de:01
```

Release Information

Command introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

IEEE 1588v2 PTP Boundary Clock Overview | **99**

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

Precision Time Protocol Overview | **68**

show ptp master

IN THIS SECTION

- Syntax | **637**
- Description | **638**
- Options | **638**
- Required Privilege Level | **638**
- Output Fields | **638**
- Sample Output | **640**
- Release Information | **642**

Syntax

```
show ptp master
<brief |detail | interface>
```

Description

(MX80, MX240, MX480, MX960 routers, and the QFX Series) Display information about the configured primary and the status of the primary.

Options

brief	Display information about the primary in brief.
detail	Display information about the primary in detail.
interface	Display information about the configured interface of the primary.

Required Privilege Level

View

Output Fields

Table 33 on page 638 lists the output fields for the **show ptp master** command. Output fields are listed in the approximate order in which they appear.

Table 33: show ptp primary Output Fields

Field Name	Field Description
Interface	Name of the interface configured for Precision Time Protocol (PTP) on the primary.

Table 33: show ptp primary Output Fields *(Continued)*

Field Name	Field Description
Status	Status of the Precision Time Protocol primary: • **Master** or **Slave** • **Active** or **Inactive** • **Initializing** or **Down**
Local Adddress	IP or MAC address of the configured primary clock.
Status (Local address Status)	Status of the local address of the interface: • **Configured** or **Not configured** • **Master** or **Slave** • **Active** or **Inactive**
Status (Remote address Status)	Status of the remote address of the interface on the QFX Series: • **Configured** or **Not configured** • **Master** or **Slave** • **Active** or **Inactive**
Total Remote Slaves	Number of remote slaves.
Slave Address	IP or MAC address of the client.
Status (Member Address Status)	Status of the address of the client: • **Configured** or **Not configured** • **Master** or **Slave** • **Active** or **Inactive** or **Ready**

Sample Output

show ptp primary

```
user@host> run show ptp master brief
PTP Master Interface Configured:

Master Interface            Status
ge-7/0/2.0                  Master, Active
```

show ptp primary detail

```
user@host> run show ptp master detail
PTP Master Interface Details:
Interface   : xe-0/0/6:1.0
Status      : Master, Active
Clock Info :
    Local Address: 50.50.50.1         Status: Configured, Master, Active
        Remote Address: 224.0.1.129
    Total Remote Slaves: 1
```

show ptp primary detail

```
user@host> run show ptp slave detail
PTP Master Interface Details:

Interface   : xe-0/0/31:3.0
Status      : Master, Active
Clock Info :
    Local Address: 10.10.10.2         Status: Configured, Master, Active
        Remote Address: 10.10.10.1         Status: Learned, Slave, Active
        Remote Address: 224.0.1.129        Status: Configured, Slave, Active
    Total Remote Slaves: 2

Interface   : xe-0/0/35:3.0
Status      : Master, Active
Clock Info :
    Local Address: 10.2.2.1           Status: Configured, Master, Active
```

```
        Remote Address: 10.2.2.24          Status: Learned, Slave, Active
        Remote Address: 10.2.2.29          Status: Learned, Slave, Active
        Remote Address: 10.2.2.30          Status: Learned, Slave, Active
        Remote Address: 10.2.2.32          Status: Learned, Slave, Active
        Remote Address: 10.2.2.35          Status: Learned, Slave, Active
        Remote Address: 10.2.2.52          Status: Learned, Slave, Active
        Remote Address: 10.2.2.61          Status: Learned, Slave, Active
        Remote Address: 224.0.1.129        Status: Configured, Slave, Active
    Total Remote Slaves: 8
```

show ptp primary detail

```
user@host> run show ptp master detail
PTP Master Interface Details:
Interface  : ge-7/0/2.0
Status     : Master, Active
Clock Info :
    Local Address: 10.0.0.1               Status: Configured, Master, Active
    Total Remote Slaves: 0
        Slave IP: 10.0.0.2           Status: Configured, Slave, Active
```

show ptp primary detail

```
user@host> run show ptp master detail
 PTP Master Interface Details:
Interface  : ge-0/1/5.0
Status     : Master, Active
Clock Info :
    Local Address: 84:18:88:c0:60:a1  Status: Configured, Master, Active
        Remote Address: [Slave Mac]  Status: Configured, Slave, Active
    Total Remote Slaves: 1
```

show ptp primary detail

```
user@host> run show ptp master detail
PTP Master Interface Details:
Interface  : lo0.0
Status     : Master, Active
```

```
Clock Info :
    Local Address: 2001::1:132        Status: Configured, Master, Active
        Remote Address: 2002::1             Status: SECURE AUTO SLAVE,
                                                    Sig State: Ann + Sync
        Remote Address: 3001::1:133         Status: SECURE AUTO SLAVE,
                                                    Sig State: Ann + Sync
    Total Remote Slaves: 2
```

show ptp interface ge-7/0/2.0

```
user@host> run show ptp master interface ge-7/0/2.0
PTP Master Interface Configured:

Master Interface           Status
ge-7/0/2.0                 Master, Active
```

Release Information

Command introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

show ptp path-trace detail

IN THIS SECTION

- Syntax | 643
- Description | 643

- Options | 643
- Required Privilege Level | 643
- Output Fields | 643
- Sample Output | 644
- Release Information | 644

Syntax

```
show ptp path-trace detail
```

Description

(MX80, MX240, MX480, and MX960 routers) Display the details of the path an announce message takes in a PTP ring topology.

Options

This command has no options.

Required Privilege Level

view

Output Fields

Table 34 on page 644 lists the output fields for the **show ptp path-trace detail** command. Output fields are listed in the approximate order in which they appear.

Table 34: show ptp path-trace detail Output Fields

Field Name	Field Description
Hop Count	The count of the next router in a network trail where the announce message is received.
Member Clock Identity	Clock identity of the client or client as defined in IEEE 1588.

Sample Output

show ptp path-trace detail

```
user@host> show ptp path-trace detail
Hop count              Member Clock Identity

     1                   00:05:85:ff:fe:74:1f:d0
     2                   00:05:85:ff:fe:73:ef:d0
```

Release Information

Command introduced in Junos OS Release 13.3R4.

RELATED DOCUMENTATION

IEEE 1588v2 PTP Boundary Clock Overview | 99

Precision Time Protocol Overview | 68

show ptp phy-timestamping-interfaces

IN THIS SECTION

- Syntax | 645
- Description | 645
- Options | 645
- Required Privilege Level | 646
- Output Fields | 646
- Sample Output | 646
- Release Information | 646

Syntax

```
show ptp phy-timestamping-interfaces
```

Description

Display information about the interfaces that have PHY timestamping enabled. PHY timestamping is the timestamping of the IEEE 1588 event packets at the physical layer. Timestamping the packet at the physical layer eliminates the noise or the packet delay variation (PDV) that is introduced by the Packet Forwarding Engine.

Options

This command has no options.

Required Privilege Level

view

Output Fields

Table 35 on page 646 lists the output fields for the **show ptp phy-timestamping-interfaces** command. Output fields are listed in the approximate order in which they appear.

Table 35: show-ptp-phy-timestamping-interfaces

Field Name	Field Description
PHY time-stamp interfaces	Name of the interface configured for phy-timestamping.

Sample Output

show ptp phy-timestamping-interfaces

```
user@host> show ptp phy-timestamping-interfaces
PHY time-stamp interfaces:
    xe-0/2/1
    xe-4/1/3
```

Release Information

Command introduced in Junos OS Release 17.1R1.

RELATED DOCUMENTATION

Precision Time Protocol Overview | **68**

show ptp port

IN THIS SECTION

- Syntax | 647
- Description | 647
- Options | 647
- Required Privilege Level | 648
- Output Fields | 648
- Sample Output | 649
- Release Information | 651

Syntax

```
show ptp port
<brief | detail>
ifl logical-interface-name
```

Description

(MX80, MX240, MX480, and MX960 routers) Display information about the number of ports created according to the configuration. For each unique local IP address, one Precision Time Protocol port is created.

Options

brief	Display information about the PTP port in brief.
detail	Display information about the PTP port in detail.

logical-interface-name	Display PTP port information for a specific logical interface.

Required Privilege Level

View

Output Fields

Table 36 on page 648 lists the output fields for the **show ptp port** command. Output fields are listed in the approximate order in which they appear.

Table 36: show ptp port Output Fields

Field Name	Field Description
Local Interface	Local logical interface.
Local IP	IP address of the interface acting as the client.
Remote IP	IP address of the remote node.
Clock Stream	Unique index for each session created.
Clock Identity	IP address of the client.
Port State	Status of the port: **PTP listening** or **PTP initializing**.
Delay Req Interval	Interval in seconds between the delay request messages sent by the client to the primary.
Announce Interval	Logarithmic mean interval for the announce messages to be sent by the primary.

Table 36: show ptp port Output Fields *(Continued)*

Field Name	Field Description
Announce Timeout	Number of times the announce interval message has to pass between the client and the primary without receipt of an announce message.
Sync Interval	Logarithmic mean interval for sync interval messages to be sent by the primary.
Delay Mechanism	Type of delay mechanism used.
Port Number	PTP port number.
Operating Mode	Clock mode of the node.
Master Clock ID	Unique clock-identity of the primary.
Previous Announce Messages	Previous announce messages.
Current Announce Message	Current announce messages.

Sample Output

show ptp port brief

```
user@host> run show ptp port brief
PTP port-data:
Local IP           : 10.0.0.1       Remote IP          : 10.0.0.2
Clock Stream       : 1              Clock Identity     : 00:05:85:ff:fe:73:ef:d0
Port State         : Listening      Delay Req Interval: -4
Announce Interval : 1               Announce Timeout   : 3
```

```
Sync Interval      : -6             Delay Mechanism    : End-to-end
Port Number        : 2              Operating Mode     : Master only

Local IP           : 10.10.1.10     Remote IP          : 10.10.1.2
Clock Stream       : 0              Clock Identity     : 00:05:85:ff:fe:73:ef:d0
Port State         : Listening      Delay Req Interval: -4
Announce Interval : 1               Announce Timeout   : 3
Sync Interval      : -6             Delay Mechanism    : End-to-end
Port Number        : 1              Operating Mode     : BMC Mode
```

show ptp port detail

```
user@host> run show ptp port detail
PTP port-data:
Local IP           : 10.0.0.1       Remote IP          : 10.0.0.2
Clock Stream       : 1              Clock Identity     : 00:05:85:ff:fe:73:ef:d0
Port State         : Listening      Delay Req Interval: -4
Announce Interval : 1               Announce Timeout   : 3
Sync Interval      : -6             Delay Mechanism    : End-to-end
Port Number        : 2              Operating Mode     : Master only

Local IP           : 10.10.1.10     Remote IP          : 10.10.1.2
Clock Stream       : 0              Clock Identity     : 00:05:85:ff:fe:73:ef:d0
Port State         : Listening      Delay Req Interval: -4
Announce Interval : 1               Announce Timeout   : 3
Sync Interval      : -6             Delay Mechanism    : End-to-end
Port Number        : 1              Operating Mode     : BMC Mode

Foreign Master Clock Details:
Master Clock Id                : 00:18:0b:ff:ff:20:01:62
Previous Announce Messages     : 8
Current Announce Messages      : 1
```

command-name

```
user@host> show ptp port ifl ge-1/0/5.0
PTP port-data:
Local Interface    : ge-1/0/5.0
Local Address      : 2001:db8:00:05:85:73:b0:aa
```

```
Remote Address     : 2001:db8:01:80:c2:00:00:0e
Clock Stream       : 0                 Clock Identity     :
2001:db8::85:ff:fe:73:b7:d0
Port State         : Master            Delay Req Interval: -4
Announce Interval : 1                  Announce Timeout   : 3
Sync Interval      : -6                Delay Mechanism    : End-to-end
Port Number        : 1                 Operating Mode     : Master only
```

Release Information

Command introduced in Junos OS Release 12.2.

ifl *logical-interface-name* added in Junos OS Release 16.1.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

show ptp quality-level-mapping

IN THIS SECTION

- Syntax | 652
- Description | 652
- Required Privilege Level | 652
- Output Fields | 652
- show ptp quality-level-mapping (ACX710) | 653
- Release Information | 653

Syntax

```
show ptp quality-level-mapping
```

Description

Display Precision Time Protocol (PTP) clock class to Ethernet Synchronization Message Channel (ESMC) quality mapping.

Required Privilege Level

maintenance

Output Fields

Table 37 on page 652 lists the output fields for the **show ptp quality-level-mapping** command. Output fields are listed in the approximate order in which they appear.

Table 37: show ptp quality-level-mapping Output Fields

Field Name	Field Description
quality level	ESMC quality level
ptp clock class	PTP clock class

show ptp quality-level-mapping (ACX710)

command-name

```
user@host> show ptp quality-level-mapping

quality level          ptp clock class
PRC                       140
SSU-A                     150
SSU-B                     160
SEC                       255
```

Release Information

Command introduced in Junos OS Release 12.2R2.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | 232

show ptp slave

IN THIS SECTION

- Syntax | 654
- Description | 654
- Options | 654
- Required Privilege Level | 654
- Output Fields | 654
- Sample Output | 656
- Release Information | 657

Syntax

```
show ptp slave
<brief | detail | interface>
```

Description

(MX80, MX240, MX480, MX960 routers, and the QFX Series) Display information about the configured client and the status of the client.

Options

brief	Display information about the client in detail.
detail	Display information about the client in detail.
interface	Display information about the configured interface of the client.

Required Privilege Level

View

Output Fields

Table 38 on page 655 lists the output fields for the **show ptp slave** command. Output fields are listed in the approximate order in which they appear.

Table 38: show ptp client Output Fields

Field Name	Field Description
Interface	Name of the interface configured for Precision Time Protocol.
Status	Status of the Precision Time Protocol client: • **Master** or **Slave** • **Active** or **Inactive** • **Initializing** or **Down**
Interface	Interface configured on the client.
Local Address	IP or MAC address of the local interface.
Status (Local address Status)	Status of the local address of the interface acting as the client: • **Configured** or **Unconfigured** • **Master** or **Slave** • **Active** or **Inactive** or **Ready**
Status (Remote address Status)	Status of the remote address of the interface on the QFX Series: • **Configured** or **Not configured** • **Master** or **Slave** • **Active** or **Inactive**
Total Remote Masters	Number of remote primaries.
Remote Master	IP or MAC address of the remote node.

Table 38: show ptp client Output Fields *(Continued)*

Field Name	Field Description
Status (Member IP Address Status)	Status of the address of the primary: • **Configured** or **Unconfigured** • **Master** or **Slave** • **Active** or **Inactive**

Sample Output

show ptp slave

```
user@host> run show ptp slave
PTP Slave Interfaces Configured:

Slave Interface                Status
ge-7/0/0.0                     Slave, Active
```

show ptp slave detail

```
user@host> run show ptp slave detail
PTP Slave Interface Details:

Interface         : ge-7/0/0.0
Status            : Slave, Active
Clock Info
    Local address : 10.10.1.10               Status: Configured, Slave, Active
    Total Remote Masters: 0
        Remote Master: 10.10.1.2        Status: Configured, Master, Active
```

show ptp slave detail

```
user@host> run show ptp slave detail
PTP Slave Interface Details:

Interface        : ge-0/1/5.0
Status           : Slave, Active
Clock Info
    Local Address 2001:cdba:0000:0000:0000:0000:3257:9653        Status:
Configured, Slave, Active
        Remote Master:: 2001:cdba:0000:0000:0000:0000:3257:9652 Status:
Configured, Master, Active
    Total Remote Masters: 1
```

show ptp slave detail

```
user@host> run show ptp slave detail
PTP Slave Interface Details:

Interface        : ae0.0
Status           : Slave, Active
Clock Info
    Local Address : 2003::b                  Status: Configured, Slave, Active
        Remote Master: 2003::a          Status: Configured, Master, Active
    Total Remote Masters: 1
```

Release Information

Command introduced in Junos OS Release 12.2.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

Configuring the Precision Time Protocol G.8275.2 Enhanced Profile (Telecom Profile) | 119

show ptp stateful detail

IN THIS SECTION

- Syntax | 658
- Description | 658
- Options | 658
- Required Privilege Level | 658
- Output Fields | 659
- Sample Output | 659
- Release Information | 660

Syntax

```
show ptp stateful detail
```

Description

Display information about the stateful interfaces.

Options

This command has no options.

Required Privilege Level

view

Output Fields

Table 39 on page 659 lists the output fields for the **show ptp stateful detail** command. Output fields are listed in the approximate order in which they appear.

Table 39: show ptp stateful detail

Field Name	Field Description
Interface	Name of the configured stateful interface.
Status	Status of the stateful interface: stateful and active or inactive.
Local Address	MAC address of the configured stateful interfaces.
Status (of local address)	Status of the local address of the interface: • Configured or not configured • Active or inactive
Port Status	Status of the port configured: • Primary or client
Remote Address	MAC address of the remote stateful interface.

Sample Output

show ptp stateful detail

```
user@host> show ptp stateful detail
Interface   : ge-7/0/1.0
Status      : Stateful, Active
Clock Info :
    Local Address: 01:00:5E:90:10:00  Status: Configured, Active
```

```
     Port Status: Slave
         Remote Address: 01:00:5E:90:10:FF
```

Release Information

Command introduced in Junos OS Release 17.1R1.

RELATED DOCUMENTATION

Precision Time Protocol Overview | 68

show ptp statistics

IN THIS SECTION

- Syntax | 660
- Description | 661
- Options | 661
- Required Privilege Level | 661
- Output Fields | 661
- Sample Output | 663
- Release Information | 666

Syntax

```
show ptp statistics
<brief | detail>
```

Description

Display information about Precision Time Protocol (PTP) statistics.

Options

brief	Display brief statistics about the operation of configured PTP clocks.
detail	Display detailed statistics about the operation of configured PTP clocks.

Required Privilege Level

view

Output Fields

Table 40 on page 661 lists the output fields for the **show ptp statistics** command. Output fields are listed in the approximate order in which they appear.

Table 40: show ptp statistics Output Fields

Field Name	Field Description
Local Address	IP address of the local PTP primary and client interfaces.
Remote Address	IP address of the remote PTP primary and client interfaces.
Role	Function performed by an Ethernet interface configured as a client or primary.
Stream	Stream ID uniquely identifies the connection between one primary and one client.

Table 40: show ptp statistics Output Fields *(Continued)*

Field Name	Field Description
Received	1588v2 packets received by the primary or client interface. For the QFX Series, all packets transmitted by the primary or client interface.
Transmitted	1588v2 packets transmitted by the primary or client interface. For the QFX Series, all packets transmitted by the primary or client interface.
Signalling	Packet count for signalling messages: • Rx—Number of packets received. • Tx—Number of packets transmitted.
Announce	Packet count for announce messages: • Rx—Number of packets received. • Tx—Number of packets transmitted.
Sync	Packet count for synchronization messages: • Rx—Number of packets received. • Tx—Number of packets transmitted.
Delay	Packet count for delay request or response messages: • Rx—Number of packets received. • Tx—Number of packets transmitted.
Error	Packet count for signal loss errors: • Rx—Number of packets received with errors. • Tx—Number of packets transmitted with errors.

Sample Output

show ptp statistics

```
user@host> show ptp statistics
Local Address     Remote Address     Role  Stream      Received  Transmitted
2.2.2.2           10.10.20.50       Slave       0         45716        22826
6.6.6.2           6.6.6.1          Master       4         24960        74880
```

show ptp statistics

```
user@host> show ptp statistics
Local Clock      Remote Clock                              Role  Stream
Received  Transmitted
        ge-0/1/5.0       2001:cdba:0000:0000:0000:0000:3257:9653 Master
4        727205       345698
        ge-0/2/0.0       2001:cdba:0000:0000:0000:0000:3256:0101 Master
5       4493776      2222524
```

show ptp statistics detail

```
user@host> show ptp statistics detail
Local Address     Remote Address     Role  Stream      Received  Transmitted
2.2.2.2           10.10.20.50       Slave       0         47009        23470
         Signalling    Announce        Sync       Delay       Error
   Rx:            5         184       23399       23426           0
   Tx:           45           0           0       23426           0

6.6.6.2           6.6.6.1          Master       4         25600        76800
         Signalling    Announce        Sync       Delay       Error
   Rx:            0           0           0       25600           0
   Tx:            0       25600       25600       25600           0
```

show ptp statistics detail

```
user@host> show ptp statistics detail
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
ge-0/1/5.0       2001:cdba:0000:0000:0000:0000:3257:9653  Master      4
727205       345698
         Signalling    Announce        Sync       Delay       Error
   Rx:            0       33978      347535      345692           6
   Tx:            0           0           0      345698           0
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
ge-0/2/0.0       2001:cdba:0000:0000:0000:0000:3256:0101 Master      5
4493776      2222524
         Signalling    Announce        Sync       Delay       Error
   Rx:            0       36819     2234472     2222485          14
   Tx:            0           0           0     2222524           0
```

show ptp statistics)

```
user@host> show ptp statistics
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
ae0.0            2003::a           Slave       0        666694       331379
lo0.0            2002::1          Master       4        696526      1405758
lo0.0            3001::1:133      Master       5        680312      1373318
```

show ptp statistics detail

```
user@host> show ptp statistics detail
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
xe-0/0/6:0.0     224.0.1.129       Slave       0             0            0
         Signalling    Announce        Sync       Delay       Error
   Rx:            0        1688      217905      129833         131
   Tx:            0           0           0      130608           0


Local Clock      Remote Clock       Role  Stream      Received  Transmitted
xe-0/0/6:1.0     224.0.1.129      Master       0             0        80517
         Signalling    Announce        Sync       Delay       Error
   Rx:            0           0           0           0           0
   Tx:            0         625       79892           0           0
```

```
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
xe-0/0/6:1.0     50.50.50.2       Master       0        249980       249980
         Signalling    Announce         Sync       Delay       Error
   Rx:            0           0            0      249980           0
   Tx:            0           0            0      249980           0

Local Clock      Remote Clock       Role  Stream      Received  Transmitted
xe-0/0/6:1.0     50.50.50.3       Master       0         18520        18600
         Signalling    Announce         Sync       Delay       Error
   Rx:            0           0            0       18520           0
   Tx:            0           0            0       18600           0

Local Clock      Remote Clock       Role  Stream      Received  Transmitted
xe-0/0/6:1.0     50.50.50.10       Master       0            0            0
         Signalling    Announce         Sync       Delay       Error
   Rx:            0           0            0           0           0
   Tx:            0           0            0           0           0
```

show ptp statistics detail

```
user@host> show ptp statistics detail
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
ae0.0            2003::a           Slave       0        167235        82773
         Signalling    Announce         Sync       Delay       Error
   Rx:           15        1303        83174       82758           0
   Tx:           17           0            0       82761           0
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
lo0.0            2002::1          Master       4         82152       167879
         Signalling    Announce         Sync       Delay       Error
   Rx:          132           0            0       82020           0
   Tx:          132        1320        84407       82020           0
Local Clock      Remote Clock       Role  Stream      Received  Transmitted
lo0.0            3001::1:133      Master       5           131         1450
         Signalling    Announce         Sync       Delay       Error
   Rx:          131           0            0           0           0
   Tx:          131        1319            0           0           0
```

Release Information

Command introduced in Junos OS Release 12.3.

RELATED DOCUMENTATION

IEEE 1588v2 PTP Boundary Clock Overview | **99**

IEEE 1588v2 Precision Timing Protocol (PTP) | **103**

show synchronous-ethernet esmc statistics

IN THIS SECTION

- Syntax | **666**
- Description | **667**
- Required Privilege Level | **667**
- Output Fields | **667**
- Sample Output | **667**
- Release Information | **668**

Syntax

```
show synchronous-ethernet esmc statistics
<brief interface interface-name>
<detail interface interface-name>
< interface interface-name>
< interface interface-name (brief | detail)>
```

Description

(MX5, MX10, MX40, MX80, MX80-T, MX240, MX480, MX960, MX2010, MX2020 , and PTX Series routers only) Display the Synchronous Ethernet ESMC statistics.

Required Privilege Level

maintenance

Output Fields

Table 41 on page 667 lists the output fields for the**show synchronous-ethernet esmc statistics** command. Output fields are listed in the approximate order in which they appear.

Table 41: show synchronous-ethernet esmc statistics Output Fields

Field Name	Field Description
Interface Name	**interface-slot/pic/port**—Displays the name of the interface for which the ESMC statistics are displayed.
Transmit Count	**number**—Displays the number of ESMC packets transmitted.
Receive Count	**number**—Displays the number of ESMC packets received.

Sample Output

show synchronous-ethernet esmc statistics

```
user@host> show synchronous-ethernet esmc statistics
ESMC statistics:
Interface Name        Transmit Count       Receive Count
```

```
ge-1/0/4            3540                0
ge-1/0/2            3539                0
ge-1/2/4            3540                0
```

show synchronous-ethernet esmc statistics detail

```
user@host> show synchronous-ethernet esmc statistics detail
ESMC Statistics:

Interface Name  :  xe-2/0/10
Transmit Count  :  40908             Receive Count        : 40534
Total Drop Count:  336               Ineligible Drop Count: 0
Adjacency Count :  4
```

show synchronous-ethernet esmc statistics interface (PTX)

```
user@host> show synchronous-ethernet esmc statistics interface et-1/1/0:0
ESMC statistics:
Interface Name      Transmit Count      Receive Count
et-1/1/0:0          358                 338
```

Release Information

Command introduced in Junos OS Release 11.2R4.

Command introduced in Junos OS Release 14.2R1 for PTX Series Packet Transport Routers.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

Configuring Clock Synchronization Interface on MX Series Routers | **303**

request chassis synchronization mode | **568**

request chassis synchronization switch | **570**

show synchronous-ethernet global-information | **672**

show synchronous-ethernet esmc transmit | **669**

clear synchronous-ethernet esmc statistics | 556

show synchronous-ethernet esmc transmit

IN THIS SECTION

- Syntax | 669
- Description | 669
- Required Privilege Level | 670
- Output Fields | 670
- Sample Output | 670
- show synchronous-ethernet esmc transmit (PTX) | 671
- Release Information | 671

Syntax

```
show synchronous-ethernet esmc transmit
<brief interface interface-name>
<detail interface interface-name>
< interface interface-name>
< interface interface-name (brief | detail)>
```

Description

(MX5, MX10, MX40, MX80, MX80-T, MX240, MX480, MX960, MX2010, MX2020, and PTX Series routers only) Display the Synchronous Ethernet ESMC transmit interface details.

Required Privilege Level

maintenance

Output Fields

Table 42 on page 670 lists the output fields for the **show synchronous-ethernet esmc transmit detail** command. Output fields are listed in the approximate order in which they appear.

Table 42: show synchronous-ethernet esmc transmit detail Output Fields

Field Name	Field Description
Interface name	**interface-slot/pic/port**—Displays the name of the interface for which the ESMC transmit details are displayed.
Status	**string**—Displays the ESMC transmit interface status details.

Sample Output

command-name

```
user@host# show synchronous-ethernet esmc transmit detail
ESMC Transmit interface details:
    Interface name: ge-1/0/4          Status: ESMC Tx (QL SSU-A/SSM 0x4)
    Interface name: ge-1/0/2          Status: ESMC Tx (QL DNU/SSM 0xf)
    Interface name: ge-1/2/4          Status: ESMC Tx (QL SSU-A/SSM 0x4)
```

show synchronous-ethernet esmc transmit

```
user@host> show synchronous-ethernet esmc transmit
ESMC Transmit interfaces:
    xe-2/0/10
```

show synchronous-ethernet esmc transmit (PTX)

command-name

```
user@host> show synchronous-ethernet esmc transmit
ESMC Transmit interfaces:
    et-1/1/0:0
    et-2/0/22:3
```

Release Information

Command introduced in Junos OS Release 11.2R4.

Command introduced in Junos OS Release 14.2R1 for PTX Series Routers.

RELATED DOCUMENTATION

- Synchronous Ethernet Overview | **232**
- Configuring Clock Synchronization Interface on MX Series Routers | **303**
- request chassis synchronization mode | **568**
- request chassis synchronization switch | **570**
- show synchronous-ethernet global-information | **672**
- show synchronous-ethernet esmc statistics | **666**

show synchronous-ethernet global-information

IN THIS SECTION

- Syntax | 672
- Description | 672
- Required Privilege Level | 672
- Output Fields | 673
- Sample Output | 674
- Release Information | 674

Syntax

```
show synchronous-ethernet global-information
<brief>
```

Description

(MX5, MX10, MX40, MX80, MX80-T, MX240, MX480, MX960, and PTX routers only) Display information about the global configuration for Synchronous Ethernet chassis synchronization.

Required Privilege Level

maintenance

Output Fields

Table 43 on page 673 lists the output fields for the **show synchronous-ethernet global-information** command. Output fields are listed in the approximate order in which they appear.

Table 43: show synchronous-ethernet global-information Output Fields

Field Name	Field Description
Network option	**(option-1(EEC1) | option-2(EEC2))**—Displays the network option configuration, either option-1(EEC1) or option-2(EEC2).
Clock mode	**(free-run | auto-select)**—Displays the configured mode of operation. The clock source can be either from the free-run local oscillator or from an external qualified clock. The default is auto-select mode.
QL mode	**(enable | disable)**—Displays the configured quality level mode configuration. The default is disable.
Switchover mode	**(revertive | non-revertive)**—Displays the configured synchronization clock switching mode. The default mode is revertive.
Config change holdover	**seconds**—Displays the time interval to wait before selecting the new clock source during a configuration change. The default value is 30 seconds.
Switchover holdover	**seconds**—Displays the time interval to wait before selecting the new clock source during switchover. The default value is 30 seconds.
Reboot holdover	**seconds**—Displays the time interval to wait before selecting the new clock source during reboot. The default value is 120 seconds.

Sample Output

show synchronous-ethernet global-information (MX)

```
user@host# show synchronous-ethernet global-information
Global Configuration:

Network option          : option-1(EEC1)
Clock mode              : Auto-select
QL mode                 : Disabled
Switchover mode         : Revertive
Config change holdover : 15  seconds
Switchover holdover     : 30  seconds
Reboot holdover         : 120 seconds
```

show synchronous-ethernet global-information (PTX)

```
user@host# show synchronous-ethernet global-information
Global Configuration:

Network option          : option-1(EEC1)
Clock mode              : Auto-select
Max transmit quality    : PRC
QL mode                 : Disabled
Clock selection mode    : Config-QL based
Switchover mode         : Revertive
Config change holdover : 15  seconds
Switchover holdover     : 30  seconds
Reboot holdover         : 120 seconds
RE Status               : Master
Global Wait to Restore : 0   min
```

Release Information

Command introduced in Junos OS Release 11.2R4.

RELATED DOCUMENTATION

Synchronous Ethernet Overview | **232**

Configuring Clock Synchronization Interface on MX Series Routers | **303**

request chassis synchronization mode | **568**

show synchronous-ethernet esmc statistics | **666**

show synchronous-ethernet esmc transmit | **669**