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6. Security Configuration

7. VPN Configuration

8. Reliability Configuration

9. QoS Configuration

10. DDR Configuration

11. VoIP Configuration

VRP

User Manual – Configuration Guide

Volume 3

V200R001

VRP

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About This Manual

Contents

To help readers to better understand, use and maintain Quidway series routers, we publish the manual suit of Quidway series routers. This manual suit includes:

- VRP User Manual — Configuration Guide (V1.5) -Volume 1
- *VRP User Manual — Configuration Guide* (V1.5) -Volume 2
- *VRP User Manual — Configuration Guide* (V1.5) -Volume 3
- *VRP User Manual — Command Reference* (V1.5) -Volume 1
- *VRP User Manual — Command Reference* (V1.5) -Volume 2
- *VRP User Manual — Command Reference* (V1.5) -Volume 3
- *Quidway R1602 Router Installation Manual*
- *Quidway R1603/1604 Routers Installation Manual*
- *Quidway R2501 Router Installation Manual*
- *Quidway R2501E Router Installation Manual*
- *Quidway R2509/2511 Routers Installation Manual*
- *Quidway R2509E/2511E Routers Installation Manual*
- *Quidway R4001 Router Installation Manual*
- *Quidway R4001E Router Installation Manual*
- *Quidway R26/36 Modular Router Installation Manual*

Among the manual suit, the first two manuals are applicable to all routers, and the other installation manuals are separately used for their own types of routers.

In *VRP User Manual — Configuration Guide* (V1.5) -Volume 3, the modules are arranged as follows:

- Module 6 Security Configuration (06SC)

This module mainly introduces the principle and basic specific configuration of security features provided by VRP1.5, including AAA configuration, Radius protocol configuration, terminal access security configuration, firewall and packet filtering configuration, IPSec protocol configuration and IKE protocol configuration.

- Module 7 VPN Configuration (07VPN)

This module mainly introduces the principle and specific configuration of VPN solutions provided by VRP1.5, including configuration of L2TP protocol and GRE protocol.

- Module 8 Reliability Configuration (08LC)

This module mainly introduces the principle and specific configuration of backup center and HSRP protocol.

- Module 9 QoS Configuration (09QC)

This module mainly introduces the principle and specific configuration of QoS service features supported by VRP1.5, including configuration of congestion management, priority-queue and custom-queue.

- Module 10 DDR Configuration (10DC)

This module mainly introduces the principle and specific configuration of dial solutions provided by VRP1.5, including Legacy DDR configuration, Dialer Profile configuration and modem management configuration.

- Module 11 VoIP Configuration (11VC)

This module mainly introduces the principle and specific configuration of IP voice service features supported by VRP1.5, including configuration of VoIP, IP Fax, E1 voice, GK client and IPHC.

Note:

For questions regarding the product specifications, please confirm with the concerned personnel in Huawei's Enterprise Network Section as the software specifications are varied with the product of different type.

Target Readers

The manual is intended for the following readers:

- Network engineers
- Technical assistance engineers
- Network administrators

Conventions Used in the Document

Keyboard operation

Format	Description
<Key >	Press the key with key name expressed with a pointed bracket, e.g. **<Enter>**, **<Tab>**, **<Backspace>**, or **<A >.**
<Key 1 + Key 2>	Press the keys concurrently; e.g. **<Ctrl+Alt+A>** means the three keys should be pressed concurrently.
<Key 1, Key 2>	Press the keys in turn, e.g. **<Alt, A>** means the two keys should be pressed in turn.
[Menu Option]	The item with a square bracket indicates the menu option, e.g. **[System]** option on the main menu. The item with a pointed bracket indicates the functional button option, e.g. **<OK>** button on some interface.
[Menu 1/Menu 2/Menu 3]	Multi-level menu options, e.g. **[System/Option/Color setup]** on the main menu indicates **[Color Setup]** on the menu option of **[Option]**, which is on the menu option of **[System]**.

Mouse operation

Action	Description
Click	Press the left button or right button quickly (left button by default).
Double Click	Press the left button twice continuously and quickly.
Drag	Press and hold the left button and drag it to a certain position.

Symbol

Some distinct symbols are employed in the manual to indicate the special notice that should be taken for the operation. The symbols are:

⚠ **Caution, Notice, Warning, Danger:** Notify the special attention that should be given to the operation.

🕮 **Note, Prompt, Tip, Thought:** Give further necessary supplement or explanation for the operation description.

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User Manual – Configuration Guide

Volume 3

06 – Security Configuration (SC)

Chapter 5 Configuration of IKE

5.1 Brief Introduction to IKE Protocol

I. IKE

IKE, an Internet key exchange protocol, implements hybrid protocol of both Oakley and SKEME key exchanges in ISAKMP network. This protocol defines standards for automatically authenticating IPSec peer end, negotiating security service and generating shared key, and provide services such as automatic key exchange negotiation and security association creation, thus simplifying the use and management of IPSec.

IKE has a set of self-protection mechanism, which enables to securely deliver keys, authenticate ID and establish IPSec secure association in insecure network.

IKE uses ISAKMP at two stages:

- The first stage is to negotiate to create a communication channel and authenticate it, as well as to provide confidentiality, message integrity and message source authentication services for further IKE communication between both parties.
- The second stage is to use the created IKE SA to create IPSec SA.

The following figure shows the relationship between IKE and IPSec.

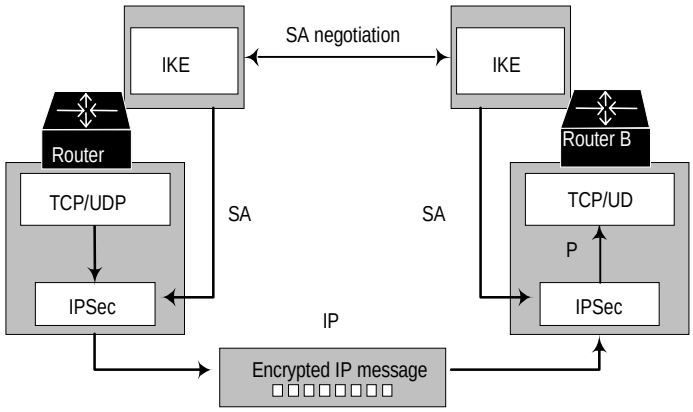

Figure SC-5-1 Diagram of relationship between IKE and IPSec

II. IKE features

- Avoid specifying manually all IPSec security parameters in password mapping of both communication ends.
- Allow specifying the lifetime of IPSec SA
- Allow exchanging ciphering key during IPSec session
- Allow IPSec to provide anti-replay service
- Allow manageable and scalable IPSec to implement certificate authorization support.
- Allow dynamic end-to-end authentication.

5.2 Configuring IKE

5.2.1 IKE Configuration Task List

IKE configuration task list is as follows:

- Create IKE security policy
- Select encryption algorithm
- Select authentication algorithm
- Configure pre-shared key
- Select hashing algorithm
- Select DH group ID
- Set IKE negotiation SA lifetime

5.2.2 Creating IKE Security Policy

I. Why these policies should be created?

IKE negotiation must be protected, so each IKE negotiation begins when each terminal comes to the public (shared) IKE policy, which describes which security parameter to use to protect subsequent IKE negotiation.

When two terminals come to a policy, the security parameters of this policy are identified by SA established by each terminal, and these SAs apply to all subsequent IKE communication during negotiation. Multiple policies with priority must be created on each terminal so as to ensure that at least one policy can match that of the remote terminal.

II. Parameters to be defined in policy

- Encryption algorithm: at present, it includes only 56-bit DES-CBC (DES-Cipher Block Chaining)
- Hashing algorithm: SHA-1(HMAC anamorphosis) or MD5 (HMAC anamorphosis) algorithm
- Authentication method: RSA signature or RSA real-time encryption
- Diffie-Hellman group ID
- SA lifetime

III. How to form matched policy

When IKE negotiation begins, IKE looks for a kind of IKE policy, which is consistent at both terminals. The terminal that originates negotiation sends all its policies to the remote terminal, and the latter will try to find a matched policy by comparing its policies with highest priorities with those received from the former. When the policies from the two terminals include the same encryption, hashing, authentication and Diffie-Hellman parameters and when the specified lifetime of the policy from the remote terminal is shorter than or equal to the compared policy lifetime, the matching selection is made (if no lifetime is specified, the shorter one of the remote terminal policy will be used). If no acceptable matched policy is found, IKE refuses to negotiate and will not establish IPSec. If a matched policy is found, IKE will complete negotiation then create IPSec security tunnel.

IV. Create IKE policy

The following should be clear before IKE configuration:

- Determine the intensity of authentication algorithm, encryption algorithm and Diffie-Hellman algorithm (i.e., the calculation resources consumed and the security capability provided). Different algorithms are of different intensities, and the higher the algorithm intensity is, the more difficult it is to decode the protected data, but the more the consumed resources are. The longer key usually has higher algorithm intensity.
- Determine the security protection intensity needed in IKE exchange (including hashing algorithm, encryption algorithm, ID authentication algorithm and DH algorithm).
- Determine the authentication algorithm, encryption algorithm, hashing algorithm and Diffie-Hellman group.
- Determine the pre-shared key of both parties.

1) Create IKE policy

The user can create multiple IKE policies, but must allocate a unique priority value for each created policy. Both parties in negotiation must have at least one matched policy for successfully negotiation, that is to say, a policy and the one in the remote terminal must have the same encryption, hashing, authentication and Diffie-Hellman parameters (the lifetime parameters may be a little different). If it is found there are multiple matching policies after negotiation, the one with higher priority will be matched first.

Please perform the following tasks in global configuration mode.

Table SC-5-1 Create IKE policy

Operation	Command
Create IKE policy and enter IKE policy configuration mode	**crypto ike policy** *priority*
Delete IKE policy	**no crypto ike policy** *priority*

No IKE security policy is created by default.

5.2.3 Select Encryption Algorithm

There is only one encryption algorithm: 56-bit DES-Cipher Block Chaining (DES-CBC). Before being encrypted, each plain text block will perform exclusive-OR operation with an encryption block, thus the same plain text block will never map the same encryption and the security is enhanced.

Please perform the following tasks in IKE policy configuration mode.

Table SC-5-2 Select encryption algorithm

Operation	Command
Select encryption algorithm	**encryption des-cbc**
Set the encryption algorithm to the default value	**no encryption**

By default, DES-CBC encryption algorithm (i.e. parameter **des-cbc**) is adopted.

5.2.4 Select Authentication Algorithm

There is only one authentication algorithm: pre-share key

Please perform the following tasks in IKE policy configuration mode.

Table SC-5-3 Select authentication method

Operation	Command
Select authentication method	**authentication pre-share**
Restore the authentication method to the default value	**no authentication pre-share**

By default, pre share key (i.e., **pre-share**) algorithm is adopted.

5.2.5 Set Pre-shared Key

If pre-shared key authentication method is selected, it is necessary to configure pre-shared key.

Perform the following tasks in global configuration mode.

Table SC-5-4 Configure pre-shared key

Operation	Command
Configure pre-shared key	**crypto ike key** *keystring* **address** *peer-address*
Delete pre-shared key to restore its default value	**no crypto ike key** *keystring*

By default, both ends of the security channel have no pre-shared keys.

5.2.6 Select Hashing Algorithm

Generally hashing algorithm uses HMAC framework to achieve its function. HMAC algorithm adopts encryption hashing function to authenticate message, providing frameworks to insert various hashing algorithm, such as SHA-1 and MD5.

There are two hashing algorithm options: SHA-1 and MD5. Both algorithms provide data source authentication and integrity protection mechanism. MD5 has less digest information, so it is usually considered to be slightly faster than SHA-1. A kind of attack subject to MD5 is proved successful (but it is very difficult), but HMAC anamorphosis used by IKE can stop such attacks.

Please perform the following tasks in IKE policy configuration mode.

Table SC-5-5 Select hashing algorithm

Operation	Command
Select hashing algorithm	**hash { md5 | sha }**
Set hashing algorithm to the default value	**no hash**

By default SHA-1 hashing algorithm (i.e., parameter **sha**) is adopted.

5.2.7 Select DH Group ID

There are two DH (Diffie-Hellman) group ID options: 768-bit Diffie-Hellman group (Group 1) or 1024-bit Diffie-Hellman group (Group 2). The 1024-bit Diffie-Hellman group (Group 2) takes longer CPU time

Please perform the following tasks in IKE policy configuration mode.

Table SC-5-6 Select DH group ID

Operation	Command
Select DH group ID	**group {1 | 2}**
Restore the default value of DH group ID	**no group**

By default, 768-bit Diffie-Hellman group (Group 1) is selected.

5.2.8 Set Lifetime of IKE Association SA

Lifetime means how long IKE exists before it becomes invalid. When IKE begins negotiation, the first thing for it to do is to make its security parameters of the two parties be consistent. SA quotes the consistent parameters at each terminal, and each terminal keeps SA until its lifetime expires. Before SA becomes invalid, it can be negotiated by the subsequent IKE to be reused. The new SA is negotiated before the current SA becomes invalid.

The shorter the lifetime is (to a critical point), the more secure the IKE negotiation is. But to save time for setting IPSec, the longer IKE SA lifetime should be configured.

If the policy lifetimes of two terminals are different, only when the lifetime of originating terminal must be greater than or equal to that of the peer end can IKE policy can be selected, and the shorter lifetime should be selected as IKE SA lifetime.

Perform the following tasks in IKE policy configuration mode.

Table SC-5-7 Set lifetime of IKE negotiation SA

Operation	Command
Set lifetime of IKE SA	**lifetime** *seconds*
Set lifetime as the default value	**no lifetime**

By default, SA lifetime is 86400 seconds (a day). It is recommended that the configured *seconds* should be greater than 10 minutes.

5.3 Monitoring and Maintenance of IKE

Please perform the monitoring and maintenance in privileged user mode.

Table SC-5-8 Monitoring and maintenance of IKE

Operation	Command
Show IKE security association parameter	**show crypto ike sa**
Show IKE security policy	**show crypto ike policy**
Clear an SA	**clear crypto ike sa** *connection-id*

1) Show IKE SA parameter

```
Quidway# show crypto ike sa
conn-id    peer        flags     phase       doi
1       202.38.0.2     RD|ST       1        IPSEC
2       202.38.0.2     RD|ST       2        IPSEC
```

```
Flag meaning:
RD--Ready ST--Stayalive RT--Replaced FD--Fading
```

Execute the following command to clear security association 1.

Quidway# clear crypto ike sa 1

Then the SA will show the following information:

Quidway# show crypto ike sa

```
conn-id    peer        flags     phase   doi
2       202.38.0.2     RD|ST       2    IPSEC
Flag meaning:
RD--Ready ST--Stayalive RT--Replaced FD--Fading
```

Table SC-5-9 Description about the command field show crypto ike sa

Operation	Command
Security channel ID	conn-id
Peer IP address of this SA	peer
Show the status of this SA NONE means this SA is being established READY means this SA has been established successfully STAYALIVE means that lifetime is negotiated, and this SA will be refreshed in fixed interval. REPLACED means that a timeout has happened FADING means this SA has been replaced, and will be cleared automatically after some time	Flags
Phase of SA	phase
Explanation domain of SA	doi

2) Show IKE security policy

Quidway# show crypto ike policy

```
Protection suite priority 15
   encryption algorithm: DES - CBC
   hash algorithm: MD5
   authentication method: Pre-Shared Key
   Diffie-Hellman Group: MODP1024
   Lifetime:  5000 seconds, no volume limit
Protection suite priority 20
   encryption algorithm: DES - CBC
   hash algorithm: SHA
   authentication method: Pre-Shared Key
   Diffie-Hellman Group: MODP768
   lifetime:      10000 seconds, no volume limit
Default protection suite
   encryption algorithm: DES - CBC
   hash algorithm: SHA
    authentication method: Pre-Shared Key
   Diffie-Hellman Group: MODP768
   Lifetime: 86400 seconds, no volume limit
```

The information shows the protection priority, encryption algorithm, hashing algorithm, authentication algorithm, Diffie-Hellman group and IKE SA lifetime.

5.4 Typical Configuration of IKE

I. Networking requirements

- Hosts A and B communicates securely, and a security channel is established with IKE automatic negotiation between security gateways A and B.

- Configure an IKE policy on Gateway A, with Policy 10 is of highest priority and the default IKE policy is of the lowest priority.
- Pre-shared key authentication algorithm is adopted.

II. Networking diagram

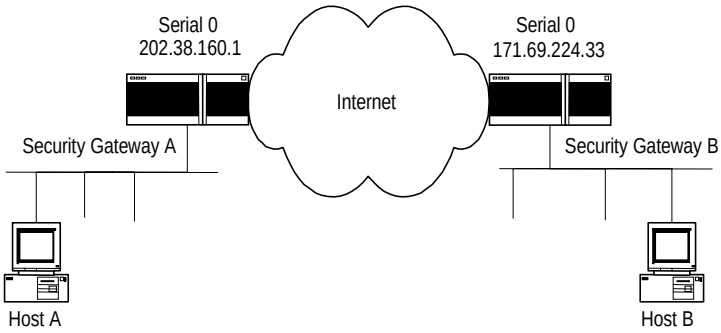

Figure SC-5-2 Networking diagram of IKE configuration example

III. Configuration procedure

Configuration on Security Gateway A.

! Configure a IKE Policy 10

Quidway (config)# crypto ike policy 10

! Specify the hashing algorithm used by IKE policy as MD5

Quidway (config-crypto-ike-policy-10)# hash md5

! Use pre-shared key authentication method

Quidway (config-crypto-ike-policy-10)# authentication pre-share

! Configure “abcde” for peer 171.69.224.33

Quidway (config)# crypto ike key abcde address 171.69.224.33

! Configure IKE SA lifetime to 5000 seconds

Quidway (config-crypto-ike-policy-10)# lifetime 5000

Configuration on Security Gateway B.

! Use default IKE policy on Gateway B and configure the peer authentication word.

Quidway (config)# crypto ike key abcde address 202.38.160.1

The above are IKE negotiation configurations. To establish IPSec security channel for secure communication, it is necessary to configure IPSec correspondingly. For detailed contents, please refer to the configuration samples in the chapter *IPSec Configuration.*

5.5 IKE Fault Diagnosis and Troubleshooting

When configuring parameters to establish IPSec security channel, you can use the **debug ike error** command to enable the Error debugging of IKE to help us find configuration problems. The command is as follows:

Problem 1: Invalid user ID information

Troubleshooting: please follow the steps below.

User ID information is the data for the user originating IPSec communication to identify itself. In practical applications we can use user ID to establish different security path for protecting different data streams. At present we use the user IP address to identify the user.

```
got NOTIFY of type INVALID_ID_INFORMATION
```

or

```
drop message from A.B.C.D due to notification type INVALID_ID_INFORMATION
```

Check whether ACL contents in cryptomap configured at interfaces of both ends are compatible. It is recommended for the user to configure ACL of both ends to mirror each other.

Problem 2: Unmatched policy

Troubleshooting: please follow the steps below.

Enable the **debug ike error** command, you can see the debugging information.

```
got NOTIFY of type NO_PROPOSAL_CHOSEN
```

or

```
drop message from A.B.C.D due to notification type NO_PROPOSAL_CHOSEN
```

Both parties of negotiation have no matched policy. Check the protocol used by cryptomap configured on interfaces of both parties to see whether the encryption algorithm and authentication algorithm are the same.

Problem 3: Unable to establish security channel

Troubleshooting: please follow the steps below.

Check whether the network is stable and the security channel is established correctly. Sometimes there is a security channel but there is no way to communicate, and ACL of both parties are checked to be configured correctly, and there is also matched policy. In this case, the problem is usually cased by the restart of one router after the security channel is established.

Solution:

1) Use the command **show crypto ike sa** to check whether both parties have established SA of Phase 1.
2) Use the command **show crypto ipsec sa map** to check whether the cryptomap on interface has established IPSec SA.
3) If the above two results show that one party has SA but the other does not, then use the command **clear crypto ike sa** to clear SA with error and re-originate negotiation.

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User Manual – Configuration Guide

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07 – VPN Configuration (VPN)

Table of Contents

Chapter 1 VPN Overview

Virtual Private Network, VPN for short, is one of the rapidly developing technologies along with the development of Internet in recent years. In the wake of enterprise expansion, widely located clients and increasing partners, modern enterprises make more and more use of Internet resources to conduct such activities as promotion, marketing, after-sale service, training and cooperation. Many enterprises tend to replace their private data network with Internet. Like the current private networks of enterprises, VPN established on the public network is safe, reliable and manageable. This kind of logic network, which uses Internet to transmit private information, is called VPN.

1.1 VPN features

VPN features the following:

1) Different from conventional networks, VPN does not actually exist; it is a virtual network formed by resource configuration of the existing network .So the carriers can make use of their spare network resources to provide VPN service and profit from the network resources to the maximum extent.
2) VPN is specially used for specific enterprises or user groups. It makes no difference to VPN users in using VPN and conventional private networks. However, VPN is actually established on the public network or on the networks of other carriers. In order to meet the requirements of private networks, some technical means must be adopted to ensure the resource independence between VPN and the public network or its bearing network. That is, the resources of a VPN are not usually allowed to be used by other VPNs on the bearing network or network members not belonging to the VPN. Another point is that VPN should be safe enough, that is, the information from VPN users should not go out of VPN and the external users can not generally access the information in VPN. The above mentioned two problems are the main problems to be solved in VPN protocol.
3) VPN is not a simple higher-level service. Network interconnection between the users of private networks is required for VPN service, including creation of VPN internal network topology, route calculation, access and exit of members. So VPN technology is much more complicated compared with the mechanism of various ordinary point-to-point applications.

VPN has the following advantages:

1) With VPN, reliable and safe connection can be established between remote users, branches of companies and commercial partners, and between suppliers and companies. And security of data output can be ensured. The advantage is especially significant in the integration of E-commerce or financial network with the communication network.
2) With VPN, IP network of lower cost can be used to transmit data stream so as to downsize the cost to establish Intranet and to make effective use of the currently idle network resources.
3) VPN users can be added and deleted with only relative configurations and without changing hardware, making VPN applications highly flexible.
4) With VPN, a great amount of maintenance personnel of private network of the enterprises can engage in more important services, leaving the VPN management and maintenance of ISP or other network companies.

5) With VPN, users can make mobile access at any time and place, meeting the increasing mobile service requirements.
6) VPN with service quality guarantee, e.g. MPLS VPN, can provide different levels of service quality guarantees for users in exchange for different service charges, harvesting surplus profit. In addition, in terms of implementing the same functions, the networks can be used more effectively when these services are provided by specialized public networks rather than the networks established by the enterprises themselves.

Take an enterprise for example. The Intranet established with VPN is shown in the following figure.

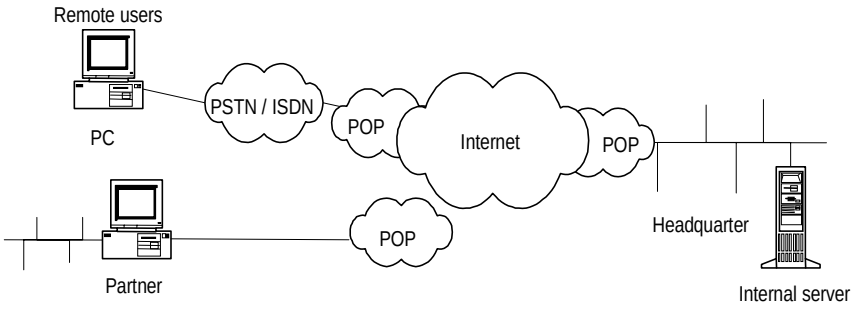


Figure VPN-1-1 Schematic diagram of VPN networking

It can be found in the above figure that the users of internal resources of enterprises access the POP (Point of Presence) server of local ISP via PSTN network, and thus they can communicate with each other. Conventional WAN construction technique can only score the same goal with the aid of leased line between them. After VPN is established, the remote users and the clients in other places can access internal resources of enterprises even if they do not have the Internet access authority of local ISP. This means a lot to clerks who travel a lot and geographically widely distributed clients.

VPN services of enterprises only require a server supporting VPN at resource sharing location (a Windows NT server or a router supporting VPN). After accessing local POP server via PSTN, resource users directly call the remoter servers of enterprises (VPN servers). The call mode is the same as that with PSTN connection, with the rest of work completed by Access Server of ISP.

1.2 Classification of IP VPN

IP VPN means the simulation of leased line services of private WAN equipment performed with IP facilities (including public Internet or private IP backbone network).

IP VPN has the following classification methods:

I. According to operation mode

1) CPE-based VPN

The users not only install expensive equipment and private authentication tools, but also are engaged in multifarious VPN maintenance (e.g. channel maintenance and bandwidth management). The networking is complicated, but its service scalability is weak.

2) Network-based VPN（NBIP-VPN）

The maintenance function of VPN is allocated to be completed by to ISP (the users are allowed to manage and control services to some extent) and VPN functions are mainly fulfilled on the equipment at network side. This practice reduces the investments of the users, increases the flexibility and scalability of services and brings new incomes to the operators.

II. According to the layer where the tunnel is

1) Layer 2 tunneling protocol

Layer 2 tunneling protocol starts from NAS (Network Access Server) and ends on the equipment at user side. All the PPP frames are encapsulated in the tunnel. The current layer 2 tunneling protocol mainly includes Point-to-Point Tunneling Protocol (PPTP) (supported by Microsoft, Ascend and 3COM, and also in Windows NT 4.0 above), Layer 2 Forwarding Protocol (L2F) (supported by Cisco and Nortel), and Layer 2 Tunneling Protocol (L2TP) (drafted by IETF and aided by Microsoft, integrating the advantages of the above two protocols, and thus accepted by the industry as standard RFC). L2TP can be used for not only dial-up VPN services but also VPN services of leased line.

2) Layer 3 tunneling protocol

Layer 3 tunneling protocol starts from and ends in ISP. PPP session ends in NAS and only layer 3 messages are carried in the tunnel. The current layer 3 tunneling protocol mainly includes General Route Encapsulation Protocol (GRE) and IPSec. GRE and IPSec are mainly used for VPN services of leased line.

Comparing with layer 2 tunnel, layer 3 tunnel is safe, scalable and reliable. In terms of security, as layer 2 tunnel usually ends on the equipment at user side, there exist great challenges for the security and firewall technical of user's network. But layer 3 tunnel usually ends on ISP gateway and does not impose any threat to the security of user's network.

In terms of scalability, all the PPP frames are encapsulated in layer 2 IP tunnel and transmission efficiency may be degraded. And PPP session will be run through entire tunnel and end on nodes or servers of user's network. So the gateway at user side must save a great deal of the status and information of PPP session, which will add to system load and affect scalability considerably. In addition, as LCP and NCP negotiations of PPP are very sensitive for time, the efficiency of IP tunnel will result in such a series of problems as PPP session timeout. As layer 3 tunnel ends in ISP gateway and PPP session ends in NAS, it is unnecessary for the gateway at user side to manage and maintain the status of respective PPP session, thus minimizing the system load.

Generally, layer 2 and 3 tunneling protocols are independently used, however, reasonable combination of the two layers of protocols will provide better security for the users (e.g. use L2TP together with IPSec protocol).

III. According to service purpose

1) Intranet VPN

In Intranet VPN, respective locations of enterprises are interconnected through public network, which is the extension or alternative of traditional leased line networks or other enterprise networks.

2) Access VPN

Access VPN has two structures: Client-initiated VPN connection and NAS-initiated VPN connection.

3) Extranet VPN

Extranet VPN means that the VPN extends Intranet to partners and clients through VPN, so that different enterprises can build their VPNs through public networks.

IV. According to networking model

1) Virtual Leased Line (VLL)

VLL simulates the conventional leased line service, i.e., simulating the leased line with IP network and providing asymmetrical and inexpensive “DDN” service. For the users at both ends of VLL, the VLL is equivalent to the previous leased line.

2) Virtual Private Dial-up Network (VPDN)

In VPDN, VPN is implemented with dial-up and access services (ISDN PSTN) of public network, which provides access service for enterprises, mini ISPs and mobile offices.

3) Virtual Private LAN Segment (VPLS) service

In VPLS, LANs can interconnect through virtual private network segment, which is the extension of LAN across IP public network.

4) Virtual Private Route Network (VPRN) service

There are two types: one is the VPRN, using with such conventional VPN protocols as IPSec and GRE, and the other is VPN in MPLS mode.

Chapter 2 Configuration of L2TP

2.1 Brief Introduction to L2TP Protocol

2.1.1 Overview of VPDN

I. Brief induction to VPDN

In VPDN, VPN is fulfilled with dial-up and access services (ISDN PSTN) of public network, which provides access service for enterprises, mini ISP and mobile offices. As telecom carriers and large ISPs have a lot of access equipment, facilities and management experiences, other enterprises can make full use of their existing equipment and facilities instead their own investment on access equipment, so that their services can be more specialized and systematic.

VPDN adopts private network encryption and communication protocol, so enterprises can establish safe VPN on public networks. Enterprise personnel on business leave can connect with enterprise's remote internal network via virtual encryption channel, while other users on public networks can not access the Intranet resources via such virtual channel.

VPDN is often used by the following users:

- Those users whose branches are geographically distributed, with many mobile personnel, e.g. enterprise users and tele-education users.
- Those users whose are geographically distributed have to rely on toll calls or even international toll calls.
- Those who have specific requirements for line security and availability.

II. Operation principle of VPDN

The networking diagram of typical VPDN application is shown in the following figure.

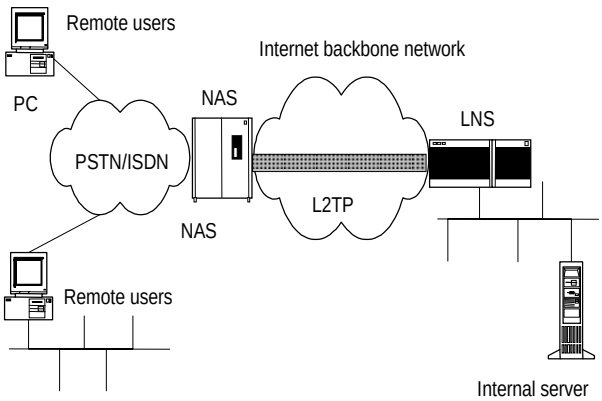


Figure VPN-2-1 Networking diagram of typical VPDN application

VDPN is composed of NAS, equipment at user side and management tool.

1) NAS is provided by telecom departments or large ISPs. As the access server of VPDN, NAS provides WAN interfaces, is in charge of connecting PSTN or ISDN, and supports various LAN protocols, security management and authentication, and supports tunnels and relative techniques.
2) The user-side equipment is located in the headquarters of the user. According to different network functions, it may be the equipment, which provide such functions as NAS, router or firewall. LNS in the figure stands for L2TP Network Server.
3) The management tool manages VPDN equipment and users, including NMS, authentication, authorization and accounting (AAA).

Remote dial-up users dial up and access local ISP NAS via local PSTN or ISDN. With local ISP connection and proper tunneling protocol encapsulating higher-level protocol, a VPN is established between NAS and the gateway of opposite end.

III. Method to realize VPDN

There are two modes to realize VPDN:

1) One mode is that NAS and VDPN gateway establish the channel with tunneling protocol. Directly connect PPP of clients to the gateways of enterprises. The current available protocols are L2F and L2TP.The advantage of the mode is its transparency to users. With one login, the users can access Intranet, which authenticates the users and distributes the addresses without occupying public addresses. The platform to access such network is not limited. In the mode, NAS should support VPDN protocol and the authentication system should support VPDN attributes. The gateway is usually router or VPN private gateway.
2) The other mode is that the client and VPDN gateway establish the tunnel. The client first connects Internet, then establishes channel connection with the gateway through private client software (such as L2TP supported by Win2000). The advantage of the mode is that there is no mode and geographical limits for Internet access of users, depending on no ISP. The setback is that the users need to install special software (usually Windows2000 platform), instead of other platforms familiar with the users.

VPDN tunneling protocol includes PPTP, L2F and L2TP. The most popular one is L2TP at present.

2.1.2 L2TP Protocol

L2TP (Layer 2 Tunneling Protocol) supports the tunneling transmission of the packets on PPP link layer. Integrating the respective advantages of L2F protocol of Cisco and PPTP protocol of Microsoft, it becomes the industrial standard of layer 2 tunneling protocol of IETF.

I. Tunnel and session

L2TP is a connection-based protocol.L2TP tunnel is established between LAC (L2TP Access Concentrator) and LNS (L2TP Network Server), which is composed of one control connection and n ($n \geqq 0$) sessions. Only one L2TP tunnel can be established between a pair of LAC and LNS. Both control message and PPP data message are transmitted in the tunnel. The session is also established between LAC and LNS. But its establishment must follow the successful establishment of tunnel (including the exchange of such information as identity protection, L2TP version, frame type and hardware transmission type). One session connection corresponds to one PPP data stream between LAC and LNS.

L2TP header includes the information of Tunnel ID and Session ID, which are used to identify different tunnels and sessions. The messages with the same Tunnel ID and different Session ID will be multiplexed in one tunnel. Tunnel ID and Session ID are distributed by opposite end.

L2TP uses HELLO message to detect the connectivity of a tunnel. When the tunnel is idle for some time, LAC and/or LNS begin to transmit HELLO message to opposite end. If not receiving a reply to HELLO message for some time, the tunnel will be cleared up.

II. Control message and data message

L2TP has two types of messages: control message and data message. The control message is used to establish, maintain and transmit the tunnel and session connection. And the data message is used to encapsulate PPP frame and transmit in the tunnel. The transmission of control message is reliable, while that of data message is not. If data message is lost, it will not be transmitted again. L2TP supports flow control and congestion control of control message instead of those of data message.

L2TP is transmitted in the form of UDP message. L2TP registers UDP1701 port, which is only used for initial tunnel establishment. Originating side of L2TP tunnel randomly selects an idle port (it is unnecessarily 1701) and transmits a message to 1701 port of receiving side. After receiving the message, the receiving side randomly selects an idle port (it is unnecessarily 1701 and transmits a message back to the specified port of the originating side. By now, the selected ports of both sides are selected and remain unchanged during the time segment when the tunnel is connected.

After being transmitted to L2TP and added with L2TP header, PPP frame is encapsulated into UDP message and transmitted on TCP/IP network.

III. Two typical L2TP tunnel modes

- Originated by remote dial-up users. Remote system accesses LAC via PSTN/ISDN, then LAC originates the request of establishing channel connection to LNS via Internet. Dial-up user addresses are distributed by LNS. The authentication and charging of remote dial-up users can be completed by the agent at LAC side or completed at LNS side.
- Directly originated by LAC clients (the users who locally support L2TP protocol). Here, LAC clients directly originate the request of channel connection to LNS without separate LAC equipment. Here, the distribution of LAC client addresses and AAA authentication are completed by LNS.

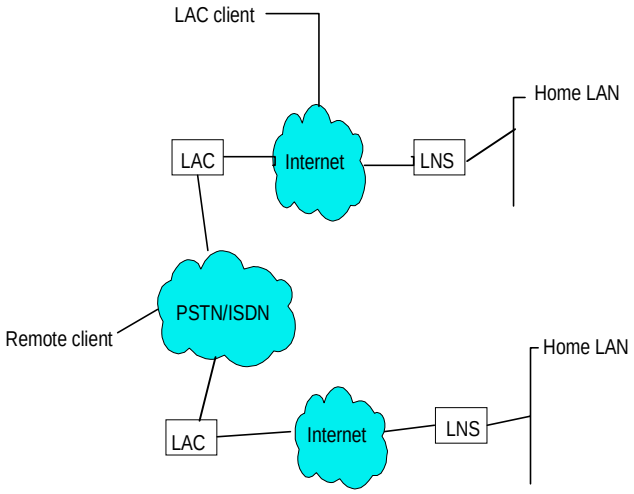


Figure VPN-2-2 Two typical L2TP tunnel modes

IV. Call setup flow of L2TP tunnel

Call setup flow of L2TP channel is shown in the following:

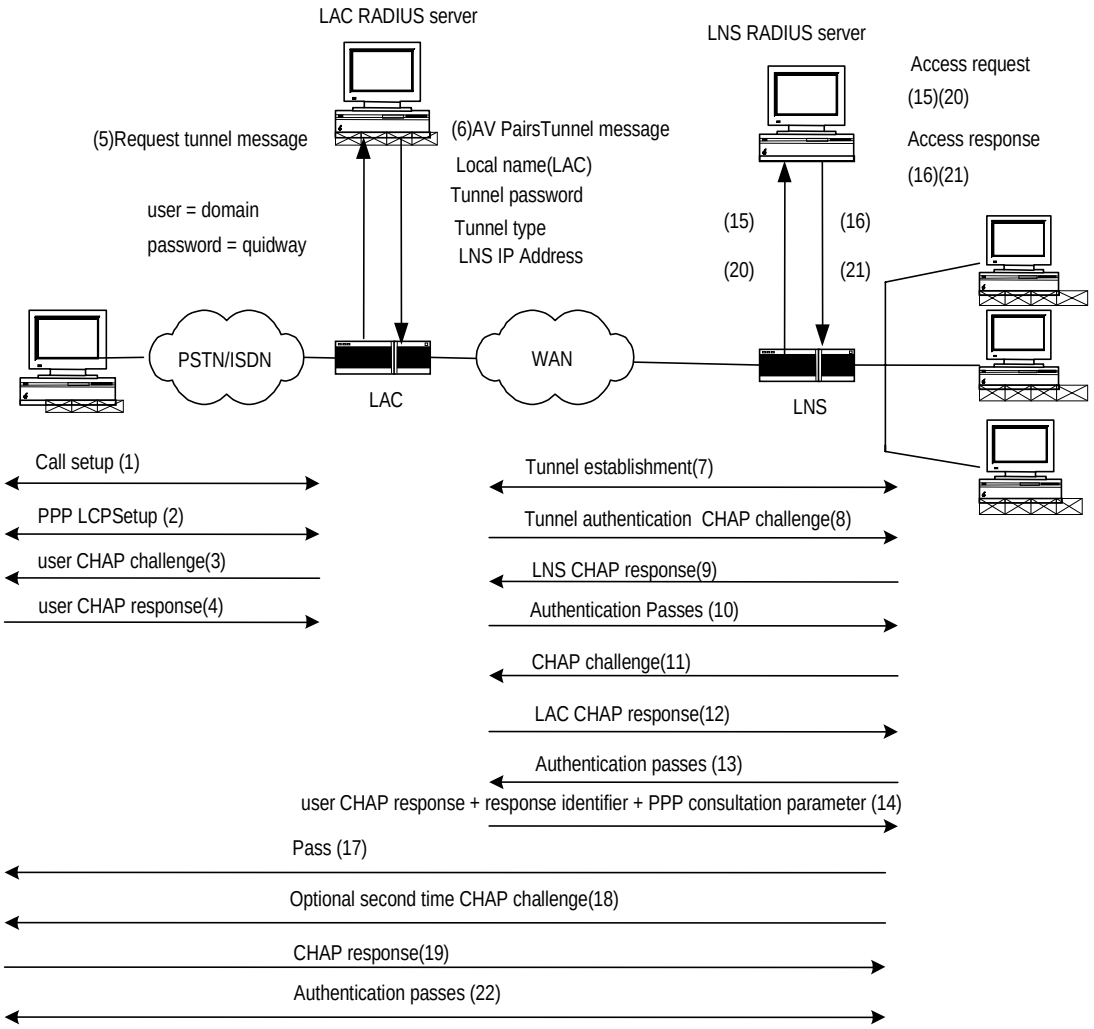


Figure VPN-2-3 Call setup flow of L2TP channel

V. Features of L2TP protocol

- Flexible identity authentication mechanism and high security

L2TP protocol does not provide connection security, but it can depend on the authentication (e.g. CHAP and PAP) provided by PPP, so it has all security features of PPP. L2TP can integrate with IPsec to fulfill data security, so it is difficult to attack the data transmitted with L2TP. As required by specific network security, L2TP adopts channel encryption technique, end-to-end data encryption or application layer data encryption on it to improve data security.

- Multi-protocol transmission

L2TP transmits PPP packet. Thus multi-protocol can be encapsulated in PPP packet.

- Support the authentication of RADIUS server

LAC requires the authentication of RADIUS with user name and password. RADIUS server is in charging of receiving authentication request of the user, fulfilling the authentication and returning to LAC the configuration information for connection establishment.

- Support internal address distribution

LNS can be put behind Intranet firewall. It can dynamically distribute and manage the addresses of remote users and support the application of private addresses (RFC1918). The distributed addresses for remote users are private addresses in enterprise instead of Internet addresses, thus the addresses can be easily managed and the security can also be improved.

- Flexible network charging

Charge in both LAC and LNS at the same time, that is, in ISP (to generate bills) and Intranet gateway (to pay for charge and audit). L2TP can provide such charging data as transmitted packet number, byte number, start time and end time of the connection. And it can easily perform network charging according to these data.

- Reliability

L2TP supports backup LNS. When an active LNS is inaccessible, LAC (access server) can reconnect the backup LNS to improve the reliability and fault tolerance of VPN service.

2.2 Configuring L2TP

2.2.1 L2TP Configuration Task List

L2TP configuration task can be divided into the configurations at LAC and LNS sides.

I. Configuration at LAC side

- Start/Disable VPDN.
- Create VPDN group.
- Set to originate L2TP connection request and LNS addresses.
- Set user name and password.

II. Configuration at LNS side

- Start/Disable VPDN.
- Create VPDN group.
- Create or delete virtual interface template.
- Set the name of receiving channel opposite end.

III. Optional configuration

- Set local name.
- Set channel authentication and password.
- Force local end to perform CHAP authentication.
- Force LCP to re-negotiation.
- Set domain name delimiter and search sequence.
- Force to disconnect channel.

2.2.2 Configuring at LAC Side

I. Enable/disable VPDN

Perform the following task in global configuration mode.

Table VPN-2-1 Enable/disable VPDN

Operation	Command
Enable VPDN to run.	**vpdn enable**
Disable VPDN to run.	**no vpdn enable**

Disable VPDN to run by default.

II. Create VPDN group

The information of dial-up users will be loaded on specific VPDN group, so LAC and LNS can establish L2TP tunnel only on specific VPDN group.

Perform the following task in global configuration mode.

Table VPN-2-2 Create VPDN group

Operation	Command
Create VPDN group and enter the configuration mode of VDPN group.	**vpdn-group** *group-number*
Delete the existing VPDN group.	**no vpdn-group** *group-number*

Do not create VPDN by default. *group-number* is an integer, ranging 1 to 3000.

III. Set user name and password and configure user authentication

LAC will authenticate remote dial-in user name and password to check whether he is a VPN user. Only after the authentication, can the request of establishing channel connection be generated, or the user will be turn to services of other types.

As the authentication and charging at LAC side are performed via RADIUS server, the authentication function of RADIUS server on PPP users will be started.

Table VPN-2-3 Set user name and password and configure user authentication

Operation	Command
Set user name and password.	**user** *username* **password** { **0** | **7** } *password*
Cancel the set user name and password.	**no user** *username*
Configure to authenticate users.	**ppp authentication { pap | chap }**
Cancel the operation to authenticate users.	**no ppp authentication { pap | chap }**
Enable AAA.	**aaa-enable**
Authentication method table of PPP user configuration.	**aaa authentication ppp** { **default** | *list-name* } { *method1*} [*method2* ...]

As L2TP is not the standard attribute of RADIUS protocol, it is necessary to add the definition of L2TP attribute table to RADIUS server attribute domain.

Table VPN-2-4 L2TP attribute table

Attribute value	Name	Meaning
100	Tunnel-Type	Tunnel type (L2TP=1).
101	L2TP-Tunnel-Password	L2TP tunnel password.
102	Local-Name	Local name of the channel.
103	LNS-IP-Address	IP address of LNS.
104	Tunnel-Medium-Type	Medium type of the tunnel (IP=1).
105	Vpdn Group Number	VPDN group number.

IV. Set the connection request to originate L2TP channel.

After dial-in users pass the authentication of VPN users, LAC is in charge of originating the channel establishment request to LNS and set the corresponding IP addresses of LNS side.

In addition to specifying IP addresses of LNS side, LAC side provides three user authentication modes: according to "*user-name"*, the specific "*domain-name"* and the "*dialed-number"*.

At most five LNS IP addresses can be set, which can be searched according to the sequence of the configured IP addresses of users.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-5 Set connection request to originate L2TP channel

Operation	Command
Configure the connection request to originate the channel.	**request dialin l2tp ip** *ip-address* [**ip** *ip-address ...*] { **domain** *domain-name* | **fullusername** *user-name* }
Cancel the connection request to originate the channel.	**no request dialin l2tp** [**ip** *ip-address*]

By default, the channel connection request is originated according to the full "*user-name*".

2.2.3 Configuring at LNS Side

I. Enable/disable VPDN

Perform the following task in global configuration mode.

Table VPN-2-6 Enable/disable VPDN

Operation	Command
Enable VPDN to run.	**vpdn enable**
Disable VPDN to run.	**no vpdn enable**

Disable VPDN running by default.

II. Create VPDN group

LAC and LNS can establish L2TP tunnel only on specific VPDN group.

Perform the following task in global configuration mode.

Table VPN-2-7 Create VPDN group

Operation	Command
Create VPDN group.	**vpdn group** *group-number*
Delete VPDN group.	**no vpdn group** *group-number*

No VPDN group is created by default. The value of *"group-number"* may be an integer between 1 and 3000.

III. Create/delete virtual interface template

Virtual template is mainly used to configure operational parameters of dynamically creating virtual interface in router operation.

Perform the following task in global configuration mode.

Table VPN2-8 Create/delete virtual interface template

Operation	Command
Create virtual interface template.	**interface virtual-template** *virtual-template-number*
Delete virtual interface template.	**no interface virtual-template** *virtual-template-number*

By default, the value of *virtual-template-number"* is 1, which may be an integer between 1 and 25.

After creating virtual template, designate IP address of virtual template and encapsulate PPP protocol, then the virtual template can work. The users can select to configure authentication on virtual template interface as required.

IV. Set receiving the connection request to originate L2TP channel

After receiving the channel establishment request originated at LAC side, channel establishment depends on LAC name.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-9 Set to receive the connection request to originate L2TP channel

Operation	Command
Set to receive the connection request to originate L2TP channel.	**accept dialin l2tp virtual-template** *virtual-template-number* [**remote** *remote-name*]
Delete the connection request to originate L2TP channel.	**no accept dialin**

When VPDN group 1 is used, it is not necessary to specify channel opposite end name "*remote-name"*. If the opposite end name is designated in the configuration mode of VPDN group 1, VPDN 1 will not be the default VPDN group.

2.2.4 Optional configuration

I. Set local name of channel

After a channel is established, the users can respectively configure the local channel name at LAC side and LNS side.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-10 Set local name of channel

Operation	Command
Set local channel name.	**local name** *name*
Delete local channel name.	**no local name** *name*

By default, the host name "*hostname"* of the router acts as the local channel name.

II. Start channel authentication and set authentication password

Before creating a channel connection, the users can decide as required whether to start channel authentication.

There are the following three channel authentication modes:

- LAC authenticates LNS.
- LNS authenticates LAC.
- LAC and LNS authenticate each other.

It can be found that LAC or LNS can originate channel authentication request. However, if one side starts the channel authentication, the channel can be established only when the passwords on both ends of the channel are totally the same. If channel authentication is disabled on both ends of the channel, whether the channel authentication passwords are the same will be meaningless.

In order to ensure channel security, users are recommended not to disable channel authentication.

Perform the following task in the configuration mode of VPDN group.

VPN-2-11 Start channel authentication and set authentication password

Operation	Command
Start channel authentication	**l2tp tunnel authentication**
Disable channel authentication.	**no l2tp tunnel authentication**
Set the password of channel authentication.	**l2tp tunnel password** { *0* | *7* } *password*
Cancel the password of channel authentication.	**no l2tp tunnel password**

Start channel authentication by default. If no channel authentication password is configured, the "*hostname"* of the router will act as channel authentication password.

III. Force local end to perform CHAP authentication

In some cases (e.g. consider the security at LNS side), after LAC performs agent authentication on the users, LNS can authenticate the users again. Here, the users will be authenticated twice. The first authentication is at LAC side and the second one at

LNS side. Only after passing the two authentications can the channel be established. Only when configured at LNS side will it be valid to force local end to perform CHAP authentication.

If CHAP authentication is forced to perform at LNS side, user name, password and user authentication need to be set in advance at LNS side and AAA must be started, before local end can be forced to perform CHAP authentication.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-12 Force local end to perform CHAP authentication

Operation	Command
Force local end to perform CHAP authentication.	**force-local-chap**
Cancel the operation that local end performs CHAP authentication.	**no force-local-chap**

Local end does not perform CHAP authentication by default.

IV. LNS forces LCP to renegotiate

For NAS-Initialized VPN service request, at the beginning of PPP session, the users first perform PPP negotiation with NAS. If negotiation succeeds, NAS initiated channel will be connected and the user information will be transmitted to LNS that decides the legality based on the received agent authentication information.

But in some specific cases (e.g. when it is necessary to authenticate and charge at LNS), the command "**lcp renegotiation**" can be used to force LNS to perform LCP negotiation with users again, neglecting agent authentication information at NAS side. Only when configured at LNS side, can it be valid to force LCP to renegotiate.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-13 Force LCP to renegotiate

Operation	Command
Force LCP to renegotiate.	**lcp renegotiation**
Disable LCP to renegotiate.	**no lcp renegotiation**

LCP does not renegotiate by default.

V. Set domain name delimiter and search sequence

In the case of a lot of L2TP access users, it will waste time to search users in sequence. Here, set the necessary search tactics (e.g. prefix and suffix delimiters) to speed up the search.

The delimiter includes prefix delimiter and suffix delimiter. The delimiter includes four special characters: @, # , & and /. The example of the user with prefix delimiter is "**huawei.com**# vpdnuser" and the example of the user with suffix delimiter is "vpdnuser@**huawei.com".** In the search, separate user name from prefix/suffix delimiter. The search based on defined rules will greatly speed up search sequence.

After setting prefix/suffix delimiter, four search orders are optional:

- "dnisdomain" (First search according to called number, then according to domain name)

- "dnisonly" (Search only according to called number)
- "domaindnis" (First search according to domain name, then according to called number)
- "domainonly" (Search only according to domain name)

Perform the following task in global configuration mode.

Table VPN-2-14 Set domain name delimiter and search sequence

Operation	Command
Set prefix delimiter	**Vpdn domain-delimiter prefix** *prefix-delimiters*
Cancel the set prefix delimiter	**no vpdn domain-delimiter prefix**
Set suffix delimiter	**vpdn domain-delimiter suffix** *suffix-delimiters*
Cancel the set suffix delimiter	**no vpdn domain-delimiter suffix**
Set search order	**vpdn search-order** { **dnisdomain** | **dnisonly** | **domaindnis** | **domainonly** }
Recover the default search order	**no vpdn search-order**

By default, first search according to called number, then according of domain name.

VI. Set the size of receiving window of channel flow control.

L2TP has simple flow control function. The users can designate the size of channel receiving window to control the flow.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-15 Set the size of receiving window of channel flow control

Operation	Command
Set the size of receiving window of channel flow control.	**l2tp flow-control receive-window** *size*
Disable to use the function of receiving window of channel flow control.	**no l2tp flow-control receive-window**

By default, the size of receiving window of channel flow control is 0 (no flow control). The value of "*size*" ranges between 0 and 100.

VII. Enable/disable hiding AV pairs

L2TP enables hiding AV pairs. The feature is very useful when PAP or agent authentication is used between LAC and LNS. When AV pairs are hidden, L2TP hiding algorithm will be executed so that AV pairs can encrypt user name and password transmitted in clear text during agent certification.

Perform the following task in the configuration mode of VPDN group.

Table VPN-2-16 Enable/disable hiding AV pairs

Operation	Command
Enable hiding AV pairs	**l2tp hidden**
Disable showing AV pairs	**no l2tp hidden**

Disable hiding AV pairs by default.

VIII. Force to disconnect tunnel

When the user number is 0, or faults occur to the network, or operators take the initiative to require disconnecting the channel, the tunnel will be cleared. LAC or LNS can originate the request to clear the tunnel. The end receiving the request to clear should transmit acknowledgement information (ACK) and wait for some time before clearing the tunnel so that the request transmitted again from opposite end can be properly received when ACK is lost. After forced channel disconnection, all control connections and session connections on the channel will also be cleared.

After channel disconnection, when new users dial in, the channel can be established again. Perform the following task in privileged user mode.

Table VPN-2-17 Force to disconnect channel

Operation	Command
Forced to disconnect channel	**clear vpdn tunnel l2tp** *remote-name*

2.3 Monitoring and Maintenance of L2TP

Perform the following task in privileged user mode.

Table VPN-2-18 Monitoring and maintenance of L2TP

Operation	Command
Show the current L2TP channel information.	**show l2tp tunnel**
Show the current L2TP session information.	**show l2tp session**
Open all L2TP debug information switches.	**debug l2tp all**
Open the debug switch of message control.	**debug l2tp control**
Open the debug switch of PPP message content.	**debug l2tp dump**
Open the debug switch of L2TP error information.	**debug l2tp error**
Open the event debug information switch of L2TP.	**debug l2tp event**
Open the debug information switch of hidden AVP.	**debug l2tp hidden**
Open the data message debug switch of L2TP.	**debug l2tp payload**
Open the debug switch of L2TP receiving message content.	**debug l2tp raw-dump**
Open the information debug switch of L2TP time stamp.	**debug l2tp time-stamp**

1) Show the current L2TP channel information.

```
Quidway# show l2tp tunnel
LocID  RemID  Remote Name      Remote Address  Port  Sessions
1      8      AS8010           172.168.10.2    1701  1
Total tunnels = 1
```

Table VPN-2-19 Description of "show l2tp tunnel" command domain

Domain name	Meaning
Total tunnels	Tunnel number
LocID	The unique value of local end to identify a channel.
RemID	The unique value of opposite end to identify a channel.
Remote Name	The name of opposite end.
Remote Address	IP address of opposite end.
Port	Port number of opposite end.
Sessions	Sessions number on the tunnel.

2) Show the current L2TP session information.

Quidway# show l2tp session

LocID RemID TunID

1 1 2

Total session = 1

Table VPN-2-20 Description of "show l2tp session" command domain

Domain name	Meaning
Total sessions	The sum of sessions.
LocID	The unique value of local end to identify a session.
RemID	The unique value of opposite end to identify a session.
TunID	Identification number of the channel.

2.4 Typical Configuration of L2TP

2.4.1 NAS-Initialized VPN

I. Networking requirement

The users can access Intranet of the company through local dial-up access to the Internet. The tunnel is used to transmit data between NAS and LNS and authenticate the channel.

II. Networking diagram

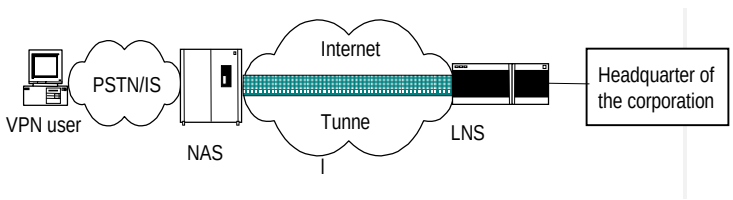


Figure VPN-2-4 Networking diagram of NAS-Initialized VPN

III. Configuration procedure

1) Configuration at user side:

Set user name to “vpnuser”, password to “hello” (the user name and password have been registered in NAS or company) and dial-in number to”170” at the dial-up terminal.

2) Configuration at NAS side (Quidway A8010 NAS in the case serves as the equipment at LAC side):

- The dial-in number is usually configured as “170” on A8010.
- On RADIUS access server, set a VPN user with user name “vpnuser” and password “hello”, and set IP address of the corresponding equipment at LNS side (In the case, IP address of the port where LNS side and the channel are connected is 202.38.160.2).
- Define the name of the equipment of local end as A8010 and authenticate the channel. The channel password is “quidway”.

3) Router configuration (at LNS side)

```
! Set a VPDN group and configure relative attributes

Quidway(config)# vpdn enable

Quidway(config)# vpdn-group 1

Quidway(config-vpdn1)# local name LNS

Quidway(config-vpdn1)# accept dialin l2tp virtual-template 1 remote A8010

! Set user name and password (consistent with the setting on A8010).

Quidway(config)# user vpnuser password 0 hello

! Start channel authentication and set channel authentication password.

Quidway(config-vpdn2)# l2tp tunnel authentication

Quidway(config-vpdn2)# l2tp tunnel password  0  quidway

! Define an address pool to distribute addresses to dial-in users.

Quidway(config)# ip local poo1 1 192.168.0.2 192.168.0.100

! Configure Virtual-Template 1.

Quidway(config)# interface virtual-template 1

Quidway(config-if-virtual-template1)# ip address 192.168.0.1 255.255.255.0

Quidway(config-if-virtual-template1)# ppp authentication chap

Quidway(config-if-virtual-template1)# peer default ip address pool 1

! Adopt AAA authentication.

Quidway(config)# aaa-enable

Quidway(config)# aaa authentication ppp default local
```

2.4.2 Client-Initialized VPN

I. Networking requirement

VPN users first connect Internet, then originate tunnel connection request to LNS. After LNS has accepted the request, a tunnel channel is established between LNS and VPN users to fulfill data transmission between the users and the company headquarters.

II. Networking diagram

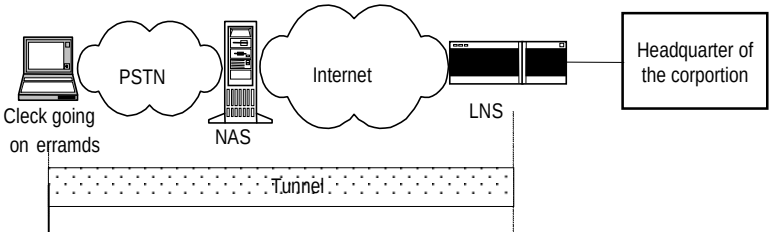


Figure VPN-2-5 Networking diagram of Client-Initialized VPN

III. Configuration procedure

1) Configuration at user side
- Set user name to “vpnuser” and password to “hello” at dial-up terminal (the user name and password have been registered in company).
- Set IP address of LNS to Internet interface address of the router (In the case, IP address of the port where LNS side and the channel are connected is 202.38.160.2).
- Modify connection attributes, set the adopted protocol to L2TP and encryption attribute to be self-defining. And select CHAP authentication to authenticate the channel whose password is “quidway”.

2) Router configuration (at LNS side)

! Set a VPDN group and configure relative attributes

Quidway (config)# vpdn enable

Quidway (config)# vpdn-group 1

Quidway (config-vpdn1)# local name LNS

Quidway (config-vpdn1)# force-local-chap

Quidway (config-vpdn1)# accept dialin l2tp virtual-template 1 remote vpdnuser

! Set user name and password (consistent with the setting on A8010).

Quidway (config)# user vpnuser password 0 hello

! Start channel authentication and set channel authentication password.

Quidway (config-vpdn1)# l2tp tunnel authentication

Quidway (config-vpdn1)# l2tp tunnel password 0 quidway

! Define an address pool to distribute addresses to dial-in users.

Quidway (config)# ip local poo1 1 192.168.0.2 192.168.0.100

! Configure Virtual-Template 1.

Quidway (config)# interface virtual-template 1

Quidway (config-if-virtual-template1)# ip address 192.168.0.1 255.255.255.0

Quidway (config-if-virtual-template1)# ppp authentication chap

Quidway (config-if-virtual-template1)# peer default ip address pool 1

! Adopt AAA authentication.

Quidway (config)# aaa-enable

Quidway (config)# aaa authentication ppp default local

2.4.3 Single User Interconnects Headquarters via Router

I. Networking requirement

A user needs to communicate with headquarters, but the network address of headquarters is a private address, e.g. 10.8.0.0 network, so the user can not directly access internal server via Internet. With VPN, the user can access the data of internal network.

II. Networking diagram

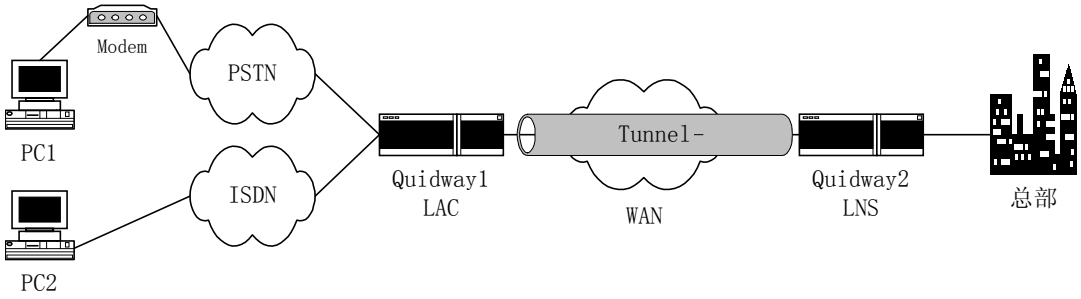


Figure VPN-2-6 Networking diagram of single user interconnecting headquarters

III. Configuration procedure

1) Configuration at user side

Set user name to "vpnuser@huawei.com" and password to "hello" at dial-in terminal (the user name and password have been registered in LAC or company).

Establish a dial-up network with access number "Quidway1", which receives the addresses distributed by server. After dial-up window appears, input user name "vpnuser@huawei.com" and the password "hello".

2) The configuration of the router Quidway1 (at LAC side) (In the case, IP address of the port where LNS side and the channel are connected is 202.38.160.2):

! Set a VPDN group and configure relative attributes

Quidway(config)# vpdn enable

Quidway(config)# vpdn-group 1

Quidway(config-vpdn1)# local name LAC

Quidway(config-vpdn1)# request dialin l2tp ip 202.38.160.2 domain huawei.com

Quidway(config-vpdn1)# ppp authentication pap

! Set user name and password.

Quidway(config)# user vpnuser password 0 hello

! Start channel authentication and set channel authentication password.

Quidway(config-vpdn1)# l2tp tunnel authentication

Quidway(config-vpdn1)# l2tp tunnel password 0 quidway

! Set the suffix delimiter of a domain name to '@'.

Quidway(config)# vpdn domain-delimiter suffix @

! Search sequence: first search according to domain name, then according to called number.

Quidway(config)# vpdn search-order domaindnis

! Adopt AAA authentication.

Quidway(config)# aaa-enable

Quidway(config)# aaa authentication ppp default local

3) The configuration of the router Quidway2 (at LNS side)

! Set a VPDN group and configure relative attributes

Quidway(config)# vpdn enable

Quidway(config)# vpdn-group 1

Quidway(config-vpdn1)# local name LNS

Quidway(config-vpdn1)# force local chap

Quidway(config-vpdn1)# accept dialin l2tp virtual-template 1 remote LAC

! Set user name and password (consistent with the user name and password at LAC side).

Quidway(config)# user vpnuser@huawei.com password 0 hello

! Start channel authentication and set channel authentication password to “quidway”.

Quidway(config-vpdn1)# l2tp tunnel authentication

Quidway(config-vpdn1)# l2tp tunnel password 0 quidway

! Force local end to perform CHAP authentication

Quidway(config-vpdn1)# force-local-chap

! Set an address pool 1 and the address ranges between 192.168.0.2 and 192.168.0.100.

Quidway(config)# ip local poo1 1 192.168.0.2 192.168.0.100

! Configure Virtual-Template 1.

```
Quidway(config)# interface virtual-template 1

Quidway(config-if-virtual-template1)# ip address 192.168.0.1 255.255.255.0

Quidway(config-if-virtual-template1)# ppp authentication chap

Quidway(config-if-virtual-template1)# peer default ip address pool 1

! Start AAA authentication.

Quidway(config)# aaa-enable

Quidway(config)# aaa authentication ppp default local
```

2.5 Fault Diagnosis of L2TP

Before debugging VPN, please confirm that LAC and LNS are on public network. The connectivity between them can be tested with “ping”.

Fault 1: The users fail to log in.

Troubleshooting: Failure reasons are as follows:

1) Fail to establish the tunnel. The reasons are as follows:
- At LAC side, LNS addresses are improperly set.
- LNS (usually the router) end is not set to receive VPDN group of opposite end of the channel. For details, view the description of “accept dialin” command.
- Tunnel authentication does not pass. If the authentication is configured, make sure that channel passwords of both sides are consistent.
- If local end forcedly disconnects the connection and opposite end fails to receive the corresponding “Disconnect” message due to network transmission error, an immediately originated tunnel connection will fail. The reason is that both sides cannot detect the disconnected link within certain time, and the tunnel connections originated by two opposite ends with the same IP addresses are not allowed.

2) PPP negotiation does not pass. The reasons may be:
- Errors occur to user name and password set at LAC end, or the corresponding users are not set at LNS end.
- LNS end can not distribute addresses, e.g. the address pool is set to small, or no address pool is set.
- The types of channel password authentication are inconsistent. The default authentication type of VPN connection created by Windows 2000 is MSCHAP. If opposite end does not support MSCHAP, CHAP is recommended.

Fault 2: Fail to transmit data. After the connection is established, no data can be transmitted, e.g. cannot ping through opposite end.

Troubleshooting: Possible reasons are as follows:

- The address set by LAC is wrong: Generally, LNS distributes addresses, but LAC can also designate its own address. If the designated address and the address to be distributed by LNS are not in the same network segment, this problem will occur. It is recommended that LNS distribute the addresses.
- Network congestion: Congestion occurs to Internet backbone network and packets are often lost. L2TP transmission is based on UDP (User Datagram Protocol). UDP does not control message errors. If L2TP is adopted when line quality is unstable, “Ping” opposite end may fail.

Chapter 3 Configuration of GRE

3.1 Brief Introduction to GRE Protocol

I. Brief introduction to the protocol

GRE (Generic Routing Encapsulation) protocol can encapsulate the datagram of some network layer protocols (e.g. IP and IPX) and enable these encapsulated datagrams to transmit in another network layer protocol (e.g. IP). GRE is the layer 3 tunnel protocol of VPN (Virtual Private Network), that is, a technique called as Tunnel is adopted between protocol layers. The tunnel is a virtual point-to-point connection and can be regarded as virtual interface only supporting point-to-point connection in actual situation. The interface provides a channel where the encapsulated datagram can be transmitted. And it can also encapsulate and de-encapsulate the datagram at both ends of a tunnel.

It's necessary to encapsulate and de-encapsulate it when a message is transmitted on the tunnel.

1) Encapsulation

As shown in figure VPN-3-6, after receiving IPX datagram, the interface connecting “Novell group1” first delivers it to be processed by IPX protocol which checks the destination address domain in IPX header and determines how to route the packet. If it is found that the destination address of the message will route through the network with network number 1f (virtual network number of the tunnel), the message will be transmitted to the tunnel port with network number 1f. After receiving the packet, tunnel port will perform GRE and then, the packet will be processed by IP module. After IP header is encapsulated, the packet will be processed by the corresponding network interface according to destination address and router table.

2) De-encapsulation

The de-encapsulation is opposite to the encapsulation. When an IP message is received at Tunnel interface, its destination address is checked and the destination is found to be this router, then the IP header will be removed and processed by GRE protocol (examine the key, check sum or message serial number). Then after GRE header is removed, it will be processed by IPX protocol in the same way as processing an ordinary datagram.

The system receives a datagram to be encapsulated and routed, which is called a payload. The payload is first encapsulated in the form of GRE to become a GRE message. Then it is encapsulated in IP message. Thus the IP layer is in full charge of forwarding the message. The IP protocol which is in charge of the forwarded is often called delivery protocol or transport protocol.

The form of an encapsulated message is shown in the following figure:

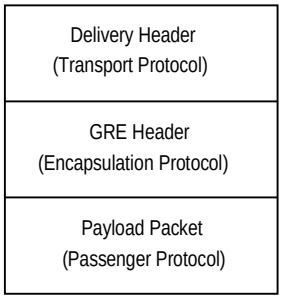


Figure VPN-3-1 Encapsulated tunnel message format

For example: The format of IPX transmission message encapsulated in IP Tunnel is as follows:

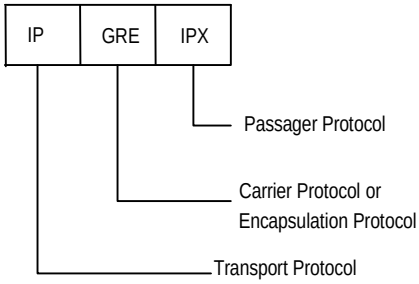


Figure VPN-3-2 Format of transmission message in the tunnel.

II. Applicable range

GRE can fulfill the following several services:

1) Multi-protocol local network transmits via single-protocol backbone network.

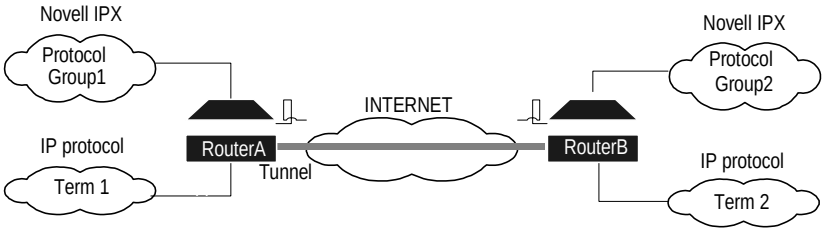


Figure VPN-3-3 Multi-protocol local network transmits via single-protocol backbone network

In the above figure, Group1 and Group2 are the local networks running Novell IPX protocol. Term1 and Term2 is the local network running IP protocol. The tunnel encapsulated with GRE protocol is adopted between Router A and Router B. Thus Group1and Group2 can communicate without affecting each other, so are Term1 and Term2.

2) Enlarge the operating range of the hop-limited network (e.g. IPX).

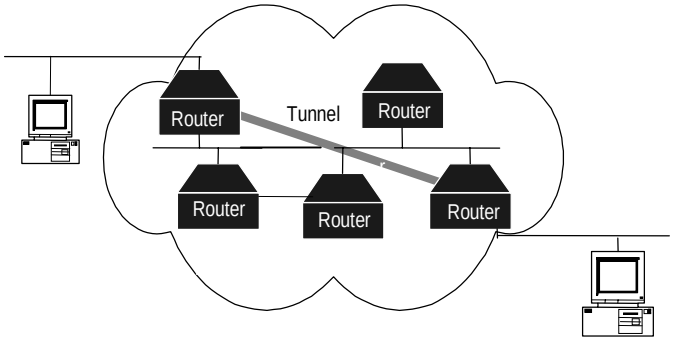


Figure VPN-3-4 Enlarge network operating range

When using RIP, if the hop count between two terminals in the above figure is more than 15, the two terminals can not communicate with each other. When the tunnel is used in the network, a part of hops can be hidden, enlarging the operating range of the network.

3) Connect some discontinuous sub-networks to establish VPN.

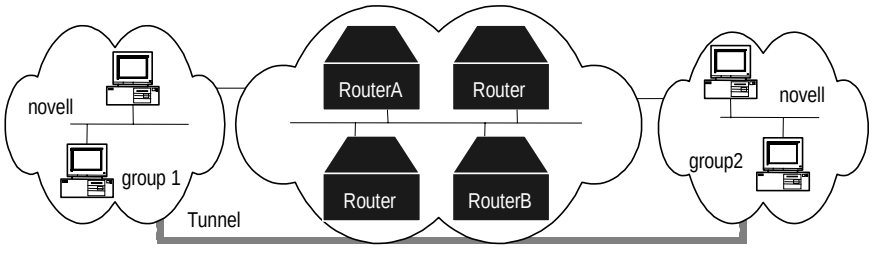


Figure VPN-3-5 Tunnel connects discontinuous sub-networks

The two sub-networks group1 and group2 running Novell IPX protocol are in different cities. With the tunnel available, the trans-WAN Virtual Private Network can be established.

In addition, GRE also supports the users to select and record identification key word of tunnel interface, supports the check of encapsulated message, and supports the use of synchronous serial numbers to ensure channel safety and correctness of transmission data.

Because of encapsulation and de-encapsulation on GRE receiving side and transmitting side and data volume increase caused by encapsulation, GRE will decrease the forwarding rate of router data to some extent.

3.2 Configuring GRE

3.2.1 GRE Configuration Task List

GRE configuration task list is as follows:

- Create virtual tunnel interface.
- Set the source address of tunnel interface.
- Set the destination address of tunnel interface.
- Set the network address of tunnel interface.

- Set the encapsulation mode of tunnel interface message.
- Set the key of tunnel interface.
- Set tunnel interface to check with check sum.
- Set tunnel interface to synchronize datagram serial numbers.

3.2.2 Creating Virtual Tunnel Interface

Perform the following task in global configuration mode.

Table VPN-3-1 Create virtual tunnel interface

Operation	Command
Create virtual tunnel interface and enter tunnel configuration mode.	**interface tunnel** *number*
Cancel virtual tunnel interface.	**no interface tunnel**

By default, no virtual tunnel interface is created. The value of "*number*" is an integer between 0 and 4294967295. But tunnel number actually depends on interface sum and memory status.

3.2.3 Setting the Source Address of Tunnel Interface

After tunnel interface is established, the source address of tunnel channel should be designated. The source address and destination address of tunnel interface uniquely identifies a channel.

Perform the following setting in tunnel interface configuration mode.

Table VPN-3-2 Designate the source address of tunnel interface

Operation	Command
Designate the source address of tunnel interface.	**tunnel source** *ip-address*
Cancel the source address of tunnel interface.	**no tunnel source**

3.2.4 Setting the Destination Address of Tunnel Interface

After tunnel interface is established, the destination address of tunnel channel should be designated. The source address and destination address of tunnel interface uniquely identifies a channel.

Perform the following setting in tunnel interface configuration mode.

Table VPN-3-3 Designate the destination address of tunnel interface

Operation	Command
Designate the destination address of tunnel interface.	**tunnel destination** *ip-address*
Cancel the destination address of tunnel interface.	**no tunnel destination**

3.2.5 Setting the Network Address of Tunnel Interface

Configure network address of tunnel interface so that the channel supports dynamic routing protocol. The users are recommended to set the network addresses at both ends of the channel to be in the same network segment.

Perform the following setting in tunnel interface configuration mode.

Table VPN-3-4 Set the network address of tunnel interface

Operation	Command
Set the IP address of tunnel interface.	**ip address** *ip-address mask*
Delete the IP address of tunnel interface.	**no ip address**
Set the IPX address of tunnel interface.	**ipx network** *network-number*
Delete the IPX address of tunnel interface.	**no ipx network**

3.2.6 Setting the Encapsulation Mode of Tunnel Interface Message

Please configure in tunnel interface configuration mode as below.

Table VPN-3-5 Set the encapsulation mode of tunnel interface message

Operation	Command
Set the encapsulation mode of tunnel interface message.	**tunnel mode gre ip**

The encapsulation mode of tunnel interface message is GRE IP by default.

3.2.7 Setting the Identification Key Word of Tunnel Interface

It is stipulated in RFC 1701 that: if the KEY field of GRE header is set, the receiving side and transmitting side will check the identification key word of the channel. Only when the set identification key words at both ends of the tunnel are totally identical, can the check pass, or the message will be discarded.

Perform the configuration in tunnel interface configuration mode.

Table VPN-3-6 Set the identification key word of tunnel interface

Operation	Command
Set the identification key word of tunnel interface.	**tunnel key** *key-number*
Cancel the identification key word of tunnel interface.	**no tunnel key**

By default, the tunnel does not use KEY, an integer ranging 0 to 4294967295.

3.2.8 Setting Tunnel Interface to Check with Check Sum

It is stipulated in RFC 1701 that: if the “Checksum” place of GRE header is set, the check sum is valid. The transmitting side calculates the check sums of GRE header and payload. The receiving side calculates the check sum of the received message and

compares it with the check sum in the message. If the two check sums are identical, the message will be further processed, or it will be discarded.

If only one end of the tunnel is configured to check with the check sum, the message will not be checked with check sum. Only when both ends of the tunnel are configured to check with the check sum, can the message be checked with the check sum.

Perform the following task in tunnel interface configuration mode.

Table VPN-3-7 Set tunnel interface to check with check sum

Operation	Command
Set tunnel interface to check with check sum.	**tunnel checksum**
Disable tunnel interface to check with check sum.	**no tunnel checksum**

Disable tunnel interface to check with check sum by default.

3.2.9 Setting Tunnel Interface to Synchronize Datagram Serial Number

It is stipulated in RFC 1701 that: if “sequence-datagram” in GRE header is set, both receiving side and transmitting side will synchronize serial numbers. The synchronized message should be further processed, or it is discarded.

With the serial numbers, the message is unreliable but in order. The receiving end establishes serial numbers for the message which is received by local end and successfully de-encapsulated (The serial numbers are integers between 0 and 2^{32}–1 and the serial number of the first packet is 0). After the channel is established, the serial numbers will be accumulated and cyclically counted. If the receiving end receives a message whose serial number is less than or equal to that of the message received last time, the packet will be considered as illegal. If the receiving end receives an orderless message, the packet will be automatically discarded.

Only when the synchronization mechanism to set/disable serial numbers is established at both ends of the tunnel, can the channel be established.

Perform the following task in tunnel interface configuration mode.

Table VPN-3-8 Set the tunnel to synchronize datagram serial numbers

Operation	Command
Set tunnel interface to synchronize serial numbers.	**tunnel sequence-datagrams**
Disable tunnel interface to synchronize serial numbers.	**no tunnel sequence-datagrams**

Disable tunnel interface to synchronize datagram serial numbers by default.

3.3 Monitoring and Maintenance of GRE

Perform the following task in privileged user mode.

Table VPN-3-9 Monitoring and maintenance of GRE

Operation	Command
Show the working status of tunnel interface.	**show interface tunnel** [*tunnel-number*]

1) Show the status of designated tunnel interface.

Quidway# show interface tunnel 1

```
Tunnel1 is up, line protocol is up
  Internet address is 3.1.1.1  255.255.255.0
  10 packets input, 640 bytes
  0 input errors, 0 broadcast, 0 drops
  10 packets output, 640 bytes
  0 output errors, 0 broadcast, 0 no protocol
```

The above information means that: The network address of “Tunnel1” is 3.1.1.1. 0 message is received. The number of received error message and broadcast message is 0. There is no discarded message. The number of transmitted messages is 0. There is no the message with error output, the broadcast message and the message with unknown protocol type

2) Show router table of the system.

Quidway(config)# show ip route

```
Routing Tables:
Destination/Mask Proto  Pref   Metric  Nexthop     Interface
3.1.1.0/24       Direct  0       0     3.1.1.1      Tunnel1
10.10.1.0/24     Direct  0       0     10.10.1.3    Serial0
10.10.1.3/32     Direct  0       0     10.10.1.3    Serial0
10.110.1.0/24    Direct  0       0     10.110.1.100 Ethernet0
20.20.1.0/24     Static  60      0     10.10.1.3    Serial0
20.110.1.0/24    Static  60      0     3.1.1.2      Tunnel1
```

The above information shows that the router table of the system includes the route of the interface **Tunnel1.**

3.4 Typical Configuration of GRE

I. Networking requirement

VPN should be built across WAN for the operation of Novell IPX’s two subnets group1 and group2. It can be implemented by using GRE.

II. Networking diagram

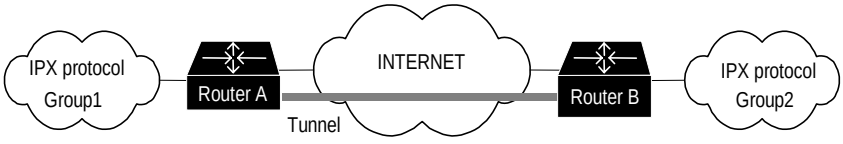


Figure VPN-3-6 Networking diagram of GRE application

III. Configuration procedure

Configure router A:

! Activate IPX.

RouterA(config)# ipx routing a.a.a

! Configure interface “Ethernet0”.

RouterA(config)# interface ethernet 0

RouterA(config-if-Ethernet0)# ip address 10.1.1.1 255.255.255.0

RouterA(config-if-Ethernet0)# ipx network 1e

! Enter tunnel source interface.

RouterA(config)# interface serial 0

RouterA(config-if-Serial0)# ip address 192.13.2.1 255.255.255.0

! Create virtual tunnel interface and configure tunnel interface

RouterA(config)# interface tunnel 0

RouterA(config-if-tunnel0)# ip address 10.1.2.1 255.255.255.0

RouterA(config-if-tunnel0)# ipx network 1f

! Designate that tunnel working mode is GRE and transmission protocol is IP.

RouterA(config-if-tunnel0)# tunnel mode gre ip

! Configure the source address of tunnel interface (It should be IP address of Serial0 of RouterA).

RouterA(config-if-tunnel0)# tunnel source 192.13.2.1

! Configure the opposite end IP address of tunnel interface (It should be IP address of Serial0 of RouterB).

RouterA(config-if-tunnel0)# tunnel destination 131.108.5.2

! Configure a static route to Group2.

RouterA(config)# ipx route 31 1f.a.a.a 30000 15

The configurations of Router B are as follows:

! Activate IPX.

RouterB(config)# ipx routing b.b.b

! Configure interface “Ethernet0”.

RouterB(config)# interface ethernet 0

RouterB(config-if-Ethernet0)# ip address 10.1.3.1 255.255.255.0

RouterB(config-if-Ethernet0)# ipx network 31

! Enter tunnel source interface.

RouterB(config)# interface serial 0

RouterB(config-if-Serial0)# ip address 131.108.5.2 255.255.255.0

! Create and enter “Tunnel0” interface configuration mode.

RouterB(config)# interface tunnel 0

RouterB(config-if-tunnel0)# ip address 10.1.2.2 255.255.255.0

RouterB(config-if-tunnel0)# ipx network 1f

! Designate that tunnel working mode is GRE and transmission protocol is IP.

RouterB(config-if-tunnel0)# tunnel mode gre ip

! Configure the source address of Tunnel0 interface (It should be IP address of Serial0 of RouterB).

RouterB(config-if-tunnel0)# tunnel source 131.108.5.2

! Explain the opposite end address of Tunnel0 interface (It should be IP address of Serial0 of RouterA).

RouterB(config-if-tunnel0)# tunnel destination 192.13.2.1

! Configure a static route to Group1.

RouterB(config)# ipx route 1e 1f.b.b.b 30000 15

3.5 Troubleshooting GRE

As GRE configuration is relatively simple, only the consistency of the configuration needs to be noted. Here, analyze a relative error, as shown in the following figure:

Fault 1: The interfaces at both ends of the tunnel are properly configured and both ends of the tunnel can be “pinged” through, but PC A and PC B can not be “pinged” through.

Troubleshooting: In this case, mainly check whether there is a route passing through tunnel interface. That is, at RouterA, a route to 10.2.0.0/16 passes through Tunnel0 interface; at RouterB, a route to 10.1.0.0/16 passes through Tunnel0 interface (fulfilled by adding static route).

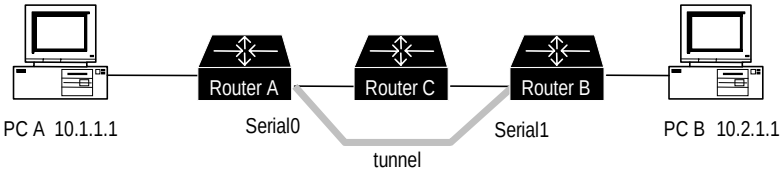


Figure VPN-3-7 Networking group of GRE troubleshooting example

HUAWEI®

VRP

User Manual – Configuration Guide

Volume 3

08 – Reliability Configuration (LC)

Table of Contents

Chapter 1 Configuration of Backup Center

1.1 Backup Center Overview

To enhance network's reliability, VRP provides perfect backup functions through the use of Backup Center.

- Interfaces that can be backed up are called main interfaces. Every physical interface or sub-interface on a router can serve as a main interface. A logical channel such as X.25 on any interface or a virtual circuit of a frame relay can also serve as a main interface.
- Any physical interface, virtual interface template, or a logical channel on an interface other than the Ethernet interface of a router can serve as the backup interface of aother interface or logical channel.
- A main interface can be provided with multiple backup interfaces; when the main interface gets faulty, backup interfaces can take over the main interface's work in an order based on their priority.
- Interfaces (such as ISDN BRI and ISDN PRI interfaces) that have multiple physical channels can provide backups to multiple main interfaces by using Dialer Map.

1.2 Configuring the Backup Center

1.2.1 Configuration Task List

Follow the steps below to configure VRP backup center.

- Enter the configuration mode of the main interface to be backed up.
- Specify the backup interface and priority used by the main interface.
- Set the delay time for the switchover between main and backup interfaces.
- Set state-judging conditions when the main interface is a logical channel.
- Set the state-judging conditions when the backup interface is a logical channel.
- Configure routes for main and backup interfaces.

1.2.2 Entering the Configuration Mode of the Main Interface to be Backed Up

On a Quidway router, not only every physical interface or sub-interfaces of the router, but every virtual circuit of X.25 or frame relay can work as a main interface. If the main interface is a physical interface or sub-interface, please use the following commands in global configuration mode to enter the configuration mode of the interface.

Table LC-1-1 Enter the configuration mode of the main interface

Operation	Command
Enter the configuration mode of the main interface	**interface** *interface-type interface-number*

Here, interface-type specifies the interface type of the physical interface or sub-interface, interface-number specifies the interface number of the physical interface or sub-interface. Combined, they specify a physical interface or sub-interface.

If the main interface is a virtual circuit, it should be treated differently depending on the type of the virtual circuit: firstly, specify its logical channel number in the configuration mode of the physical interface to which it's subordinate; then enter corresponding logical channel configuration mode. *logic-channel-number* ranges between 0 to 255.

Please use following commands in corresponding configuration modes.

Table LC-1-2 Enter the logical channel configuration mode

Operation	Command
Specify logical channel number for X.25 virtual circuit.	**x25 map** *protocol address x.121-address* **lin** *logic-channel-number* [**lin** *logic-channel-number ...*]
Specify logical channel number for frame relay virtual circuit	**frame-relay map** *protocol address dlci* **lin** *logic-channel-number* [**lin** *logic-channel-number ...*]
Enter corresponding logical channel configuration mode.	**logic-channel** *logic-channel-number*

1.2.3 Specifying Backup Interface and Priority Used by the Main Interface

Except Ethernet interface, any physical interface or virtual interface template, or a certain logical channel (including virtual circuit or Dialer Map) can work as a backup interface of the main interface. Please use the following commands in the configuration mode of the main interface backed up.

Table LC-1-3 Specify backup interface and priority used by the main interface

Operation	Command
Specify a physical interface or virtual interface template, except Ethernet interface, to back up the main interface; its priority can also be set here.	**backup interface** *interface-type interface-number* [*priority*]
Specify a logical channel to back up the main interface, its priority can also be set here.	**backup logic-channel** *logic-channel-number* [*priority*]

Here, interface-type interface-number specifies a physical interface or virtual interface template; the value range of logic-channel-number is 1~255; the value range of priority of the backup interface is 0~255, with 0 as default. The larger the value, the higher the priority, i.e., when the main interface gets faulty, its work will be first taken over by an interface with the highest priority.

If the main interface has multiple backup interfaces, simply repeat the above operations. In addition, if the backup interface is a logical channel, the logical channel should be made to correspond to the actual virtual circuit or Dialer Map.

Please use the commands below to specify corresponding logical channel numbers for these virtual circuits or Dialer Map in the configuration mode of the physical interface to which they are subordinate.

Table LC-1-4 Establish a corresponding relation between logical channel and virtual circuit or Dialer Map

Operation	Command
Specify a logical channel number for X.25 virtual circuit	**x25 map** *protocol address x.121-address* **lin** *logic-channel-number*
Specify a logical channel number for frame relay virtual circuit	**frame-relay map** *protocol address dlci* **lin** *logic-channel-number*
Specify a logical channel number for Dialer Map	**dialer map** *protocol next-hop-address dialer-string* **lin** *logic-channel-number*

1.2.4 Setting Delay Time for Switchover Between Main and Backup Interface

When the state of the main interface changes from up to down, the system doesn't switch to backup interface right away, but wait for a preset time delay instead. The system will switch to the backup interface only if the state of the main interface remains down after the delay time runs out; if the main interface recovers within the delay time, the system will not switch to the backup interface.

When the state of the main interface changes from down to up, the system doesn't switch to the main interface right away, but wait for a preset time delay instead. The system will switch back to the main interface only if the state of the main interface remains 'up' after the delay time runs out; if the main interface restores its down state again within the delay time, the system will not switch to the main interface

To run following commands normally, user should run those commands firstly, which specify a physical interface or virtual interface template, or a certain logical channel, except Ethernet interface, to backup main interface (**backup interface/logic-channel**).

Please use the following command in the configuration mode of the main interface backed up.

Table LC-1-5 Set the delay time for the switchover between main and backup interfaces

Operation	Command
Set the delay time for switchover between main and backup interfaces	**backup delay** *enable-delay disable-delay*
Restore to the default value of the delay time for switchover between main and the backup interfaces	**no backup delay**

Here, *enable-dela*y is the delay time for the main interface to switch over to backup interface, the value ranges from 0 to 65535 seconds, and the default value is 0, indicating an immediate switchover. *disable-delay* is the delay time for backup interface to switch over to the main interface, the value ranges from 0 to 65535 seconds, and the default value is 0, indicating an immediate switchover.

1.2.5 Setting State-Judging Conditions for Logic-Channel Main Interface

When the main interface is a logical channel, the logical channel is regarded as down after a specified number of unsuccessful calls. After it switches over to the backup interface, regular inspections at specified time interval must be made on the state of the logical channel to check if it's recovered its up state or not.

To run following commands normally, user should run those commands firstly, which specify a physical interface or virtual interface template, or a certain logical channel, except Ethernet interface, to backup main interface (**backup interface/logic-channel**).

Please use the following command in the configuration mode of the logical channel

Table LC-1-6 Set the state-judging conditions when the main interface is a logical channel

Operation	Command
Set the condition for judging the logical channel as down: the logical channel is regarded as down after the specified number of unsuccessful calls.	**backup state-down** *number*
After system switches to backup interface, interval-time is set to make regular inspections so as to check whether the original logical channel has recovered its "up" state.	**backup state-up** *interval-time*

By default, the number of call and state checking interval-time are not configured.

1.2.6 Setting State-Judging Conditions for Logic-Channel Backup Interface

If the main interface has multiple backup interfaces of which one is a logical channel, it's necessary to judge whether the logical channel is down or up before opening it. If it is down, open the hypo-higher priority backup interface in an order of priority; after the logical channel changes to up, it's required to switch from the hypo-higher priority backup interface of a low priority to this logical channel.

To run following commands normally, the command that specifies logical channel backup main interface (**backup logic-channel**) must be ran at first.

Please use the following commands in the configuration mode of the logical channel

Table LC-1-7 Set the state-judging conditions when the backup interface is a logical channel

Operation	Command
Set the condition for judging the backup logical channel as down: the backup logical channel is regarded as down after the specified number of unsuccessful calls.	**backup state-down** *number*
Interval-time is set to make regular inspections so as to check if the backup logical channel has restored to the up state or not.	**backup state-up** *interval-time*

By default, the number of call and state checking interval-time are not configured.

1.2.7 Configuring Routes for Main and Backup Interfaces

By using command **ip route** in the global configuration mode, it is possible to configure routes to the destination network segment through the main interface and all the backup interfaces. Please refer to relevant chapters of "Network Protocol Configuration" in this manual for details about the command **ip route**.

1.3 Monitoring and Maintaining of Backup Center

Table LC-1-8 monitoring and maintenance of backup center

Operation	Command
Turn on the backup debug	**debug backup** { **event** | **packet** }

1.4 Typical Configuration of Backup Center

1.4.1 An example of Backup Between Interfaces

I. Networking requirements

Take interface Serial 2 as the backup interface for interface Serial 1.

II. Configuration procedure

! Enter the configuration mode of Serial 1.

Quidway(config)# interface serial 1

! Set Serial 2 as its backup interface.

Quidway(config-if-Serial1)# backup interface serial 2

! Set the time for switchover between main and backup interfaces as 10 seconds.

Quidway(config-if-Serial1)# backup delay 10 10

1.4.2 An Example of Multiple Backup Interfaces

I. Networking requirements

Take both interfaces Serial 1 and Serial 2 as the backup interface of interface Serial 0, and use interface Serial 1 as a preference.

II. Configuration procedure

! Enter the configuration mode of Serial 0.

Quidway(config)# interface serial 0

! Set interfaces Serial 1 and Serial 2 as the backup interfaces, their priorities being 30 and 20 respectively.

Quidway(config-if-Serial0)# backup interface serial 1 30

Quidway(config-if-Serial0)# backup interface serial 2 20

1.4.3 An Example of Logical Channel Backup Interface

I. Configuration requirements

Set interface Serial 1 as the backup interface for an X.25 virtual circuit on interface Serial 0.

II. Configuration procedure

! Configure that interface Serial 0 encapsulates X.25 virtual circuit and specify its IP address and X.121 address.

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# encapsulation x25

Quidway(config-if-Serial0)# ip address 1.1.1.2 255.0.0.0

Quidway(config-if-Serial0)# x25 address 1

! Match an X.25 virtual circuit on interface Serial 0 with logical channel 10.

Quidway(config-if-Serial0)# x25 map ip 2.2.2.3 2 lin 10

! Enter the configuration mode of logical channel 10.

Quidway(config-if-Serial0)# logic-channel 10

! Specify interface Serial 1 as the backup interface of this logical channel.

Quidway(config-logic-channel10)# backup interface serial 1

! Set the time interval as 10 seconds for judging the logical channel as up.

Quidway(config-logic-channel10)# backup state-up 10

1.4.4 An Example of Multiple Backup Interfaces with a Logical Channel

I. Configuration requirements

Take both logical channel 3 on interface Serial 1 and interface Serial 2 as the backup interfaces of logical channel 5 on interface Serial 0.

II. Configuration procedure

! Configure that interface Serial 0 encapsulates X.25 virtual circuit and specify its IP address and X.121 address.

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# encapsulation x25

Quidway(config-if-Serial0)# ip address 1.1.1.2 255.0.0.0

Quidway(config-if-Serial0)# x25 address 1

! Match an X.25 virtual circuit on interface Serial 0 with logical channel 5.

Quidway(config-if-Serial0)# x25 map ip 2.2.2.3 2 lin 5

! Configure that interface Serial 1 encapsulates X.25 virtual circuit and specify its IP address and X.121 address.

Quidway(config-if-Serial0)# interface serial 1

Quidway(config-if-Serial1)# encapsulation x25

Quidway(config-if-Serial1)# ip address 3.3.3.4 255.0.0.0

Quidway(config-if-Serial1)# x25 address 3

! Match logical channel 3 with an X.25 virtual circuit on interface Serial 1.

Quidway(config-if-Serial1)# x25 map 4.4.4.5 4 lin 3

! Enter the configuration mode of logical channel 5 and set logical channel 3 and interface Serial 1 as its backup interfaces, their priorities being 50 and 20 respectively.

Quidway(config-if-Serial1)# logic-channel 5

Quidway(config-logic-channel5)# backup logic-channel 3 50

Quidway(config-logic-channel5)# backup interface serial 2 20

Chapter 2 Configuration of HSRP

2.1 HSRP Overview

HSRP (Hot Standby Router Protocol), is a reliability protocol based on hot standby mechanism. It aims, when using a router as the gateway, to enhance the connection reliability between the network and the outside through hot standby mechanism. It will be suffice to configure HSRP on a router, which does not affect the local host and there is no need to make configuration on the local host.

Put two or more routers into a hot standby group to implement HSRP: from the local host's point of view, this hot standby group is a virtual router itself, with its own IP address (a virtual IP address), and the local hosts use this virtual router as a gateway.

In the hot standby group, there is one active Router. It does the work of a virtual router such as forwarding the local host's data and messages to the virtual router. And there is a router in the standby state that is ready to switch over to the active state at any time when it is necessary. The other routers (if any) in the group are in a listen state. The state of non-active routers (standby or listen) are determined by their own priority, i.e., the router with the highest priority will be in standby state, which leaves the other routers to be in a listen state. If they have the same priority, then the one with a bigger Ethernet interface IP address will be in a standby state, leaving the rest ones to be in a listen state.

When fault occurs, a standby router will take over the work of the active router, and one of the rest routers (if any) with the highest priority will be selected as the standby router. Thus, the local host can keep using this virtual router gateway without any modifications.

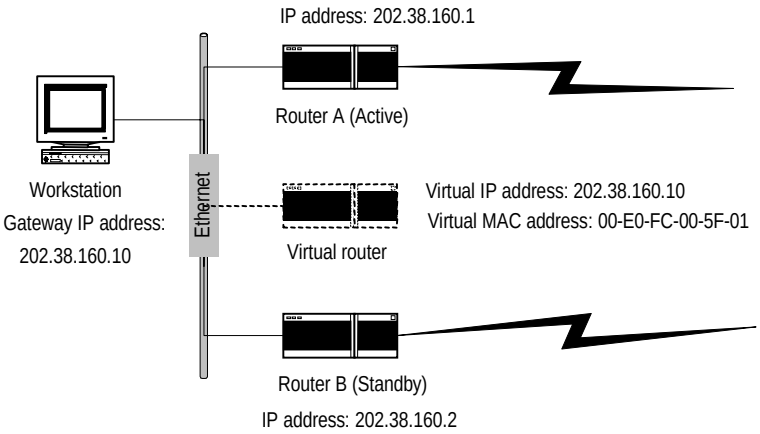


Figure LC-2-1 Schematic diagram of HSRP application

In this figure, Router A and Router B form a hot standby group, which has the following workflow:

A certain local host takes the IP address 202.38.160.10 of the hot standby group—virtual router as its own gateway address. Before transmitting messages through gateway, it sends out an ARP request in the hope of obtaining a virtual MAC address

corresponding to this IP address; and as Router A is active now, it will respond to this ARP request by informing the host that this MAC address is 00-E0-FC-00-5F-01.

In this way all the messages sent by the host to the gateway will use this MAC address as a destination MAC address. Router A will receive these messages, forward them, or process them in some other ways.

At the same time, Router A will send out Hello messages periodically to keep its state informed to Router B. If Router B doesn't receive the messages sent by Router A in the set time, it will conclude that Router A isn't usable anymore. Thus Router B changes to the active state and receives all the messages sent by the local host to virtual router gateways (i.e., to IP address 202.38.160.10 or MAC address 00-E0-FC-00-5F-01), forwards them, processes them in some other ways. And the local host can still use gateway as usual (i.e., use 202.38.160.10 as its own gateway IP address).

2.2 Configuring HSRP

2.2.1 Configuration Task List

HSRP protocol is designed to support multicast or broadcast LAN such as Ethernet. Therefore HSRP configuration is performed in the configuration mode of the Ethernet interface.

The HSRP configuration tasks of VRP include:

- Start HSRP function
- Set router's priority in HSRP Hot Standby group
- Set Router's preemption working mode in HSRP Hot Standby group
- Set HSRP authorization word
- Set HSRP timer
- Set to monitor the specified interface.
- Set to use the actual interface MAC address.
- Modify virtual MAC address

2.2.2 Starting HSRP Function

Start Ethernet interface's HSRP function in the router to add a Hot Standby group to a specified LAN segment. It is necessary to specify a Hot Standby group number and virtual IP address.

Please use the following commands in the configuration mode of Ethernet interface.

Table LC-2-1 Start HSRP function

Operation	Command
Start HSRP function	**Standby** [*group-number*] **ip** [*virtual-ip-address*]
Prohibit HSRP function	**No standby** [*group-number*] **ip** [*virtual-ip-address*]

Group-number is the number of the Standby group, with a value range of 0~255 and a default value of 0.virtual-ip-address is the virtual IP address. If the virtual IP address is not specified, the router will not participate in the backup process until it receives the virtual IP address from among the messages sent by an active router in the Hot Standby group. Note that the virtual-ip-address should be at the same network segment as the interface's IP address.

Note:

1) Please note that if some Ethernet interface configured with HSRP has its IP address changed, its HSRP will become disabled.
2) If a route is configured with several HSRP Hot Standby Group, then there can be at most one Hot Standby Group without specified virtual IP address.

2.2.3 Setting Router's Priority in HSRP Hot Standby Group

HSRP determines the state of every router in Hot Standby group according to their priority parameters, i.e., a router with both the highest priority and a virtual IP address will be an active router, leaving others in the standby or listen state.

Please use the following command in the Ethernet interface configuration mode.

Table LC-2-2 Set router's priority in HSRP Hot Standby group

Operation	Command
Set router's priority in HSRP Hot Standby group.	**standby** [*group-number*] **priority** [*priority-value*]

Priority-value is its priority, the larger the value, the higher the priority, and it has a value range of 0~255 and a default value of 100.

2.2.4 Setting Router's Preemption Mode in HSRP Standby Group

Once a Router in the Standby group becomes an active Router, as long as the active Router does not break down, other Routers will not become active even if they have a higher priority level later on, except that they are set in a preemption working mode. If a router is set in a preemption mode in an HSRP hot standby group, once it finds out that it has a higher priority than the present active router, it will 'preempt ' to become an active router. The previous active router will therefore exit its active state to become a 'standby' or 'listen' router.

Please use the following commands in Ethernet interface configuration mode.

Table LC-2-3 Set router's priority in HSRP hot standby group

Operation	Command
Set router's preemption working mode in HSRP hot standby group.	**standby** [*group-number*] **preempt**
Forbid router's preemption working mode in HSRP hot standby group.	**no standby** [*group-number*] **preempt**

By default it means no router is set in a preemption mode in any HSRP hot standby group.

2.2.5 Setting HSRP Authorization Word

HSRP authorization word is used to check other routers' validity in the same hot standby group.

Please use the following commands in the Ethernet interface configuration mode.

Table LC-2-4 Set HSRP authorization word

Operation	Command
Set HSRP authorization word	**standby** [*group-number*] **authentication** [*string*]

By default, the value of *group-number* is 0 and the authorization word *string* is "quidway". The length of the authorization word should not exceed 8 characters.

Note:

The same authorization word must be set in the same hot standby group.

2.2.6 Setting HSRP Timer

Routers in the same HSRP hot standby group check each other's state through hello-time packets sent among each other: if no hello-packet is received from a router during a hold-time, this router is then considered as being turned off or some fault has occurred. By setting HSRP timer hello-time and hold-time are adjusted for sending hello-packets.

Please use the following commands in the Ethernet interface configuration mode.

Table LC-2-5 Set HSRP timer

Operation	Command
Set HSRP timer	**standby** [*group-number*] **timers** [*hello-time*] [*hold-time*]

Both hello-time and hold-time have a value range of 1~255 and have second as their unit, their default values are 3 and 10 seconds respectively.

Note:

The same hello-time and hold-time must be set in the same hot standby group and hold-time must be longer than hold-time.

2.2.7 Monitoring the Specified Interface

The interface monitoring function of HSRP expands backup function satisfactorily: backups are available not only for a router when it goes wrong but for an interface of a router in case it's not usable. After the interface monitoring function is set, the router's priority will be adjusted dynamically according to the state of the interface that is under monitoring. Once the monitored interface becomes unavailable, the priority value of this router will be reduced, so that another router with a more stable interface state in the same backup group can become the active one, or preempt to be the active one.

Please use the following commands in the Ethernet interface configuration mode.

Table LC-2-6 Monitor the specified interface

Operation	Command
Monitor the specified interface	**standby** [*group-number*] **track** *interface-type interface-number* [*priority-reduced*]
Cancel the monitoring of the specified interface	**no standby** [*group-number*] **track** *interface-type interface-number* [*priority-reduced*]

This command is used to monitor the interface specified by interface-type interface-number, of which interface-type specifies the type of a physical interface or sub-interface, while interface-number specifies the number of a physical interface or sub-interface.

If the state of the interface turns unavailable, its priority will be reduced by a value specified by priority-reduced. The value range of priority-reduced is 1~255, with 10 as default.

2.2.8 Using Actual Interface MAC Address

When the host uses HSRP virtual router, it uses both virtual IP address and virtual MAC address of the HSRP virtual router. By default, each HSRP hot standby group takes the reserved special MAC address as virtual MAC address in order to guarantee that the hot standby group is transparent to the host. However, users can also set HSRP hot standby group to use actual MAC address (Burned in Address，BIA) of the active router.

Please use the following commands in the Ethernet interface configuration mode.

Table LC-2-7 Set to use the actual interface MAC address

Operation	Command
Use the actual MAC address.	**standby use-bia**
Use the virtual MAC address.	**No standby use-bia**

Note:

1. When BIA is used, the same Ethernet interface must not participate in multiple hot standby groups.
2. The use of BIA might lead to a change in the state of HSRP.

2.2.9 Modifying Virtual MAC Address

Virtual MAC addresses of HSRP hot standby group are different with different manufacturers. Virtual MAC addresses can be modified to achieve interworking with routers from different manufacturers.

Please use the following commands in the Ethernet interface configuration mode.

Table LC-2-8 Modify virtual MAC address

Operation	Command
Set to use other virtual MAC addresses.	**standby use-ovmac** [xx-xx-xx-xx-xx]
Reuse default virtual MAC address	**no standby use-ovmac**

xx-xx-xx-xx-xx indicates the first 5 bytes of other virtual MAC addresses, the last byte being the hot standby group's number. The setting is valid for all HSRP hot standby groups on the configured Ethernet interface.

2.3 Monitoring and Maintaining HSRP

After the configuration, the following commands can be used to turn on the debug switch of HSRP or display relevant information of HSRP so as to monitor and maintain HSRP.

Table LC-2-9 Monitoring and maintenance of HSRP

Operation	Command
Debug HSRP(in the mode of privileged users)	**debug standby**
Display relevant information of HSRP (in any configuration mode)	**show standby**

- Show relevant HSRP information

Quidway# show standby

```
Ethernet0 |Group Number : 1
             State        : Init
             Hot Standby IP   : 103.1.1.5
             Priority     : 100      Preempt : no
             Hold Time    : 10       Hello Time: 3
             Use Virtual Mac Address : 00-e0-fc-00-5f-01
```

The above information includes the standby group that the interface belongs to, state, virtual IP address, priority, preemption, hold-time, hello-time, and virtual MAC address.

Note:

As output of the debugging information affects router's running efficiency, please don't turn on the debug switch unless necessary; and please turn it off after debugging.

2.4 Typical Configurations of HSRP

2.4.1 An example for single hot standby group configuration

I. Networking requirements

As shown in the following diagram, hosts A and B take the hot standby group, which consists of Routers A and B, as its default gateway (i.e., specify virtual IP address 202.38.160.111 as its gateway IP address), and they access host C on Internet through this gateway. Normally, it is Router A that fulfils the tasks of the gateway as an active router, if Router A switches off or breaks down, Router B will take over its tasks.

Specific parameters of HSRP hot standby group: standby group number is 0, virtual IP address is 202.38.160.111. Router A is an active router with a priority of 120, and its HSRP is set as preemption so that it can go on with the gateway's task as an active router after it restores. Router B is a backup router, set as preempted without a priority (i.e., its priority has a default value of 100).

II. Networking diagram

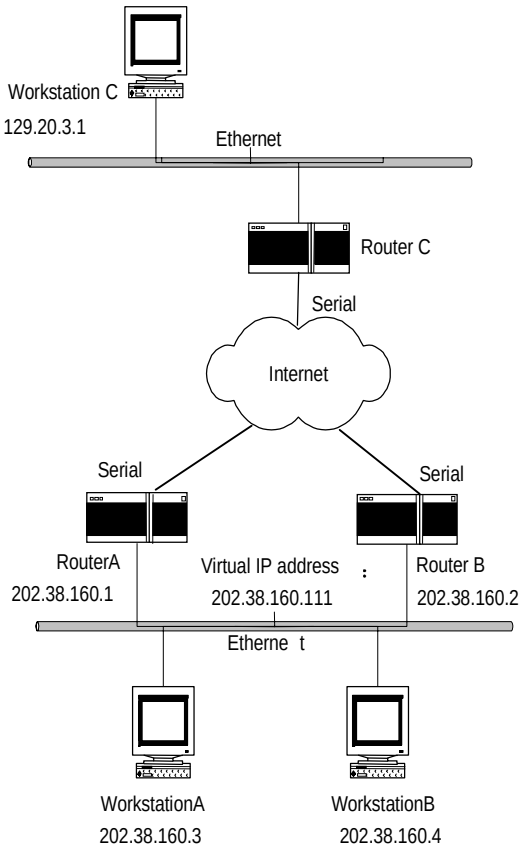


Figure LC-2-2 HSRP single hot standby group configuration—an application of HSRP

III. Configuration procedure

- Configure Router A:

! Start HSRP function and set its working virtual IP address as 202.38.160.111.

Quidway(config-if-Ethernet0)# standby ip 202.38.160.111

! Set this router to be in the preemption mode.

Quidway(config-if-Ethernet0)# standby preempt

! Set this router's priority to 120.

Quidway(config-if-Ethernet0)# standby priority 120

- Configure Router B:

! Start HSRP function and set its working virtual IP address as 202.38.160.111.

Quidway(config-if-Ethernet0)# standby ip 202.38.160.111

! Set this router to work in preemption mode.

Quidway(config-if-Ethernet0)# standby preempt

2.4.2 An example for setting HSRP to monitor a specified interface

I. Networking requirements

As shown in the above diagram, even if Router A can still work normally, once its interface that connects Internet fails, Router B will take over its work. And this can be achieved by configuring a monitoring interface.

Normally, Router A shall fulfil the tasks of the gateway. Once the WAN interface Serial 0 of Router A becomes disabled, the priority of Router A will be reduced by 30, which is lower than that of Router B. Therefore Router B preempts to become the active router and starts working as the gateway. Once interface Serial 0 of Router A recovers, Router A can go on with the work of the gateway as an active router.

In this example, the number of the hot standby group is 1, and configurations of authorization word and timer are added (they aren't a must in this application, though.)

II. Networking diagram

It's the same as the networking diagram in "HSRP single hot standby group configuration".

- Configure Router A:

! Start HSRP function and set it to be in No. 1 HSRP hot standby group, its virtual IP address is 202.38.160.111.

Quidway(config-if-Ethernet0)# standby 1 ip 202.38.160.111

! Set this router to work in preemption mode in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 preempt

! Set this router to have a priority of 120 in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 priority 120

! Set the authentication word of No. 1 HSRP hot standby group to be "quidway".

Quidway(config-if-Ethernet0)# standby 1 authentication quidway

! Set hello-time of No. 1 HSRP hot standby group to 5 seconds, and hold-time to 15 seconds.

Quidway(config-if-Ethernet0)# standby 1 timers 5 15

! Set the priority of this router to reduce by 30 once HSRP monitoring interface Serial 0 turns disabled.

Quidway(config-if-Ethernet0)# standby 1 track serial0 30

- Configure Router B:

! Start HSRP function and set it to be in No. 1 HSRP standby group, its virtual IP address being 202.38.160.111.

Quidway(config-if-Ethernet0)# standby 1 ip 202.38.160.111

! Set this router to be in the preemption mode in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 preempt

! Set the authentication word of No. 1 HSRP hot standby group to be "quidway".

Quidway(config-if-Ethernet0)# standby 1 authentication quidway

! Set hello-time of No. 1 HSRP standby group to be 5 seconds, and hold-time be 15 seconds.

Quidway(config-if-Ethernet0)# standby 1 timers 5 15

2.4.3 An example for multiple hot standby groups configuration

I. Networking requirements

One Quidway router may make backups for multiple standby groups.

Load sharing can be achieved by configuring multiple standby groups. For example, Router A can work both as an active router for hot standby group 1 and a backup router for hot standby group 2 at the same time. On the contrary, Router B can work as an active router for hot standby group 2 and a backup router for hot standby group 1 at the same time. Some hosts (like host A) use hot standby group 1 as their gateways, some other hosts (like host B) use hot standby group 2 as their gateways. In this way, both load sharing of network data stream and cross backup among routers can be achieved.

II. Networking diagram

It's the same as the networking diagram in "HSRP single hot standby group configuration".

III. Configuration procedure

- Configure Router A:

! Start HSRP function and set it to be in No. 1 HSRP hot standby group, its virtual IP address being 202.38.160.111.

Quidway(config-if-Ethernet0)# standby 1 ip 202.38.160.111

! Set this router to work in preemption mode in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 preempt

! Set this router to have a priority of 120 in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 priority 120

! Set this router to belong to number 2 HSRP standby group at the same time, its virtual IP address being 202.38.160.112.

Quidway(config-if-Ethernet0)# standby 2 ip 202.38.160.112

! Set this router to work in preemption mode in number 2 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 2 preempt

- Configure Router B:

! Start HSRP function and set it to be in No. 1 HSRP standby group, its virtual IP address being 202.38.160.111.

Quidway(config-if-Ethernet0)# standby 1 ip 202.38.160.111

! Set this router to work in preemption mode in No. 1 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 1 preempt

! Set this router to belong to number 2 HSRP hot standby group at the same time, its virtual IP address being 202.38.160.112.

Quidway(config-if-Ethernet0)# standby 2 ip 202.38.160.112

! Set this router to work in preemption mode in number 2 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 2 preempt

! Set this router to have a priority of 120 in number 2 HSRP hot standby group.

Quidway(config-if-Ethernet0)# standby 2 priority 120

2.5 Fault Diagnosis and Troubleshooting of HSRP

Configuration of HSRP is not very complicated. Generally, fault can be located by viewing the configuration and debugging information:

Fault 1: impossible to ping virtual IP address.

It is normal that virtual IP address cannot be pinged on an active router, for virtual IP address is visible only from outside.

If virtual IP address cannot be pinged on other network equipment, check as follows.

- As state conversion of HSRP requires a little time, command **show standby** can be used to view HSRP information to confirm that at least one router in hot standby group is in the active state.
- If this equipment is in the same network segment as the virtual router, see if there is an ARP item of the virtual IP address in this equipment's ARP table. If not, please check network line. If this equipment is in a different network segment, it must be confirmed if the equipment has any route to the virtual IP address or not.
- Fault 2: Multiple active routers exist in the same hot standby group.

Check whether the authorization word and the timer configured on the Ethernet interface of the routers in the hot standby group are consistent.

HUAWEI®

VRP

User Manual – Configuration Guide

Volume 3

09 – QoS Configuration (QC)

Table of Contents

Chapter 1 QoS Overview

1.1 About QoS

In traditional IP networks, all packets are processed equally. Each router processes the packets with first-in first-out (FIFO) policy. It sends the packet to the destination in the mode of best-effort, but the throughput, delay, delay jitter and packet discarding rate cannot be predicted. The situation can be very perfect, or be very bad, and it can only be determined by the state of the network. However, people raise higher demand for the network along with the rapid development of computer network. As more and more voice, image and important data are transmitted over the network, which are sensitive to bandwidth, delay, jitter and real-time features, network resources now become increasingly diversified. At the same time, the service quality also becomes an important issue. People expect that they can get enough guarantee in the aspects of the throughput, delay, delay jitter and discarding rate of packets, so that their special requirements on the special services can be satisfied. People also expect that they could obtain customized service quality according to the client types. One way to solve this problem is to increase the bandwidth. But bandwidth increase is limited and costs a lot. The problem can only be solved to a certain extent.

QoS (Quality of Service) indicates the integration of a series of technologies that permit users to get predictable service quality in the aspects of throughput, delay jitter, delay, and packet discarding rate. QoS (Quality of Service) provides network service function with different service quality according to different demands. It can be said that the capability of providing QoS is the basic requirement for future IP networks.

1.2 Three service types of QoS

Usually, the service of QoS is classified into the following three types:

I. Best-effort Service

Best-effort Service indicates to work with “the best effort”, but it cannot guarantee the service quality.

II.Integrated Service

This service type uses signaling mechanism to inform the data flow passing route to obligate resource, so it can implement quality guarantee very well. Bur when the size of the network is large, the cost is high, and then the integrated service is usually applicable for the edge of network. The signaling used to transfer QoS request is RSVP (Resource ReSerVation Protocol), which informs the QoS request of application to the router.

The integrated service provides the following two types of services:

1) Guarantee: i.e., to provide guaranteed bandwidth and delay limit to satisfy the application request
2) Load control: to guarantee that it would provides the packets services almost the same as those when the network is not overloaded even if the network is

overloaded. When the network is congested, it can also guarantee the low delay high pass of some types of packets.

III. Differentiated Service

Differentiated service is to classify services with the same requirement, and to provide different service quality according to the different classification. It does not need the support of special signaling, but implements the packets classification, traffic shaping, traffic policing and queuing through some features of the IP packet. It can also adopt different working modes to assort with the edge network or the core network. Differentiated Service adopts the following technology as an important application to provide point-to-point QoS guarantee:

- CAR: to police the traffic of one flow, several or all the flows.
- GTS: to shape the traffic of one flow, several or all the flows.
- Queuing technology: such queuing debugging technologies as First-In First-Out Queuing, Priority Queuing, Custom Queuing, Weighted fair queuing, Class Based Weighted Fair Queuing operate congestion management on interfaces.

Differentiated Service implements VRP QoS, its specific performances are as follows:

- Packets classification

At the edge of the network, classify operations with different service quality into different types. In the core network, execute the operation of corresponding service quality level according to the classification.

- Congestion Management

When there is congestion on the interface, provide diversified queuing mechanism to cache and allocate the congested packets.

- Congestion Avoidance

Avoid congestion through predicting the congestion state of the network. Congestion Avoidance can decrease the packet loss rate and improve the efficiency of using network.

- Traffic Policing

Control the traffic of single flow, several flows and all the packets, and make the service quality customized.

- Traffic Shaping

Shape the traffic that does not accord with the predefined traffic features so as to facilitate the bandwidth matching. It also can shape every flow or all the packets on the interface.

- Interface Speed Restriction

Tailor the bandwidth of the physical interface to enrich the managing methods of network bandwidth.

1.3 Functions of QoS

The features of QoS enable the network to provide controllable and predicable services for different network applications and network traffic types. With QoS applied to the network, the followings can be implemented:

- Network resource control. Users can control the network resources being used. For example, the user can restrict the bandwidth resource to be consumed for FTP transmission in a specific connection, or provide higher priority for a more important data access.
- Providing trimmed network service. If the user is an ISP, QoS can be used to provide trimmed network service with different priorities for different customers.

- Ensuring network service for the specified data flow. For example, it enables multimedia data flow and voice flow that are sensitive to delay to receive the service in time.

Quidway series routers can realize multiple congestion management policies, and can meet different service quality demands for different users.

Chapter 2 Traffic Classification and Policing

2.1 Traffic Classification and Policing

2.1.1 Introduction to Traffic Classification

Packets can be classified into multiple types of different precedence levels and services. For example, the user can sort IP packets into 6 types (2 types reserved for other purposes) according to the ToS (Type of Service) field in IP header. After the classification, other QoS features, such as congestion management and bandwidth distribution can be applied to different types.

Network administrator can set the classification policy, which includes physical interface, source address, destination address, MAC address, IP protocol and the port number of the application program. Common classification algorithms are limited to IP packet header, link layer, network layer and transport layer. The content of packet is rarely used as classification criterion. The range of the classification result is not limited. The result can be the flow defined by a quin-tuple (source address, source port number, protocol code, destination address and destination port number), or all the packets in a network segment.

When classifying packets on network vorder, ToS field in IP header should be set as the IP precedence which will be used as classification criterion within the network. Queuing techniques such as WFQ can also handle the packets according to IP precedence. The classification feature of CAR in QoS can be used to classify the traffic.

Downstream network can select and receive the classification result from Upstream network or reclassify the traffic according to its own criterion.

I. IP Precedence

The user can specify the service type of the packet with 3 precedence-identifying bits of ToS field in the IP header. These bits can be used in other features configured in the network to handle the packets according to the committed services. For example, other queuing methods such as WFQ can sort the priority order of the traffic according to the set IP precedence, though IP precedence is not a queuing method.

II. CAR (Committed Access Rate)

CAR is the main feature to support packet classification. CAR performs classification by using the ToS field in IP header. The user can use CAR classification command to classify or reclassify the packets.

The following examples show the packet classification rules:

- The packets received via all the interfaces are set to the highest precedence.
- All the HTTP traffic is classified to medium-level precedence (application classification).
- Video traffic from specified IP address is classified to medium-level precedence.
- Traffic to the specified destination address is classified to high-level precedence.

2.1.2 Introduction to Traffic Policing

For ISP (Internet Service Provider), it is necessary to control the load and traffic imported into the network by the user. For the Intranet, traffic controlling of some applications will also prove an effective means to control the network state.

The typical function of the Traffic Policing is to supervise the specification of the imported traffic and confine it to a committed range. If the packet traffic is oversized on a connection point, under the Traffic Policing, some packets will be dropped or precedence of the packets will be reset (i.e., confine HTTP packet to less than 50% of the network bandwidth). Therefore, the network resource and carrier's interest is protected from damage.

One example of Traffic Policing is CAR (Committed Access Rate). CAR is widely used for monitoring and classifying the traffic entering the network of ISP (CAR is so well known as to be the second name for Traffic Policing). CAR predefines monitoring actions according to the different evaluation results of the traffic. These actions include:

- Forward. Forward the packet with the evaluation "conforming".
- Drop. Drop the packet that does not conform to the traffic rule.
- Lower the precedence level and forward. Mark the packet evaluated as "partly conforming" with lower precedence and forward it.
- Enter the monitoring of next level. Traffic Policing can be divided into multiple levels and each level focuses on more specific objects.

Traffic Policing adopts Token Bucket algorithm, as shown in Figure QC-2-1.each type of service has a corresponding number of Tokens. The Token is sent out at the specified speed. If the user service arriving speed is greater than the Token sending speed, actions need to be taken towards these service data which exceed the prescribed speed (for example, these data can be marked and forwarded only when there is no congestion. When congestion occurs in the network, these data will be dropped first.). these packets can also be dropped at the beginning. The specific method depends on the protocols and rules adopted between the carrier and the user.

I. Features of Token Bucket

Token Bucket can be seen as a vessel with limited capacity containing Tokens. The system puts Tokens into Token Bucket at a specified speed. when the Bucket is full, extra Token will overflow and the number of Tokens inside the Bucket will stop increasing.

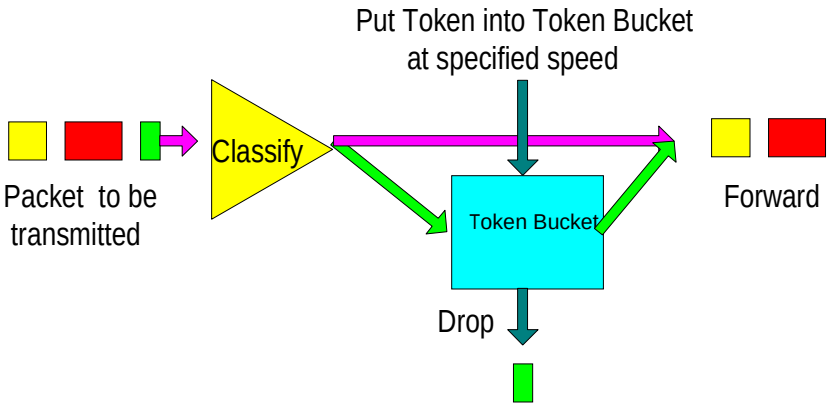


Figure QC-2-1 Packet classification and traffic policing

II.Traffic Measuring with Token Bucket

Whether the total number of Tokens in Token Bucket meet the packet forwarding requirement is the basis to evaluate the traffic size. If there are enough Token to forward the packets (usually one Token is associated with the forwarding authority of one bit), the traffic does not exceed the specification; otherwise, the traffic exceeds the specification.

There are main three parameters to evaluate the traffic:

- Average speed: the speed of Token put into Token Bucket. It is usually set to CIR (Committed Information Rate), that is, allowed average flow speed.
- Burst size: the capacity of the Token Bucket. It is usually set to CBS (Committed Burst Size), that is, the allowed maximum traffic during the evaluation time interval. Burst size must be greater than the longest packet.
- Time Interval: evaluate the traffic every other cycle. It is set by the system. If there are enough Tokens for the packets, it is evaluated as “confirming”. If there are not enough Tokens, it is “not conforming”. “Conforming” indicates that the traffic does not exceed the specification and corresponding number of Tokens that conform to packet forwarding authority will be taken out from the Bucket; “not conforming” indicates that the traffic exceeds the specification and too many Tokens have been consumed.

III Complicacy Evaluation

If there is only one Token Bucket, the evaluation result falls into two types: conforming and not conforming.

In order to evaluate more complicated situation and implement more flexible control policy, two Token Buckets will be set. For example, there are 3 parameters in CAR.

CIR(Committed Information Rate)

CBS(Committed Burst Size)

EBS(Excess Burst Size)

The two Token Buckets used transceives Tokens at the same speed of CIR, but with different size--CBS and EBS respectively (CBS is less than EBS. The two Buckets are called C and B.) CBS and EBS are different burst level allowed. The evaluation results in the three cases (that is, sufficient Tokens in C, insufficient Tokens in C but sufficient in D, and sufficient Tokens in neither C nor D), the results are “conforming, partly conforming and not conforming” respectively.

2.1.3 Introduction to CAR

CAR provides classification service and traffic policing by limiting the speed. The user can set IP precedence of the packets coming into the network with CAR classification in order to divide the traffic into multiple precedence levels and service types. The other network equipment can process the data according to the modified IP precedence.

The user can be defined as 6 types of services according to the precedence field of ToS segment in IP packet header. The rule to define the type of packets can be based on multiple criterion, including physical port, source IP address, source MAC address, destination IP address, destination MAC address, application port, IP protocol type or other criterion which can perform classification by using access list or extended access list. Packets can also be classified according to the situation outside the network (i.e., the client type). The network can accept or ignore the classification or reclassify the packets according to a certain rule.

Set the corresponding CAR based on one of the following features:

- IP
- IP precedence
- MAC address
- IP Access Control List (including Standard Access Control List or Extended Access Control list)

Multiple CAR rules can be applied on an interface to process different types of packets (i.e., restrict the speed of low precedence communication to lower than that of high precedence communication). The router will check the CAR rules in configuration order until the packet matches a certain rule. If the matched rule is not found, the transmission will be performed in the default way. CAR rules can be independent(different CAR rules process different types of packets) or overlapped(one packet can match multiple CAR rules).

2.2 CAR Configuration

2.2.1 CAR Configuration Task List

CAR configuration task include:

- Set up CAR rules
- Apply CAR rules on the interface
- Monitoring and maintenance of CAR

2.2.2 Specify CAR rules

Classification of the packets is needed on the network border. The classification criterion can be designed for the packets received on a specified interface or a group of packets defined by the **access-list** command. The packets will be set to different precedence levels on the interface that will serve as classification criterion within the network. The packets exceeding the traffic limit in the unit time can be processed differently with those which do not exceed the limit.

Perform the following configuration in global configuration mode.

Table QC-2-1 Specify the CAR rules

Operation	Command
Specify the CAR rule based on precedence level	**rate-limit-list** *precedence-rate-limit-number* { *precedence* | **mask** *prec-mask* }
Delete the CAR rule based on precedence level	**no rate-limit-list** *precedence-rate-limit-number* { *precedence* | **mask** *prec-mask*]
Specify the CAR rule based on MAC address	**rate-limit-list** *macaddress-rate-limit-number mac-address*
Delete the CAR rule based on MAC address	**no rate-limit-list** *macaddress-rate-limit-number mac-address*

No CAR rule is specified by default.

Notes:

For one *precedence-rate-limit-number* or *macaddress-rate-limit-number*, only one CAR rule can be defined. The subsequent CAR rule will cover the original one. But for

different *precedence-rate-limit-number* or *macaddress-rate-limit-number*, two or more CAR rules can be defined.

2.2.3 Apply the CAR Rule on the Interface

When CAR rule is applied to an interface, only the speed of the packets meeting the requirement will be limited. The speed limit will not be performed to the packets that do not meet the requirement.

Perform the following configuration in the interface configuration mode.

Table QC-2-2 Apply the CAR rules on an interface

Operation	Command
Apply the CAR rule on an interface	**rate-limit** { **input | output** } [**access-group** *access-list-number* | **rate-limit-group** *rate-limit-number*] *bps normal-burst-size maximum-burst-size* **conform-action** *action* **exceed-action** *action*
Delete the CAR rule on an interface	**no rate-limit** { **input | output** } [**access-group** *access-list-number*| **rate-limit-group** *rate-limit-number*] *bps normal-burst-size maximum-burst-size* **conform-action** *action* **exceed-action** *action*

No CAR rule is applied on an interface by default.

Notes:

1) In the input and output directions of the interface, multiple CAR rules can be applied. The total number of the CAR rules applied in the two directions of an interface is 100.

2) When neither **access-group** nor **rate-limit-group** is configured, the interface will limit the speed of all the IP packets.

3) When the CAR rule is applied, the interface will not support fast-forwarding.

4) Quidway series of routers support the application of CAR rules on Ethernet interface encapsulated with PPP, FR and HDLC, and sync/async serial port (including sub-interface).

5) If the CAR rule based on *access-list-number* is to be applied on an interface, the *access-list-number* configured by **access-list** command must be permitted. Otherwise, the application of CAR rule on an interface will fail.

2.2.4 Monitoring and Maintenance of CAR

Table QC-2-3 Monitoring and maintenance of CAR

Operation	Command
Show the CAR statistics information	**show car** { **all** | **interface** *type number* }
Show the CAR rule	**show rate-limit-list** [*rate-limit-number*]
Delete the CAR rule	**clear car** { **all** | **interface** *type number* }
Enable the CAR debugging packets switches	**debug car** { **in | out** }

1) show CAR statistics

Quidway# show car interface serial 0

```
Interface name: Serial0
```

```
< Input >
Matched: rate-limit-group 1
Params: rate 8000 bps, normal burst 8000 bytes, maximum burst 8000 bytes
From 2-00-00 0:00:00 to 257--50-07 8477:06:00
Conformed 0 packets, 0 bytes; action: continue
Exceeded 0 packets, 0 bytes; action: continue
Matched: rate-limit-group 1
Params: rate 8000 bps, normal burst 8000 bytes, maximum burst 8000 bytes
From 19-00-00 19:00:00 to 257--50-07 8477:06:00
Conformed 0 packets, 0 bytes; action: continue
Exceeded 0 packets, 0 bytes; action: drop
Matched: none
0 packets, 0 bytes; action: transmit

< Output >
Matched: none
0 packets, 0 bytes; action: transmit
```

2) Show the first CAR rule

Quidway# show rate-limit-list 1

```
Rate-limit access list 1
mask 3D
```

3) Show all of the access rules in CAR

Quidway# show rate-limit-list

```
Rate-limit access list 1
mask 3D
Rate-limit access list 100
```

7777.9999.1111

2.3 CAR Configuration Example

2.3.1 Applying CAR Rules to All Packets

I. Requirements

- Apply CAR to all the packets entering Ethernet interface 0 of router A, forwarding the packets according with the qualification, discarding those unqualified ones.
- Apply CAR to all the packets outing Ethernet interface 1 of router A, forwarding the packets according with the qualification, discarding those unqualified ones.

II. Networking diagram

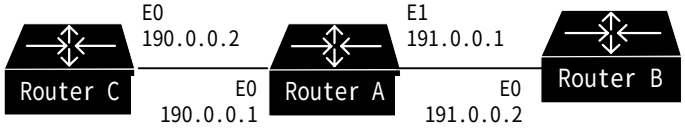


Figure QC-2-2 Networking diagram of applying CAR rules to all packets

II.Configuration

Configure router A:

! Apply CAR to all the packets entering Ethernet interface 0 of router A.

Quidway(config-if-Ethernet0)# ip address 190.0.0.1 255.255.255.0

Quidway(config-if-Ethernet0)# rate-limit input 8000 8000 8000 conform transmit exceed drop

! Apply CAR to all the packets outing Ethernet interface 1 of router A.

Quidway(config-if-Ethernet1)# ip address 191.0.0.1 255.255.255.0

Quidway(config-if-Ethernet1)# rate-limit output 8000 8000 8000 conform transmit exceed drop

2.3.2 Apply CAR Rules to Packets Which is Matched the ACL

I. Requirements

- Apply CAR to packets entering serial 0 of router A and matching the specified ACL, forwarding the packets according with the qualification, discarding those unqualified ones.
- Apply CAR to packets outing serial 0 of router A and matching the specified ACL, forwarding the packets according with the qualification, discarding those unqualified ones.

II. Networking diagram

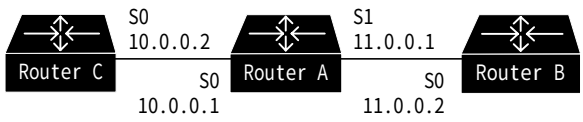


Figure QC-2-3 Networking diagram of apply CAR rules to packets which is matched the ACL

III. Configuration

Configure router A:

! Apply CAR to packets entering serial 0 of router A and matching the specified ACL.

Quidway(config)# access-list 1 permit 10.0.0.2

Quidway(config-if-Serial0)# ip address 10.0.0.1 255.255.255.0

Quidway(config-if-Serial0)# rate-limit input access-group 1 8000 8000 8000 conform transmit exceed drop

! Apply CAR to packets outing serial 0 of router A and matching the specified ACL.

Quidway(config)# access-list 1 permit 10.0.0.2

Quidway(config-if-Serial0)# ip address 11.0.0.1 255.255.255.0

Quidway(config-if-Serial0)# rate-limit output access-group 1 8000 8000 8000 conform transmit exceed drop

2.3.3 Configure CAR Rules Based on the Priority Level

I. Requirements

- Matching CAR based on the priority level to the packets entering serial 0 of router A, forwarding the packets according with the qualification, discarding those unqualified ones.
- Matching CAR based on the priority level to the packets outing serial 1 of router A, forwarding the packets according with the qualification, discarding those unqualified ones.

II.Networking diagram

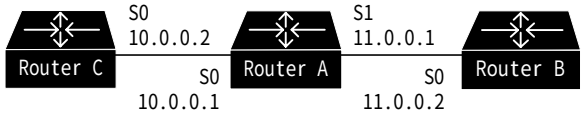


Figure QC-2-4 Networking diagram of configuring CAR rules based on the priority level

III. Configuration

Configure router A:

! Matching CAR based on the priority level to the packets entering serial 0 of router A.

Quidway(config)# rate-limit-list 1 1

Quidway(config-if-Serial0)# ip address 10.0.0.1 255.255.255.0

Quidway(config-if-Serial0)# rate-limit input rate-limit-group 1 8000 8000 8000 conform transmit exceed drop

! Matching CAR based on the priority level to the packets outing serial 1 of router A.

Quidway(config)# rate-limit-list 1 2

Quidway(config-if-Serial0)# ip address 11.0.0.1 255.255.255.0

Quidway(config-if-Serial0)# rate-limit output rate-limit-group 1 8000 8000 8000 conform transmit exceed drop

2.3.4 Configure CAR Rules Based on the MAC Address

I. Requirements

- Matching CAR based on MAC address to the packets entering serial 0 of router A (packets from source address 00e0.34b0.7676), modify the priority level value of the packet according with the qualification into 7, discarding those unqualified packets.

II. Networking diagram

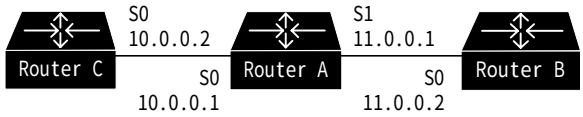


Figure QC-2-5 Networking diagram of configuring CAR based on the MAC address

III. Configuration

Configure router A
! Matching CAR based on MAC address to the packets entering serial 0 of router A.

```
Quidway(config)# rate-limit-list 1 100 00e0.34b0.7676

Quidway(config-if-Serial0)# ip address 10.0.0.1 255.255.255.0
Quidway(config-if-Serial0)# rate-limit input rate-limit-group 1 8000 8000 8000 conform
      transmit exceed drop
```

Chapter 3 Congestion Management

3.1 Congestion and Congestion Management

3.1.1 About Congestion

For a network unit, if data packets reach the interface at a speed faster than that the interface can transmit the data packets, congestion will occur at this interface. And some packets may be lost if there is no enough space to store them. The loss of data packets will in turn cause the same host or router to redirect the data packets due to timeout, as a result, a vicious circle will happen.

There are many factors to cause congestion. For example, if the packet flow enters the router from a high-speed link and is sent out from a low-speed link, congestion will occur. And if packet flows enter the router from several interfaces at the same time while they are sent out from one interface or the processor speed is slow, congestion will also occur.

As shown in the figure below, two LANs of an enterprise is interconnected through a low-speed link. When a user in LAN1 sends data packets to a user in LAN 2, congestion may occur at the interface that connects the router of LAN 1 with the low-speed link. If an important application is running between the servers of the two LANs, while an unimportant application is running between the two PCs, the important application will be affected.

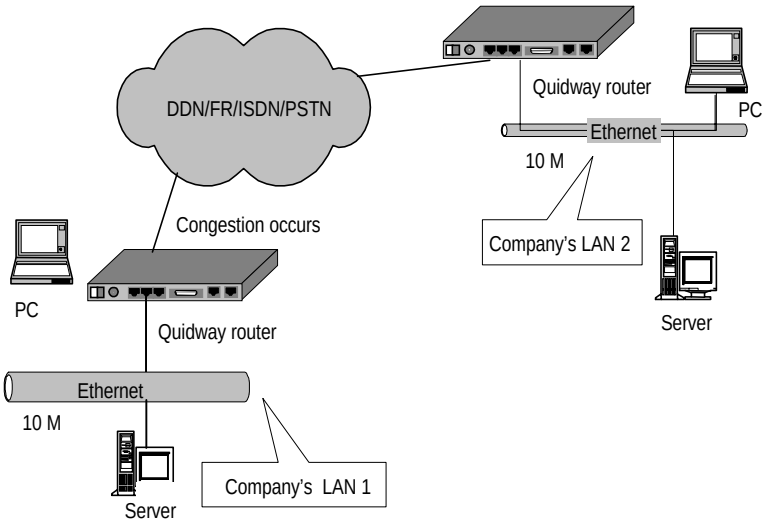


Figure QC-3-1 Example of congested network

3.1.2 Congestion Management Policy

When congestion occurs, some packets may be discarded if there is no enough buffer to store them. The loss of data packets will in turn cause the same host or router to

resend the data packets due to timeout, and congestion happens again, and then the packets are sent again, a vicious circle happens. To manage the congestion of network, people adopt some policies. When congestion occurs, the router can adopt a specific policy to dispatch the data packets, and decide which packets to be sent with priority, and which packets to be discarded. The policy adopted by the router to deal with congestion is called congestion management policy. Usually Queuing technology is adopted to manage the congestion. When congestion occurs, data packets queue up at the sending interface of the router following a certain policy. When the packets are dispatched, the sending sequence of the packets is determined following a certain policy.

I. FIFO Queuing

In FIFO (First-In First-Out) queuing, communication priority and classification is not concerned. In FIFO application, the sequence of sending out data packets from the interface depends on the arriving sequence of the data packets at this interface.

FIFO provides basic capability of storage and forwarding. In some cases, FIFO is the default queuing algorithm, which should not be modified.

II. PQ (Priority Queuing)

In PQ (Priority Queuing), packets with a specific communication priority will be forwarded earlier than all other packets with lower priorities, thus ensuring that the packets with higher priority can be sent out in time.

PQ is used to provide strict priority for important network data. PQ can flexibly specify priority sequence according to network protocol (IP protocol for example), data inflow interface, length of the packet, source address/destination address, etc. It ensures that the most important data in the network unit using PQ can be processed as fast as possible.

III. CQ (Custom Queuing)

In CQ (Custom Queuing), a specific proportion of the available bandwidth of the interface is reserved for each specified traffic type. When the reserved bandwidth is not used by its type of traffic, it can be used by other types of traffic. That is, in CQ mode, bandwidth is allocated in proportion, and CQ permits to specify the total number of byte/packet to be extracted from the queue.

For interfaces with a low rate, the data flow passing through this interface can also receive network service to some extent when the queue is customized for the interface.

IV. WFQ (Weighted Fair Queuing)

WFQ (Weighted Fair Queuing) provides a dynamic and fair queuing mode, in which the traffic is distinguished based on priority/weight, and according to the different sessions. The occupation of bandwidth is determined for each session, thus ensuring a fair treatment to all communications according to their weight. The traffic is classified by WFQ in the light of source address, destination address, source port number, destination port number and protocol type, etc.

3.1.3 Selecting Congestion Management Policy

Quidway series routers implement the above four congestion management policies (FIFO, PQ, CQ and WFQ) at the Ethernet port and serial port (PPP, FR and HDLC encapsulation), meeting different QoS demands of different services.

FIFO implements non-priority policy of the packets in user data communication. In this mode, the priority and type of the communication is not necessary to be specified. But in the application of FIFO policy, some data that run abnormally may consume most of the available bandwidth, and occupy the full queue, which will lead to delay of the burst data source and some important communication data being discarded.

PQ provides strict priority. It ensures that a specific type of communication can be sent, but all other types of packets may be sacrificed at this time. In terms of PQ, a queue with lower priority is placed in an unfavorable status. Moreover, the packets in the queues with lower priority may have no chance to be sent out in the worst circumstance (available bandwidth is limited, and the transmission frequency of the emergent communications is very high).

CQ ensures all communications to get service of respective levels by allocating different bandwidths for them. And it determines the queue size by specifying the total number of packets configured in the queue, so as to control the access to the bandwidth.

WFQ dynamically divides the communication into packets by fair queuing algorithm. Packet is one part of the session. WFQ allocates the bandwidths fairly for small-capacity and interactive communications just as large-capacity communications (for example, file transmission).

Comparison for these four policies is shown in the table below:

Table QC-3-1 Comparison table of congestion management policies

	No. of queue	Advantages	Disadvantages
FIFO	1	1.No configuration is needed, and easy to use. 2. Simple processing with less processing delay	1. All packets are treated equally, and the arriving sequence of packets determines the packet occupied bandwidth, delay and loss of the packets. 2. It has no restriction on mismatched data source (for example, UDP packet sending), while the mismatched data source will affect the bandwidth of the matched data source (for example, TCP packet sending). 3. Delay of the real-time application that is sensitive to time can not be ensured (for example VoIP).
PQ	4	It provides absolute priority for the data of different services, and delay is ensured for real-time applications (for example, VoIP) that are sensitive to time. The packet of priority service has absolute priority to occupy the bandwidth.	1. Configuration is needed, and processing speed is slow. 2. If the bandwidth for packets with higher priority is not restricted, packets with lower priority may not acquire the bandwidth.
CQ	17	1. Bandwidth can be allocated in proportion for the packets of different services. 2. If no specific types of packets exist, the bandwidth can be increased automatically for the existing packet types.	Configuration is needed, and processing speed is slow.
WFQ	Specified by the user (256 by default)	1. Easy to configure. 2. The bandwidth can be protected for coordinated (interactive) data source (for example, TCP packet sending). 3. Capable of reducing the jitter of the delay. 4. Small packet is sent with priority. 5. Different bandwidths can be allocated for the flows with different priorities. 6. When the number of the flows is reduced, the bandwidths for the existing traffic can be increased automatically.	The processing speed is slower than FIFO.

3.1.4 Working Principle of Congestion Management Policy

Normally, queuing technology is adopted to manage congestion. When congestion occurs, data packets queue up at the sending interface of the router following a certain policy. When the packets are dispatched, the sending sequence of the packets is determined following a certain policy.

I. FIFO

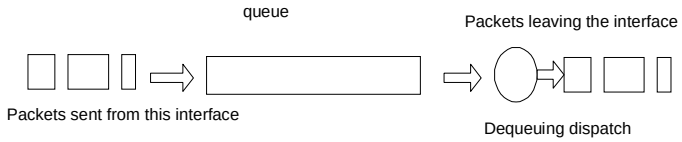


Figure QC-3-2 Schematic diagram of FIFO queuing

As shown in the figure above, packets enter FIFO queue in sequence. The dequeuing sequence is the same as the incoming queue sequence, that is, the packet that arrives earlier will be sent earlier, while the packet arrives later will be sent later. FIFO does not make any judgement on the packets, and allocation of network bandwidth and resource are determined according to the arriving sequence of the packets. Therefore, vicious application may occupy all network resources, seriously affecting data transmission of key services.

II. PQ

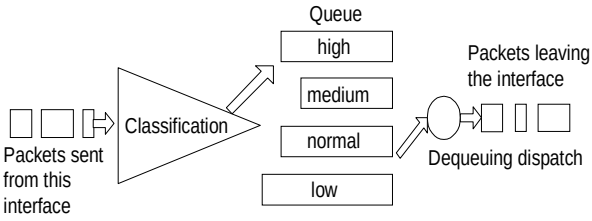


Figure QC-3-3 Schematic diagram of priority queuing

As shown in the figure above, PQ is used to provide strict priority for important network data. It ensures that the most important data in the network unit using PQ can be processed as fast as possible. PQ can flexibly specify the priority sequence according to network protocol (for example, IP and IPX), data inflow interface, length of the packet and source address/destination address.

When the queues are dispatched, PQ first sends the packets in the queue with higher priority in strict compliance with high-to-low sequence. If the queue with higher priority is empty, the packets in the queue with lower priority can be sent. The packets in the queue with lower priority might be congested due to the existence of packets in the queue with higher priority. Therefore, the packets of key service (for example, ERP) are put in the queue with higher priority, and the packets of ordinary service (for example, E-mail) are put in the queue with lower priority. In this way, it can be ensured that packets of key services are transmitted with priority, and the packets of ordinary services are transmitted in the idle intervals during the processing of the key service data.

III. CQ

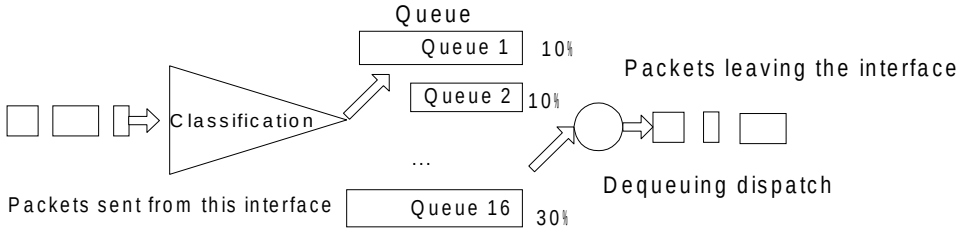


Figure QC-3-4 Schematic diagram of custom queuing

As shown in the figure above, CQ classifies the packets into 17 categories (corresponding to 17 queues in CQ) following the specified policy. According to its category, the packets queue up and enter the corresponding queue of CQ based on the first-in first-out policy. Of the 17 queues of CQ, No.0 queue is a system queue, and No.1 to No.16 are user queues. And the user can configure the proportion of interface bandwidth occupied for each user queue. When the queues are dispatched, the packets in the system queue are sent with priority until the queue is empty. Then according to the bandwidth configured beforehand, a specific amount of packets in No.1 to No.16 queues are sent out in the polling mode in sequence.

PQ assigns absolute priority to the packets with higher priority level compared with the packets with lower priority level. Although this ensures that the key service data can be transmitted with priority, the packets with lower priority level will all be congested if the bandwidth is occupied completely for transmitting massive packets with higher priority. If CQ is adopted, this case can be avoided. There are 17 queues in CQ. The user can configure the policy of flow classification, and specify the proportion of interface bandwidths occupied by the 16 user queues. Thus, the packets of different services are allocated with different bandwidths, ensuring that key services can get more bandwidths while preventing from no bandwidth available for ordinary services.

In the network diagram shown in figure QC-2-1, suppose the server of LAN 1 sends key service data to the server of LAN 2, and PC of LAN 1 sends ordinary service data to PC of LAN 2. The serial port connected with WAN is configured with CQ for congestion management. Key service data flow between the server enters queue A, and ordinary service data flow between PCs enters queue B. The proportion of interface bandwidth occupied by queue A against queue B is configured to 3:1 (for example, queue A in each dispatching can continuously send 6000 bytes of packets, and queue B in each dispatching can continuously send 2000 bytes of packets). In this way, CQ treats the two packet types of different services in different ways. When queue A is dispatched, the packets is sent continuously till the number of bytes being sent is no less than 6000 or the queue is empty, then CQ turns to dispatching the next user queue. When queue B is dispatched, the dispatching will not end till the number of bytes being sent continuously is no less than 2000 or the queue B is empty. In this way, if congestion occurs and there are always packets in queue A and B to be sent, from the statistics result it can be seen that the proportion of the bandwidths acquired by the key services against the bandwidths acquired by the ordinary services is approximately 3:1.

IV. WFQ

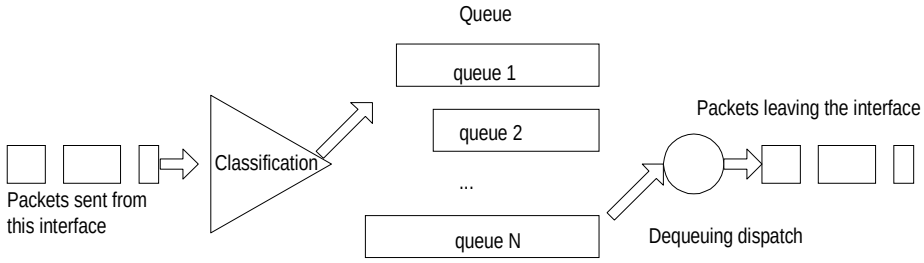


Figure QC-3-5 Schematic diagram of weighted fair queuing

WFQ embodies the weight on the basis of ensuring fairness, and the amount of the weight depends on the IP Precedence brought in the IP packet headers. As shown in the figure above, WFQ classifies the packets according to the flow (packets with the same source IP address, destination IP address, source port number, destination port number, protocol number and TOS), and each flow is allocated with to one queue. When outgoing from the queue, WFQ allocates the bandwidth to be occupied at the exit by each flow according to the precedence of the flow. The smaller number of the precedence, the less bandwidth of the flow. The bigger number of the precedence, the more bandwidth of the flow.

For example, there are currently 8 flows at the interface, with priority of 0, 1, 2, 3, 4, 5, 6 and 7.So, the total bandwidth allocated is the sum of all priorities (flow priority + 1).

That is, 1+2+3+4+5+6+7+8=36

The proportion of bandwidth occupied by each flow is: (priority number +1) / (all priorities (flow priority + 1)) That is, each flow can acquire the bandwidth as follows: 1/36, 2/36, 3/36, 4/36, 5/36, 6/36, 7/36, 8/36.

Another example: there are 4 flows currently, the priority of three flows is 4, and the priority of one flow is 5, then the total bandwidth allocated is:

(4 + 1) * 3 + (5 + 1) = 21

Therefore, the bandwidth for the three flows with priority 4 is 5/21, and the bandwidth for the flow with priority 5 is 6/21.

3.2 Configuration of Congestion Management

3.2.1 Configuring PQ

I. PQ Configuration task list

Configuration task list of priority queue is as follows:

- Configure the priority queue
- Apply priority queue at the interface
- Maintain and monitor the priority queue

II. Configuring priority queue

Priority queue includes the definition for a group of priority queues and it specifies in which queue a packet is placed and the maximum length of different priority queues.

To complete the queuing of a priority queue, you must allocate this list to the interface. The same priority queue can be applied to multiple interfaces. Certainly, you can create multiple different priority policies to be applied to different interfaces.

16 groups can be configured in the priority list at most (that is, the value range of the list-number is 1-16). In each group, the following information is specified: what kind of packets enters what kind of queue, length of each queue, the number of the bytes that can be sent continuously from the respective queues in each polling, etc.

The priority queue can be defined as four levels: **high**, **medium**, **normal** and **low**. Packets will be forwarded by the level sequence. That is, after all the packets in the **high** queue are sent out, send all the packets in the **medium** queue, and then send all the packets in the **normal** queue, and at last send the packets in the **low** queue.

Priority queue can be configured according to the modes below.

1) Configure priority queue according to network layer protocols

Data packets can be classified according to different types of protocols to make them enter different priority queues.

Perform the following task in the global configuration mode.

Table QC-3-2 Configure the priority queue according to the network layer protocol

Operation	Command
Configure the priority queue according to the network layer protocol	**priority-list** *list-number* **protocol** *protocol-name* { **high** | **medium** | **normal** | **low** } [*queue-keyword keyword-value*]
Delete classification policy in the priority queues	**no priority-list** *list-number* **protocol** *protocol-name* { **high** | **medium** | **normal** | **low** } [*queue-keyword keyword-value*]

No priority queue is established by default.

Here, *list-number* is the group number of priority queue. *protocol-name* is the name of the protocol, the value of which can be IP and IPX at present.

When *protocol-name* is IP, the value of *queue-keyword* and *keyword-value* is shown in the table below.

Table QC-3-3 Value of *queue-keyword* and *keyword-value* in IP

queue-keyword	keyword-value	Meaning
Null	Null	If it is an IP packet, it enters the queue.
fragments	Null	If it is a fragmentary IP packet, it enters the priority queue
list	*access-list-number*	IP packet in compliance with a specific *access-list-number* (normal) definition enters the priority queue.
lt	Length Value	IP packet whose length is smaller than a count value enters the priority queue.
gt	Length Value	IP packet whose length is larger than a count value enters the priority queue.
tcp	Port No.	If the source of IP packet or destination TCP port number is the specified port number, the packet enters the queue.
udp	Port No.	If the source of IP packet or destination UDP port number is the specified port number, the packet enters the priority queue.

If *protocol-name* is IPX, the value of *queue-keyword* and *keyword-value* is shown in the table below.

Table QC-3-4 Value of *queue-keyword* and *keyword-value* in IPX

queue-keyword	keyword-value	Meaning
Null	Null	If it is an IPX packet, it enters the queue
lt	Length Value	IPX packet whose length is smaller than a count value enters the priority queue.
gt	Length Value	IPX packet whose length is larger than a count value enters the priority queue.

2) Configure the priority queue according to the interface

Data packet is classified by the interface through which it enters, and is accordingly put into queue with different priority.

Perform the following task in the global configuration mode.

Table QC-3-5 Configuring priority queue according to the interface

Operation	Command
Configure the priority queue according to the interfaces	**priority-list** *list-number* **interface** *type number* { **high** | **medium** | **normal** | **low** }
Delete classification policies in the priority queue	**no priority-list** *list-number* **interface** *type number* {**high** | **medium** | **normal** | **low** }

No priority queue is established by default.

3) Configure the default queue

Packets not in compliance with any matching policy in the priority queue should be allocated to a default priority queue.

Perform the following task in the global configuration mode.

Table QC-3-6 Configuration the default priority queue

Operation	Command
Configure the default priority queue	**priority-list** *list-number* **default** { **high** | **medium** | **normal** | **low** }
Restore the default priority of the priority queue	**no priority-list** *list-number* **default**

No priority queue is established by default.

Multiple policys can be defined for a group of the priority queue, and this group can be applied to a certain interface. When a packet reaches this interface (then sent out from this interface), the system matches this packet along the policy link. If the packet is matched with a certain policy, it enters the corresponding queue, and the matching is completed. If the packet does not match with any policy, it enters the default queue. The default priority of the priority queue is **normal**.

4) Specify the queue length of the priority queue (optional)

The queue length in each priority queue can be specified (the queue length refers to the maximum number of packets that can be accommodated in a queue).

Perform the following task in the global configuration mode.

Table QC-3-7 Configuration of queue length of priority queue

Operation	Command
Configure the queue length of the priority queue	**priority-list** *list-number* **queue-limit** *high-limit medium-limit normal-limit low-limit*
Restore the default value of priority queue length	**no priority-list** *list-number* **queue-limit**

The default length of respective queues is shown in the table below.

Table QC-3-8 The value of default length of the priority queue

Queue	Length
high	20
medium	40
normal	60
low	80

III. Applying priority queue to the interface

The configured priority queue can be applied to a specific interface, and each interface can be allocated only with one priority queue.

Perform the following task in the interface configuration mode.

Table QC-3-9 Apply the priority queue to the interface

Operation	Command
Apply the priority queue to the interface	**priority-group** *list-number*
Restore the default congestion management policy at the interface	**no priority-group**

The interface adopts FIFO queuing by default.

IV. Maintaining and monitoring the priority queue

Table QC-3-10 Maintenance and monitoring of the priority queue

Operation	Command
Show the status of the priority queue	**show queueing priority**
Show the configuration of the priority queue at the interface	**show interface** [*type number*]
Enable the priority queue debugging packets switches	**debug priority-queue**

1) Show the status of the priority queue. (If a value is the same with its default value, the status is not showed).

Quidway# show queueing priority

```
List    Queue     Args
1       high      645
1       medium    22
1       normal    123
1       low       567
5       high      protocol ip
```

3.2.2 Configuring CQ

I. CQ configuration task list

Configuration task of custom queuing is as follows:

- Configure the custom queue
- Apply the custom queue to the interface
- Maintenance and monitoring of the custom queue

II. Configuring the custom queue

16 groups can be configured in the custom queue at most (that is, the value range of the list-number is 1-16). In each group, the following information is specified: what kind of packets enters what kind of queue, length of each queue, the number of the bytes that can be sent continuously from the respective queues in each polling, etc. Each time packets of No.1-16 queues are sent in turn. The number of bytes sent each time cannot be less than the number defined by the queue, and packets will be sent out until the queue is empty.

Multiple priority queues can be configured. The system will match the packets according to the sequence specified in the policy list. If the system finds that the packet matches with a policy, it ends the whole searching process.

Custom queue can be configured according to the modes below.

1) Configure the custom queue according to the network layer protocol

Packets can be classified according to the different protocol types, and make them enter the queues with different custom priority.

Perform the following task in the global configuration mode.

Table QC-3-11 Configuring the custom queue according to network layer protocol

Operation	Command
Configure the custom queue according to the network layer protocol	**custom-list** *list-number* **protocol** *protocol-name queue-number* [*queue-keyword keyword-value*]
Delete the classification policy in the custom queue	**no custom-list** *list-number* **protocol** *protocol-name queue-number* [*queue-keyword keyword-value*]

Here, *list-number* is the group number of the custom queue. *Queue-numbe*r is the queue number, the value of which can be 0-16. *protocol-name* can be IP and IPX. The values of *queue-keyword* and *keyword-value* are the same as the values in the priority queue.

2) Configure the custom queue according to the interface configuration

Packets can be classified according to different types of router interfaces into which the packet enters, so that the packets can enter different custom-queues.

Perform the following task in the global configuration mode.

Table QC-3-12 Configuring the custom queue according to the interface

Operation	Command
Configure the custom queue according to the interface	**custom-list** *list-number* **interface** *type number queue-number*
Delete the policy in the custom queue	**no custom-list** *list-number* **interface** *type number*

3) Configure the default queue

Packet not in compliance with any matching policy in the priority queue should be allocated with a default custom-queue.

Perform the following task in global configuration mode.

Table QC-3-13 Configuration the default custom queue

Operation	Command
Configure the default custom queue	**custom-list** *list-number* **default** *queue-number*
Restore the default queue number of the custom queue	**no custom-list** *list-number* **default**

Multiple policies can be defined for a custom queue, and these policies can be applied to a certain interface. When a packet reaches this interface (and sent out from this interface), the system will match for this packet along the policy link. If the packet is matched with a specific policy, it enters the corresponding queue, and the matching is completed. If the packet does not match any policy, it enters the default queue. The number of the default custom queue is 16 by default.

4) Specify the queue length of the custom queue (optional)

The queue length of each priority queue can be specified (the queue length refers to the maximum number of packets that can be accommodated in a queue).

Perform the following task in the global configuration mode.

Table QC-3-14 Configuration of queue length of the custom queue

Operation	Command
Configure the queue length of the custom queue	**custom-list** *list-number* **queue** *queue-number* **limit** *queue-limit*
Restore the default value of custom queue length	**no custom-list** *list-number* **queue** *queue-number* **limit**

The queue length of the custom queue is 20 by default, with the value range of 0-32767 packets.

5) Configure the continuously sent byte number of the custom queue (optional),

The continuously sent byte number can be specified for each custom queue (the number of bytes that can be accommodated).

Perform the following task in the global configuration mode.

Table QC-3-15 Configure the continuously sent byte number of the custom queue

Operation	Command
Configure the continuously sent byte number of the custom queue	**custom-list** *list-number* **queue** *queue-number* **byte-count** *byte-count-number*
Restore the default value of the continuously sent byte number of the custom queue	**no custom-list** *list-number* **queue** *queue-number* **byte-count**

By default the continuously sent byte number of each queue is 1500 in each polling and the value range is 0-16777215 bytes.

byte-count-number: when the router dispatches the user queue of CQ, it keeps taking out packets from this queue to send till the sent byte count is no less than the value of *byte-count-number* configured for this queue or until this queue is empty, then it turns to dispatch the next user queue of CQ. Therefore, the value of *byte-count-number* will affect the proportion of interface bandwidth occupied by each user queue of CQ, and determine the duration after which the router will dispatch the next queue of CQ.

If the value of *byte-count-number* is too small, since the router will turn to the next queue only after it has at least sent one packet, the bandwidth actually obtained by respective queues may be quite different from what is expected. If the value of *byte-count-number* is too big, long delay may be resulted from switching between the queues.

III. Applying custom queue to the interface

The configured custom queue can be applied to a specific interface, and each interface can only be allocated with one custom queue.

Perform the following task in the interface configuration mode.

Table QC-3-16 Apply the custom queue to the interface

Operation	Command
Apply the custom queue to the interface	**custom-group** *list-number*
Restore the default congestion management policy at the interface	**no custom-group**

The interface adopts FIFO queuing by default.

IV. Maintaining and monitoring the custom queue

Table QC-3-17 Maintenance and monitoring of the custom queue

Operation	Command
Show the custom queue status	**show queuing custom**
Show the configuration of the custom queue at the interface	**show interface** [*type number*]
Enable the custom queue debugging packets switches	**debug custom-queue**

6) Show the status of the custom queue.

Quidway# show queueing custom

```
Current custom-queue-list configuration:
  List    Queue    Args
   1       0       default
```

3.2.3 Configuring WFQ

I. WFQ configuration task list

Configuration task of weighted fair queue is as follows:

- Configure the weighted fair queue
- Maintenance and monitoring of the weighted fair queue

II. Configuring the weighted fair queue

Perform the following task in the interface configuration mode.

Table QC-3-18 Configuring the weighted fair queue

Operation	Command
Configure the weighted fair queue	**fair-queue** [*discard-threshold* [*dynamic-queue-count*]]
Restore the managing policy of the default queue congestion on the interface	**no fair-queue**

By default, FIFO is adopted as the congestion management policy. *discard-threshold* is 64 bytes and *dynamic-queue-count* is 256 bytes by default.

III. Maintenance and monitoring of the weighted fair queue

Table QC-3-19 Maintenance and monitoring of the weighted fair queue

Operation	Command
Show the configuration of the weighted fair queue	**show queueing fair**
Enable the fair queue debugging packets switches	**debug fair-queue**

1) Show the status of the weighted fair queue.

Quidway# show queueing fair

```
Current fair queue configuration:
 Interface    Discard threshold    Dynamic queue count
```

```
Serial0          64                    256
```

3.3 Configuration Example of Congestion Management

3.3.1 PQ Configuration Example

! Define access control list, permitting packets from network segment 10.10.0.0 to pass.

Quidway(config)# access-list 1 permit 10.10.0.0

! Define a policy for the 1st group of the priority queue, allow IP packet with *access-list-list* 100 to enter the queue with **high** priority.

Quidway(config)# priority-list 1 protocol ip high list 1

! Define the length of the 1st high queue of the priority queue as 10, and the lengths of other queues adopt default values.

Quidway(config)# priority-list 10 queue-limit 10 40 60 80

! Apply priority queue 1 on Serial 0.

Quidway(config-if-Serial0)# priority-group 1

! Define a policy for the 2nd group of the priority queue, making all the packets from Serial 1 enter the queue with **medium** priority.

Quidway(config)# priority-list 2 interface serial 1 medium

! Apply priority queue 2 on Serial 1.

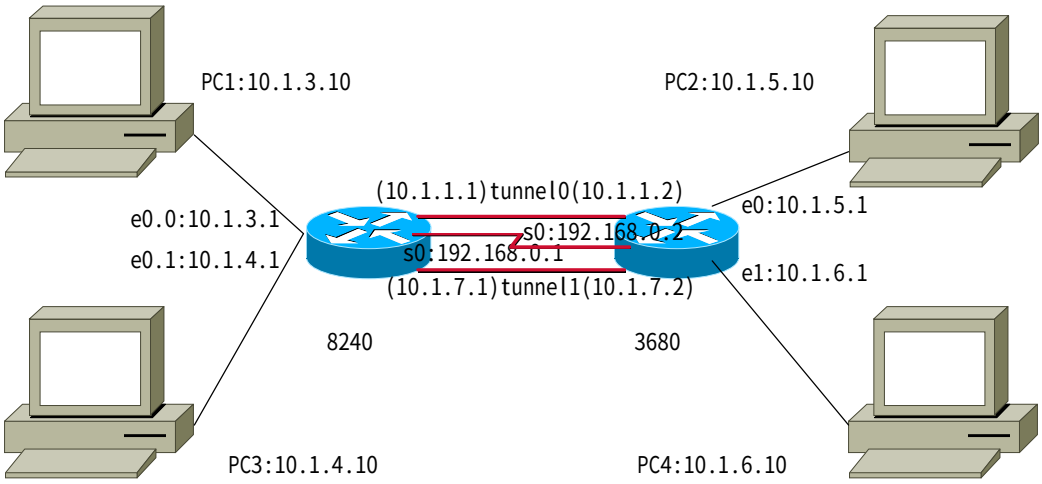
Quidway(config-if-Serial0)# priority-group 2

3.3.2 CQ Configuration Example

I. Requirements

In WAN, establish two parallel tunnels (GRE encapsulation) that correspond the same physical line, requiring that the physical line bandwidths are proportionally allocated according to the services on the two tunnels.

II. Networking diagram



Figre QC-3-6 Networking diagram of CQ Configuration

III. Configuration

1) Configuring 8240 router

! Configure access control list

Quidway(config)# access-list normal 105 permit ip 10.1.5.0 0.0.0.255 10.1.4.0 0.0.0.255

Quidway(config)# access-list normal 105 deny ip any any

Quidway(config)# access-list normal 107 permit ip 192.168.0.1 0.0.0.0 192.168.0.2 0.0.0.0

Quidway(config)# access-list normal 108 permit ip 192.168.1.1 0.0.0.0 192.168.1.2 0.0.0.0 (CQ uses this command)

! Configure CQ

Quidway(config)# custom-list 1 queue 1 limit 100

Quidway(config)# custom-list 1 queue 1 byte-count 5000

Quidway(config)# custom-list 1 queue 2 limit 100

Quidway(config)# custom-list 1 queue 2 byte-count 1000

Quidway(config)# custom-list 1 protocol ip 1 list 107

Quidway(config)# custom-list 1 protocol ip 2 list 108 (CQ restricts that the flow of tunnel0 is larger than that of tunnel1, and CQ is effective at the exit)

! Configure main and slave address of Serial0

Quidway(config-if-Serial0)# ip address 192.168.0.2 255.255.255.252

Quidway(config-if-Serial0)# ip address 192.168.1.2 255.255.255.252 secondary

! Apply CQ 1 on Serial0

Quidway(config-if-Serial0)# custom-group 1

! Configure Tunnel0

Quidway(config-if-Tunnel0)# ip address 10.1.2.1 255.255.255.0

Quidway(config-if-Tunnel0)# tunnel source 192.168.0.2

Quidway(config-if-Tunnel0)# tunnel destination 192.168.0.1

! Configure Tunnel1

Quidway(config-if-Tunnel1)# ip address 10.1.7.1 255.255.255.0

Quidway(config-if-Tunnel1)# tunnel source 192.168.1.2

Quidway(config-if-Tunnel1)# tunnel destination 192.168.1.1

2) Configuring 3680 router

Quidway(config)# access-list normal 105 permit ip 10.1.4.0 0.0.0.255 10.1.5.0 0.0.0.255

Quidway(config)# access-list normal 105 deny ip any any

Quidway(config)# access-list normal 107 permit ip 192.168.0.2 0.0.0.0 192.168.0.1 0.0.0.0

Quidway(config)# access-list normal 108 permit ip 192.168.1.2 0.0.0.0 192.168.1.1 0.0.0.0 (CQ uses this command)

! Configure CQ

Quidway(config)# custom-list 1 queue 1 limit 100

Quidway(config)# custom-list 1 queue 1 byte-count 5000

Quidway(config)# custom-list 1 queue 2 limit 100

Quidway(config)# custom-list 1 queue 2 byte-count 1000

Quidway(config)# custom-list 1 protocol ip 1 list 107

Quidway(config)# custom-list 1 protocol ip 2 list 108 (CQ restricts that the flow of tunnel0 is larger than that of tunnel1, and CQ is effective at the exit)

! Configure main and slave address of Serial0

Quidway(config-if-Serial0)# ip address 192.168.0.1 255.255.255.252

Quidway(config-if-Serial0)# ip address 192.168.1.1 255.255.255.252 secondary

! Apply CQ 1 on Serial0

Quidway(config-if-Serial0)# custom-group 1

! Configure Tunnel0

Quidway(config-if-Tunnel0)# ip address 10.1.2.2 255.255.255.0

Quidway(config-if-Tunnel0)# tunnel source 192.168.0.1

Quidway(config-if-Tunnel0)# tunnel destination 192.168.0.2

! Configure Tunnel1

Quidway(config-if-Tunnel1)# ip address 10.1.7.2 255.255.255.0

Quidway(config-if-Tunnel1)# tunnel source 192.168.1.1

Quidway(config-if-Tunnel1)# tunnel destination 192.168.1.2

3.4 Troubleshooting of Congestion Management

The common fault of congestion management configuration is that the expected goal of the user can not be fulfilled when the configuration is completed. The fault is usually caused by the incorrect policy of flow classification configured by the user. To solve the problem, enable the information debugging and locate the fault according to the debugging information displayed on the screen.

- Display PQ debugging information

Quidway#debug priority-queue

Quidway(config)#logging on

Quidway(config)#log console debug

When packets are sent by the interface configured with PQ policy, all information about queue selection will be shown on the screen.

- Display CQ debugging information

Quidway# debug custom-queue

Quidway(config)# logging on

Quidway(config)#log console debug

When packets are sent by the interface configured with CQ policy, all information about queue selection will be shown on the screen.

- Display WFQ debugging information

Quidway# debug fair-queue

Quidway(config)# logging on

Quidway(config)# logging console debug

When packets are sent by the interface configured with WFQ policy, all information about queue selection will be shown on the screen.

HUAWEI®

VRP

User Manual – Configuration Guide

Volume 3

10 – DDR Configuration (DC)

Table of Contents

Chapter 1 DDR Configuration

1.1 Brief Introduction to Dial Configuration

VRP1.3 provides subscribers with a perfect dial solution:

- Support various dial interfaces, including asynchronous serial ports, ISDN BRI interface and ISDN PRI interface, for subscribers to choose from according to networking needs and network conditions.
- Provide powerful DDR (Dial-on-Demand Routing) function to meet the needs of subscribers for various network topologies.
- Support link layer protocols like PPP.
- Support network layer protocols like IP and IPX.
- Support to run dynamic routing protocols like RIP on dial interfaces.
- Support flexible dial interface backup modes.
- Provide, at asynchronous dial interfaces, powerful control on various Modems.
- Highly interoperable with the dial functions of other various routers of the industry.

The following are the meanings of terms used in this chapter.

- Physical interface: interface that physically exists, like Serial0 interface or Bri0 interface.
- Dialer interface: logical interface that is set for DDR configuration. Specific physical interfaces can be bound to Dialer interface to enable DDR.
- Dial interface: a generic term for any interface used for dial connection—possibly a logical Dialer interface, or a physical interface bound to the Dialer interface, or a physical interface that directly enables DDR.
- Dial string: PSTN telephone number or ISDN telephone number
- Legacy DDR (Legacy DDR): a DDR configuration mode as compared with the “Dialer Profile”.
- Dialer Profile (Dialer Profiles): developed to meet the needs of various dial configurations for some common physical interfaces.

1.2 Introduction to DDR Technology

DDR is short for Dial-on-Demand Routing, referring to the routing technique used for interconnection of routers through PSTN. Currently there are two major kinds of public switched networks, PSTN (public switched telephone network) and ISDN (integrated services digital network). Dialing is necessary to get connected to them.

DDR is adopted when routers are interconnected by asynchronous serial ports through PSTN, or by ISDN BRI/PRI interface through ISDN. In most cases, routers are not connected. Only if there are packets to be transferred between them, will DDR be started and dialup connection established between them to transfer packets. When the links are idle, DDR will automatically disconnect them— in other words, “dial-on-demand”.

Therefore, DDR is quite cost-effective when there is not much information between two points and, if any, it is transferred in burst mode.

DDR is not a protocol, hence no international standards. It is implemented by various router vendors themselves as needed.

1.3 Preparing DDR Configuration

For a network needing DDR, subscribers can make configuration preparations following the flow below.

- Specify which routers in the network need DDR, which interfaces of these routers use DDR, what transmission medium is used, what topology is adopted, whether these interfaces are sending calls, receiving calls, or sending and receiving calls at the same time.
- Specify the type of interface to be used (asynchronous serial port or ISDN BRI/PRI interface).
- Specify the interface encapsulation to be used (PPP etc.).
- Specify the network protocol to be used (IP or IPX etc.).
- Specify the dynamic routing protocol (RIP etc.) to be used at DDR interface.
- Select either Legacy DDR or Dialer Profile to configure DDR.
- Configure DDR.

The flow chart of configuration preparations is shown in the following figure.

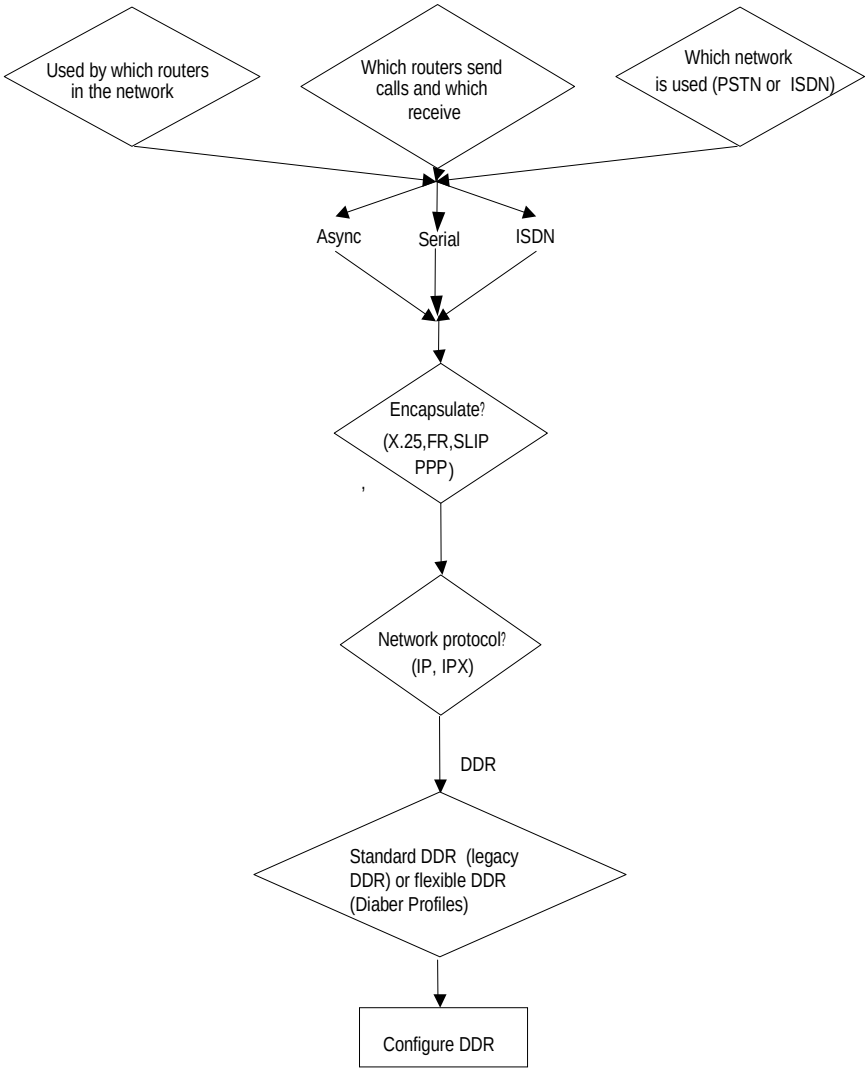


Figure DC-1-1 DDR configuration preparation flow

For details about the configurations of link layer protocol, network layer protocol and dynamic routing protocol, please refer to “WAN Protocol Configuration”, “Network Protocol Configuration” and “Routing Protocol Configuration” of this manual.

1.4 Configuring DDR

VRP1.3 provides two DDR configuration modes: Legacy DDR and Dialer Profile. The differences between the two DDRs are given below:

- Different scopes of applications

As described above, Dialer Profile is developed to meet the needs of various dial configurations for some common physical interfaces. For example, with only one ISDN BRI interface, Legacy DDR cannot enable Internet access and interconnection with another remote terminal at the same time, but this is possible with Dialer Profile.

- Different application methods and configurations

For Legacy DDR, a dial interface may be served by multiple physical interfaces, but a physical interface can belong to only one dial interface. A physical interface inherits the attributes of the dial interface that it serves. A physical interface can be both bound to the dial interface and configured as a dial interface, or directly configured as a dial interface (which is later referred to as “a physical interface directly enables DDR”). Finally, a dial interface can correspond to multiple call destination addresses through dialer map.

For Dialer Profile, although any interface may be served by multiple physical interfaces, a physical interface may serve multiple dial interfaces at the same time. It is necessary to configure authentication on the physical interface that serves Dialer Profile so that it can find, through the subscriber name of the dial-in party, the dial interface it should serve in this call. A physical interface must be bound to the dial interface to implement dial function. Finally, a dial interface corresponds to only one call destination address designated by the command dialer string.

By default, dialer in-band command is configured on ISDN BRI and PRI interfaces. That is, ISDN BRI/PRI interface is designated by default to enable DDR in Legacy DDR mode. Therefore:

- If ISDN BRI/PRI interface is configured in Legacy DDR mode, it is unnecessary to execute dialer in-band command.
- If ISDN BRI/PRI interface is configured in Dialer Profile mode, it is necessary to execute no dialer in-band command first.

Described below are the configurations of Legacy DDR, Dialer Profile, callback and special functions.

1.4.1 Configuring Legacy DDR

I. The configuration tasks of Legacy DDR include:

- Configure an interface to send calls
- Configure an interface to receive calls
- Configure an interface to send and receive calls
- Set the attribute parameters of Legacy DDR.

II. Configure an interface to send calls

1) Call to a single point

Step 1: enable DDR.

Please use the following commands in the configuration mode of the designated physical interface.

Table DC-1-1 Enable DDR in Legacy DDR mode

Operation	Command
Enable DDR in Legacy DDR mode	**dialer in-band**

This command is needed to make a call through an asynchronous serial port. For ISDN interface, the system automatically loads this command, making manual configuration with this command unnecessary.

Step 2: set the dial string of the interface.

The following command is needed to call only one destination through this interface.

Please use the following command in the configuration mode of the physical interface that directly enables DDR.

Table DC-1-2 Set the dial string of the interface

Operation	Command
Set the dial string of the interface	**dialer string** *dial-string* [*:isdn-address*]

2) Call to multiple points

Step 1: enable DDR.

For configuration mode and command format, please refer to Step 1 of “Call to a single point”.

Step 2: set different dial strings for different destinations.

Please use the following command in the configuration mode of the physical interface that directly enables DDR.

Table DC-1-3 Set different dial strings for different destinations

Operation	Command
Set different dial strings for different destinations	**dialer map** *protocol next-hop-address dialstring* [*: isdnsubaddress*]
Can define different identifiers for ISDN interface	**dialer map** *protocol next-hop-address dialstring* [*: isdnsubaddress*]

3) Call from Dialer Rotary Group

Dialer Rotary Group matches a logic dial interface to a group of physical interfaces. The configurations for this logic dial interface will be inherited by the physical interfaces in the Dialer Rotary Group. When a logic dial interface has been configured, once a physical interface is put in Dialer Rotary Group, this physical interface will inherit all configurations for the logic dial interface.

When Dialer Rotary Group has been configured, if multiple destinations have been set for a logic dial interface, then any physical interface in Dialer Rotary Group can be used to call any previously set destination.

Dialer Rotary Group applies to the interfaces with multiple calls to multiple destinations.

To configure a Dialer Rotary Group, follow the steps below:

Step 1: create a logic dial interface.

Please use the following command in global configuration mode.

Table DC-1-4 Create a logic dial interface

Operation	Command
Create a logic dial interface	**interface dialer** *number*

In the command, number is both the interface number of the logic dial interface and the identification number of Dialer Rotary Group. That is to say, when a logic dial interface is created, a Dialer Rotary Group is also specified for this interface.

Step 2: enable DDR.

Please use this command in the configuration mode of the logic dial interface.

For the command format, please refer to Step 1 of “Call to a single point”.

Step 3: designate multiple destinations for this Dialer Rotary Group.

Please use this command in the configuration mode of the dial interface.

Table DC-1-5 Set different dial strings for different destinations

Operation	Command
Set different dial strings for different destinations	**dialer map** *protocol next-hop-address Dialstring* [*: isdnsubaddress*]

Step 4: put the physical interface into Dialer Rotary Group.

Table DC-1-6 Put the designated physical interface into Dialer Rotary Group.

Operation	Command
Enter the configuration mode of the designated physical interface (used in global configuration mode)	**interface** *interface-type interface-number*
Put the physical interface into Dialer Rotary Group (used in the configuration mode of the designated physical interface)	**dialer rotary-group** *number*

The physical interface in Dialer Rotary Group doesn’t use its own IP address—in application, it will inherit the IP address of the logic dial interface. The parameter number in the command dialer rotary-group number in the configuration mode of the physical interface should be the same as the number in the command interface dialer number in the configuration mode of the logic interface corresponding to the physical interface.

In addition, an ISDN interface (BRI or PRI) itself can be regarded as Dialer Rotary Group of its subordinate B channel. Meanwhile, it can serve as a physical interface in other Dialer Rotary Groups.

Following is the schematic diagram of Dialer Rotary Group.

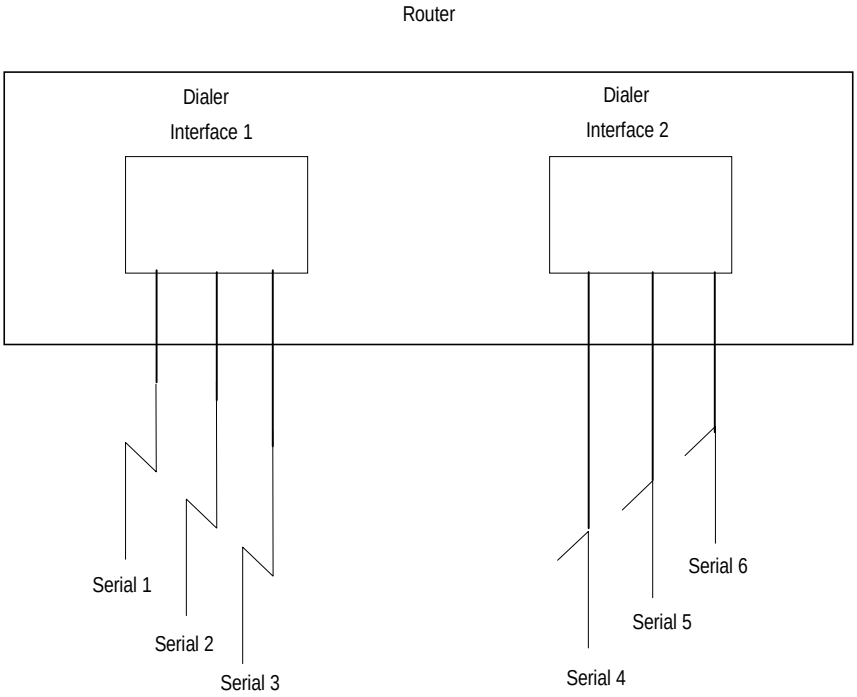


Figure DC-1-2 Schematic diagram of Dialer Rotary Group

III. Configure an interface to receive calls

1) Receive calls from a single point

To configure an interface to receive calls from a single point, just enable DDR.

For configuration mode and command format, please refer to Step 1 of “Call to a single point”.

As described above, for ISDN BRI/PRI interface, Legacy DDR has been enabled by default, making execution of this command unnecessary.

2) Receive calls from multiple points

Usually, Dialer Rotary Group can be defined to receive calls from multiple points. Calls can be received flexibly from Dialer Rotary Group.

Step 1: create a logic dial interface.

For configuration mode and command format, please refer to Step 2 of “Call from Dialer Rotary Group”.

Step 2: enable DDR.

For configuration mode and command format, please refer to Step 2 of “Call from Dialer Rotary Group”.

Step 3: select PPP encapsulation and select CHAP or PAP authentication.

Receiving calls from multiple points entails CHAP or PAP authentication, otherwise various points cannot be distinguished from each other. CHAP authentication is recommended because it has encrypted password before transferring it, while PAP authentication transfers clear text.

Please use this command in the configuration mode of the logic dial interface.

Table DC-1-7 Select PPP encapsulation and select CHAP or PAP authentication

Operation	Command
Select PPP encapsulation	**encapsulation ppp**
Select authentication mode	**ppp authentication** {**chap** | **pap**}

Step 4: set the correspondence between remote call subscriber name and protocol address so that the router can distinguish them.

Please use the following command in the configuration mode of the logic dial interface.

Table DC-1-8 Set the correspondence between remote subscriber name and protocol address

Operation	Command
Set the correspondence between remote subscriber name and protocol address	**dialer map** *protocol next-hop-address* **name** *hostname*

Step 5: if CHAP authentication is selected, users need to set the correspondence between user name and password. The settings of both parties of the call shall be consistent.

Please use the following command in the global configuration mode.

Table DC-1-9 Set the correspondence between user name and password

Operation	Command
Set the correspondence between user name and password	**user** *name* **password** {**0** | **7**} *password*

Step 6: put the physical interface into Dialer Rotary Group.

For the configuration mode, command format and use mode, please refer to Step 4 of "Call from Dialer Rotary Group".

IV. Configure an interface to send and receive calls

1) Send calls to and receive calls from a point

To send calls to and receive calls from a point, just make the following configurations and select PPP encapsulation. It is unnecessary to select authentication mode.

Table DC-1-10 Configure a point to send and receive calls

Operation	Command
Enter the configuration mode of a specified physical interface (used in global configuration mode)	**interface** *interface-type interface-number*
Enable DDR in Legacy DDR (used in the configuration mode of a specified physical interface)	**dialer in-band**
Set dial string (used in the configuration mode of the physical interface that directly enables DDR)	**dialer string** *dial-string* [: *isdnsubaddress*]

2) Send calls to and receive calls from multiple points

To send calls to and receive calls from multiple points, make the following configurations.

Table DC-1-11 Configure to send calls to and receive calls from multiple points

Operation	Command
Enter the configuration mode of a specified physical interface (used in global configuration mode)	**interface** *interface-type interface-number*
Select PPP encapsulation (used in the configuration mode of the specified physical interface)	**encapsulation ppp**
Select authentication mode (used in the configuration mode of the specified physical interface)	**ppp authentication** {**chap** | **pap**}
Configure the correspondence between the protocol address of the remote interface and user name and dial string (used in the configuration mode of the specified physical interface)	**dialer map** *protocol next-hop-address* **name** *hostname dialerstring* [: *isdnsubaddress*]

V. Set the attribute parameters of Legacy DDR

1) Set link idle time

If an interface has been set to send calls, then it is possible to set that DDR will disconnect the link in case of link idle timeout.

Please use the following command in the configuration mode of dial interfaces (including logic dial interface and physical interface that directly enables DDR, same below).

Table DC-1-12 Set link idle timeout

Operation	Command
Set link idle timeout	**dialer idle-timeout** *seconds*

2) Set idle time of busy interface

When links compete with each other, fast-idle timer will be started. Competition refers to the case when an interface, which has already established a link, is required to establish a new link with another interface. If the idle time of the first link exceeds the time set by fast-idle timer, DDR will disconnect the first link and establish a new link.

Please use the following command in the configuration mode of the dial interface.

Table DC-1-13 Set the idle time of busy interface

Operation	Command
Set the idle time of busy interface	**dialer fast-idle** *seconds*

3) Set link disconnection time

When a link is disconnected due to failure or onhook, a new connection can be established only after the set time.

Please use the following command in the configuration mode of the dial interface.

Table DC-1-14 Set link disconnection time

Operation	Command
Set link disconnection time	**dialer enable-timeout** *seconds*

4) Set the maximum waiting time interval from call originating to call connection establishment.

Please use the following command in the configuration mode of the dial interface.

Table DC-1-15 Set wait-for-carrier time for port data

Operation	Command
Set the maximum waiting time interval from call originating to call connection establishment.	**dialer wait-for-carrier-time** *seconds*

5) Set access control of the dial interface

Message filtering function can be set for the dial interface. Messages passing the dial interface can be classified into two categories through access control:

- Interesting—messages undergoing access control. When the dial interface receives an interesting message, if the corresponding link has been established, then DDR will send the message through this link and clear idle-time timer. If the corresponding link has not been established, then a call will be sent.
- Uninteresting—messages not under access control. When the dial interface receives an uninteresting message, if the corresponding link has been established, DDR will send the message through this link and do not clear idle-time timer. If the corresponding link has not been established, no call will be sent and this message will be discarded.

If no dialer-group has been configured in the interface configuration, or no dialer-list corresponding to dialer-group has been configured in the global configuration, the dial interface cannot send the message.

Table DC-1-16 Set access control of the dial interface

Operation	Command
Configure standard access control list (used in global configuration mode)	**access-list** *access-list-number* {**deny** | **permit**} [wildcard-mask]
Configure extended access control list (used in global configuration mode)	**access-list** access-list-number {**deny** | **permit**} protocol
Configure the correspondence between access-list and Dialer Access Group (used in global configuration mode)	**dialer-list** *dialer-group* **protocol** *protocol-name* {**permit** | **deny**} or **dialer-list** *dialer-group* **list** *access-list-number*
In the configuration of dial interface, put the interface in Dialer Access Group (used in the configuration mode of dial interface)	**dialer-group** *group-number*

6) Set the priorities of physical interfaces in Dialer Rotary Group

Specify the sequence to use various interfaces based on their priorities.

Please use the following command in the configuration mode of the designated physical interface.

Table DC-1-17 Set the priorities of physical interfaces in Dialer Rotary Group

Operation	Command
Set the priorities of physical interfaces in Dialer Rotary Group	**dialer priority** *number*

The value range of number is 1-127, 1 being the highest, 127 the lowest, and 1 by default.

7) Set hold-queue

If no hold-queue has been established at the dial interface, when a message reaches the dial interface, the message will be lost. If a hold-queue has been established, then the message will be cached rather than get lost before connection establishment.

Please use the following command in the configuration mode of the dial interface.

Table DC-1-18 Set hold-queue at the dial interface

Operation	Command
Set hold-queue at the dial interface	**dialer hold-queue** *packets*

8) Set load threshold

In a Dialer Rotary Group, when the proportion between flow and bandwidth, which locate on a physical interface that directly enables DDR (including serial port, ISDN BRI/PRI interface) or a Dialer interface, exceeds load threshold presupposed, DDR will start another physical interface or another physical interface belongs to the same Dialer Rotary Group and transfer data to the same destination. Actually, it realizes dynamic PPP link binding under Legacy DDR.

This command must be used together with **ppp multilink** command. To have the detail of **ppp multilink**, please refer to ”Configure Link Layer protocols” in “VRP User Manual-Command Reference (V1.5)”.

In a Dialer Rotary Group, when the traffic bandwidth of a physical interface exceeds the preset threshold, DDR will start another physical interface and transfer data to the same destination.

Perform the following task in the dialer interface configuration mode.

Table DC-1-19 Set load threshold

Operation	Command
Set load threshold	**dialer load-threshold** *load* [**either** | **inbound** | **outbound**]
Configure the interface encapsulated with PPP to operate in MP mode	**ppp multilink**

9) Set autodial interval

The following command, used in combination with the key word autodial in dialer map command, is used to set the interval for DDR to make autodial attempts.

Please use the following command in the configuration mode of the dial interface.

Table DC-1-20 Set autodial interval

Operation	Command
Set autodial interval	**dialer autodial-interval** *seconds*

The default interval is 300 seconds.

1.4.2 Configuring Dialer Profile

I. Introduction to Dialer Profile

Dialer Profile allows the configuration of a physical interface and the logic configuration of a call to be made separately, and then dynamically bind the two to place a call.

Dialer Profile uses Dialer Profiles to describe its dial attributes. All calls to the same destination network use the same Dialer Profiles. A Dialer Profiles include the following elements:

- A logic dial interface, corresponding to a dial string, used to reach a destination network.
- Features of the dial interface, such as idle-timeout.
- A Dialer Pool, the set of bound physical interfaces with priorities, used for dial.

In a Dialer Profiles, the relation between dial interfaces, Dialer Pool and physical interfaces is:

- One dial interface can use only one Dialer Pool.
- One Dialer Pool may contain several physical interfaces with different priorities, and a physical interface may belong to several different Dialer Pool.

Therefore, in configuring DDR with Dialer Profile, the configuration tasks for a physical interface include: select encapsulation, configure Dialer Pool to which the interface belongs, and set dial authentication mode.

The relation between dial interfaces, Dialer Pool and physical interfaces is shown in the following diagram.

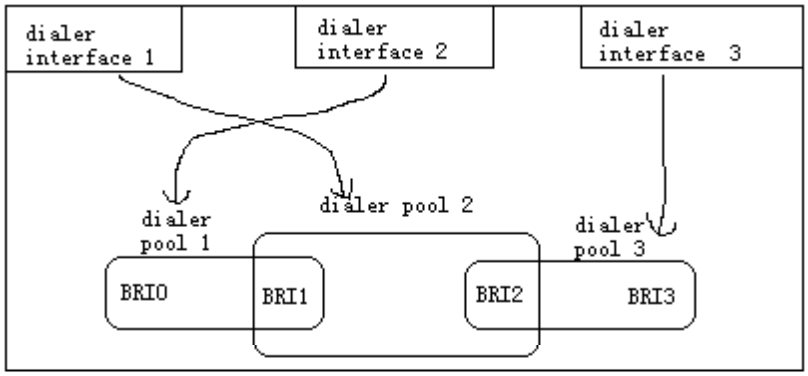


Figure DC-1-3 Schematic diagram of the relation between dial interfaces, dialer pool and physical interfaces

In the above diagram, dial interface 1 uses Dialer Pool 2, physical interface BRI 1 belongs to Dialer Pool 2, with a priority. Physical interface BRI 2 also belongs to Dialer Pool 2, but with a different priority. For example, suppose that the priority of BRI 1 in Dialer Pool 2 is 100 and that of BRI 2 is 50. Because the priority of BRI 1 is higher than that of BRI 2, dial interface 1 will first select BRI 1 in Dialer Pool 2.

II. Configuration task list of Dialer Profile

The configuration tasks of Dialer Profile include:

- Configure a logic dial interface
- Set the attribute parameters of the logic dial interface
- Bind physical interfaces for a Dialer Pool

III. Configure a logic dial interface

Many logic dial interfaces (the specific number depends on router resources) can be created in a router. Every logic dial interface includes all configurations required to reach a destination network.

Follow the steps below to configure a logic dial interface. Please use the following command in the configuration mode of the logic dial interface.

Table DC-1-21 Configure a logic dial interface

Operation	Command
Set fast-idle time	**dialer fast-idle** *seconds*
Set idle-timeout time	**dialer idle-timeout** *seconds*
Set wait-for-carrier-time	**dialer wait-for-carrier-time** *seconds*
Set autodial interval	**dialer autodial-interval** *seconds*
Set hold-queue	**dialer hold-queue** *packets*
Set load threshold (only in Dialer interface configuration mode)	**dialer load-threshold** *load* [**either** | **inbound** | **outbound**]
Set link disconnection time	**dialer enable-timeout** *seconds*

IV. Set the attribute parameters of a dial interface

Please use the following command in the configuration mode of the logic dial interface.

Table DC-1-22 Configure the features of the dial interface

Operation	Command
Set fast-idle time	**dialer fast-idle** *seconds*
Set idle-timeout time	**dialer idle-timeout** *seconds*
Set wait-for-carrier-time	**dialer wait-for-carrier-time** *seconds*
Set autodial interval	**dialer autodial-interval** *seconds*

V. Bind physical interfaces for a dialer pool

The following steps are enough to bind a physical interface for a Dialer Pool.

Table DC-1-23 Configure a physical interface for a dialer pool

Operation	Command
Enter the configuration mode of the designated physical interface (used in global configuration mode)	**interface** *interface-type interface-number*
Select PPP encapsulation (used in the configuration mode of the designated physical interface)	**encapsulation ppp**
Set CHAP authentication (used in the configuration mode of the designated physical interface)	**ppp authentication chap**
Designate this interface as a member of a Dialer Pool, and set its priority (use this command again to designate this interface as a member of another Dialer Pool at the same time) (used in the configuration mode of the designated physical interface)	**dialer pool-member** *number* [**priority** *priority*]

1.4.3 Configuring Callback

I. The significance of callback

Callback enables “call receiver” to call back “call sender” so as to:

- Enhance security: in callback processing, Server end calls Client (as above) end according to locally configured call number, thus avoiding insecurity due to disclosed user name and password.
- Save call charge (when the charge rates of two directions are different).
- Change charge bearer.
- Combine charge lists.

II. Terms and abbreviations

- Client end: the first call originator, which requires the opposite end to call back the local end.
- Server end: the first call receiver, which will call back the opposite end.

III. Functions implemented by callback

Callback requires the common participation of two ends, one as Client end and the other as Server end. The basic operation flow is: Client end originates a call as “call sender”, Server end determines whether to call back; if so, Server end disconnects the incoming call, and sends a call to Client end.

VRP1.3 implements the following two callback functions:

1) In PPP callback, the following supports are considered:

- General support (both ends have fixed network layer addresses and have implemented RFC1570).
- Support when Client end needs dynamic distribution of network layer addresses.
- Support when only Server end has implemented RFC1570.

2) In ISDN environment, use ISDN calling line identification function to realize callback.

IV. Configure ISDN calling line identification callback

To support ISDN calling line identification callback, a dialer caller command is provided at ISDN interface.

1) The configurations when ISDN calling line identification callback is combined with Legacy DDR.

Table DC-1-24 Use Legacy DDR to configure ISDN calling line identification callback

Operation	Command
Enter the configuration mode of the designated dial interface (used in global configuration mode)	**interface** *interface-type interface-number*
Perform callback or connection for an incoming call that matches remote-number (used in the configuration mode of the dial interface)	**dialer caller** *remote-number* **callback** or **dialer caller** *remote-number*
Set delay time before callback (used in the configuration mode of the dial interface)	**dialer enable-timeout** *seconds*

remote-number in dialer caller command refers to the telephone number of the remote end.

2) The configurations when ISDN calling line identification callback is combined with Dialer Profile.

Table DC-1-25 Use Dialer Profile to configure ISDN calling line identification callback

Operation	Command
Enter the configuration mode of the logic dial interface (used in global configuration mode)	**interface dialer** *interface-number*
Perform callback or connection for an incoming call that matches remote-number (used in the configuration mode of the dial interface)	**dialer caller** *remote-number* **callback** or **dialer caller** *remote-number*
Set delay time before callback (used in the configuration mode of the dial interface)	**dialer enable-timeout** *seconds*

3) Application features of ISDN calling line identification callback

i. An incoming call is processed in any of the following three ways based on the matching of incoming call number and the locally configured dialer caller:

- Reject the incoming call—if dialer caller has been configured and the incoming call number doesn't have any matching dialer caller.
- Accept the incoming call—dialer caller has not been configured, or the incoming call number matches the dialer caller without the key word "callback".
- Callback—the incoming call number matches the dialer caller containing the key word "callback".

ii. The matching between the incoming call number and dialer caller is “right end matching”, with “*” representing any character.

iii. If multiple dialer callers match the incoming call number, then select one in line with the following principle:

- Majority principle: first select the one with less “*”.
- Minority principle: first select the one that is found first.

iv. Specify the dialer caller related to an incoming call in line with the following principle:

- If the physical interface receiving the call is an interface bound by Legacy DDR, then, in “dialer caller” configured by the logic dial interface to which it belongs, search the dialer caller matching the incoming call number.
- If the physical interface receiving the call is an interface bound by Dialer Profile, then, in all “dialer callers” configured by the logic dial interface to which it belongs, search the dialer caller matching the incoming call number.

v. Before callback, take enable-timeout value configured at the corresponding dial interface (or the physical interface that directly enables DDR) as the delay time.

vi. For an incoming call which is determined as needing callback according to dialer caller, it is also necessary to configure, at the corresponding interface, dialer map completely consistent with dial string and incoming call string (when combining with the dialer string of Dialer Profile, dialer string has to be configured, which needn’t be consistent with the incoming call string).

V. Configure PPP callback

In applying PPP callback, configure one end as Client end and the other end as Server end.

1) The system provides three configuration commands to implement PPP callback

Please use the following two commands in the configuration mode of the dial interface.

Table DC-1-26 PPP callback commands in the configuration mode of the dial interface

Operation	Command
Set the local end as callback Server end/Client end	**ppp callback accept | request**
Configure callback by searching the matching dialer map according to the name of the remote end or by the callback dial string. At this time, dialer map command must contain name parameter, otherwise callback is impossible	**dialer callback-server username** or **dialer callback-server dial-string**

The first command is configured at Server end, used by DDR to determine whether to call back by using the dial string provided PPP, or to call back according to the configuration contents of dialer map.

The key word “accept” in the second command sets the router as Server end and the key word “request” sets the router as Client end.

Please use the following command in global configuration mode.

Table DC-1-27 PPP callback command in global configuration mode

Operation	Command
The call string for the local end to determine callback according to the name of the remote end	**user** *name* [**callback-dialstring** *telephone-number*]

2) Use Legacy DDR to configure PPP callback

The configurations of Client end are shown in the following table.

Table DC-1-28 Client end using Legacy DDR to configure PPP

Operation	Command
Enter the configuration mode of the dial interface (used in global configuration mode)	**interface** *interface-type interface-number*
Select PPP encapsulation (used in the configuration mode of the dial interface)	**encapsulation ppp**
Set local end name and password for remote authentication (used in the configuration mode of the dial interface)	**ppp pap sent-username** *name* **password** {**0** | **7**} *password* or **ppp chap host** *name* **ppp chap password** { **0** | **7** } *password*
Set the local end to authenticate the name and password of the remote end in CHAP mode (used in global configuration mode)	**user** *remotename* **password** {**0** | **7**} *password*
Set the local end as callback Client end (used in the configuration mode of the dial interface)	**ppp callback request**
Set local call and dial strings (used in the configuration mode of the dial interface)	**dialer map** *protocol nexthopaddr dial-string*

The configurations of Server end are shown in the following table.

Table DC-1-29 Server end using Legacy DDR to configure PPP callback

Operation	Command
Enter the configuration mode of the dial interface (used in global configuration mode)	**interface** *interface-type interface-number*
Select PPP encapsulation (used in the configuration mode of the dial interface)	**encapsulation ppp**
Set PPP authentication mode (used in the configuration mode of the dial interface)	**ppp authentication pap** or **ppp authentication chap**
Set the local end as callback Server end (used in the configuration mode of the dial interface)	**ppp callback accept**
Configure callback by searching the matching dialer map according to the name of the remote end or by the callback dial string. At this time, dialer map command must contain name parameter, otherwise callback is impossible (used in the configuration mode of the dial interface)	**dialer callback-server username** or **dialer callback-server dial-string**
If dialer callback-server dial-string has been configured, callback dial string needs to be configured (used in global configuration mode)	**user** *name* **callback-dialstring** *telephone-number*

3) Use Dialer Profile to configure PPP callback

The configurations of Client end are shown in the following table.

Table DC-1-30 Client end using Dialer Profile to configure PPP callback

Operation	Command
Enter the configuration mode of the dial interface (used in global configuration mode)	**interface dialer** *interface-number*
Select PPP encapsulation (used in the configuration mode of the dial interface)	**encapsulation ppp**
Set local end name and password for remote authentication	**ppp pap sent-username** *name* **password** {**0** | **7**} *password* or **ppp chap host** *name* **ppp chap password** {**0** | **7**} *password*
Set the local end to authenticate the name and password of the remote end in chap mode (used in global configuration mode)	**user** *remotename* **password** {**0** | **7**} *password*
Set the local end as callback Client end (used in the configuration mode of the dial interface)	**ppp callback request**
Set local call and dial strings (used in the configuration mode of the dial interface)	**dialer string** *dial-string*

The configurations of Server end are shown in the following table.

Table DC-1-31 Server end using Dialer Profile to configure PPP callback

Operation	Command
Enter the configuration mode of the dial interface (used in global configuration mode)	**interface dialer** *interface-number*
Select PPP encapsulation (used in the configuration mode of the dial interface)	**encapsulation ppp**
Set PPP authentication mode, which should be the same as that selected by the Client end (used in the configuration mode of the dial interface)	**ppp authentication pap** or **ppp authentication chap**
Set the local end as callback Server end (used in the configuration mode of the dial interface)	**ppp callback accept**
Set callback based on callback dial string (used in the configuration mode of the dial interface)	**dialer callback-server dial-string**
Set callback dial string (used in global configuration mode)	**user** *name* **callback-dialstring** *telephone-number*

1.4.4 Configuring DDR Special Functions

I. Configure ISDN dedicated line

The essence of configuring ISDN is to establish a semi-permanent connection. ISDN dedicated line configuration can only be used in combination with Legacy DDR configuration. This function requires that the switch of the telecom office should have corresponding dedicated lines connecting the remote equipment.

Table DC-1-32 Use Legacy DDR to configure ISDN dedicated line

Operation	Command
Configure dial string, according to which DDR determines datagram (used in the configuration mode of the dial interface)	**dialer-list** *dialer-group* **protocol** *protocol-name* {**permit** | **deny** | **list** *access-list-number*}
Enter the configuration mode of the designated ISDN interface (used in global configuration mode)	**interface** *interface-type interface-number*
Set the ISDN interface to belong to a dialer group (used in the configuration mode of ISDN interface)	**dialer-group** *number*
Set B channel used to connect dedicated lines (used in the configuration mode of ISDN interface)	**dialer isdn-leased** *channel-number*
Configure dialer map (used in the configuration mode of the dial interface)	**dialer map** *protocol next-hop-address dial-string*

II. Configure autodial

Autodial means that when the router has been started, DDR will automatically try to establish dial connection with the remote end, making it unnecessary to trigger datagram. If dial connection fails, DDR will automatically try to establish dial connection at regular intervals. Once the dial connection is established, it won't disconnect itself due to timeout (i.e. dialer idle-timeout is not functional).

Table DC-1-33 Configure autodial

Operation	Command
Enter the configuration mode of the designated dial interface (used in global configuration mode)	**interface** *interface-type interface-number*
Configure dialer map for autodial (used in the configuration mode of the dial interface)	**dialer map** *protocol next-hop-address* **name** *hostname dialerstring* [*: isdnsubaddress*] **autodial**
Set autodial interval (used in the configuration mode of the dial interface)	**dialer autodial-interval** *seconds*

Autodial interval is 300 seconds by default.

III. Configure cyclic use of dialer map

In dialer map configuration, the same destination network layer address can be configured with multiple dialer maps, using different dial strings, thus forming dial string backup between them. When DDR is establishing dial connection with the remote end, if the dial string currently used can't connect the remote end, then, in the next call, the next dialer map and the dial string configured by it will be selected automatically. The configurations are as follows:

Table DC-1-34 Configure cyclic use of dialer map

Operation	Command
Enter the configuration mode of the dial interface (used in global configuration mode)	**interface** *interface-type interface-number*
Configure dialer map (used in the configuration mode of the dial interface)	**dialer map** *protocol next-hop-address* **name** *hostname dialerstring* [*: isdn subaddress*]
Configure several other dialer maps oriented to the same destination network layer address and using different dial strings (used in the configuration mode of the dial interface)	**dialer map** *protocol next-hop-address* **name** *hostname dialerstring* [*: isdn subaddress*]

1.5 Monitoring and Maintenance of DDR

In any configuration mode, the following command can be used to display dial interface information, thus monitoring and maintaining DDR.

Table DC-1-35 Display DDR interface information

Operation	Command
Display dial interface information	**show dialer** [**interface** *interface-type interface-number*]

For example:
Quidway# show dialer interface serial 1

The system displays:

```
Serial1 - dialer type = Serial
NextHop_address      Dialer_Strings       Successes       Failures Max_call
Last_call
100.1.1.1           8888
Idle timer (120 secs),           Fast Idle timer (20 secs)
Wait for carrier  (60 secs),   Re_enable (20 secs)
```

The above includes dialer map table at the interface and such information as the configuration of DDR features. Specific items are explained in the following table.

Table DC-1-36 Description of the display information items of show dialer command

Name	Meaning
NextHop_address	The address of the remote end corresponding to a Dialer map at the interface
Dialer_Strings	Dial string corresponding to the Dialer map
Successes	Number of Dialer map call successes
Failures	Number of Dialer map call failures
Max_call	The maximum time Dialer map is used
Last_call	The time Dialer map is used for the last call
Idle timer	The time set by Dialer idle-timeout command
Fast Idle timer	The time set by Dialer fast-idle command
Wait for carrier	The time set by Dialer wait-for-carrier-time command
Re_enable	The time set by Dialer enable-timeout command

1.6 DDR Typical Configuration Example

1.6.1 Legacy DDR

I. Network requirements

In the following diagram, the local router XXX and the remote routers YYY and ZZZ are connected through DDR. Remote routers YYY and ZZZ can call the local router XXX, while XXX can only call YYY, not ZZZ.

II. Networking diagram

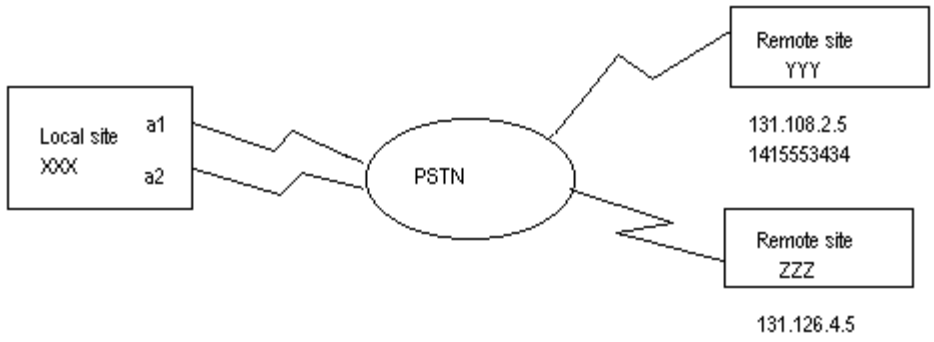


Figure DC-1-4 Schematic diagram of a Legacy DDR configuration

III. Configuration procedure

! Create a dial interface

Quidway (config)# interface dialer 1

! Configure IP address of the dial interface

Quidway (config-if-Dialer1)# ip address 131.108.2.1 255.255.255.0

Quidway (config-if-Dialer1)# ip address 131.126.4.1 255.255.255.0 secondary

! Configure encapsulation PPP of the dial interface and CHAP authentication

Quidway (config-if-Dialer1)# encapsulation ppp

Quidway (config-if-Dialer1)# ppp authentication chap

! Configure domain name XXX of the local router

Quidway (config-if-Dialer1)# ppp chap host XXX (this name is the same as the user name when the remote router configuration authenticates the local end. This will not be explained further in later examples).

! Configure password xxxsystem when the local router is authenticated by the remote router

Quidway (config-if-Dialer1)# ppp chap password 0 xxxsystem

! Enable DDR in Legacy DDR mode

Quidway (config-if-Dialer1)# dialer in-band

! Designate the subordinate Group

Quidway (config-if-Dialer1)# dialer-group 1

! Indicating that the local end and YYY can send calls to and receive calls from each other

Quidway (config-if-Dialer1)# dialer map ip 131.108.2.5 name YYY 1415553434

! Indicating that the local end can only receive calls from ZZZ

Quidway (config-if-Dialer1)# dialer map ip 131.126.4.5 name ZZZ

Quidway (config-if-Dialer1)# exit

! Set dial control

Quidway (config)# dialer-list 1 protocol ip permit

! Designate the asynchronous serial ports Serial0 and Serial1 to belong to rotary-group 1 (corresponding to interface dialer 1, which will not be explained further in later examples).

Quidway (config)# interface serial 0

Quidway (config-if-Serial0)# dialer rotary-group 1

Set Serial0 to asynchronous mode and enable Modem attributes.

Quidway (config-if-Serial0)# physical-layer async

Quidway (config-if-Serial0)# modem

Quidway (config-if-Serial0)# exit

Quidway (config)# interface serial 1

Set Serial1 as asynchronous mode and enable Modem attributes.

Quidway (config-if-Serial1)# physical-layer async

Quidway (config-if-Serial1)# modem

Quidway (config-if-Serial1)# dialer rotary-group 1

! Configure remote user name and password for CHAP authentication: router YYY password to be authenticated is yyysystem; router ZZZ password to be authenticated is zzzsystem.

Quidway (config)# user YYY password 0 yyysystem

Quidway (config)# user ZZZ password 0 zzzsystem

1.6.2 Dialer Profile

I. Networking requirements

In the following diagram, the central router is connected to the remote end through four ISDN BRI interfaces. It can send and receive calls. Each remote end is in a different IP network section.

II. Networking diagram

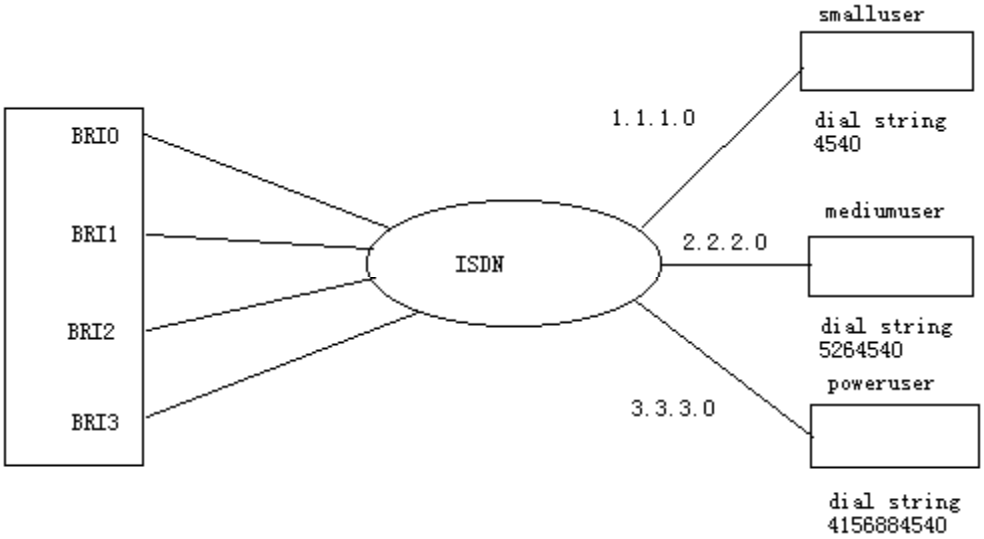


Figure DC-1-5 Schematic diagram of a Dialer Profile configuration

III. Configuration procedure

! Create Dialer Profile going to IP subnetwork 1.1.1.0
Quidway(config)# interface dialer 1
Quidway(config-if-Dialer1)# no dialer in-band
Quidway(config-if-Dialer1)# ip address 1.1.1.1 255.255.255.0
Quidway(config-if-Dialer1)# encapsulation ppp
Quidway(config-if-Dialer1)# dialer remote-name Smalluser
Quidway(config-if-Dialer1)# dialer string 4540
Quidway(config-if-Dialer1)# dialer pool 3
Quidway(config-if-Dialer1)# dialer-group 1
Quidway(config-if-Dialer1)# exit
! Create Dialer Profile going to IP subnetwork 2.2.2.0
Quidway(config)# interface dialer 2
Quidway(config-if-Dialer2)# no dialer in-band
Quidway(config-if-Dialer2)# ip address 2.2.2.2 255.255.255.0

```
Quidway(config-if-Dialer2)# encapsulation ppp
Quidway(config-if-Dialer2)# dialer remote-name Mediumuser
Quidway(config-if-Dialer2)# dialer string 5264540
Quidway(config-if-Dialer2)# dialer pool 1
Quidway(config-if-Dialer2)# dialer-group 2
! Create Dialer Profile going to IP subnetwork 3.3.3.0
Quidway(config)# interface dialer 3
Quidway(config-if-Dialer3)# no dialer in-band
Quidway(config-if-Dialer3)# ip address 3.3.3.3 255.255.255.0
Quidway(config-if-Dialer3)# encapsulation ppp
Quidway(config-if-Dialer3)# dialer remote-name Poweruser
Quidway(config-if-Dialer3)# dialer string 4156884540
Quidway(config-if-Dialer3)# dialer hold-queue 10
Quidway(config-if-Dialer3)# dialer pool 2
Quidway(config-if-Dialer3)# dialer-group 2
! Configure interface Bri0
Quidway(config)# interface bri 0
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# dialer pool-member 1 priority 100
Quidway(config-if-Bri0)# ppp authentication chap
! Configure interface Bri1
Quidway(config)# interface bri 1
Quidway(config-if-Bri1)# encapsulation ppp
Quidway(config-if-Bri1)# dialer pool-member 1 priority 50
Quidway(config-if-Bri1)# dialer pool-member 2 priority 50
Quidway(config-if-Bri1)# dialer pool-member 3
Quidway(config-if-Bri1)# ppp authentication chap
! Configure interface Bri2
Quidway(config)# interface bri 2
Quidway(config-if-Bri2)# encapsulation ppp
Quidway(config-if-Bri2)# dialer pool-member 2 priority 100
Quidway(config-if-Bri2)# ppp authentication chap
! Configure interface Bri3
Quidway(config)# interface bri 3
Quidway(config-if-Bri3)# encapsulation ppp
```

Quidway(config-if-Bri3)# dialer pool-member 2 priority 150

Quidway(config-if-Bri3)# ppp authentication chap

! Configure remote user name and password for CHAP authentication and set dial control. Please refer to Example 1 (omitted here).

1.6.3 Point-to-Point DDR

I. Networking diagram

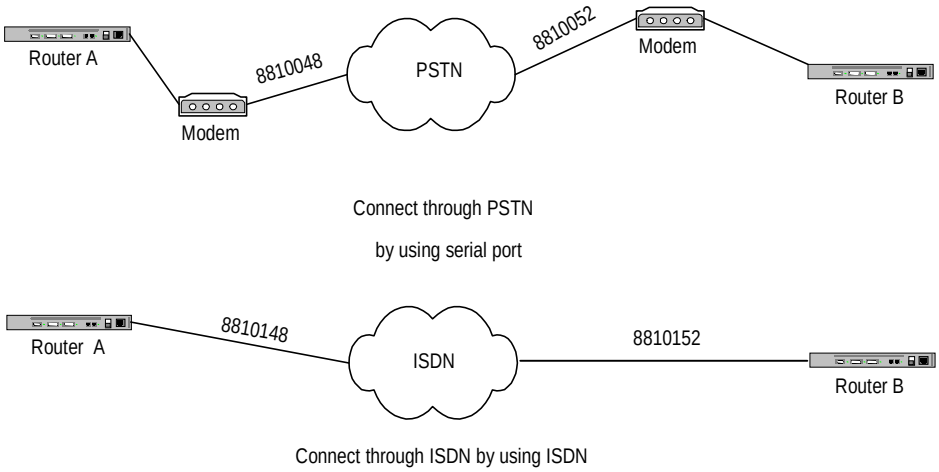


Figure DC-1-6 Networking diagram of point-to-point DDR configuration example

II. Configuration procedure

Solution 1: use Legacy DDR configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810052

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048

Solution 2: use Dialer Profile configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810048

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

Solution 3: use Legacy DDR configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 8810152

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

Solution 4: use Dialer Profile configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810152

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer string 8810148
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

1.6.4 Point-to-Multipoint DDR

I. Networking requirements

In the connection as shown in the following diagram, A and B can call each other, A and C can call each other, but B and C can't call each other.

II. Networking diagram

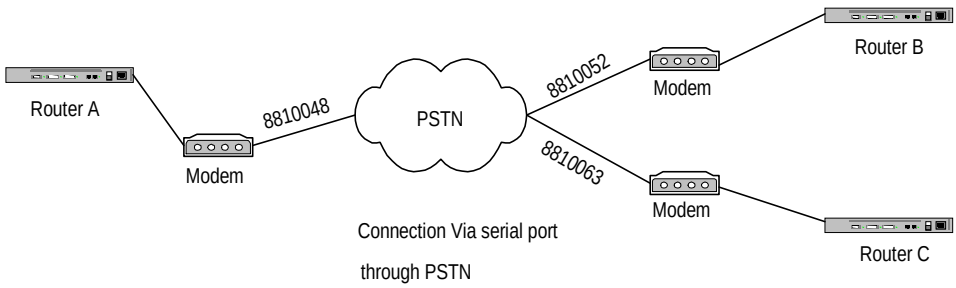


Figure DC-1-7 Networking diagram of point-to-multipoint DDR configuration example

III. Configuration procedure

Solution 1: use Legacy DDR configuration mode to realize the following at the serial port:

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
```

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810052

Quidway(config-if-Serial0)# dialer map ip 100.1.1.3 8810063

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048

3) Configure router C:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.3 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048

Solution 2: use Dialer Profile configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# user userc password 0 passc

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

```
Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# dialer string 8810052
Quidway(config-if-Dialer0)# interface dialer 1
Quidway(config-if-Dialer1)# ip address 122.1.1.1 255.255.255.0
Quidway(config-if-Dialer1)# dialer remote-name userc
Quidway(config-if-Dialer1)# dialer-group 1
Quidway(config-if-Dialer1)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer1)# dialer pool 2
Quidway(config-if-Dialer1)# dialer string 8810063
Quidway(config-if-Dialer1)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer pool-member 1
Quidway(config-if-Serial0)# dialer pool-member 2
Quidway(config-if-Serial0)# encapsulation ppp
Quidway(config-if-Serial0)# ppp authentication pap
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# dialer string 8810048
Quidway(config-if-Dialer0)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer pool-member 1
Quidway(config-if-Serial0)# encapsulation ppp
Quidway(config-if-Serial0)# ppp authentication pap
```

3) Configure router C:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 122.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userc password 0 passc
Quidway(config-if-Dialer0)# dialer string 8810048
Quidway(config-if-Dialer0)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer pool-member 1
Quidway(config-if-Serial0)# encapsulation ppp
Quidway(config-if-Serial0)# ppp authentication pap
```

1.6.5 Multipoint-to-Multipoint DDR

I. Networking requirements

In the connection as shown in the following diagram, A can establish calls with B and C at the same time.

II. Networking diagram

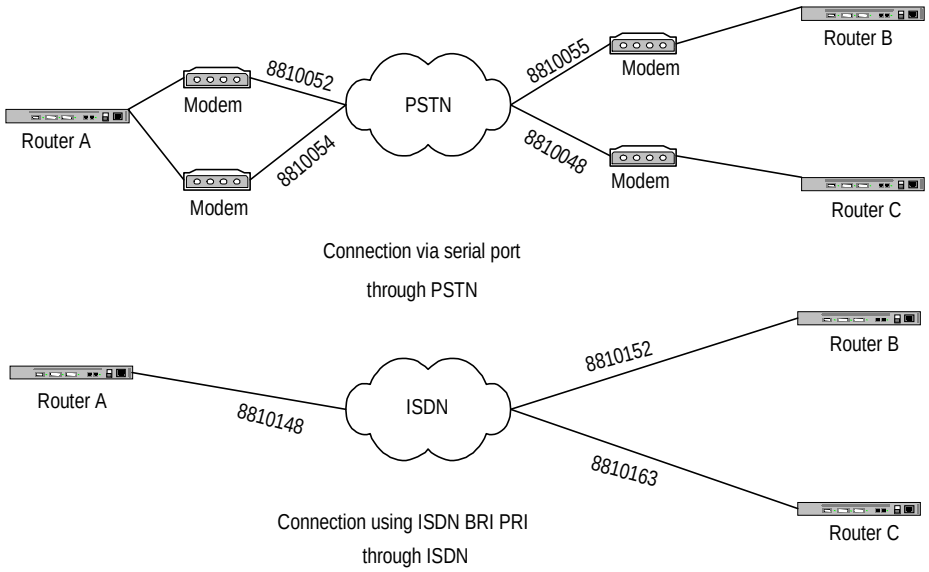


Figure DC-1-8 Networking diagram of multipoint-to-multipoint DDR configuration example

III. Configuration procedure

Solution 1: use Legacy DDR configuration mode to realize the following at the serial port:

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Dialer0)# dialer in-band
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer map ip 100.1.1.2 8810055
Quidway(config-if-Dialer0)# dialer map ip 100.1.1.3 8810048
Quidway(config-if-Dialer0)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer rotary-group 0
Quidway(config-if-Serial0)# interface serial 1
Quidway(config-if-Serial1)# physical-layer async
Quidway(config-if-Serial1)# modem
Quidway(config-if-Serial1)# dialer rotary-group 0
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810052
Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810054
```

3) Configure router C:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# ip address 100.1.1.3 255.255.255.0
```

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810054

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810052

Solution 2: use Dialer Profile configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# user userc password 0 passc

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# dialer string 8810055

Quidway(config-if-Dialer0)# interface dialer 1

Quidway(config-if-Dialer1)# ip address 122.1.1.1 255.255.255.0

Quidway(config-if-Dialer1)# dialer remote-name userc

Quidway(config-if-Dialer1)# dialer-group 1

Quidway(config-if-Dialer1)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer1)# dialer pool 2

Quidway(config-if-Dialer1)# dialer string 8810048

Quidway(config-if-Dialer1)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# dialer pool-member 2

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

Quidway(config-if-Serial0)# interface serial 1

Quidway(config-if-Serial1)# physical-layer async

Quidway(config-if-Serial1)# modem

Quidway(config-if-Serial1)# dialer pool-member 1

Quidway(config-if-Serial1)# dialer pool-member 2

Quidway(config-if-Serial1)# encapsulation ppp

Quidway(config-if-Serial1)# ppp authentication pap

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

3) Configure router C:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 122.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userc password 0 passc

Quidway(config-if-Dialer0)# dialer string 8810054

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

Solution 3: use Legacy DDR configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 8810152

Quidway(config-if-Bri0)# dialer map ip 100.1.1.3 8810163

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

3) Configure router C:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.3 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

Solution 4: use Dialer Profile configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# user userc password 0 passc

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# dialer string 8810152

```
Quidway(config-if-Dialer0)# interface dialer 1
Quidway(config-if-Dialer1)# ip address 122.1.1.1 255.255.255.0
Quidway(config-if-Dialer1)# dialer remote-name userc
Quidway(config-if-Dialer1)# dialer-group 1
Quidway(config-if-Dialer1)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer1)# dialer pool 2
Quidway(config-if-Dialer1)# dialer string 8810163
Quidway(config-if-Dialer1)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# dialer pool-member 2
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# dialer string 8810148
Quidway(config-if-Dialer0)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

3) Configure router C:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 122.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
```

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userc password 0 passc

Quidway(config-if-Dialer0)# dialer string 8810148

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

1.6.6 DDR Bearing IPX

DDR can bear both IP network layer protocol and IPX network layer protocol. Make the following three modifications to the above-mentioned various solutions, and it is possible to connect DDR bearing IPX.

- Replace the statements configuring IP network layer addresses of various interfaces with the statements configuring IPX addresses;
- Replace the IP address in dialer map configuration command with IPX address;
- Change ip in dialer-list configuration command into ipx.

The following is the implementation solution of DDR bearing IPX and oriented to point-to-point connection. Its hardware configurations and dial string configurations are the same as the configurations in the example “Point-to-Point DDR”.

I. Networking diagram

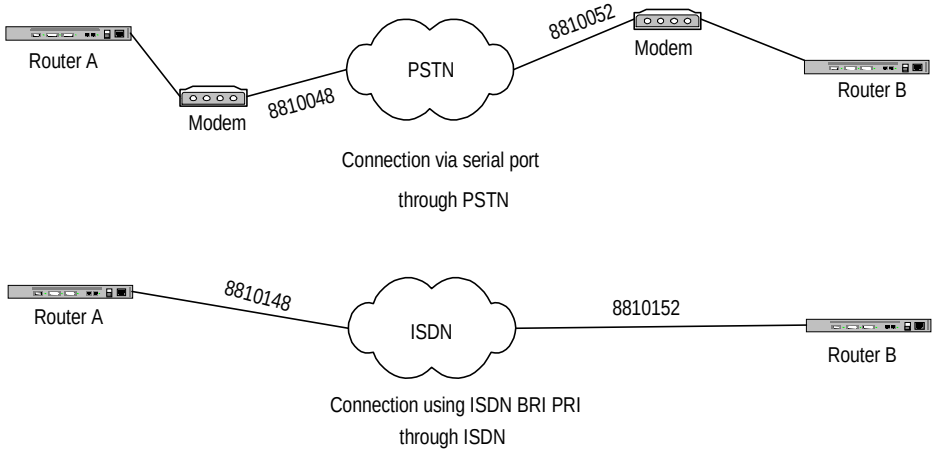


Figure DC-1-9 Networking diagram of the configuration example of DDR bearing IPX

II. Configuration procedure

Solution 1: use Legacy DDR configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ipx network 1

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

2) Quidway(config-if-Serial0)# dialer map ipx 1.1.1.2 8810052Configure router B:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ipx network 1

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ipx 1.1.1.1 8810048

Solution 2: use Dialer Profile configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810048

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

Solution 3: use Legacy DDR configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ipx network 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ipx 1.1.1.2 8810152

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ipx network 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ipx 1.1.1.1 8810148

Solution 4: use Dialer Profile configuration mode to realize the following at ISDN BRI and PRI interfaces

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# ipx routing 1.1.1
Quidway(config)# user userb password 0 passb
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ipx network 1
Quidway(config-if-Dialer0)# dialer remote-name userb
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer string 8810152
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer0)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# ipx network 1.1.2
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ipx network 1
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer string 8810148
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

1.6.7 DDR Bearing IP and IPX at the Same Time

DDR can bear IP and IPX at the same time on one dial connection. That is, when a call connection has been established, IP message and IPX message can be sent at the same time on this connection.

The following is the implementation solution of DDR bearing IP and IPX at the same time and oriented to point-to-point connection. Its hardware configurations and dial string configurations are the same as the configurations in the example “Point-to-Point DDR”

I. Networking diagram

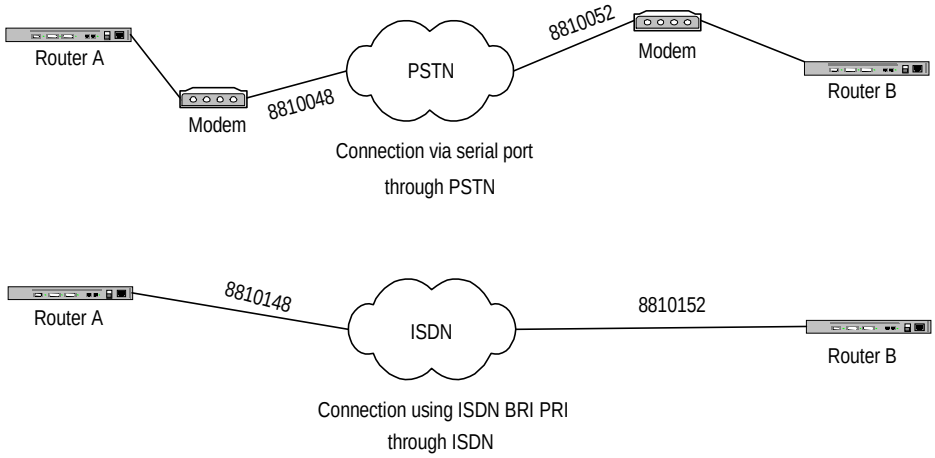


Figure DC-1-10 Networking diagram of DDR configuration bearing IP and IPX at the same time

II. Configuration procedure

Solution 1: use Legacy DDR configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# ipx network 1

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810052

Quidway(config-if-Serial0)# dialer map ipx 1.1.1.2 8810052

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# ipx network 1

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048

Quidway(config-if-Serial0)# dialer map ipx 1.1.1.1 8810048

Solution 2: use Dialer Profile configuration mode to realize the following at the serial port:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810048

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

Solution 3: use Legacy DDR configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# ipx network 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 8810152

Quidway(config-if-Bri0)# dialer map ipx 1.1.1.2 8810152

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# ipx network 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

Quidway(config-if-Bri0)# dialer map ipx 1.1.1.1 8810148

Solution 4: use Dialer Profile configuration mode to realize the following at ISDN BRI and PRI interfaces:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.1

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name userb

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810152

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# ipx routing 1.1.2

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# ipx network 1

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810148

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

1.6.8 Flow Control of Dialer Profile (MP over Dialer Profile)-Case 1

By setting flow load threshold to control flow distribution, bandwidth can be distributed in real-time and maximum bandwidth can be provided.

I. Networking requirements

In the following diagram, local router and remote router are interconnected through two BRI interface. Bandwidth should be provided according to the real flow.

II. Networking diagram

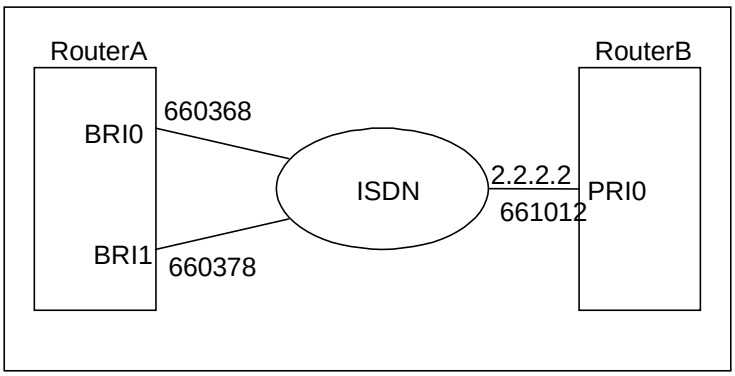


Figure DC-1-11 Networking diagram of DDR - Case 1

III. Configuration procedure

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# flow-interval 3

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 2.2.2.1 255.255.255.0

```
Quidway(config-if-Dialer0)# encapsulation ppp
Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer0)# ppp multilink
Quidway(config-if-Dialer0)# dialer remote-name userb
Quidway(config-if-Dialer0)# dialer string 661012
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer load-threshold 80
! Configure physical interface
Quidway(config)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp multilink
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# ppp authentication pap
Quidway(config-if-Bri0)# ppp pap sent-username usera password 0 passa
Quidway(config)# interface bri 1
Quidway(config-if-Bri1)# no dialer in-band
Quidway(config-if-Bri1)# encapsulation ppp
Quidway(config-if-Bri1)# ppp multilink
Quidway(config-if-Bri1)# dialer pool-member 1
Quidway(config-if-Bri1)# ppp authentication pap
Quidway(config-if-Bri1)# ppp pap sent-username usera password 0 passa
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# flow-interval 3
Quidway(config)# controler e1 0
Quidway(config-if-E1-0)# pri-group
Quidway(config-if-E1-0)# interface Serial 0:15
Quidway(config-if-Serial0:15)# encapsulation ppp
Quidway(config-if-Serial0:15)# ppp multilink
Quidway(config-if-Serial0:15)# ip address 2.2.2.1 255.255.255.0
```

Quidway(config-if-Serial0:15)# dialer in-band

Quidway(config-if-Serial0:15)# dialer-group 1

Quidway(config-if-Serial0:15)# dialer map ip 2.2.2.2 660368

Quidway(config-if-Serial0:15)# dialer map ip 2.2.2.2 660378

Quidway(config-if-Serial0:15)# ppp authentication pap

Quidway(config-if-Serial0:15)# ppp pap sent-username userb password 0 passb

1.6.9 B Channels for Dial-up and Connection to the Remote End - Case 2

Case 2: DDR in which one B channel in ISDN BRI interface is used for dial connection to the remote end and the other for dedicated connection to the remote end.

Using one of the B channels of ISDN BRI interface for dial-up, the other one for remote dial-up connection.

I. Networking requirements

DDR is the implementation solution. As shown in the following diagram, router A can dial-up and dial to router B at the same time. We assume user access Internet with 163 Special Service number (user name: user163, password: pass163).

II. Networking diagram

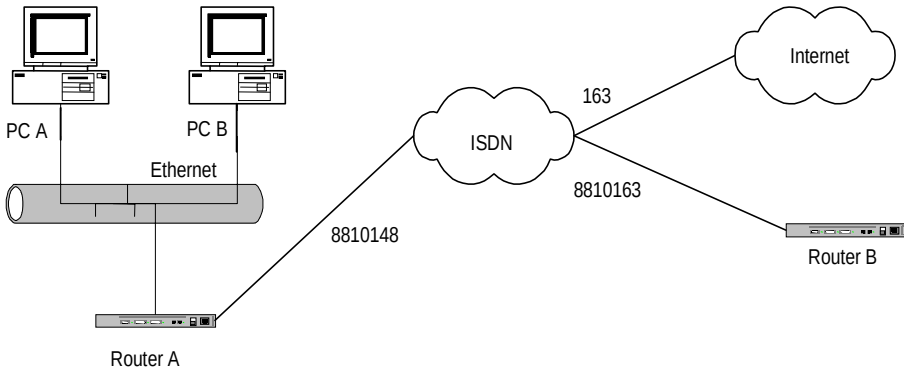


Figure DC-1-11 Networking diagram of DDR - Case 2

III. Configuration procedure

Solution: use Dialer Profile to realize:

1) Configure router A:

Quidway(config)# access-list 1 deny any

Quidway(config)# access-list 1 permit 10.110.10.0 0.0.0.255

Quidway(config)# nat pool 202.110.10.10 202.110.10.11 pool 1

Quidway(config)# dialer-list 1 protocol ip permit

```
Quidway(config)# user userb password 0 passb
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name userb
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# dialer string 8810163
Quidway(config-if-Dialer0)# interface dialer 1
Quidway(config-if-Dialer1)# ip address negotiate
Quidway(config-if-Dialer1)# nat inside 1 pool 1
Quidway(config-if-Dialer1)# dialer remote-name userc
Quidway(config-if-Dialer1)# dialer-group 1
Quidway(config-if-Dialer1)# ppp pap sent-username user163 password 0 pass163
Quidway(config-if-Dialer1)# dialer pool 2
Quidway(config-if-Dialer1)# dialer string 163
Quidway(config-if-Dialer1)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
Quidway(config-if-Bri0)# dialer pool-member 1
Quidway(config-if-Bri0)# dialer pool-member 2
Quidway(config-if-Bri0)# encapsulation ppp
Quidway(config-if-Bri0)# ppp authentication pap
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer string 8810148
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# interface bri 0
Quidway(config-if-Bri0)# no dialer in-band
```

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

1.6.10 Two Serial Ports for Dial-up and Remote Dial Connection – Case 3

Case 3: DDR in which one serial port is used for dial access to Internet and another for remote dial connection.

I. Networking requirements

One of the two B channels of ISDN BRI can be used for private line and the other for dial-up. As shown in the following diagram, router A and router B are interconnected with one B channel, the other B channel dial to router B.

II. Networking diagram

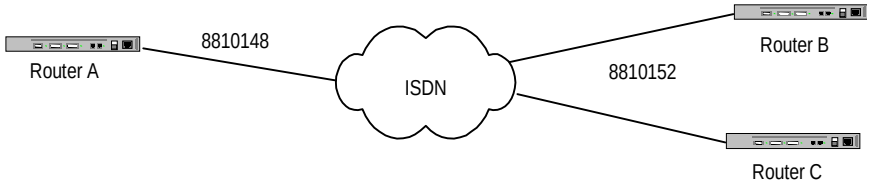


Figure DC-1-12 Networking diagram of DDR - Case 3

III. Configuration procedure

Solution: use Legacy DDR configuration to realize:

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# dialer isdn-leased 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 8810152

Quidway(config-if-Bri0)# dialer map ip 100.1.1.3

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

3) Configure router C:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.3 255.255.255.0

Quidway(config-if-Bri0)# dialer isdn-leased 1

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1

1.6.11 One Serial Port for Dial-up and Remote Dial Connection – Case 4

Case 4: DDR in which one serial port is used both for dial access to Internet and for remote dial connection.

I. networking requirements

Using Dialer Profile, we can configure a serial port to dial-up and dial to the remote end. As shown in the following diagram, router A can dial-up and dial to router B at the same time. We assume user access Internet with 163 Special Service number (user name: user163, password: pass163).

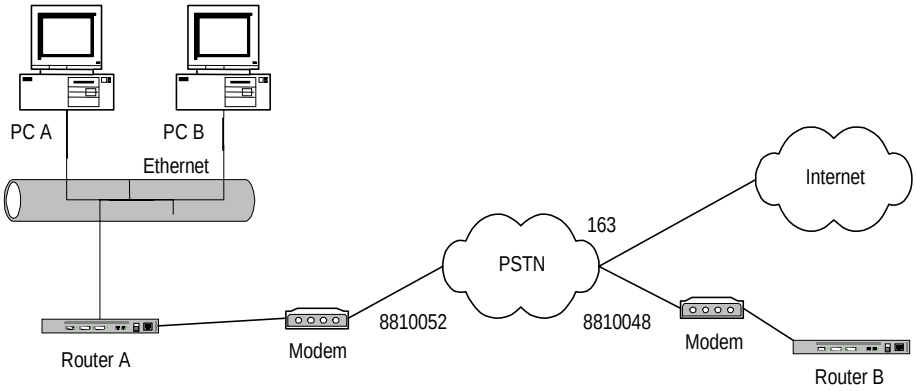


Figure DC-1-13 Networking diagram of DDR - Case 4

Solution: use Dialer Profile configuration to realize:

1) Configure router A

Quidway(config)# access-list 1 deny any

Quidway(config)# access-list 1 permit 10.110.10.0 0.0.0.255

Quidway(config)# nat pool 202.110.10.10 202.110.10.11 pool 1

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user userb password 0 passb

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name userb

```
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# ppp pap sent-username usera password 0 passa
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# dialer string 8810048
Quidway(config-if-Dialer0)# interface dialer 1
Quidway(config-if-Dialer1)# ip address negotiate
Quidway(config-if-Dialer1)# nat inside 1 pool 1
Quidway(config-if-Dialer1)# dialer remote-name userc
Quidway(config-if-Dialer1)# dialer-group 1
Quidway(config-if-Dialer1)# ppp pap sent-username user163 password 0 pass163
Quidway(config-if-Dialer1)# dialer pool 2
Quidway(config-if-Dialer1)# dialer string 163
Quidway(config-if-Dialer1)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer pool-member 1
Quidway(config-if-Serial0)# dialer pool-member 2
Quidway(config-if-Serial0)# encapsulation ppp
Quidway(config-if-Serial0)# ppp authentication pap
```

2) Configure router B

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user usera password 0 passa
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Dialer0)# dialer remote-name usera
Quidway(config-if-Dialer0)# dialer string 8810052
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# dialer pool 1
Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb
Quidway(config-if-Dialer0)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer pool-member 1
Quidway(config-if-Serial0)# encapsulation ppp
```

```
Quidway(config-if-Serial0)# ppp authentication pap
```

1.6.12 DDR for Access Service

I. Networking requirements

We have designed the DDR implementation solution for access service by way of asynchronous serial port and ISDN PRI interface. Here, it is supposed that the dial string resources obtained by users from the telecom office are 8810048-8810055 and 8810148 respectively, serving 16 Internet users. In the configuration command, use Serial2:15 to identify ISDN PRI interface created at cE1/PRI interface.

II. Networking diagram

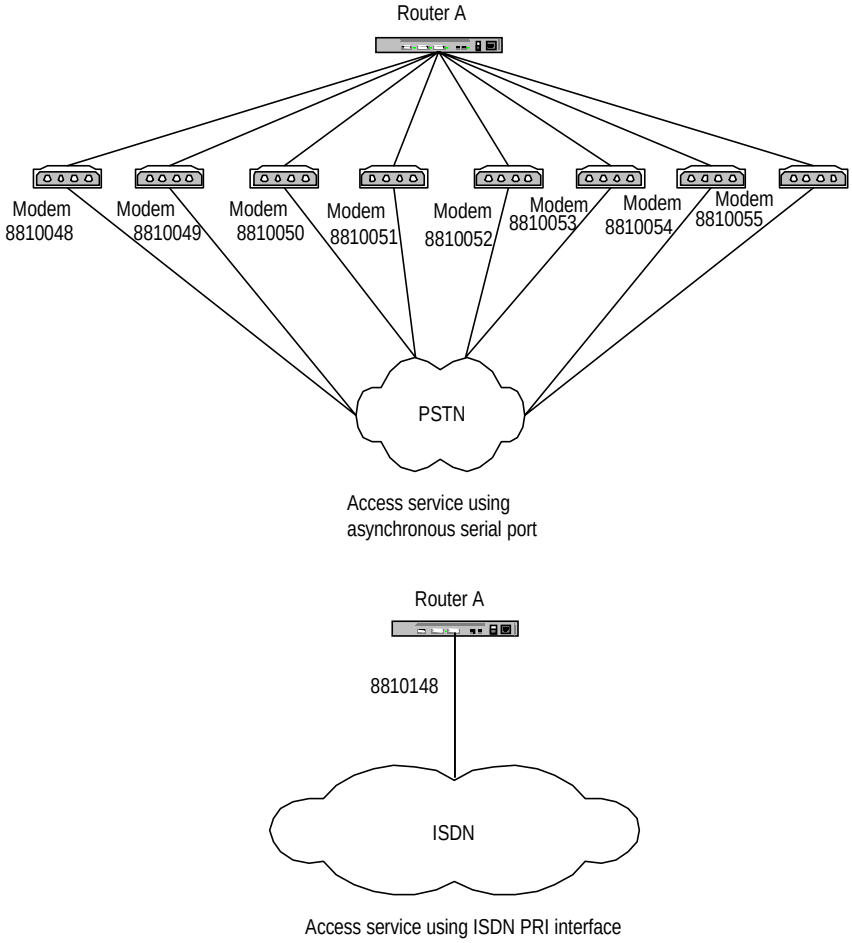


Figure DC-1-15 Networking diagram of the configuration example of DDR for access service

III. Configuration procedure

Solution 1: use Legacy DDR configuration mode, PPP PAP authentication and 8 asynchronous serial ports to realize:

Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user user1 password 0 pass1
Quidway(config)# user user2 password 0 pass2
Quidway(config)# user user3 password 0 pass3
Quidway(config)# user user4 password 0 pass4
Quidway(config)# user user5 password 0 pass5
Quidway(config)# user user6 password 0 pass6
Quidway(config)# user user7 password 0 pass7
Quidway(config)# user user8 password 0 pass8
Quidway(config)# user user9 password 0 pass9
Quidway(config)# user user10 password 0 pass10
Quidway(config)# user user11 password 0 pass11
Quidway(config)# user user12 password 0 pass12
Quidway(config)# user user13 password 0 pass13
Quidway(config)# user user14 password 0 pass14
Quidway(config)# user user15 password 0 pass15
Quidway(config)# user user16 password 0 pass16
Quidway(config)# ip local pool 1 100.1.1.1 100.1.1.16
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.254 255.255.255.0
Quidway(config-if-Dialer0)# peer default ip address pool 1
Quidway(config-if-Dialer0)# dialer in-band
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# encapsulation ppp
Quidway(config-if-Dialer0)# ppp authentication pap
Quidway(config-if-Dialer0)# interface async 1
Quidway(config-if-Async1)# dialer rotary-group 0
Quidway(config-if-Async1)# interface async 2
Quidway(config-if-Async2)# dialer rotary-group 0
Quidway(config-if-Async2)# interface async 3
Quidway(config-if-Async3)# dialer rotary-group 0
Quidway(config-if-Async3)# interface async 4
Quidway(config-if-Async4)# dialer rotary-group 0
```

Quidway(config-if-Async4)# interface async 5

Quidway(config-if-Async5)# dialer rotary-group 0

Quidway(config-if-Async5)# interface async 6

Quidway(config-if-Async6)# dialer rotary-group 0

Quidway(config-if-Async6)# interface async 7

Quidway(config-if-Async7)# dialer rotary-group 0

Quidway(config-if-Async7)# interface async 8

Quidway(config-if-Async8)# dialer rotary-group 0

Solution 2: use Legacy DDR configuration mode, PPP CHAP authentication and 8 asynchronous serial ports to realize:

Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user user1 password 0 pass1

Quidway(config)# user user2 password 0 pass2

Quidway(config)# user user3 password 0 pass3

Quidway(config)# user user4 password 0 pass4

Quidway(config)# user user5 password 0 pass5

Quidway(config)# user user6 password 0 pass6

Quidway(config)# user user7 password 0 pass7

Quidway(config)# user user8 password 0 pass8

Quidway(config)# user user9 password 0 pass9

Quidway(config)# user user10 password 0 pass10

Quidway(config)# user user11 password 0 pass11

Quidway(config)# user user12 password 0 pass12

Quidway(config)# user user13 password 0 pass13

Quidway(config)# user user14 password 0 pass14

Quidway(config)# user user15 password 0 pass15

Quidway(config)# user user16 password 0 pass16

Quidway(config)# ip local pool 1 100.1.1.1 100.1.1.16

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.254 255.255.255.0

Quidway(config-if-Dialer0)# peer default ip address pool 1

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# encapsulation ppp

Quidway(config-if-Dialer0)# ppp authentication chap

Quidway(config-if-Dialer0)# interface async 1

Quidway(config-if-Async1)# dialer rotary-group 0

Quidway(config-if-Async1)# interface async 2

Quidway(config-if-Async2)# dialer rotary-group 0

Quidway(config-if-Async2)# interface async 3

Quidway(config-if-Async3)# dialer rotary-group 0

Quidway(config-if-Async3)# interface async 4

Quidway(config-if-Async4)# dialer rotary-group 0

Quidway(config-if-Async4)# interface async 5

Quidway(config-if-Async5)# dialer rotary-group 0

Quidway(config-if-Async5)# interface async 6

Quidway(config-if-Async6)# dialer rotary-group 0

Quidway(config-if-Async6)# interface async 7

Quidway(config-if-Async7)# dialer rotary-group 0

Quidway(config-if-Async7)# interface async 8

Quidway(config-if-Async8)# dialer rotary-group 0

Solution 3: use Legacy DDR configuration mode and PPP PAP authentication to realize the following at ISDN PRI interface:

Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user user1 password 0 pass1

Quidway(config)# user user2 password 0 pass2

Quidway(config)# user user3 password 0 pass3

Quidway(config)# user user4 password 0 pass4

Quidway(config)# user user5 password 0 pass5

Quidway(config)# user user6 password 0 pass6

Quidway(config)# user user7 password 0 pass7

Quidway(config)# user user8 password 0 pass8

Quidway(config)# user user9 password 0 pass9

Quidway(config)# user user10 password 0 pass10

Quidway(config)# user user11 password 0 pass11

Quidway(config)# user user12 password 0 pass12

Quidway(config)# user user13 password 0 pass13

Quidway(config)# user user14 password 0 pass14

Quidway(config)# user user15 password 0 pass15

Quidway(config)# user user16 password 0 pass16

Quidway(config)# ip local pool 1 100.1.1.1 100.1.1.16

Quidway(config)# interface serial2:15

Quidway(config-if-Serial2:15)# ip address 100.1.1.254 255.255.255.0

Quidway(config-if-Serial2:15)# peer default ip address pool 1

Quidway(config-if-Serial2:15)# dialer-group 1

Quidway(config-if-Serial2:15)# encapsulation ppp

Quidway(config-if-Serial2:15)# ppp authentication pap

Solution 4: use Legacy DDR configuration mode and PPP CHAP authentication to realize the following at ISDN PRI interface:

Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user user1 password 0 pass1

Quidway(config)# user user2 password 0 pass2

Quidway(config)# user user3 password 0 pass3

Quidway(config)# user user4 password 0 pass4

Quidway(config)# user user5 password 0 pass5

Quidway(config)# user user6 password 0 pass6

Quidway(config)# user user7 password 0 pass7

Quidway(config)# user user8 password 0 pass8

Quidway(config)# user user9 password 0 pass9

Quidway(config)# user user10 password 0 pass10

Quidway(config)# user user11 password 0 pass11

Quidway(config)# user user12 password 0 pass12

Quidway(config)# user user13 password 0 pass13

Quidway(config)# user user14 password 0 pass14

Quidway(config)# user user15 password 0 pass15

Quidway(config)# user user16 password 0 pass16

Quidway(config)# ip local pool 1 100.1.1.1 100.1.1.16

Quidway(config)# interface serial2:15

Quidway(config-if-Serial2:15)# ip address 100.1.1.254 255.255.255.0

Quidway(config-if-Serial2:15)# peer default ip address pool 1

Quidway(config-if-Serial2:15)# dialer-group 1

Quidway(config-if-Serial2:15)# encapsulation ppp

Quidway(config-if-Serial2:15)# ppp authentication chap

1.6.13 DDR for Inter-Router Callback

I. Networking requirements

We have designed two implementation solutions: “use ISDN calling line identification callback” and “Use PPP callback”. In the implementation solution “use ISDN calling line identification callback”, routers at both ends need to use ISDN interface for interconnection. In the following configuration procedure, Bri 0 is used to identify ISDN interface, router A is used as callback Server end and router B as callback Client end.

“ISDN calling line identification callback” and “PPP callback” can be used in combination, and users can simply combine the configuration procedures of the two listed below:

II. Networking diagram

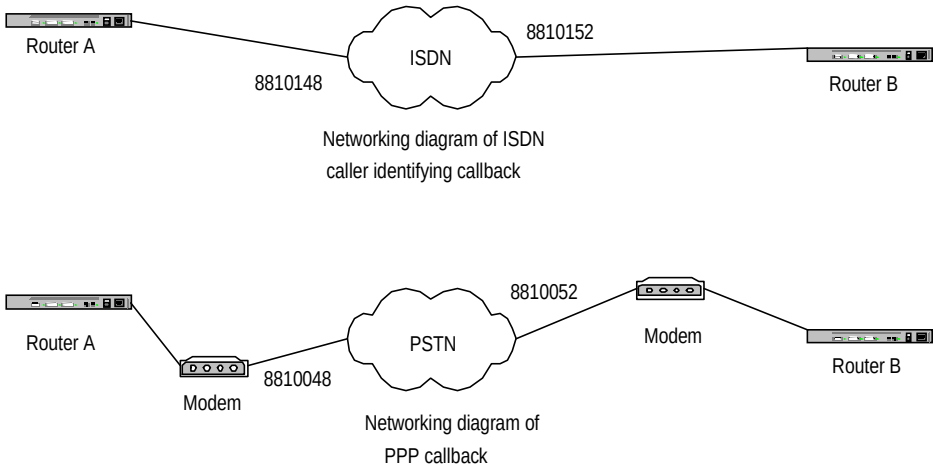


Figure DC-1-16 Networking diagram of inter-router callback DDR configuration example

III. Configuration procedure

Solution 1: use ISDN calling line identification callback

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 8810152

Quidway(config-if-Bri0)# dialer caller 8810152 callback

3) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810148

Solution 2: use PPP callback and Server end uses user-configured dialer map for callback

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user quidwayb password 0 quidwayb

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 name quidwayb 8810052

Quidway(config-if-Serial0)# dialer callback-server username

Quidway(config-if-Serial0)# ppp authentication pap

Quidway(config-if-Serial0)# ppp callback accept

4) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048

Quidway(config-if-Serial0)# ppp pap sent-username quidwayb password 0 quidwayb

Quidway(config-if-Serial0)# ppp callback request

Solution 3: use PPP callback and Server end dynamically creates dialer map for callback

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# user quidwayb password 0 quidwayb callback-dialstring 8810052
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# dialer callback-server dialstring
Quidway(config-if-Serial0)# ppp authentication pap
Quidway(config-if-Serial0)# ppp callback accept
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810048
Quidway(config-if-Serial0)# ppp pap sent-username quidwayb password 0 quidwayb
Quidway(config-if-Serial0)# ppp callback request
```

1.6.14 DDR in Which the Router Calls Back PC

I. Networking requirements

We have designed two implementation solutions: “use user-configured dialer map for callback” and “dynamically create dialer map for callback”. In both solutions, routers are used to allocate IP addresses for PCs.

II. Networking diagram

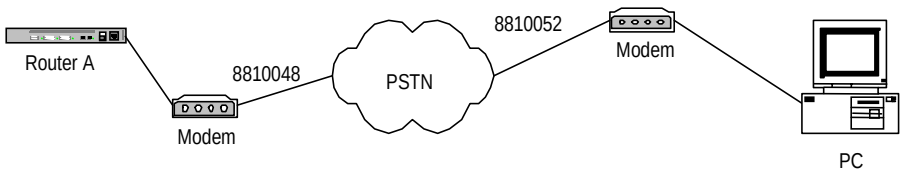


Figure DC-1-17 Networking diagram of DDR configuration example in which routers call back PCs

III. Configuration procedure

Solution 1: using user-configured dialer map for callback, with router A serving as server end.

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user pc password 0 pc

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# peer default ip address 100.1.1.2

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 name pc 8810052

Quidway(config-if-Serial0)# dialer callback-server username

Quidway(config-if-Serial0)# ppp authentication pap

Quidway(config-if-Serial0)# ppp pap sent-username quidway password 0 quidway

Quidway(config-if-Serial0)# ppp callback accept

2) Configure PC:

a. Configure Modem connected to PC end to “automatic answering mode”;

b. Click: Start-> Programs-> Accessories-> Communications-> Dialup network;

c. In “Dialup network” window, select “Set up new connection”;

d. In “My connection” established, select “TCP/IP setting”, in which:

- Select “Server allocated with IP address”;
- Cancel “Use IP head pointer compression”;
- Cancel “Use default gateway of the remote network”;

e. In “My connection” established, select “Server type”, in which:

- Select “ppp”;
- Cancel “Logon network”;
- Cancel “Start software compression”.

Solution 2: Dynamically creating dialer map for callback, with router A as Server end

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user pc password 0 pc callback-dialstring 8810052

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# peer default ip address 100.1.1.2

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer callback-server dialstring

Quidway(config-if-Serial0)# ppp authentication pap

Quidway(config-if-Serial0)# ppp pap sent-username quidway password 0 quidway

Quidway(config-if-Serial0)# ppp callback accept

2) Configure PC:

a. Configure Modem connected to PC end to “automatic answering mode”;

b. Click: Start-> Programs-> Accessories-> Communications-> Dialup network;

c. In “Dialup network” window, select “Set up new connection”;

d. In “My connection” established, select “TCP/IP setting”, in which:

- Select “Server allocated with IP address”;
- Cancel “Use IP head pointer compression”;
- Cancel “Use default gateway of the remote network”;

e. In “My connection” established, select “Server type”, in which:

- Select “ppp”;
- Cancel “Logon network”;
- Cancel “Start software compression”.

1.6.15 DDR for Autodial

I. Networking requirements

We have designed point-to-point autodial configuration solution. Point-to-multipoint and multipoint-to-multipoint autodial can be configured in a similar way. In the following diagram, router A automatically dials to call router B at an interval of 180 seconds.

II. Networking diagram

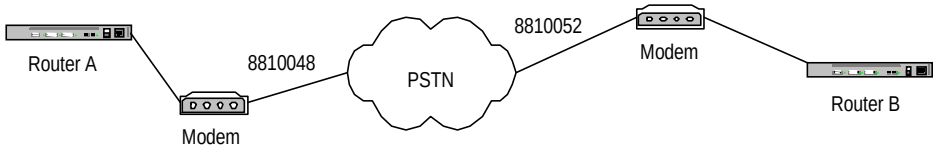


Figure DC-1-18 Networking diagram of the configuration example of DDR for autodial

III. Configuration procedure

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810052 autodial

Quidway(config-if-Serial0)# dialer autodial-interval 180

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

1.6.16 DDR Using Dialer Map Cyclically

I. Networking requirements

We have designed two routers to use dialer map cyclically. In the following networking diagram, router A calls router B.

II. Networking diagram

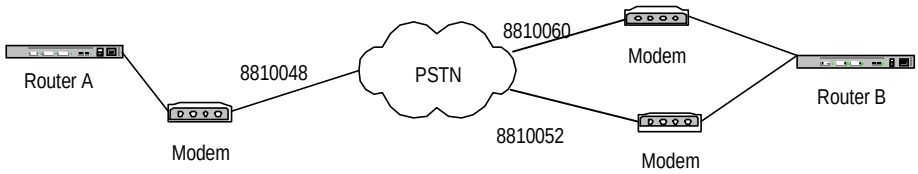


Figure DC-1-19 Networking diagram of the configuration example of DDR using dialer map cyclically

III. Configuration procedure

1) Configure router A:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810052

Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810060

2) Configure router B:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

Quidway(config-if-Serial0)# interface serial 1

Quidway(config-if-Serial1)# physical-layer async

Quidway(config-if-Serial1)# modem

Quidway(config-if-Serial1)# dialer rotary-group 0

1.6.17 DDR Using Dialer Map as Backup

I. Networking requirements

We have designed two configurations in which the logical interface designed by dialer map is used as backup interface and as main interface. In the following diagram, we have configured backup in router A. s0 port of router A is configured as dial port, and s1 port is configured as DDN directly connected port of encapsulation PPP.

II. Networking diagram

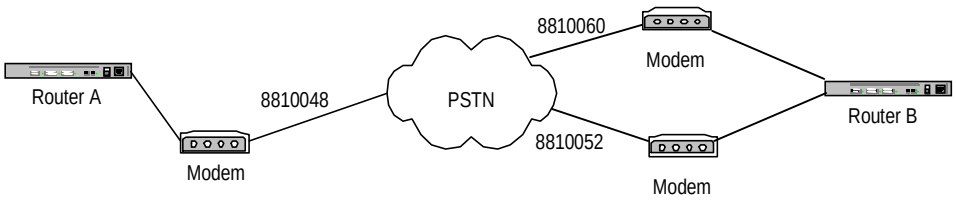


Figure DC-1-20 Networking diagram of the configuration example of DDR with dialer map as backup

III. Configuration procedure

Solution 1: Logical interface as backup interface

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810060 lin 1
Quidway(config-if-Serial0)# interface serial 1
Quidway(config-if-Serial1)# ip address 200.1.1.1 255.255.255.0
Quidway(config-if-Serial1)# encapsulation ppp
Quidway(config-if-Serial1)# backup logic-channel 1
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# interface serial 1
Quidway(config-if-Serial1)# ip address 200.1.1.2 255.255.255.0
Quidway(config-if-Serial1)# encapsulation ppp
```

Solution 2: Logical interface as main interface

1) Configure router A:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# dialer map ip 100.1.1.2 8810060 lin 1
```

```
Quidway(config-if-Serial0)# exit
Quidway(config)# logic-channel 1
Quidway(config-logic-channel1)# backup interface serial 1
Quidway(config-logic-channel1)# exit
Quidway(config)# interface serial 1
Quidway(config-if-Serial1)# ip address 200.1.1.1 255.255.255.0
Quidway(config-if-Serial1)# encapsulation ppp
```

2) Configure router B:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Serial0)# physical-layer asynct
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# interface serial 1
Quidway(config-if-Serial1)# ip address 200.1.1.2 255.255.255.0
Quidway(config-if-Serial1)# encapsulation ppp
```

1.7 Precautions for DDR Configuration

1.7.1 Configuring Dialer-group

Dialer-group must be configured at the logic dial interface or at the physical interface that directly enables DDR, and dialer-group must correspond to dialer-list configured in global configuration status, as shown in the following bold-typed parts.

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# dialer in-band
Quidway(config-if-Dialer0)# dialer-group 1
```

1.7.2 Configuring Synchronous/Asynchronous Serial Port Using DDR

To make synchronous/asynchronous serial port visible and perform DDR configuration on it, it is necessary to execute two configuration commands, physical-layer async and modem, and enable DDR command, as shown in the following bold-typed parts.

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

1.7.3 Configuring Network Layer Address

To enable network layer to find a route to the correct interface, network layer address (such as IP address) must be configured at the logic dial interface or the physical interface that directly enables DDR, as shown in the following bold-typed parts.

Example 1: in Legacy DDR configuration mode, the physical interface enables DDR by being bound to the logic dial interface.

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

Example 2: in Legacy DDR configuration mode, the physical interface directly enables DDR.

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer string 8810052

Example 3: Dialer Profile configuration mode

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name user1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

1.7.4 Configuring PPP In Dialer Profile Configuration Mode

In Dialer Profile configuration mode, if the local end needs to receive an incoming call, PPP authentication must be configured at the local physical interface so as to determine which dial interface the incoming call in oriented to.

There are two PPP authentication modes: PAP authentication and CHAP authentication. With different PPP authentication modes, the desired configuration commands and application modes are different, as detailed below:

The PPP configuration commands involved are:

- **encapsulation ppp**
- **ppp authentication** { **pap** | **chap** }
- **ppp pap sent-username** *name* **password** { **0** | **7** } *password*
- **ppp chap host** *hostname*
- **user** *username* **password** { **0** | **7** } *password*

I. Apply PAP authentication

With PAP name authentication mode, configuration must be performed according to the following steps, in which *name1* and *pass1* can be replaced with specific character strings selected by the users.

- Configure the remote user name of the local Dialer interface: **dialer remote-name** *name1*
- Configure link layer protocol encapsulation of the local physical interface: **encapsulation ppp**
- Configure PPP authentication mode: **ppp authentication pap**
- Configure the user name and password of the remote router: **user** *name1* **password 0** *pass1*
- Configure the user name and password sent by the local Dialer interface or the physical interface directly enabling DDR during PAP authentication: **ppp pap sent-username** *name1* **password 0** *pass1*

Example 1: apply serial port

1) Configure local router:

Quidway(config)# user remoteuser1 password 0 remotepass1

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name remoteuser1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer-pool 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer string 8810048

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp sent-username remoteuser1 password 0 remotepass1

Example 2: apply ISDN BRI and PRI interfaces

1) Configure local router:

Quidway(config)# user remoteuser1 password 0 remotepass1

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name remoteuser1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer-pool 1

Quidway(config-if-Dialer0)# dialer string 8810152

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer string 8810048

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp sent-username remoteuser1 password 0 remotepass1

II. Apply CHAP authentication

With CHAP authentication mode, configuration must be performed according to the following steps, in which *name1*, *name2* and *pass1* can be replaced with specific character strings selected by the users.

- Configure the remote user name of the local Dialer interface: **dialer remote-name** *name1*
- Configure link layer protocol encapsulation of the local physical interface: **encapsulation ppp**
- Configure PPP authentication mode: **ppp authentication chap**
- Configure local router name of CHAP authentication: **ppp chap host** *name2*
- Configure the user name and password of the remote router: **user** *name1* **password 0** *pass1*
- Configure the user name and password of the local router: **user** *name2* **password 0** *pass1*
- Configure remote router name at Dialer interface, or the physical interface directly enabling DDR, of the remote router: **ppp chap host** *name1*

Example 1: apply serial port

1) Configure local router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user remoteuser1 password 0 togetherpass

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name remoteuser1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication chap

Quidway(config-if-Serial0)# ppp chap host localuser1

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user localuser1 password 0 togetherpass

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810048

Quidway(config-if-Dialer0)# ppp chap host remoteuser1

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

Example 2: apply ISDN BRI and PRI interfaces

1) Configure local router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user remoteuser1 password 0 togetherpass

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name remoteuser1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# dialetr string 8810152

Quidway(config-if-Dialer0)# interface bri 0

Quidway(config-if-Bri0)# no dialer in-band

Quidway(config-if-Bri0)# dialer pool-member 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication chap

Quidway(config-if-Bri0)# ppp chap host localuser1

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user localuser1 password 0 togetherpass

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer string 8810048

Quidway(config-if-Bri0)# ppp chap host remoteuser1

1.7.5 Configuring PPP In Legacy DDR Configuration Mode

In Legacy DDR configuration mode, if the local end needs to receive an incoming call, then, when name is configured in the local dialer map, PPP authentication must be configured at the corresponding logic dial interface or the physical interface directly enabling DDR, so as to obtain the remote user name for determining dialer map at the local end.

There are two PPP authentication modes: PAP authentication and CHAP authentication. With different PPP authentication modes, the desired configuration commands and application modes are different, as detailed below:

The PPP configuration commands involved are:

- encapsulation **ppp**
- ppp **authentication** { **pap** | **chap** }
- ppp **pap sent-username** *name* **password** { **0** | **7**} *password*
- ppp **chap host** *hostname*
- user *username* **password** { **0** | **7**} *password*

I. Apply PAP authentication

With PAP name authentication mode, configuration must be performed according to the following steps, in which *name1* and *pass1* can be replaced with specific character strings selected by the users.

- Configure the remote user name of the local Dialer interface: **dialer map** *protocol next-hop-address* **name** *name1*
- Configure link layer protocol encapsulation of the local physical interface: **encapsulation ppp**
- Configure PPP authentication mode: **ppp authentication pap**
- Configure the user name and password of the remote router: **user** *name1* **password 0** *pass1*
- Configure the user name and password sent by the local Dialer interface or the physical interface directly enabling DDR during PAP authentication: **ppp pap sent-username** *name1* **password 0** *pass1*

Example 1: apply serial port

1) Configure local router:

```
Quidway(config)# user remoteuser1 password 0 remotepass1
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# interface dialer 0
Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Dialer0)# dialer map ip 100.1.1.2 name remoteuser1 8810052
Quidway(config-if-Dialer0)# encapsulation ppp
Quidway(config-if-Dialer0)# ppp authentication pap
Quidway(config-if-Dialer0)# dialer-group 1
Quidway(config-if-Dialer0)# interface serial 0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer rotary-group 0
```

2) Configure remote router:

```
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# interface serial 0
Quidway(config-if-Serial0)# ip address 100.1.1.2 255.255.255.0
Quidway(config-if-Serial0)# physical-layer async
Quidway(config-if-Serial0)# modem
Quidway(config-if-Serial0)# dialer in-band
Quidway(config-if-Serial0)# dialer string 8810048
Quidway(config-if-Serial0)# dialer-group 1
Quidway(config-if-Serial0)# encapsulation ppp
Quidway(config-if-Serial0)# ppp sent-username remoteuser1 password 0 remotepass1
```

Example 2: apply ISDN BRI and PRI interfaces

1) Configure local router:

```
Quidway(config)# user remoteuser1 password 0 remotepass1
Quidway(config)# dialer-list 1 protocol ip permit
Quidway(config)# dialer-list 1 protocol ipx permit
Quidway(config)# interface bri 0
Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0
Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 name remoteuser1 8810152
Quidway(config-if-Bri0)# dialer-group 1
```

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication pap

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer string 8810148

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp sent-username remoteuser1 password 0 remotepass1

II. Apply CHAP authentication

With CHAP authentication mode, configuration must be performed according to the following steps, in which *name1*, *name2* and *pass1* can be replaced with specific character strings selected by the users.

- Configure the remote user name of the local Dialer interface: **dialer map** *protocol next-hop-address* **name** *name1*
- Configure link layer protocol encapsulation of the local physical interface: **encapsulation ppp**
- Configure PPP authentication mode: **ppp authentication chap**
- Configure local router name of CHAP authentication: **ppp chap host** *name2*
- Configure the user name and password of the remote router: **user** *name1* **password 0** *pass1*
- Configure the user name and password of the local router: **user** *name2* **password 0** *pass1*
- Configure remote router name at Dialer interface, or the physical interface directly enabling DDR, of the remote router: **ppp chap host** *name1*

Example 1: apply serial port

1) Configure local router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user remoteuser1 password 0 togetherpass

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer map ip 100.1.1.2 name remoteuser1 8810052

Quidway(config-if-Dialer0)# encapsulation ppp

Quidway(config-if-Dialer0)# ppp authentication chap

Quidway(config-if-Dialer0)# ppp chap host localuser1

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user localuser1 password 0 togetherpass

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer string 8810048

Quidway(config-if-Dialer0)# encapsulation ppp

Quidway(config-if-Dialer0)# ppp authentication chap

Quidway(config-if-Dialer0)# ppp chap host remoteuser1

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

Example 2: apply ISDN BRI and PRI interfaces

1) Configure local router：

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user remoteuser1 password 0 togetherpass

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Bri0)# dialer map ip 100.1.1.2 name remoteuser1 8810152

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication chap

Quidway(config-if-Bri0)# ppp chap host localuser1

2) Configure remote router:

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user localuser1 password 0 togetherpass

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer string 8810148

Quidway(config-if-Bri0)# encapsulation ppp

Quidway(config-if-Bri0)# ppp authentication chap

Quidway(config-if-Bri0)# ppp chap host remoteuser1

1.7.6 Configure Dialer-list

Dialer-list is configured in global configuration mode, and, when combined with dialer-group, is used by DDR to determine whether the datagram sent is an interesting message. DDR processes the sent datagram in the following ways:

- For an uninteresting message, if no dial link has been established to send the message, DDR will discard the message;
- For an interesting message, if no dial link is available to send the message, DDR will dial and cache the message;
- If a dial link is available to send the message, then no matter whether the message is interesting or not, DDR will send the message on this dial link.

Dialer-list is configured in two modes:

- Directly configured to protocol;
- Configured through access-list;

The above two configuration modes cannot be used at the same time, that is, one dialer-list can be configured in only one mode, as exemplified below:

Example 1: in the dialer-list directly configured to protocol, IP message is interesting and IPX message is uninteresting.

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# dialer-list 1 protocol ipx deny

Example 2: in dialer-list configured through access-list, all IP messages except rip message are interesting.

Quidway(config)# access-list deny udp any eq rip any eq rip

Quidway(config)# access-list 101 permit ip any any

Quidway(config)# dialer-list 1 list 101

1.8 Troubleshooting DDR

1.8.1 DDR Fault Diagnosis

Causes for common DDR faults can be diagnosed from the following aspects:

I. Whether modem is normal

If Modem is abnormal, like persistent noise or busy tone, then try to return it to normal by executing shutdown and no shutdown commands at the physical interface connected to Modem. If this operation fails, then try to return it to normal by executing AT command string at the physical interface connected to Modem. For example:

Quidway(config)# chat-script Quidway(config)#chat-script yaho "" AT&F OK ATE0S0=0&C1&D2 OK AT&W

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# start-chat yaho

II. Check whether network layer address is configured at relevant interface

If no network layer address has been configured at the logic dial interface or at the physical interface directly enabling DDR, then, when the network layer searches for routers, it cannot find the dial interface, so that DDR cannot dial. The configurations in Example 1 below are wrong, because no IP address is configured at the interface. Example 2 shows correct configurations obtained by modifying Example 1, with IP address configured at the interface.

Example 1: wrong configurations in which IP address is not configured

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810154

Example 2: correct DDR configuration (the bold-typed part is added)

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.3 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810154

III. Check whether dialer-group is configured

The dialer-group must be configured on logical dial interface or the physical interface directly enabling DDR, otherwise DDR will not process packets sent from and received by the dial interface. As shown in the following example 1 is a wrong configuration, in which no dialer-group is configured on the interface, while shown in example 2 is a correct configuration in which the error is corrected by configuring dialer-group on the interface

Example 1: wrong DDR configuration without dialer-group.

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810152

Example 2: correct DDR configuration (the bold-typed part is added)

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810152

IV. Check whether dialer-list is configured correctly

DDR specifies whether to dial and send one packet sent to the dial interface, according to the dialer-list corresponding to the dialer-group configured by the user. If the packet is out of dialer-list range, then DDR will send the packet if the link to send this packet is existing, otherwise DDR discard this packet. That is, DDR will not automatically perform dial connection for packets beyond dialer-list range.

As shown in the following example 1, dialer-list is incorrectly configured as deny IP packet, in this case, DDR will not create call dial connection for IP packet on the corresponding dial port. Example 2 presents the correct configuration.

Example 1: incorrect DDR configuration, dialer-list configuration error (bold-typed part).

Quidway(config)# dialer-list 1 protocol ip deny

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810152

Example 2: the modified correct DDR configuration (the bold-typed part)

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface bri 0

Quidway(config-if-Bri0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Bri0)# dialer-group 1

Quidway(config-if-Bri0)# dialer map ip 100.1.1.1 8810152

V. Check whether the configuration for PPP authentication is correct

Under the Dialer Profile configuration, if the local end requires receiving incoming call, then PPP authentication must be configured at both local and remote end, and at both dialer and physical interface. If the PPP authentication configuration is incorrect, or if the remote name consulted through PPP is different from the remote-name of DDR configuration, there will be no interworking between the two ends. PPP authentication configuration error may be caused by one of the following factors:

- The user-name is not configured, causing the failure of ppp consulting.
- The ppp authentication is not configured, so that PPP fails to request name from the remote to be used by DDR.
- The ppp authentication pap is configured, but there is error in ppp pap sent-username configuration, causing the failure of ppp consulting.
- The ppp authentication chap is configured, but there is error in ppp chap host configuration, causing the failure of ppp consulting.

VI. Check whether synchronous/asynchronous serial port is correctly configured as asynchronous mode, and whether Modem is configured

The synchronous/asynchronous serial port must be configured first into asynchronous interface and configured with Modem configuration command, before any DDR configuration can proceed. If the dial configuration command is invisible on synchronous/asynchronous serial port, a frequent cause is that the synchronous/asynchronous serial port has not been configured as asynchronous interface. Now the dial configuration command will be visible, by running the following two configuration commands under this synchronous/asynchronous serial port configuration:

Quidway(config-if-SerialX)# **physical-layer async**

Quidway(config-if-SerialX)# **modem**

VII. Check whether synchronous/asynchronous serial port is bound to logical dial interface or directly enables DDR

The synchronous/asynchronous serial port has to be bound to logical dial interface or directly enable DDR, then it can be used in dial connection.

The configuration command for synchronous/asynchronous serial port to directly enable DDR dialer in-band, as shown in the following example (bold-typed):

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# ip address 100.1.1.3 255.255.255.0

Quidway(config-if-Serial0)# dialer in-band

Quidway(config-if-Serial0)# dialer-group 1

Quidway(config-if-Serial0)# dialer map ip 100.1.1.1 8810054

The configuration command to bind synchronous/asynchronous serial port to logical dial interface:

The configuration command under Legacy DDR configuration is dialer rotary-group, as shown in the following example (bold-typed part):

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.1 255.255.255.0

Quidway(config-if-Dialer0)# dialer in-band

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer map ip 100.1.1.2 8810055

Quidway(config-if-Dialer0)# dialer map ip 100.1.1.3 8810048

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer rotary-group 0

The configuration command under Dialer Profile configuration is dialer pool and dialer pool-member, as shown in the following example (bold-typed part):

Quidway(config)# dialer-list 1 protocol ip permit

Quidway(config)# user usera password 0 passa

Quidway(config)# interface dialer 0

Quidway(config-if-Dialer0)# ip address 100.1.1.2 255.255.255.0

Quidway(config-if-Dialer0)# dialer remote-name usera

Quidway(config-if-Dialer0)# dialer-group 1

Quidway(config-if-Dialer0)# dialer pool 1

Quidway(config-if-Dialer0)# ppp pap sent-username userb password 0 passb

Quidway(config-if-Dialer0)# dialer string 8810052

Quidway(config-if-Dialer0)# interface serial 0

Quidway(config-if-Serial0)# physical-layer async

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# dialer pool-member 1

Quidway(config-if-Serial0)# encapsulation ppp

Quidway(config-if-Serial0)# ppp authentication pap

1.8.2 DDR Fault Elimination

The following are the troubleshooting procedure of some typical faults:

Fault 1: Modem does not dial

Troubleshooting: when the router configuration dials DDR, if the Modem does not dial when sending data, the cause may be one of the followings:

1) Hardware
- Whether modem is connected correctly.
- Whether modem is initialized correctly.

5) Software
- If the interface is synchronous/asynchronous, it is not set as asynchronous mode.
- The modem in and modem out commands are not configured.
- DDR is not enabled.
- The dialer map or dialer string corresponding to packet is not configured.
- The dialer-group command is not configured.
- The packet, being an uninteresting packet, does not trigger any call. The packet may be set as interesting packet with dialer-list command.

Fault 2: Modem does not receive call

Troubleshooting: the causes may be as follows:

1) Hardware
- Whether modem is connected correctly.
- Whether modem is initialized correctly, whether it is set as non-automatic answer. Refer to Modem section of this manual for details.
- Whether the telephone line is connected correctly.

6) Software
- If the interface is synchronous/asynchronous, it is not set as asynchronous mode.
- The modem in and modem out commands are not configured.
- DDR is not enabled.

Fault 3: when the Modem is connected, the opposite party still cannot be pinged through.

Troubleshooting: the cause may be one of the followings:
- Whether the encapsulation of two ends is consistent.
- If encapsulation ppp is used, whether the authentication is configured correctly at both ends.
- DDR is not enabled.
- The receiving end is configured with dialer map, but there is no dialer map matching the calling end.

1.8.3 Troubleshooting with DDR Debugging Information

I. How to acquire DDR debugging information

Execute the following commands in privileged user mode, to see DDR debugging information:

Quidway# debug dialer event

Quidway# debug dialer packet

Quidway(config)# logging on

II. The debugging information displayed when DDR can interwork with the opposite end

Information displayed at the calling end:

```
DDR: try to find routing to 100.1.1.2 on interface Serial0
DDR: it is an interesting packet
DDR: Find a dialer map matching the address
DDR: Try to find a free channel to dial 8810052: on the interface
DDR: Dialing 8810052 on interface Serial0 of interface Serial0
DDR: Enqueue this packet
DDR: try to find routing to 100.1.1.2 on interface Serial0
DDR: it is an interesting packet
DDR: Find a dialer map matching the address
DDR: A link is connecting by this dialer map, waiting this link
DDR: Enqueue this packet
DDR: try to find routing to 100.1.1.2 on interface Serial0
DDR: it is an interesting packet
DDR: Find a dialer map matching the address
DDR: A link is connecting by this dialer map, waiting this link
DDR: Enqueue this packet
DDR: try to find routing to 100.1.1.2 on interface Serial0
DDR: it is an interesting packet
DDR: Find a dialer map matching the address
```

```
DDR: A link is connecting by this dialer map, waiting this link
DDR: Enqueue this packet
DDR: queue is full, discard the packet
DDR: try to find routing to 100.1.1.2 on interface Serial0
DDR: it is an interesting packet
DDR: Find a dialer map matching the address
DDR: A link is connecting by this dialer map, waiting this link
DDR: Enqueue this packet
DDR: queue is full, discard the packet
% SIMUDIAL: Serial0 changed state to UP.
DDR: Receive CALL_CONN_CFM
% interface Serial0 changed state to UP.
DDR: link layer ask the PPP_interface of the interface Serial0
DDR: link layer transfer NAME "" to DDR on interface Serial0
DDR: NAME authentication OK
DDR: link negotiation Up on interface Serial0
% Line protocol ip on interface Serial0,changed state to UP.
```

Information displayed at the call receiving end:

```
%SIMUDIAL: Serial0 changed state to UP.
DDR: Receive CALL_CONN_IND
% interface Serial0 changed state to UP.
DDR: link layer ask the PPP_interface of the interface Serial0
DDR: link layer transfer NAME "" to DDR on interface Serial0
DDR: NAME authentication OK
DDR: link negotiation Up on interface Serial0
DDR: peeraddr matching success on interface serial0, link Up.
% Line protocol ip on interface Serial0,changed state to UP.
```

III. The debugging information displayed when DDR fails to interwork with the opposite end and the solution

This section lists in turn the debugging information when DDR fails to interwork with the opposite end and explains how it is generated. Users may clear the fault by following the attached solutions.

```
DDR: Receive CALL_DISC_IND
```

This debugging information may be generated by the following causes:

a. The physical connection between local end and remote end is cut off, poor connection between telephone line and router, and poor telephone line quality.b. Incorrect PPP authentication configuration, PPP authentication fails to pass.

c. The remote DDR authentication fails to pass, the name (dialer remote-name, name in dialer map) configured by DDR is inconsistent with the name configured in PPP authentication configuration, there is no local network layer address in the remote dialer map.

d. It is not a fault, while the problem is caused when the remote DDR idle-timeout timer is timeout, the opposite end hooks on this connection.

The solutions are as follows:

a. For incorrect PPP configuration, please configure according to the example above.

b. If the names are configured inconsistently, please configure according to the example above.

c. For the problem of “Network layer address”, please take one of the following solutions in the configuration of the opposite end:

- Add in the remote router, the dialer map corresponding to local router network layer address.
- Remove all the dialer maps in the remote configuration, and use dial string instead.

```
DDR: link negotiation Down on interface ***
```

This debugging information may be generated by the following causes: incorrect PPP configuration, so that PPP consulting fails and thus the connection is hooked on.

The solution is: configure with reference of the example above.

```
DDR: NAME authentication ERROR failed
```

This debugging information may be generated by the following causes: the name (dialer remote-name, name in dialer map) configured by DDR is inconsistent with the name configured in PPP, local DDR authentication fails to pass thus this connection is hooked on.

The solution is: configure with reference of the example above.

```
DDR: peeraddr matching error on interface *** shutdown link
```

This debugging information may be generated by the following cause: there is no remote network layer address in the local dialer map.

The solution is: add in the local router, the dialer map corresponding to remote network layer address, or remove all the dialer maps in the local configuration, and use dial string instead.

```
DDR:idle-timeout on interface ***  shutdown! start enable-time
```

This debugging information does not indicate any error, instead, it means that the local DDR idle-timeout time is timeout and DDR hooks on the connection normally.

```
DDR: wait-for-carrier-timeout on a link on interface *** shutdown!start
enable-time
```

This debugging information may be generated by the following cause: local router fails to dial and connect the opposite end, because the opposite end is busy or telephone line quality is poor.

```
DDR: The interface has no dialer-group discard the packet!
```

This debugging information may be generated by the following cause: dialer-group configuration command is not configured on the corresponding logical dial interface or on the physical port directly enabling DDR.

The solution is: configure with reference of the example above.

```
DDR: there is not a dialer string on the interface failed discard packet
```

This debugging information may be generated by the following cause: dialer-map is not configured on the corresponding logical dialer interface or on the physical port directly enabling DDR, and no dial string is configured.

The solution is: configure dialer map and dial string locally according to the calls to be sent by local end.

```
DDR: Enable-timeout is effective  failed
```

This debugging information does not indicate any error, instead, it is because that the enable-timeout timer of the corresponding physical port is not yet timeout. When the timer is timeout, the corresponding physical port can be used to dial.

Chapter 2 Configuration of Modem Management

2.1 Modem Management Functions Provided by VRP1.4

Modem is a network equipment in extensive use. Satisfactory management and control of modem are important functions of router. However, as there are numerous modem manufacturers and diversified models, there may exist differences in terms of specific implementation and command details, although the standard AT command set of the industry is prevailing.

To enhance router' flexibility as much as possible, Quidway router series provide the following Modem management functions:

1) Provide a set of script language for modem management, referred to as Modem script below, in order to better the control of the Modem connected with the router. Modem script may be executed in the following two ways:
- Execute modem script directly through chat-script command, for initialization of modem or other configurations.
- Trigger the execution of modem script through specific events (such as router startup, Modem call completed and start-chat command).

2) In the meantime, the cooperation of the script and the relevant commands can enhance router's remote configuration function. When the asynchronous serial port works in Interactive mode, the user may establish its connection with this asynchronous serial port in dummy terminal mode or remotely through modem, and manage the router configuration.
3) The interoperability with other equipment providers (such as Cisco), is mainly shown in the fact that the asynchronous serial ports of both parties work in Interactive mode, and the two equipment are interconnected through modem.

2.2 Modem Script

2.2.1 Function

Quidway router series provide Modem script, mainly functions as follows:

- Modem script can be used to flexibly control modems of different models, for example, different initialization strings used can help modems of different manufacturers and models to work in harmony with the router.
- Modem script can be used for interactive login of remote systems, and the interactive consulting of scripts can be used to switch into different connection status. When connection is established through modem between the asynchronous serial port of the modems of both parties, which protocol to encapsulate on the physical link and various working parameters of the protocol can be specified through consulting.

2.2.2 Syntax

Common modem script format is as follows:

receive-string1 send-string1 receive-string2 send-string2

Here:

- send-string stands for sending character string
- receive-string stands for receiving character string
- send-string and *receive-string* usually appear in pairs, and the script must begin with sending character string. For example, *send-string1 receive-string1 .....* means that the execution flow is: send character string *send-string1* to modem in the hope of receiving character string *receive-string1*. If before timeout, successful matching of character string and *receive-string1* is received, continue to execute the following script, otherwise terminate its execution.
- If the last character string is a send-string, it means that script execution may be ended after sending this string, instead of waiting for receiving string.
- If the script begins with waiting for sending character string, instead of receiving character string, then the first send-string can be set as "", while the meaning of such mark is explained below.
- For the received string, in addition to its ending with \ c, the end of the character string will be automatically attached with a return mark when it is sent.
- The received strings are matched with the method irrelevant with positions, i.e., as long as the content to receive contains the string expected to receive, the matching is successful.
- In the matching of received strings, there may be a number of strings expected to receive which are connected with "-". So long as it matches one of them, the matching is successful.
- The timeout for waiting to receive character string is 5 seconds by default, the **TIMEOUT** *seconds* may be inserted into the script from time to time to adjust the timeout of waiting to receive character string, and such setting will remain valid in the same script before the next TIMEOUT setting.
- All the character strings and key words in the script are case sensitive.
- The character strings or key words are separated with spaces, the space in a string itself should be marked with double quotation marks " ", and if it is empty in the quotation marks (i.e.,""), the character string may two meanings. That is, if "" is at the beginning of the script, it means to directly wait for receiving character string, instead of sending any character string, while if it is in other locations, the content of the string is regarded as "".
- **ABORT** *receive-string* may be inserted into the script from time to time to change script execution flow, indicating if the received string full matches *receive-string*, the script execution will be terminated. In the script, **ABORT** *receive-string* may appear several times, which will function jointly, so long as it matches one of them, the script execution will be terminated, and wherever ABORT receive-string appears, it plays its role in the entire script execution process.
- The escape characters may be inserted into the script, to better the control of script and its flexibility, meanwhile all the escape characters are the separating characters of the character strings at the same time.

Table DC-2-1 List of key script words

Key words	Description
ABORT receive-string	**ABORT** is followed by a character string, used to match the character strings sent by Modem or the remote DTE equipment. The method is complete matching, there may be a number of ABORTs specified in a script, and each is valid in the course of script execution.
TIMEOUT seconds	**TIMEOUT** is followed by a number, used to set the waiting timeout of receiving character string, if no character string expected is received during the waiting time, the script execution fails. This setting remains valid after it is set, until the next TIMEOUT setting.

Here the unit is second, and the value range is 0-180, default value is 180.

Table DC-2-2 List of script escape characters

Escape characters	Description
\c	No additional return character is sent when sending character string, the location is at the end of send-string as other positions are invalid.
\d	Pause of 2 seconds
\n	Send line change character
\r	Send return character
\s	Send space character
\t	Send tabulate character
\\	Send \\ character
\T	As an alternative telephone number. When DDR calls the script to dial, the place with \T will be replaced with telephone number, so that the same dial script can be used for different dialing.

2.3 Configuring Modem Management

2.3.1 Modem Management Configuration Task List

The Modem management configuration task list is as follows:

- Configure modem call-in and call-out authorities
- Configure modem script
- Manually execute modem script
- Specify the event to trigger modem script
- Configure the working mode of asynchronous interface related to modem
- Configure modem answer mode

2.3.2 Configuring Modem Call-In and Call-Out Authorities

Perform the following task in asynchronous serial port mode.

Table DC-2-3 Configure modem call-in and call-out authorities

Operation	Command
Only modem call-in allowed	**modem in**
Only modem call-out allowed	**modem out**
Modem call-in and call-out allowed	**Modem**
Modem call-in and call-out disallowed	**no modem**

Modem call-in and call-out are allowed by default.

2.3.3 Configuring Modem Script

Perform the following task in global mode.

Table DC-2-4 Configure modem script

Operation	Command
Define modem script	**chat-script** *script-name script*
Delete modem script	**no chat-script** *script-name*

For specific format of script, please refer to Modem script syntax.

2.3.4 Executing Modem Script Manually

The start-chat command can be used, when necessary, to execute the specified Modem script, in order to manage the Modem externally connected with the interface.

Perform the following task in asynchronous serial port mode.

Table DC-2-5 Manually execute modem script

Operation	Command
Manually execute Modem script	**start-chat** *script-name*

2.3.5 Specifying the Event to Trigger Modem Script

Relate modem script to events, that is, the router will automatically execute corresponding script when a specific event occurs. In VRP1.4, the script events supported include:

- When the call-out connection of the line is established successfully: execute the specified script when the modem call-out connection is established successfully.
- When the call-in connection of the line is established successfully: execute the specified script when the modem call-in connection is established successfully.
- DDR dialing: start the dial script during DDR dialing.
- Line reset: execute the specified script when the line is disconnected.
- System power on and reboot: execute the specified script for corresponding asynchronous serial port during system power on and initialization.

The **script** command may be used to specify corresponding scripts for all the above events.

Perform the following task in asynchronous serial port mode.

Table DC-2-6 Specify events triggering modem script

Operation	Command
Specify the modem script to execute when call-out connection of the line is established successfully	**Script activation** *script-name*
Specify the modem script to execute when call-in connection of the line is established successfully	**Script connection** *script-name*
Specify the modem script to execute during DDR dialing.	**Script dialer** *script-name*
Specify the modem script to execute during line reset	**Script reset** *script-name*
Specify the modem script to execute during system power on and reboot	**Script startup** *script-name*
Specify the default modem initialization string	**Script init-string** *init-string*

2.3.6 Configuring Modem Answer Mode

Perform the following task in asynchronous serial port mode.

Table DC-2-7 Configure modem answer mode

Operation	Command
MODEM is in automatic answer mode	**modem-autoanswer**
MODEM is I nnon-automatic answer mode	**no modem-autoanswer**

By default, modem is in non-automatic answer mode.

The configuration mainly depends on whether the status of the external modem of the asynchronous interface is automatic answer mode (i.e., if Modem's AA indicator is on).If the modem is in automatic answer mode, the user has to be execute **modem-autoanswer** before using dialing function; if modem is not in automatic answer mode, the user has to be execute **no modem-autoanswer**.

If the configuration is inconsistent with the modem status, some incoming Modem calls may not be received normally.

2.4 Typical Configuration of Modem Management

2.4.1 Managing Modem with Modem Script

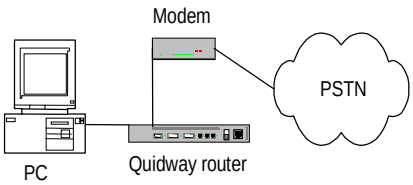


Figure DC-2-1 Networking diagram of router's management configuration for modemExample 1: Modem automatically adapts to baud rate

For the asynchronous interface connected with modem, the baud rate of modem can be configured with standard AT command, in AT command set, set "AT" to modem, if "OK" is received, the modem can automatically match the corresponding baud rate, and the configuration is written into and saved in modem, the corresponding AT command is "AT&W", therefore the corresponding configuration procedure is as follows:

1) Configure modem script

Quidway(config)# chat-script baud "" AT OK AT&W OK

2) Execute the corresponding script under interface configuration mode, assuming that modem is connected to interface Serial0.

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# start-chat baud

Example 2: Restore the ex-factory setting of modem

The modem command to restore ex-factory configuration nis "AT&F", similar to the configuration procedure of setting baud rate:

Quidway(config)# chat-script factory "" AT OK AT&F OK

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# start-chat factory

Example 3: Configure modem initialization parameter

Correctly initialize modem configuration is an important step to connect modem correctly. The following is a brief introduction to the common AT initialization commands and work to do for initialization.

- During consulting between modems, modem rates must remain unchanged, otherwise new rate matching should be performed with AT command.
- Modem locks EIA/TIA-232 serial port rate in different ways. The modem manual may be consulted to learn how modem locks rate (optional items include &b, \ j, &q, \ n or using s register).
- Modem must use data carrier detection (DCD) to indicate the establishment of its remote connection, such configuration of most modems is performed with &c1 command. Refer to modem manuals for details.
- Modem must allow to hook on its active connection through Data Terminal Ready (DTR) signal, such configuration for most modems is performed with &d2 or &d3. Refer to modem manuals for details.
- If the modem is required of call-in function, it must be configured with incoming call off-hook ringing number, our requirement is not to adopt the automatic answer ring mode, most modems are configured as S0=0. Refer to modem manuals for details.

In consideration of the above conditions, our typical initialization string is as follows:

AT&b1&c1&d2&s0=0

Explanation for functionality of the initialization string:

- Lock serial port rate
- Enable DCD detection
- Enable DTR hook-on function
- Configure as non-automatic answer

The procedure to configure is as follows:

Quidway(config)# chat-script init "" AT&b1&c1&d2&s0=0 OK

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# start-chat init

2.4.2 Remote Configuration Using Modem and Through Asynchronous Interface

I. Networking requirements

AS introduced above, modem can be used for remote configuration through Console interface, Quidway router series also support the remote configuration using modem through asynchronous interface.

II. Networking diagram

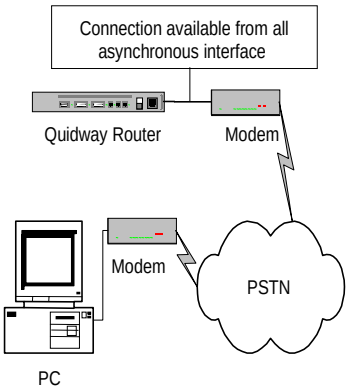


Figure DC-2-2 Networking diagram of remote configuration using modem and through asynchronous interface

III. Configuration procedure

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical asynchronous

Quidway(config-if-Serial0)# modem inout

Quidway(config-if-Serial0)# async mode interactive

2.4.3 Router Initialization with Initialization Script

I. Configuration requirements

Enable the router to initialize the modem connected with asynchronous interface during power on or restart.

II. Configuration procedure

Quidway(config)# chat-script init "" AT OK AT&B1&C1&D2&S0=1 OK AT&W OK

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical asynchronous

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# script startup init

2.4.4 Direct Dial with Script

Configuration procedure:

Quidway(config)# chat-script dial "" AT OK ATDT8810058 CONNECT

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical asynchronous

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# start-chat dial

2.4.5 Interactively Connect Cisco Router Through Modem

I. Networking requirements

The Quidway router should be interconnected with Cisco router using Modem through asynchronous interface, and the asynchronous interfaces of both parties should work in interaction mode, when the physical link is established, Quidway router requires Cisco router to conduct PPP consulting.

II. Networking diagram

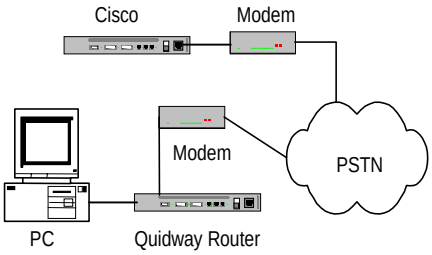


Figure DC-2-3 Networking diagram of interactive connection with cisco router through modem

III. Configuration procedure

Quidway(config)# chat-script cisco Router> -\ r-Router> "PPP 1.1.1.1"

Quidway(config)# interface serial 0

Quidway(config-if-Serial0)# physical asynchronous

Quidway(config-if-Serial0)# modem

Quidway(config-if-Serial0)# async mode interactive

Quidway(config-if-Serial0)# script activation cisco

HUAWEI®

VRP

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Chapter 1 VoIP Configuration

1.1 VoIP Overview

VoIP is the abbreviation of Voice over IP. What we often called IP phone is a typical application of the VoIP. The application of VoIP in router makes it possible that the voice service can be implemented through the IP network, including the plain phone service and fax.

VoIP is implemented through voice packet. In VoIP, the digital signal processor (DSP) splits the voice signals into frames and stores them in packets for transmission. VoIP is mainly a software solution. It needs the support of voice port board added to the router.

At the beginning of 1995, a kind of software product that could make toll calls on Internet was available for the first time, and this phone service implemented on Internet was called Internet phone, this was the early form of the IP phone. Through five years of development, the IP phone has been developed all over the world as a new type of phone service, which poses as a great threat to the plain phone service.

The development of IP telephone benefits from the promotion of technology and the drive of market.

The years of technological accumulation makes the technology of transforming voice into IP technology increasingly mature and practical. At the same time, the high-speed development of the integrated circuits (IC) causes the price of the core component of the IP phone—DSP going down greatly, these factors contribute to the technical possibility for the promotion of the IP telephone.

The drive of market benefits is also a significant reason for the rapid development of the IP phone. Using the VoIP network composed of IP voice gateway and other device, we can bypass the toll calls to the data network, thus greatly reducing large bill for toll expenses and benefits the subscribers.

Through the development from the beginning of 1990s till now, the IP phone has developed form the IP software period to the IP gateway period. And also the current VoIP application has developed from the simple PC products with voice service to the telecommunication service with multiple services and functionality such as high reliability, high quality voice, fax and data transmission.

At present, IP gateway is used to interconnect PSTN (Public Switching Telephone Network) and the Internet, so as to mature the technology of PC to phone, phone to PC and phone to phone. In addition, voice quality is greatly improved and the commercial requirements can be satisfied.

1.1.1 VoIP Principle

I. Basic composition

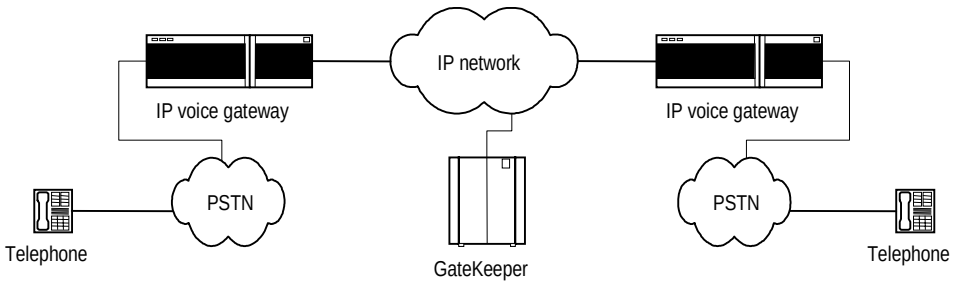

Figure VC-1-1 Basic composition of the VoIP system

For the plain voice service, all the functions from the caller to the called are implemented by PSTN, but IP voice service is quite different.

In the above figure, the IP voice gateway provides the port between the IP network and the public telephone networks (PSTN/ISDN), and user is connected to the IP voice gateway through the PSTN local loop. The IP voice gateway is responsible for converting the analogue signals to digital signals, compressing and packetizing so that they become packet voice signals that can be transmitted over the IP network. Then, they are sent to the user gateway and the IP voice gateway at the called end reverts the packets to recognizable analogue voice signals. Once these signals arrive at the called terminal through PSTN, a communication process from telephone to telephone completes. In real VoIP networking, you may need gatekeeper to accomplish functions such as routing and access control.

VoIP uses UDP (User Datagram Protocol) in the Transport Layer. Since the UDP provides connectionless and unreliable datagram service, it is not very appropriate for real-time application. The current approach is to run the RTP (Real-time Transport Protocol) over the UDP to enhance function of real-time application.

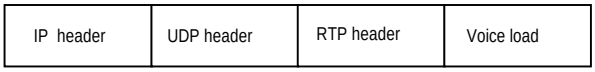

Figure VC-1-2 VoIP packet format

II. H.323 protocol stack

To realize the VoIP, currently almost all the manufacturers adopt the ITU-T standard protocol family H.323. The H.323 protocol is implemented in the Application Layer, which mainly describes the terminals, device and services for multimedia communication in local area network without quality of service (QoS) guarantee, including H.225.0, H.245, G.729, G.723.1, G.711, H.261, H.263 and T.120 series, etc.

G.723.1, G.729 and G.711 are audio codec protocols, H.263 and H.261 are video codec protocols, H.225.0 and H.245 are system control protocols, and the T.120 series are multimedia data transport protocol.

RTP and its controlled protocols RTCP (RTP Control Protocol) together ensure the real-timeliness of voice message transmission. The function of RTP is enhanced via RTCP. RTCP is used to give feedback for the quality of data dispatch. With this

feedback, the application system can adapt to different network environment. The feedback on the quality of transmission is also helpful for the fault location and diagnosis.

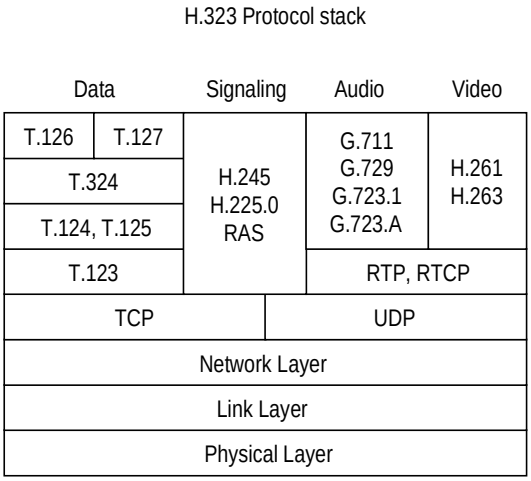

Figure VC-1-3 H.323 protocol stack

III. A typical telephone call processing by VoIP

Before configuring the voice function for router, please firstly learn the relevant flow of the Application Program Layer for the smooth configuration.

1) User picks up the hook and the voice interface board detects the action. Then the board transmits this signal to the VoIP signal processing part over the router.
2) The VoIP Session Application Program plays the dialing tone and waits for the user to dial.
3) The user begins to dial, and the VoIP session application program collects and stores the dialed number.
4) After collecting enough number to match a configured destination mode, the number will be mapped to an IP host through a dial plan mapper. The IP host directly connects with the target telephone or the PBX. If the PBX is connected, PBX will accomplish the remaining part of the call.
5) The VoIP session application program uses the H.323 protocol to transmit and receive voice data channel for the connection in each direction over the IP network. If the PBX is to processes a call, it will forward the call to the destination telephone.
6) The agreed codec mode is enabled at both ends of connection, which uses the RTP/UDP/IP as protocol stack to continue the session.
7) Once the end-to-end RTP voice channel is established, the prompt signals of all the calling procedures and the signals that can be transmitted in the band are transported through this channel over the IP network. RTCP packet is used to transmit such information as the transmission quality of voice data in the calling session.
8) When one calling party is on-hook, the session ends, and both ends resume the idle state and wait for a new call establishment triggered by the next off-hook.

1.1.2 IP Voice Implementation over VRP

The router serves as voice gateway to provide voice functions, which makes data conversion from the circuit-switching network to the packet-switching network. During the conversion, you need to convert the phone numbers to the IP addresses that the

packet switching can identify, therefore; the key factor of router configuration lies in the mapping of the phone numbers and the IP addresses.

The ports that support the voice function in the Quidway series routers include FXS (Foreign eXchange Station, i.e., the plain telephone service port), FXO (Foreign eXchange Office, two-wire loop trunk), the E&M trunk port and E1 voice port.

The device with FXS port type must be connected with the device with FXO port type (the ordinary telephone set is a standard FXO port). The ring current received by the FXS and FXO is AC current of 25Hz and 60 volts, while the signal received and sent in the E&M port is DC signal.

Table VC-1-1 The match table between the plain switch and the router interconnection interface

Switch	Router	Capacity (channel)
Loop trunk line (FXS)	FXO	1
Subscriber line (FXO)	FXS	1
E&M trunk	E&M trunk	1
E1 trunk	E1 trunk	30

1.1.3 IP Voice Feature over VRP

The IP voice over the VRP abides by G.711 (A law), G.729, G.723.1, H.225.0, H.245, and standards such as RFC1889, 1890, etc., which can support the FXS, FXO, E&M port and E1 port.

The IP voice characteristics over the VRP include:

- Silence suppression

Automatically detect the time segments of silence during session and pause the generation of data flows during these time segments, so as to reduce the sent voice data quantity.

- Comfort noise

Through generating appropriate background noise, the sharp voice between the speaking and pause that resulted from the silence suppression is avoided.

- Jitter buffering

Jitter is caused by the variations of the data packet arrival rate in the network due to the time delay variation. In order to compensate this jitter, we have added a buffer to the voice devices at the receiving side to store data packets for enough time length. Thus, even the slowest packet can arrive in time for processing in sequence. In the mean time, the buffer can adjust the packet length of the voice port board, and send the voice data to the voice port board at a stable speed

- Supporting QoS

Since there is high requirement for the real-time voice service, precedence needs to be given to voice packet sending. You can take the measures such as setting Priority Queuing (PQ) and Custom Queuing (CQ) at the transmit end. For the configuration of PQ and CQ, please refer to the relevant sections of the “QoS Configuration “.

- Supporting IP Fax

The IP Fax system is established on the basis of the VoIP, which serves to establish the fax channel, transmit and receive the fax data. The IP Fax implementation includes modulation/demodulation, fax protocol processing, IP channel maintenance, etc.

The router can also support some special service functions provided by the SPC switch, such as:

---Do not disturb

After setting the “Do not disturb “ service, no matter if it is idle, the subscriber phone set will reject any incoming call request, and the caller will only hear the busy tone.

For the DTMF phone set connecting with the voice router, after off-hook, dial *56#, and the “Do not disturb” service is set. Dial #56#, the setting is removed.

---Call Forwarding on Busy (CFB)

After setting the “Forwarding on busy”, if the subscriber phone set is in seized status, the new incoming call will be forwarded to the specified phone set.

For the DTMF phone set connecting with the voice router, after off-hook, dial *58*ABCD, the CFB service is set. Dial #58#, the setting is removed.

Note:

ABCD represents the number of the phone you want to forward the calls to. Please note that this function only apply to phone set connecting with the router FXS port, and can only specify the phone set that connects to the same router as this phone set as forwarding destination; otherwise, the setting is invalid.

--- Call Forwarding Unconditional (CFU)

After setting the call forwarding unconditional, no matter the subscriber phone is busy or not, all the incoming calls will be forwarded to the specified phone set.

For the DTMF phone set connecting with the voice router, after off-hook, dial *57*ABCD and the CFU service is set. Dial #57#, the setting is removed.

Note:

ABCD represents the number of the phone you want to forward calls to. Please note that this function only apply to phone set connecting with the router FXS port, and can only specify the phone set that connects to the same router as this phone set as forwarding destination, otherwise it is invalid.

---Alarm clock service

After setting the alarm clock service, when the time set by the subscriber is up, the phone set will continue to ring for 45 seconds and then hang up. This function only validate during the 24 hours after setting.

For the DTMF phone set connecting with the voice router, after off-hook, dial *55*HHMM for the service setting and dial #55# to remove the setting.

Note:

HH stands for hour, the virtual value is integer within the range from 0 to 23, and MM stands for minute, the virtual value is integer within the range from 0 to 59.

---Line group access

Set line group access, you can set multiple physical lines as one phone number, in this case if there is an incoming call, it will automatically select the idle line for the reply to reduce the configuration complexity and increase the networking capacity.

1.2 VoIP Configuration

1.2.1 VoIP Configuration Task List

The configuration tasks of the VoIP include:

- Configuring dial-peer
- Configuring dial terminator
- Configuring abbreviated dialing
- Configuring voice port
- Configuring the global number match policy
- Configuring the recovery method of voice board

1.2.2 Configuring Dial-peer

The key to mastering the VoIP configuration lies in understanding the dial-peers. According to different locations (the calling side or the called side), we can divide a call into four segments in a complete phone-to-phone connection and each segment (called call leg) corresponds to a dial-peer.

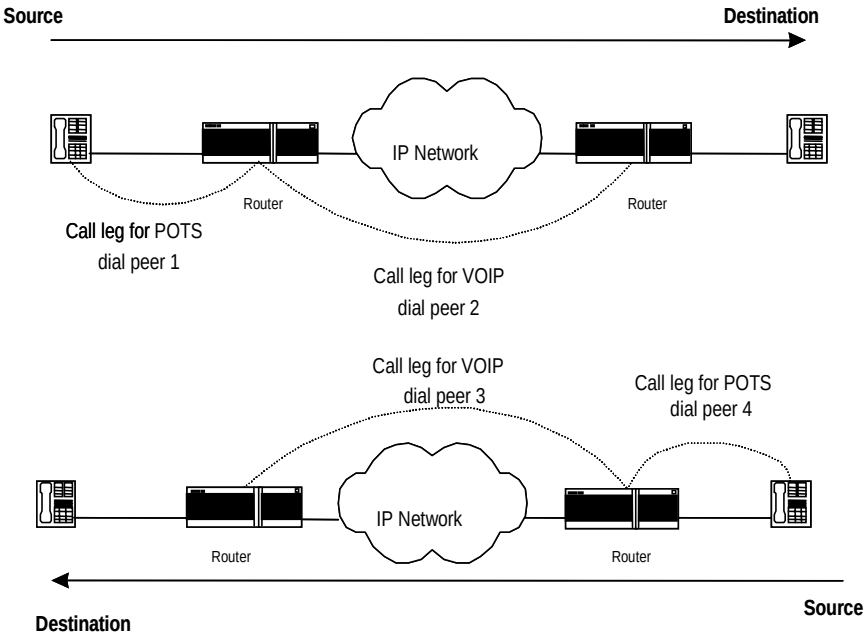

Figure VC-1-4 Call division viewed from the router at both ends

From the above figure, we can see that, there are two types of the dial-peers used in voice communications:

- POTS dial-peer
- VoIP dial-peer

I. POTS dial-peer configuration

POTS is the abbreviation of the Plain Old Telephone Service, which refers to ordinary telephone service. The POTS dial-peer configuration means to establish relationship between the physical voice port and the local telephone device. Generally we only need to configure two commands: **destination-pattern** and **port**. The command of **destination-pattern** is used to define phone numbers related to POTS dial-peer, and the command of **port** connect the POTS dial-peer with an actual voice port which is usually the voice port connecting the router to the local office. Furthermore, **prefix** should be configured for the outgoing PBX subscribers.

Please use the command **dial-peer voice pots** in the global configuration mode, and use other configurations in the dial-peer configuration mode.

Table VC-1-2 POTS dial-peer configuration commands

Operations	Commands
Configure POTS dial-peer and enter the POTS configuration	**dial-peer voice** *number* **pots**
Delete the POTS dial-peer	**no dial-peer voice** *number*
Disable truncating the called number	**cancel-truncate**
Truncate the called number	**no cancel-truncate**
Configure dial-peer destination pattern (phone number)	**destination-pattern** *string*
Delete the dial-peer destination pattern (phone number)	**no destination-pattern**
Set IP packet precedence	**ip precedence** *priority-number*
Restore the IP packet precedence to the default	**no ip precedence**
Configure the local port number	**port** *port-number*
Cancel the local port number	**no port**
Configure the phone number prefix	**prefix** *string*
Cancel the phone number prefix	**no prefix**
Disable the POTS dial-peer	**shutdown**
Enable the POTS dial-peer	**no shutdown**
Enable the silence detection	**vad**
Disable the silence detection	**no vad**

By default, the command **no cancel-truncate** (i.e., truncate the called number) and the command **no vad** (disable the silence detection) are valid.

The default value of the configuration command **ip precedence** (IP packet precedence) is 0.

II. VoIP dial-peer configuration

The VoIP dial-peer configuration involves the corresponding of the phone numbers with the IP addresses. The key configuration commands are **destination-pattern** and **session target**. The destination-pattern defines the phone numbers related to the VoIP dial-peer, and the **session target** specifies the destination IP address for the VoIP dial-peer.

Note:

The configuration commands here are addressed to the router, and the "Incoming" and "Outgoing" are also defined in respect of router. Therefore, the POTS dial-peer uses the destination-pattern to define the phone number of the phone set connected with the local router voice port, while the VoIP dial-peer uses the destination-pattern to define the called number.

Please use the command **dial-peer voice voip** in the global configuration mode, and use other configurations in the dial-peer configuration mode.

Table VC-1-3 VoIP dial-peer configuration commands

Operations	Commands
Configure the VoIP dial-peer and enter the VoIP configuration	**dial-peer voice** *number* **voip**
Delete the VoIP dial-peer	**no dial-peer voice** *number*
Configure the codec mode	**codec** { **1st-priority-level | 2nd-priority-level | 3rd-priority-level | 4th-priority-level** } { **g711alaw | g711ulaw | g723r53 | g723r63 | g729r8** }
Restore the codec default value	**no codec { 1st-priority-level | 2nd-priority-level | 3rd-priority-level | 4th-priority-level }**
Configure phone number	**destination-pattern** *string*
Delete phone number	**no destination-pattern**
Set IP packet precedence	**ip precedence** *priority-number*
Restore the IP packet precedence to the default value	**no ip precedence**
Configure the target IP address	**session target** { **ipv4**:a.b.c.d | **ras** }
Delete the configured IP address	**no session target**
Disable the VoIP dial-peer	**shutdown**
Enable the VoIP dial-peer	**no shutdown**
Configure the technical prefix of the H.323 gateway	**tech-prefix** *string*
Delete the technical prefix of the H.323 gateway	**no tech-prefix**
Enable the silence detection	**vad**
Disable the silence detection	**no vad**

By default, the command **no tech-prefix** (i.e., do not configure the technical prefix of the H.323 gateway at the beginning) validates, and the command **no vad** (Disable the silence detection) validates.

The default of the configuration command **codec** (voice codec mode) is **g729r8**. The default of the configuration command **ip precedence** (IP packet precedence) is 0.

1.2.3 Configuring Dial Terminator

The dial terminator configuration can notify the router that, on receiving the keystroke input, the dialing is finished and it will begin to make mode match and find the called end.

Please make the following configurations in the global configuration mode:

Table VC-1-4 Configuring the dial terminator

Operations	Commands
Configure the dial terminator	**dial-peer terminator** *character*
Delete the dial terminator	**no dial-peer terminator**

By default, we do not configure the dial terminator.

1.2.4 Configuring Abbreviated Dialing

In many enterprises, the first several digits of all the phone numbers are the same, and you only need to dial the last several digits for internal call. The VoIP service can also use this kind of abbreviated dialing with the command **num-exp**. After the dialing completes, the abbreviated dialing will automatically expand to the complete E.164 number.

Please make the following configurations in the global configuration mode.

Table VC-1-5 Configuring abbreviated dialing

Operations	Commands
Configure the abbreviated dialing	**num-exp** *extension-number expanded-number*
Delete the abbreviated dialing	**no num-exp** *extension-number*

By default, we do not configure the abbreviated dialing.

1.2.5 Configuring Voice Port

The router provides analogue voice ports for the implementation of the VoIP. The signaling type of these analogue voice ports depends upon the VI (Voice Interface) board installed. The command **voice-port** is used to configure the characteristics related to the special voice port signaling type.

The voice port support the following three basic voice signaling types:

- FXS (Foreign eXchange Station): FXS port used the standard RJ-11 line to directly connect with the device such as ordinary phone set, fax, PBX, etc., which can provide ring, voltage and dial tone.
- FXO (Foreign eXchange Office): two wire loop trunk, the FXO port uses RJ-11 line to connect the local calls to the PSTN central office or to the PBX that does not support the E&M signalings. The FXO port device can only connect to device with FXS port.
- E&M: The E&M port uses the RJ-45 line to connect the remote calls from the IP network to the PBX trunk. The E&M signaling provides the on-hook and off-hook signals and reduces the interference to some lower degree, which is usually used in the PBX backbone or connection line.

The voice port configuration mainly involves the configuration of some physical characteristics. Usually, you can use defaults for the physical port parameters and do not need to configure again.

Please use the command **voice-port** in the global configuration mode, and make other configurations in the voice-port configuration mode.

Table VC-1-6 Configuring voice-port

Operations	Commands
Configure voice physical port	**voice-port** ***port-number***
Set the busy tone detection type for the port	**area** { **north-america** | **custom** | **europe** }
Restore the port detection busy tone type to the default	**no area**
Enable comfort noise setting	**comfort-noise**
Disable comfort noise setting	**no comfort-noise**
Specify E.164 phone number of the destination end	**connection plar** *string*
Delete E.164 phone number of the destination end	**no connection plar**
Configure the port description character string	**description** *string*
Delete the port description character string	**no description**
Enable the echo cancellation function or set the sample length of the echo cancellation	**echo-cancel** { **enable** | **coverage** *coverage-time* }
Cancel the echo cancellation function or restore the sample length of the echo cancellation to the default	**no echo-cancel** { **enable** | **coverage** }
Configure the voice input gain	**input gain** *value*
Restore the voice input gain to the default	**no input gain**
Configure the E&M trunk circuit type	**operation** { **2-wire** | **4-wire** }
Delete the available wire selection scenario	**no operation** { **2-wire** | **4-wire** }
Configure the voice output attenuation	**output attenuation** *value*
Restore the voice output attenuation to the default	**no output attenuation**
Set the port start mode	**signal** { **loopstart** | **groudstart** | **wink-start** | **immediate** | **delay-dial** }
Delete the set voice port start mode	**no signal** { **loopstart** | **groudstart** | **wink-start** | **immediate** | **delay-dial** }
Configure the relevant time interval of the voice port dialing	**timeouts** {**call-disconnect** | **initial** | **interdigit** } *seconds*
Restore the relevant time interval of the voice port dialing to the default	**no timeouts** {**call-disconnect** | **initial** | **interdigit** }
Configure the relevant time parameters in the E&M port	**timing** {**delay-duration** | **delay-start** | **digit** | **interdigit** | **wink-duration** | **wink-wait** } *milliseconds*
Restore the relevant time parameters in the E&M port to the default	**no timing** {**delay-duration** | **delay-start** | **digit** | **interdigit** | **wink-duration** | **wink-wait** }
Configure the E&M trunk type	**type** { **1** | **2** | **3** | **5** }
The E&M trunk type specified in the configuration	**no type** { **1** | **2** | **3** | **5** }

The default of the configuration command **operation** (E&M trunk circuit type) is 4-wire. The default of the configuration command **signal** (port start mode) for the FXS and FXO ports is **loop start**, and for the E&M port, its default is **immediate**.

The value for configuration command **input gain** is 0 and the value for **output attenuation** is 0. The default value of the configuration command **timeouts initial** (initialization timeout interval) is 10s.

The default value of the configuration command **timeouts interdigit** (keystroke timeout interval) is 10s.

The default value of the configuration command **timing delay-duration** (timing delay timeout interval) is 400 ms.

The default value of the configuration command **timing delay-start** (timing delay start timeout interval) is 300 ms.

The default value of the configuration command **timing digit** (DTMF signal duration) is 120 ms.

The default value of the configuration command **timing interdigit** (time interval between the DTMF signals) is 120 ms.

The default value of the configuration command **timing wink-duration** (wink time delay interval) is 500 ms.

The default value of the configuration command **timing wink-wait** (wink-wait time interval) 500 ms.

The default value of the configuration command **type** (E&M trunk type) is 5.

1.2.6 Configuring Global Number Match Policy

To better adapt to the diversity of the subscriber dial plan, the number match policy includes match as per the longest number or the shortest number. When using the longest number match, if the input number length is less than the number length configured by the command **destination-pattern**, please wait until timeout, and then select the shortest number policy. When using the shortest number match, if the input number length is greater than that configured by the command **destination-pattern**, then the redundant numbers will be neglected.

Please make the following configurations in the global mode:

Table VC-1-7 Configuring the global number match policy

Operations	Commands
Configure the number match policy of the whole office	**voip match-policy** { **longest** | **shortest** }

By default, please use the shortest number match policy.

1.2.7 Configuring the Recovery Method of Voice Board

When the voice board becomes abnormal for some reason, two methods can be adopted to recover the board, i.e., the manual recovery and automatic recovery. After enabling the WATCHDOG, it will monitor the board status every five seconds and will automatically recover the board if any abnormality is detected. In this case, manual interference is not necessary. If WATCHDOG is disabled, the board cannot be recovered automatically if any abnormality occurs and manual recovery is needed.

Please make the following configuration in global configuraiton mode.

Table VC-1-8 Configuring the recovery method of voice board

Operations	Commands
Enable WATCHDOG	**voip enable-watchdog**
Disable WATCHDOG	**voip disable-watchdog**

By default, WATCHDOG is enabled.

1.3 VoIP Monitoring and Maintenance

Please use the command **voip reset** in the global configuration mode, and use the following commands **show** and **debug** in the privileged user mode.

Table VC-1-9 VoIP monitoring and maintenance

Operations	Commands
Reset the voice board	**voip reset** *slot-number*
Display the call information of the voice port	**show call-history voice-port** *number*
Display the call statistic information of the KHT module	**show kht statistics**
Display the call control block information in the RCV module	**show rcv ccb**
Display the call statistic information between the RCV module and other modules	**show rcv statistic** { **all** | **call** | **cc** | **error** | **ipp** | **proc** | **timer** | **vpm** | **vpp** }
Display the voice port information	**show voice-port** *number*
Display various statistic information in the VPP module	**show vpp** [**channel** *channel-no*]
Enable the debugging information output switch of the H.225.0 negotiated packets or events	**debug h225** { **asn1** | **event** }
Enable the debugging information output of the H.245 negotiated packets or event	**debug h245** { **asn1** | **event** }
Enable the debugging information output of the KHT module	**debug kht** { **all** | **error** | **ipp** | **rcv** | **timer** | **vpp** }
Enable the debugging information output of the RCV module	**debug rcv** { **all | cc | error** | **ipp** | **timer** | **vpm** | **vpp** }
Enable the debugging information output of the VPM module	**debug vpm** { **all** | **buffer** | **command** | **dsp** | **em** | **error** | **ipp** | **port** | **receive** | **send** }
Enable the debugging information output of the VPP module	**debug vpp** { **all | codecm | error | ipp** | **kht** | **rcv** | **timer** | **vpm** }

1) Display the call information of the voice port

Quidway# show call-history voice-port 2

```
Voice-port 2 type FXS POTS, Line state is opened
start   outgoing call 4 times, 3 success
receive incoming call 8 times, 6 success
the latest 10 calling number is:
  %1% called number 1001
  %2% called number 1001
  %3% called number 1001
  %4% called number 1001
```

The above information indicates that the type of the voice port 2 is FXS, the line is in an activated status. Four calls are originated at this port, in which three are successful calls. There are eight calls received, in which six are successful. The ten latest called numbers originated at this port, if the calls are less than ten, it will display as per the actual calls.

2) Display the call statistic information of the KHT module

Quidway# show kht statistics

```
KHT:  Receive IPP packet, begin KHT flow:       0
```

```
 KHT:  Dial successfully, match POTS dial-peer:   0
 KHT:  Dial successfully, match VoIP dial-peer:   0
 KHT:  Dial successfully, NOT match dial-peer:    0
 KHT:  Send IPAlerting packet to RCV:           0
 KHT:  Send IPConnect packet to RCV:            0
 KHT:  Send PlayDialTone packet to VPP:         0
 KHT:  Send RecvNum packet to VPP:              0
 KHT:  Timer malloc failed:                      0
 KHT:  Invalid timer error:                      0
 KHT:  Invalid timeout packet error:            0
 KHT:  Receive invalid packet from IPP:         0
 KHT:  Receive invalid packet from VPP:         0
 KHT:  Receive invalid phone number from IPP:    0
 KHT:  CCB NOT found:                            0
 KHT:  CCB status error:                         0
```

The above information indicates the amount of various types of information in sequence. The information includes the amount of the following packets:

- packet of receiving the IPP module
- successful dialing and matching the POTS dial-peer
- successful dialing and matching the VoIP dial-peer
- successful dialing but not matching the dial-peer
- the ring packet sent by the KHT to the RCV module
- the connection establishment packet sent by the KHT to the RCV module
- the prompt tones playing packet sent by the KHT to the VPP module
- the dialing number receiving packet sent by the KHT to the VPP module
- timer distribution error
- invalid timer error
- invalid timeout packet
- invalid information received by the IPP module
- invalid information received by the VPP module
- the invalid phone numbers received by the IPP module
- the call control block (CCB) not found
- CCB status error, etc.

3) Display the call control block information in the RCV module

Quidway# show rcv ccb

```
RCV  :  CCB [ 1 ]
   {
      CallID          :  0x0043
      CallState       :  TALK
      IppID           :  0x004f
      IppState        :  IPPS_CONNECTED
      CcID            :  0xffff
      CcState         :  CCS_CONNECTED
      VpmID           :  0xffff
      CallType        :  OUTGOING
      CallAttribute   :  0x00000000
      CallSignaling   :  0x00000002
      EncodeType      :  0x0000001f
      E1Slot          :  0xffffffff
      E1Port          :  0xffffffff
      TimeSlot        :  0xffffffff
      ChannelID       :  0x00000003
      VpuState        :  VS_CONNECTED
      IppTimer        :  0x00000000
      CcTimer         :  0x00000000
      VpuTimer        :  0x00000000
      CcChanMsg       :  0x00000000
      E1ChanMsg       :  0x00000000
      CallerNumber    :  111
      CalledNumber    :  660010
      prev            :  0x00000000
      next            :  0x01409500
```

```
   }
```

The above information indicates that the call control block 1 serves as outgoing call, the state of each module is connection established, the call state is in call process, the calling number is 111 and the called number is 660010.

```
  RCV  : CCB [ 2 ]
{
     CallID          :  0x0042
     CallState       :  TALK
     IppID           :  0x004e
     IppState        :  IPPS_CONNECTED
     CcID            :  0xffff
     CcState         :  CCS_CONNECTED
     VpmID           :  0x0039
     CallType        :  INCOMING
     CallAttribute   :  0x00000000
     CallSignaling   :  0x00000004
     EncodeType      :  0x00000009
     E1Slot          :  0xffffffff
     E1Port          :  0xffffffff
     TimeSlot        :  0xffffffff
     ChannelID       :  0x00000000
     VpuState        :  VS_CONNECTED
     IppTimer        :  0x00000000
     CcTimer         :  0x00000000
     VpuTimer        :  0x00000000
     CcChanMsg       :  0x00000000
     E1ChanMsg       :  0x00000000
     CallerNumber    :  111
     CalledNumber    :  660010
     prev            :  0x01409000
     next            :  0x00000000
  }
```

The above information indicates that the call control block 2 serves as incoming call, the state of each module is connection established, the call state is in call process, the calling number is 111 and the called number is 660010.

4) Display the call statistic information between the RCV module and other modules

Quidway# show rcv statistic call

```
  Statistic about RCV calls :
  {
     RCV_CC_ACTIVE_CALL                  :  0
     RCV_CC_ACTIVE_CALL_SUCCEEDED        :  0
     RCV_CC_ACTIVE_CALL_FAILED           :  0
     RCV_CC_PASSIVE_CALL                 :  0
     RCV_CC_PASSIVE_CALL_SUCCEEDED       :  0
     RCV_CC_PASSIVE_CALL_FAILED          :  0
     RCV_R2_ACTIVE_CALL                  :  5
     RCV_R2_ACTIVE_CALL_SUCCEEDED        :  2
     RCV_R2_ACTIVE_CALL_FAILED           :  3
     RCV_R2_PASSIVE_CALL                 :  4
     RCV_R2_PASSIVE_CALL_SUCCEEDED       :  1
     RCV_R2_PASSIVE_CALL_FAILED          :  3
     RCV_VPM_ACTIVE_CALL                 :  39
     RCV_VPM_ACTIVE_CALL_SUCCEEDED       :  11
     RCV_VPM_ACTIVE_CALL_FAILED          :  28
     RCV_VPM_PASSIVE_CALL                :  18
     RCV_VPM_PASSIVE_CALL_SUCCEEDED      :  15
     RCV_VPM_PASSIVE_CALL_FAILED         :  3
  }
```

The above information indicates the total number of the CC, R2 signaling in the RCV module and the call packets of each VPM module, the number of successful call packets, the number of the failed call packets. Using the other parameters (such as CC, IPP, VPM, etc), it will display the statistic information in corresponding module.

5) Display the voice port information

! Execute this command for a voice port in calling progress.

Quidway# show voice-port 0

```
  Voice-port 0 type FXS POTS , Line state is opened
  channel status is CH_TALKING
  coding protocol 729, decoding protocol 729
  calling number 1001 called number 2001, direction outgoing
  Call-ID is 2 Call-reference is 12
  comfort-voice is  enabled, reset 0 times
  Administrative State is UP
  In Gain is Set to 0 dB
  Out Attenuation is Set to 0 dB
  Echo Cancellation is enable
  Initial Time Out is set to 10 s
  Interdigit Time Out is set to 10 s
```

The above information indicates that the voice port type is FXS, the line is in activated state, the voice port is calling progress now, the codec mode is G.729, the calling number is 1001 and the called number is 2001.

! Execute this command for a currently idle voice port.

Quidway# show voice-port 0

```
  Voice-port 0 type FXS POTS , Line state is opened
  channel status is CH_IDLE
  coding protocol 0, decoding protocol 0
  calling number  called number , direction outgoing
  Call-ID is 2 Call-reference is 0
  comfort-voice is  enabled, reset 0 times
  Administrative State is UP
  In Gain is Set to 0 dB
  Out Attenuation is Set to 0 dB
  Echo Cancellation is enable
  Initial Time Out is set to 10 s
  Interdigit Time Out is set to 10 s
```

Since the voice codec mode is mutually negotiated and determined in the session, we cannot see the codec information in the idle state.

6) Display various statistic information in the VPP module

Quidway# show vpp

```
 Channel = 0       Status = CH_TRANSFRAME
  ConnectRightTimes        = 53        ConnectWrongTimes        = 0
  DisConnectRightTimes     = 52        DisConnectWrongTimes     = 0
  RecvCodecmDataRightTimes = 577898    RecvCodecmDataWrongTimes = 0
  SendCodecmDataRightTimes = 78272     SendCodecmDataWrongTimes = 0
  RecvIppDataRightTimes    = 78275     RecvIppDataWrongTimes    = 0
  SendIppDataRightTimes    = 577906    SendIppDataWrongTimes    = 0
  RecvCodecmDataBytes      = 17337270  RecvIppDataBytes  = 1845370
Channel = 1        Status = CH_IDLE
  ConnectRightTimes        = 4         ConnectWrongTimes        = 0
  DisConnectRightTimes     = 4         DisConnectWrongTimes     = 0
  RecvCodecmDataRightTimes = 207       RecvCodecmDataWrongTimes = 0
  SendCodecmDataRightTimes = 181       SendCodecmDataWrongTimes = 0
  RecvIppDataRightTimes    = 181       RecvIppDataWrongTimes    = 0
  SendIppDataRightTimes    = 207       SendIppDataWrongTimes    = 0
  RecvCodecmDataBytes      = 6210      RecvIppDataBytes     = 5430
……
Total
  ConnectRightTimes        = 66        ConnectWrongTimes        = 0
  DisConnectRightTimes     = 64        DisConnectWrongTimes     = 0
  RecvCodecmDataRightTimes = 607188    RecvCodecmDataWrongTimes = 2
  SendCodecmDataRightTimes = 107473    SendCodecmDataWrongTimes = 0
  RecvIppDataRightTimes    = 107473    RecvIppDataWrongTimes    = 0
```

```
SendIppDataRightTimes    = 607188    SendIppDataWrongTimes    = 0
RecvCodecmDataBytes      = 18215640  RecvIppDataBytes   = 2721160
```

The above information indicates the information as follows:

- times of right and wrong connection establishment in each voice channel
- the times of correct and wrong disconnection
- the times of correct and wrong coding data receiving
- the times of correct and wrong coding data sending
- the times of correct and wrong IPP data receiving
- the times of correct and wrong IPP data sending
- the total number of the received coding data byte
- the total number of the received IPP data byte.

1.4 Typical VoIP Configuration Examples

1.4.1 Configuring Router FXS Port for Interconnection

I. Networking requirements

Telephones in Beijing and Shenzhen can directly make phone calls via WAN through router with voice functions.

This network connected in this way is of simple structure, subscribers can directly make phone calls from the router. But the shortcoming of this kind of network is the small capacity, so the group calls cannot be implemented. This scenario is applicable for small office system.

The FXS (POTS) port number of the router determines the number of the phones that the router can support to directly access. Depending upon the type, the router can at maximum connect with three or seven voice interface boards respectively. According to the port type, the voice interface board can be divided into FXO board, FXS board and E&M board, which provide two or four FXO ports, FXS ports and E&M ports respectively.

II. Networking diagram

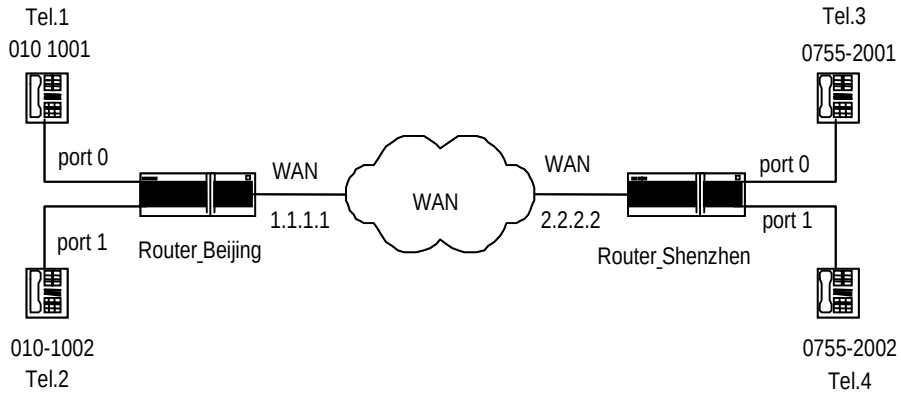

Figure VC-1-5 The router directly connects with ordinary DTMF phones

III. Configuration procedures

1) Router_Beijing configuration:

```
Quidway# config
! Configure VoIP dial-peer.
Quidway(config)# dial-peer voice 4 voip
! Configure the called number, the dot is wildcard character.
Quidway(config-peer-voip4)# destination-pattern 0755....
! Configure the IP address of the called party.
Quidway(config-peer-voip4)# session target ipv4:2.2.2.2
! Configure the local ports Tel.1 connects with.
Quidway(config-peer-voip4)# dial-peer voice 6 pots
! Configure the phone number of Tel.1.
Quidway(config-peer-pots6)# destination-pattern 0101001
! Configure the relationship between POTS dial-peer 6 and port 0.
Quidway(config-peer-pots6)# port 0
! Configure the local ports Tel.2 connects with.
Quidway(config-peer-pots6)# dial-peer voice 5 pots
! Configure the phone number of Tel.2.
Quidway(config-peer-pots5)# destination-pattern 0101002
! Configure the relationship between POTS dial-peer 5 and port 1.
Quidway(config-peer-pots5)# port 1
```

2) Router_Shenzhen configuration

```
Quidway# config
Quidway(config)# dial-peer voice 1 voip
Quidway(config-peer-voip1)# destination-pattern 010....
Quidway(config-peer-voip1)# session target ipv4:1.1.1.1
! Configure the local ports Tel.3 connects with.
Quidway(config-peer-voip1)# dial-peer voice 4 pots
Quidway(config-peer-pots4)# destination-pattern 07552001
Quidway(config-peer-pots4)# port 0
! Configure the local ports Tel.4 connects with.
Quidway(config-peer-pots4)# dial-peer voice 5 pots
Quidway(config-peer-pots5)# destination-pattern 07552002
Quidway(config-peer-pots5)# port 1
```

1.4.2 Configuring Router FXO and E&M Trunk Ports for Interconnection

I. Networking requirements

There is a local telephone network established by PBX in Beijing, Shenzhen and Shanghai respectively, it is required that the three networks implement interconnection via three routers with voice function and the internal PBX subscribers can make non-local ordinary calls via VoIP.

The routers in Beijing and shanghai can provide the FXO ports, while the router in Shenzhen uses the E&M port.

You may select any of the following modes for the connection of any router and the PBX:

- The routers provide the FXS ports, the PBXs provide two wire loop trunk port FXOs
- The routers provide the FXO ports, the PBXs provide ordinary line port FXSs
- All the routers and the PBXs provide the E&M trunk ports

The number of connection established between the PBX subscribers in Shenzhen and Beijing are determined by the smaller one of the number of Router_Shenzhen E&M trunk ports and Router_Beijing FXO trunk ports, so it is with Shanghai.

In the following figure, Tel.1 in Beijing is an ordinary PSTN subscriber. If not using VoIP, when the subscribers in Shenzhen or Shanghai dial Tel.1, they need to add the area code 010, but through the VoIP configuration, instead of dialling the area code, you can call in local mode, which is very convenient and can also save call charge.

Provided that when the internal PBX subscribers in the three cities make external calls, they need to dial “0” firstly.

II. Networking diagram

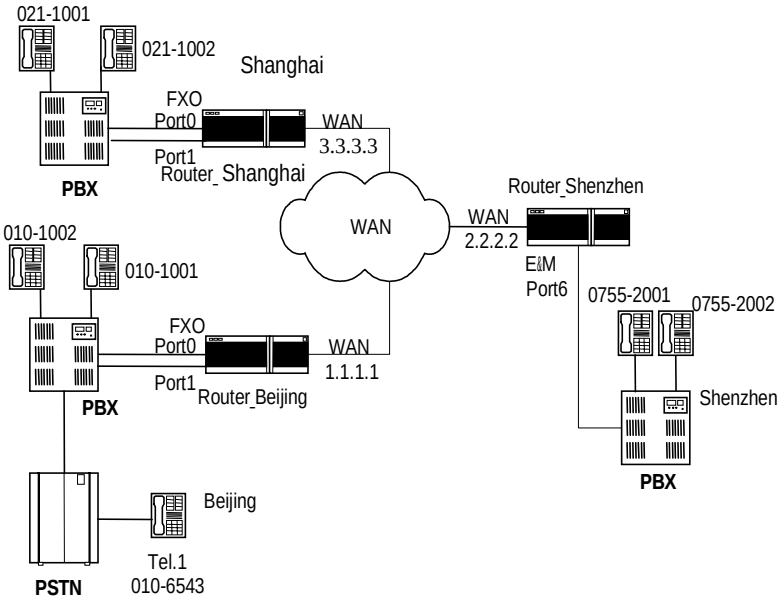

Figure VC-1-6 The routers connect with the PBXs via the E&M trunk

III. Configuration procedures

1) Router_Beijing configuration:

! Configure the VoIP dial-peer to Shenzhen.

Quidway(config)# dial-peer voice 0755 voip

Quidway(config-peer-voip775)# destination-pattern 0755....

Quidway(config-peer-voip775)# session target ipv4:2.2.2.2

! Configure the VoIP dial-peer to Shanghai.

Quidway(config-peer-voip775)# dial-peer voice 021 voip

Quidway(config-peer-voip21)# destination-pattern 021....

Quidway(config-peer-voip21)# session target ipv4:3.3.3.3

! Configure local port Port0.

Qduiway(config-peer-voip21)# dial-peer voice 4 pots

Quidway(config-peer-pots4)# destination-pattern 010....

Quidway(config-peer-pots4)# port 0

! Configure prefix, dial 0 first for outgoing call, and the comma indicates that it will send the number 500 ms after sending the prefix “0”.

Quidway(config-peer-pots4)# prefix 0,

! Configure the local port Port 1.

Quidway(config-peer-pots4)# dial-peer voice 5 pots

Quidway(config-peer-pots5)# destination-pattern 010....

Quidway(config-peer-pots5)# port 1

! Configure prefix, dial “0” first for outgoing calls, with 500 ms time delay.

Quidway(config-peer-pots5)# prefix 0,

2) The configuration of Router_Shanghai is the same as that of Router_Beijing.
3) Router_Shenzhen configuration:

Quidway# config

! Configure the VoIP dial-peer to Shanghai.

Quidway(config)# dial-peer voice 21 voip

Quidway(config-peer-voip21)# destination-pattern 021....

Quidway(config-peer-voip21)# session target ipv4:3.3.3.3

! Configure the VoIP dial-peer to Beijing.

Quidway(config-peer-voip21)# dial-peer voice 010 voip

Quidway(config-peer-voip10)# destination-pattern 010....

Quidway(config-peer-voip10)# session target ipv4:1.1.1.1

! Configure the local port Port 6.

Qduiway(config-peer-voip10)# dial-peer voice 7 pots

Quidway(config-peer-pots7)# destination-pattern 0755....

Quidway(config-peer-pots7)# port 6

! E&M port setting.

Quidway(config-peer-pots7)# voice-port 6

Quidway(config-voice-port6)# signal wink-start

Quidway(config-voice-port6)# operation 4-wire

Quidway(config-voice-port6)# type 5

1.4.3 Configuring the Interconnection of Router FXO Port in PLAR Mode

I. Networking requirements

We specify that the FXO port of Router_Shenzhen works in the PLAR (Private Line Auto Ringdown) mode, the default remote connection phone number is 0101001.

When the PBX subscriber 0755-2001 dials the number 0755-2003, firstly it will connect with the Router_Shenzhen. Since the FXO port works in the PLAR mode, it will automatically use the set remote connection number to request connection with the subscriber 010-1001 in Beijing.

II. Networking diagram

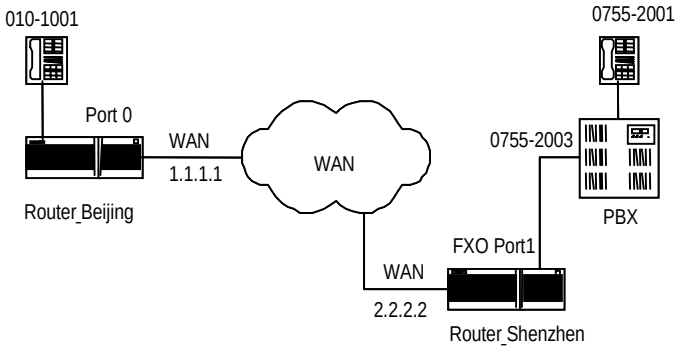

Figure VC-1-7 Router_Shenzhen FXO works in the PLAR mode

III. Configuration procedures

1) Router_Beijing configuration

Quidway(config)# dial-peer voice 4 voip

Quidway(config-peer-voip4)# destination-pattern 0755....

Quidway(config-peer-voip4)# session target ipv4:2.2.2.2

Quidway(config-peer-voip4)# dial-peer voice 5 pots

Quidway(config-peer-pots5)# destination-pattern 0101001

Quidway(config-peer-pots5)# port 0

2) Router_Shenzhen configuration

Quidway# config

Quidway(config)# dial-peer voice 10 voip

Quidway(config-peer-voip10)# destination-pattern 010....

Quidway(config-peer-voip10# session target ipv4:1.1.1.1

Quidway(config-peer-voip10)# dial-peer voice 11 pots

Quidway(config-peer-pots11)# destination-pattern 07552001

Quidway(config-peer-pots11)# port 1

! Make the following FXO Port1 configuration.

Quidway(config)# voice-port 1

Quidway(config-voice-port1)# connection plar 0101001

1.4.4 Configuring Interconnection with Refiner for Large Network Solution

I. Network requirements

Router_Beijing and Router_Shanghai connect with the PBXs via trunk port, while Router_Shenzhen connects with Quidway A8010 Refiner through the Ethernet via a high-speed router. With the separated data and voice service, the network processing capacity can be improved. The burden of VoIP and the voice service of large Intranet can be lessened. With the expansion of the enterprise scale, you may use GateKeeper to carry out management according to actual requirements.

II. Networking diagram

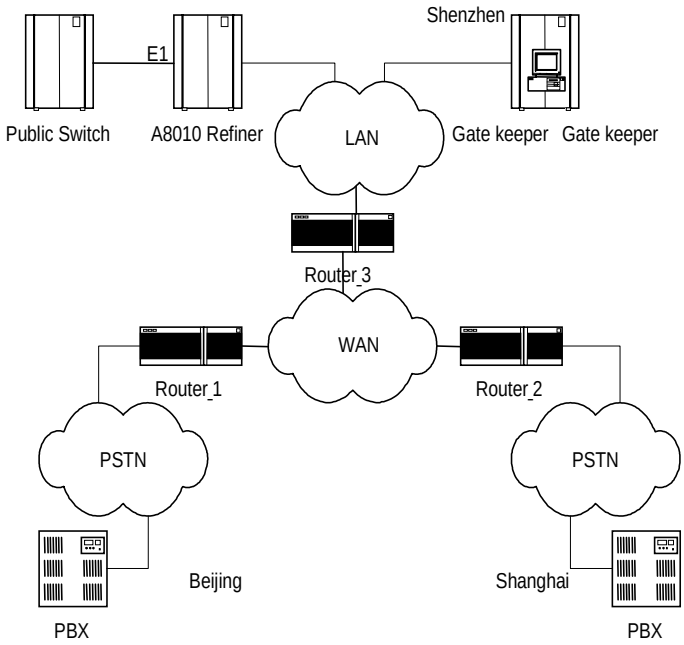

Figure VC-1-8 Interconnecting mode of the voice router and the voice gateway

III. Configuration description

In the networking diagram, Router_1 and Router_2 are routers with voice function. In configuration, the **session target** should point to the interface between the A8010 Refiner and the Ethernet.

Since the A8010 Refiner itself does not have routing function, we need Router_3 to implement the work related to routing function.

1.5 VoIP Troubleshooting

Fault 1: The user hears busy tone after dialing.

Troubleshoot: Take the following procedures.

- Firstly check that the remote router exists and you can ping the remote IP address.
- Check that the dial-peer configuration is correct.
- Check that the phone number configuration is correct. You can use the command **show call voice-port** *number to* view the call history.

Chapter 2 IP Fax Configuration

2.1 Overview to IP Fax

Traditional faxes are sent and received over PSTN. Today fax services are widely used due to its advantages, such as many kinds of transmissive information, fast speed for information transmission and easy to use. Type G3 facsimile machines are frequently used fax terminals in the current fax communications. Type G3 fax is a communication equipment with digital signal process technology. In the process, image signal is turned into analog signal through a modem after it is digitized and compressed, then the analog signal is input into switch via general subscriber line.

The so-called IP Fax, just as its name implies, indicates that fax is sent and received over Internet. Quidway series router can provide VoIP function. With the features of IP Fax, it also can offer IP Fax functions. IP Fax can provide PSTN subscribers with Internet fax services, thus the subscribers only need to pay for considerable cheap expenses when sending international and domestic faxes.

The diagram of IP Fax architecture is as follows:

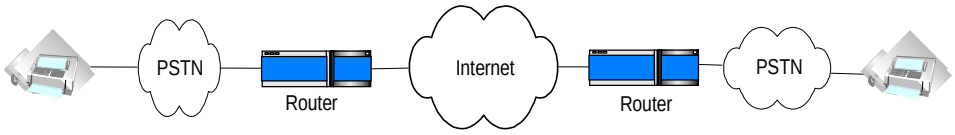

Figure VC-2-1 Architecture of IP Fax

IP realtime fax complies with ITU-T T.30 and T.4 protocols on the side of PSTN and complies with H.323 and T.38 protocols on the side of IP. T.30 protocol is the transmission protocol and recommendation for the document fax in the Public Switched Telephone Network (PSTN). It has made detailed description and rules on the communication process, the signal format adopted in communication, control signaling and error correction mode of category 3 facsimile over PSTN network. T.4 protocol regulates the related standards and specifications for the file transmission through category 3 facsimile terminals. It has made the standardization rules on image coding mode, signal modulation mode and rate, transmission time, error correction mode as well as file transfer mode of the category 3 facsimile terminal. T.38 protocol stipulates the recommendations and specifications for the realtime communication through category 3 facsimile terminals over IP network. It has made some description and rules on the communication mode, packet format, error correction and some communication process of the category 3 facsimile over IP network.

2.2 Configuring IP Fax

2.2.1 Task List of IP Fax Configuration

You should configure VoIP before configuring IP Fax. For the detailed procedure of VoIP configuration, please refer to the section “Chapter 1 VoIP Configuration” in the manual.

IP telephone works after VoIP is configured. Generally speaking, faxes can now be sent and received by using the default configuration of IP Fax only after a facsimile machine is connected. The procedures of configuring IP Fax are mainly used to set up the specific parameters of IP Fax or used for some specified conditions. For example, fax operation can not be completed when the default gateway carrier transmit energy level.

The task of IP Fax configuration is as follows:

- Check if configuring fax to use ECM mode
- Configure fax rate
- Configure fax train mode
- Configure Fax Local-train Threshold Value
- Configure gateway carrier transmit energy level
- Configure redundancy packet number of T38 fax protocol
- Configure the fax protocol intercommunicating with Cisco equipment
- Configure the intercommunication method with other equipment

All of the above configuration tasks should be carried out under the condition of dial peer entity configuration mode.

2.2.2 Checking If Configuring Fax to Use ECM Mode

According to ITU-T Recommendation, Error Correction Mode (ECM) is necessary to the transmission of facsimile message with the half-duplex and half-modulation system of ITU-T V.34 protocol, at the same time the category G3# facsimile terminal operating in full duplex mode is required to support half-duplex mode, that is to support ECM mode.

If the facsimile adopts ECM mode, it has error correction function, and provides automatic request for retransmission (ARQ) technology, at the same time facsimile packet will be transmitted in the form of HDLC frame. On the contrary, if the facsimile machine adopts non-ECM mode (the mode that facsimile must support), it has no error correction function, and the facsimile uses binary string to transmit.

In actual configuration, if the facsimile machines on both sides support ECM mode, but the configuration on the side of gateway is non-ECM mode, then non-ECM mode should be adopted. If the facsimile machine on either or neither of sides does not support ECM mode, then non-ECM mode should also be used. Only when the facsimile machines on both sides support ECM mode and the gateway uses ECM mode, ECM mode can be adopted.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-1 Check if configuring fax to use ECM mode

Operation	Command
Configuring fax does not use ECM mode	**fax-relay ecm disable**
Configuring fax uses ECM mode	**no fax-relay ecm disable**

The gateway does not use ECM mode by default.

2.2.3 Configuring Fax Rate

Subscribers can configure fax rate according to the different protocols.

If it is set to be the values except for “disable” and “voice”, the fax rate shall be set to be the corresponding values. The rate set here is not specified rate but the highest allowable rate.

When the setting is voice mode (i.e. ”**voice**”), the highest allowable rate of fax should be finally determined by the differences among voice codec protocols.

- The fax rate is 14400bps if G.711 voice encoding & decoding protocol is used
- The fax rate is 4800bps if G.723.1 Annex A voice encoding & decoding protocol is used.
- The fax rate is 7200bps if G.729 voice encoding & decoding protocol is used

The fax function is disable when the setting is “disable”.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-2 Configure fax rate

Operation	Command
Configure fax rate	**fax rate { 12000 | 14400 | 2400 | 4800 | 7200 | 9600 | disable | voice }**

By default, the fax rate will be determined by voice mode.

2.2.4 Configuring Fax Train Mode

Local-train mode indicates that the gateway takes part in the rate train between the facsimile machines on the both ends. In the mode, the facsimile machine and gateway respectively take part in the training, then the receiving gateway sends the train results of the receiving end to the sending gateway, finally the sending gateway will determine the final message transmission rate according to the train results of the receiving end and its own end.

Point-to-point train mode indicates that the gateways do not take part in the rate train between the facsimile machines on the both ends. In the mode, the rate train processes between the two facsimile machine terminals and is transparent to the gateways.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-3 Configure fax train mode

Operation	Command
Configure fax train mode	**fax train-mode { local | ppp}**

The mode is local-train mode (**local**) by default.

2.2.5 Configuring Fax Local-train Threshold Value

When the rate train is being processed between facsimile machines, the sending facsimile machine sends TCF data of “0” to the receiving facsimile machine for 1.5 +10% seconds, then the receiving end will determine if the rate is acceptable according to the received TCF data.

When it is configured to be local-train mode, use this command to configure the threshold value of the local-train. When “1” appears in the received TCF data, it indicates TCF data encountered errors during the transmission. If the number of the

received “1” is less than the preset threshold value, then the current rate train is successful, otherwise, it is not successful.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-4 Configure fax local-train threshold value

Operation	Command
Configure fax local-train threshold value	**fax local-train threshold** *threshold*
Restore the default value of fax local-train threshold value	**no fax local-train threshold**

By default, the fax local-train threshold value is 10. The threshold value ranges from 0 to 100.

2.2.6 Configuring Gateway Carrier Transmit Energy Level

Generally, the default values of gateway carrier transmit energy level are acceptable. If subscriber found fax could not established when the other configurations are correct, you may try to adjust the gateway carrier transmit energy level. Less energy level value shows higher energy.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-5 Configure gateway carrier transmit energy level

Operation	Command
Configure gateway carrier transmit energy level	**fax level** *level*
Restore the default value of gateway carrier transmit energy level	**no fax level**

By default, the gateway carrier transmit energy level is 15. The level value ranges from 3 to 60.

2.2.7 Configuring Sending Redundancy Packet Number of T38 Fax Protocol

Low-speed data indicates the command data compliant with V.21 and the data rate is 300bps. High-speed data indicates TCF and image data.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-6 Configure sending redundancy packet number of T38 fax protocol

Operation	Command
Configure redundancy packet number of low-speed data of T38 fax protocol	**fax protocol t38 ls-redundancy** *number*
Restore the default value of redundancy packet number of low-speed data of T38 fax protocol	**no fax protocol t38 ls-redundancy**
Configure redundancy packet number of high-speed data of T38 fax protocol	**fax protocol t38 hs-redundancy** *number*
Restore the default value of redundancy packet number of high-speed data of T38 fax protocol	**no fax protocol t38 hs-redundancy**

By default, the number for sending two kinds of redundancy packet is 0.The redundancy packet number for sending low-speed data ranges from 0 to 5, and the redundancy packet number for sending high-speed data ranges from 0 to 2.

2.2.8 Configuring the Fax Protocol Intercommunicating with Cisco Equipment

The two kinds of fax protocols including T.38 and Cisco fax protocol are supported. When it intercommunicates with Cisco fax terminal, please select Cisco fax protocol. When it is intercommunicates with other fax terminals supporting T.38 protocol, select T.38 protocol. Because Cisco device does not support the fax local train mode, point-to-point train mode must be adopted to communication with Cisco device.

Please perform the following configuration in dial peer configuration mode.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-7 Configure the fax protocol intercommunicating with Cisco equipment

Operation	Command
Configure the fax protocol intercommunicating with Cisco equipment	**fax protocol { cisco | t38 }**

By default, T.38 protocol is used.

2.2.9 Configuring the Intercommunication Method with Other Equipment

Generally, RTP mode (the corresponding parameter is **rtp**) is used when using T.38 protocol. But you should select to use VT mode (the corresponding parameter is **vt**) if it intercommunicates with the gateway of VocalTec.

Please perform the following configuration in dial peer configuration mode.

Table VC-2-8 Configure the modes intercommunicating with other equipment

Operation	Command
Configure the intercommunication method with other equipment	**fax support-mode { standard | rtp | vt }**

By default, **rtp** protocol is used.

2.3 Monitoring and Maintenance of IP Fax

Please use the following commands to monitor and maintain IP Fax in the privileged user mode.

Table VC-2-9 Monitoring and maintenance of IP Fax

Operation	Command
Open all of the debugging information switches of ipfax	**debug ipfax all**
Open the debugging information switch of function api of ipfax	**debug ipfax api**
Open the debugging information switch of main task of ipfax	**debug ipfax cc**
Open the debugging information switch of controller of ipfax	**debug ipfax controller**
Open the debugging information switch of level 1 error message of ipfax	**debug ipfax error 1_level**
Open the debugging information switch of level 2 error message of ipfax	**debug ipfax error 2_level**
Open the debugging information switch of level 3 error message of ipfax	**debug ipfax error 3_level**
Open the debugging information switch of all levels of error messages of ipfax	**debug ipfax error all**
Open the debugging information switch of T38 message of ipfax	**debug ipfax t38**
Open the debugging information switch of cisco message of ipfax	**debug ipfax cisco**
Open the debugging information switch for reading and writing fax data between vpm module and voice card.	**debug vpm fax**

2.4 Typical Configuration of IP Fax

The networking mode of IP Fax is basically the same as IP Phone. Thus, the functions of IP Fax can be realized only when the telephone sets in the network of IP Phone are replaced by facsimile machines. You can basically use the functions of IP Fax only if you can configure IP Phone. The operation is easy to use.

1) Networking Requirements

Suppose a company headquarter located in Shenzhen plans to send/receive faxes to/from its Beijing branch via IP network.

The fax number of its Beijing branch is 0101002, and the number of Shenzhen headquarter is 07551001.

The IP address used to access to the Internet port through the router in Beijing is 1.1.1.2. The IP address used to access to the Internet port through the router in Shenzhen is 1.1.1.1.

The facsimile machine in Beijing is connected with the second voice port on the router, and the facsimile machine in Shenzhen is connected with the first voice port on the router.

2) Networking Diagram

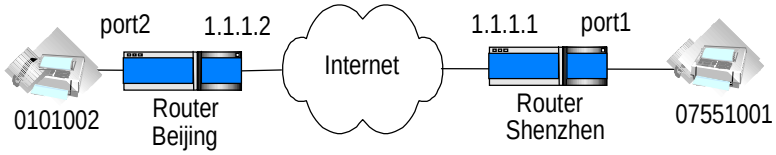

Figure VC-2-2 Networking diagram for typical IP fax configuration

3) Configuration Procedure

The parameter settings for the router in Beijing is as follows:

Quidway(config)# dial-peer voice 1 voip

Quidway(config-peer-voip1)# destination 07551001

Quidway(config-peer-voip1)# session target ipv4:1.1.1.1

Quidway(config-peer-voip1)# dial-peer voice 2 pots

Quidway(config-peer-pots2)# destination 0101002

Quidway(config-peer-pots2)# port 2

The parameter settings for the router in Shenzhen is as follows:

Quidway(config)# dial-peer voice 2 voip

Quidway(config-peer-voip2)# destination 0101002

Quidway(config-peer-voip2)# session target ipv4:2.2.2.2

Quidway(config-peer-voip2)# dial-peer voice 1 pots

Quidway(config-peer-pots1)# destination 07551001

Quidway(config-peer-pots1)# port 1

Chapter 3 E1 Voice Configuration

3.1 Overview of E1 Voice Configuration

3.1.1 Function of E1 Voice

E1 voice refers to the implementation of VoIP function over E1 line, so as to provide voice transmission mode compatible with data transmission. In order to implement this function, the corresponding E1 voice port needs to be provided on the router and also a range of functions suitable for voice transmission over E1 line should be provided. The networking that adopts E1 line for voice transmission is the same as the ordinary VoIP networking applications, except that the connection between PSTN switch and the router is through E1 trunk, and the signaling adopted for the line is R2 signaling (similar to China No. 1 Signaling) or DSS1 subscriber signaling on ISDN PRI interface. The basic networking is shown in the diagram below:

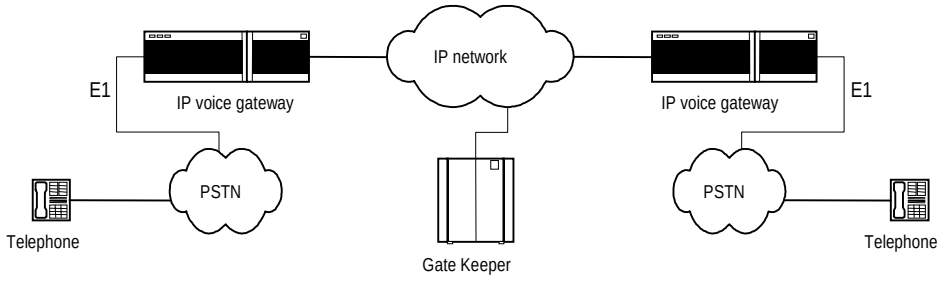

Figure VC-3-1 Basic Structure of E1 Voice System

Adopting E1 voice mode, the router can provide more channels for voice communication and supports integrated transmission of data and voice, greatly enhancing the utilization rate of the router and the range of the services supported.

3.1.2 Usage of cE1/PRI Interface

The physical port of E1 voice is cE1/PRI interface, which is divided into 32 TSs (time slots) numbered from 0 to 31. The following lists three methods to use this interface:

I. Interface not divided into TSs logically

When used as E1 interface, do not divide it into TSs logically and use the full capability of the interface for data transmission. The bandwidth of the interface is 2Mbit/s (TSs 0 to 31) and its logical attribute is equal to the synchronous serial port with rate of 2Mbit/s. On the interface, link layer protocols such as PPP, FR, LAPB, X.25 and HDLC, and network protocols such as IP and IPX, are supported.

II. Interface divided into TSs logicailly & TS 16 not as special channel

When used as cE1 interface, all the other 31 TSs except TS0 can be divided into several groups, with each group of TSs used as one interface (channel-group) after being bound. Its logical attribute is equal to the synchronous serial ports of different rates. On the interface, link layer protocols such as PPP, FR, LAPB, X.25 and HDLC, and network protocols such as IP and IPX, are supported.

III. Interface divided into TSs logicailly & TS 16 as signaling channel

When DSS1 subscriber signaling is adopted, the interface is used as ISDN PRI interface. Since TS16 is used as transmission connection signaling for D channel, you can only bind TS 16 with any other TSs (except for TS0 and TS16) and use as one interface (pri-group). Its logical attribute is the same as ISDN dial-up. On this interface, PPP link layer protocol and network protocols such as IP and IPX are supported, and parameters such as DDR can be configured.

When the upper layer uses R2 signaling, the contents transported in the TSs are: Every 32 TSs constitute a basic frame; every 16 basic frames constitute one multiframe; the TS0 of every odd basic frame is used to transport the synchronous identity of the frame; the TS16 of every odd basic frame is used to transport line signaling. In each multiframe, the TS0 of the odd basic frame is used to transport FAS (Frame Alignment Signal), and that of the even basic frame is used to transport NFAS (Non Frame Alignment Signal). What transported on it is the state information about the links, which provides control signaling for basic rate multiplexing. The 4 significant bits of the TS 16 of the first basic frame (Frame 0) of every multiframe are used to transport the synchronous identity (Multiframe Alignment Signal (MFAS)) and the insignificant 4 bits are used to transport asynchronous identity. The TS16 of the other 15 basic frames transport the line state of every two TSs respectively, for instance, basic frame 1 is used to transport the states of TS1 and TS16; basic frame 2 is used to transport the states of TS2 and TS17.

3.1.3 Features of E1 Voice

I. Signaling modes supported

DSS1 subscriber signaling is supported on ISDN PRI interface and R2 signaling is supported on E1 interface.

II. Protocols and standards supported

Support the relevant protocols under ITU-T H.323 frame and support the 5.3K and 6.3K compression algorithms of G.711, G.729 and G.723.1 Annex A of ITU standard, support CRC4 and non-CRC4 framing modes, support the two kinds of line coding of HDB3 and AMI.

III. Support single stage dialing and two-stage dialing

It supports the two access functions of single stage dialing and two-stage dialing, which adapts itself to the difference between various PBX exchanges in their transportation of called numbers to the router. When one PBX exchange is transporting voice access number to the router and the number is deleted, the router adopts single stage dialing access mode to access the subscriber. If PBX exchange does not delete the access

number, the router will receive the complete dial number of the subscriber. In this case, the router adopts two-stage dialing mode and releases prompt tone to guide the subscriber to input other information.

IV. Integrated transmission of voice and data

When DSS1 subscriber signaling is adopted on ISDN PRI interface, Integrated transmission of voice and data is supported. By Integrated transmission, it means that data and voice are transported in the different B channels in one physical line.

3.2 E1 Voice Configuration

3.2.1 Configuration Task List of E1 Voice

The tasks of E1 voice configuration includes:

- Configure POTS dial-peer
- Configure VoIP dial-peer
- Configure the basic parameters of E1 interface
- Configure the voice port (E1 interface)
- Configure E1 voice R2 signaling
- Configure the basic parameters of ISDN PRI interface
- Configure voice port (ISDN PRI interface)

3.2.2 Configuring POTS dial-peer

POTS, the abbreviation of Plain Old Telephone Service, i.e., the ordinary telephone service. Configuring POTS dial-peer is to establish relationship between the voice port and the local telephone device. There are two basic configuration commands: **destination-pattern** and **port**. Destination-pattern is used to define the destination pattern associated with POTS dial-peer, while **port** relates POTS dial-peer to one logical voice port, which is generally the voice port that the router connects to the local exchange (PBX) through E1 line. Besides, the prefix may need to be configured for the outgoing PBX subscribers.

Please perform the configuration of **dial-peer voice pots** in global configuration mode, and perform other configurations in POTS dial-peer configuration mode.

Table VC-3-1 Configuration Commands of POTS dial-peer

Operation	Command
Enter POTS dial-peer configuration mode	**dial-peer voice** *number* **pots**
Delete POTS dial-peer	**no dial-peer voice** *number*
Disable the truncating of the called number	**cancel-truncate**
Truncate the called number	**no cancel-truncate**
Configure the destination pattern of the dial-peer (telephone number)	**destination-pattern** *string*
Delete the destination pattern of the dial-peer (telephone number)	**no destination-pattern**
Configure the access number of two-stage dialing	**incoming called-number** *number*
Delete the access number of two-stage dialing	**no incoming called-number**
Set the precedence of IP packet	**ip precedence** *priority-number*
Recover the default value of the precedence of the IP packet	**no ip precedence**
Configure the correspondence between POTS dial-peer and DS0 group logical voice port	**port** *e1-controller-number :ds0-group-number*
Configure the correspondence between POTS dial-peer and ISDN PRI group logical voice port	**port** *e1-controller-number :15*
Cancel the correspondence between POTS dial-peer and logical voice port	**no port**
Configure the prefix of the outgoing number	**prefix** *string*
Delete the prefix of the outgoing number	**no prefix**
Disable the POTS dial-peer	**shutdown**
Enable the POTS dial-peer	**no shutdown**
Enable silence detection	**vad**
Disable silence detection	**no vad**

By default, **no cancel-truncate** (i.e. truncate the called number) and **no vad** (i.e. disable silence detection) become effective.

The default value of configuration command **ip precedence** (the precedence of IP packet) is 0.

3.2.3 Configuring VoIP dial-peer

VoIP is the abbreviation of Voice over IP. VoIP dial-peer is used to match telephone number with IP address. There are two basic configuration commands: **destination-pattern** and **session target**. The destination-pattern defines the telephone number associated with VoIP dial-peer, while session target specifies the destination IP address for VoIP dial-peer.

Please perform dial-peer voice voip in global configuration mode, and perform other configurations in VoIP dail-peer (dial-peer) configuration mode.

Table VC-3-2 Configuration Commands of VoIP dial-peer

Operation	Commands
Enter VoIP dial-peer configuration mode	**dial-peer voice** *number* **voip**
Delete VoIP dial-peer	**no dial-peer voice** *number*
Configure voice codec method	**codec** { **1st-priority-level** | **2nd-priority-level** | **3rd-priority-level** | **4th-priority-level** } { **g711alaw** | **g711ulaw** | **g723r53** | **g723r63** | **g729r8** }
Recover the default value of voice codec method	**no codec** { **1st-priority-level** | **2nd-priority-level** | **3rd-priority-level** | **4th-priority-level** }
Configure the destination pattern of dial-peer (telephone number)	**destination-pattern** *string*
Delete the destination pattern of the dial-peer (telephone number)	**no destination-pattern**
Set the precedence of IP packet	**ip precedence** *priority-number*
Recover the default value of the precedence of IP packet	**no ip precedence**
Set the session target of the dail-peer	**session target** { **ipv4**:*a.b.c.d* | **ras** }
Delete the session target of the dial-peer	**no session target**
Disable the VoIP dial-peer	**shutdown**
Enable the VoIP dial-peer	**no shutdown**
Configure H.323 gateway tech-prefix	**tech-prefix** *string*
Delete H.323 gateway tech-prefix	**no tech-prefix**
Enable silence detection	**vad**
Disable silence detection	**no vad**

By default, **no tech-prefix** (i.e. H.323 gateway tech-prefix not configured initially) command becomes effective, and **no vad** (disable silence detection) command becomes effective.

The default value of configuration command **codec** (voice coding and decoding method) is g729r8. The default value of configuration command **ip precedence** (the precedence of IP packet) is 0.

3.2.4 Configuring the Basic Parameters of E1 Interface

In order that the device on the two ends of E1 trunk will be synchronized in communication, E1 clock source needs to be configured for the device on both ends. At this stage, there are two ways to select the clock source: generating the clock by itself and extracting the clock from the line.

When channel-group is successfully configured, the system will create the serial port corresponding to the channel-group automatically. The number of the new serial port is "(the number of the serial port where the channel group lies + the total number of the serial ports): channel-group number".

Please use commands **controller e1** and **interface serial** in global configuration mode and perform other configurations in E1 controller interface configuration mode.

Table VC-3-3 Configuration Commands of E1 Interface

Operation	Command
Enter E1 controller interface configuration	**controller e1** *port*
Establish channel-group for the specified TS	**channel-group** *channel-group-no* **timeslots** *timeslots-list*
Delete specified channel-group	**no channel-group** *channel-group-no*
Set clock source	**clock** { **line** [**primary**] | **internal** }
Cancel clock source	**no clock**
Configure framing mode	**framing** { **crc4** | **no-crc4** }
Configure line coding mode	**linecode** { **ami** | **hdb3** }
Start loopback test	**loopback**
Disable loopback test	**no loopback**
Select interface mode	**using** { **e1** | **ce1** }
Enter the serial port corresponding to the channel-group	**interface serial** serial-no :channel-group-no

By default, **no loopback** (i.e. disable loopback test) becomes effective.

The default value of the configuration command **clock** (clock source) is line. The default value of the configuration command **framing** (framing mode) is no-crc4. The default value of the configuration command **linecode** (line coding mode) is hdb3. The default value of the configuration command **using** (E1 interface mode) is ce1.

3.2.5 Configuring Voice Port (E1 Interface)

Before entering voice port (E1 interface) configuration mode, first DS0 group needs to be created in E1 controller interface configuration mode. In this way, the system will create the voice port corresponding to the DS0 group automatically.

Please use voice-port command in global configuration mode and perform other configurations in voice port configuration mode.

Table VC-3-4 Configuration Commands of E1 Voice Port

Operation	Command
Enter voice port configuration mode	**voice-port** *port-nunmber :ds0-group-number*
Enable comfort noise setting	**comfort-noise**
Disable comfort noise setting	**no comfort-noise**
Establish PLAR mode connection for voice port	**connection plar** *telephone-number*
Delete the PLAR connection of the voice port	**no connection plar**
Configure the description information of the port	**description** *string*
Delete the description information of the port	**no description**
Enable echo cancellation function or set the time coverage of echo cancellation sampling	**echo-cancel** { **enable** | **coverage** *coverage-time* }
Cancel echo cancellation function or recover the default value of the time coverage of echo cancellation sampling	**no echo-cancel** { **enable** | **coverage** }
Set voice input gain	**input gain** *value*
Recover the default value of voice input gain	**no input gain**
Set echo cancellation to use non-linear processing procedure	**non-linear**
Cancel echo cancellation's use of non-linear processing procedure	**no non-linear**
Configure voice output attenuation	**output attenuation** *value*
Recover the default value of voice output attenuation	**no output attenuation**
Disable the voice port	**shutdown**
Enable the voice port	**no shutdown**

By default, **comfort-noise** (i.e. enable comfort-noise setting) command becomes effective and **no connection plar** (i.e. the system has not established PLAR mode connection initially) command becomes effective, and **non-linear** (i.e. enable non-linear processing procedure) becomes effective.

The default value of configuration command **echo-cancel** (enable echo cancellation) is enable. The default value of command **echo-cancel coverage** (time coverage of echo cancellation sampling) is 16ms. The default value of configuration command **input gain** (voice input gain) is 0. The default value of configuration command **output attenuation** (voice output attenuation) is 0.

3.2.6 Configuring E1 Voice R2 Signaling

I. Configuring DS0 group

DS0 is the logical voice port abstracted from the actual E1 port by defining the time slot list, and it serves voice transmission. The time slots included in the DS0 group are all used to transmit voice, while the other time slots not included still can serve data information transmission. Only one DS0 can be defined on one E1 port. The R2 signaling configuration for E1 line is facilitated by configuring signaling type and the relevant parameters of R2 signaling for each DS0. When DS0 group is successfully configured, the system will create the voice port corresponding to the DS0 according to the current E1 port number and DS0 group number. The voice port number is "E1 port number: DS0 group number".

For the commands in the table below, please use controller e1 in global configuration mode and the others in E1 controller interface configuration mode.

Table VC-3-5 DS0 Configuration Commands of DS0 Group

Operation	Command
Enter E1 controller interface configuration mode	**controller e1** *port-number*
Create DS0 of certain type	**ds0-group** *group-number* **timeslots** *timeslots-list* **type** { **e&m-fgb** | **e&m-immediate-start** | **fxs-loop-start** | **r2-digital** [**r2-compelled** [**ani**]] }
Delete the specified DS0 group	**no ds0-group** *group-number*

By default, the system has not created any DS0 group.

II. Configuring Related Parameters of R2 Signaling

R2 signaling conforms to ITU-T recommendation, and is classified into line signaling and register signaling, which can be used for national network and international network. China No. 1 signaling is a subset of R2 signaling. The line signaling, which is classified into forward and backward signaling, is mainly used to monitor the seizure, release and block state of the trunk. The register signaling, also classified into forward and backward signaling, adopts multi-frequency compelled mode to transmit address information, the language bit and authentication bit of international call, echo cancellation information, caller attribute and callee attribute information, and etc.

Please use **cas-custom** command in E1 controller interface configuration mode and perform other configurations in R2 signaling configuration mode.

Table VC-3-6 Configuration Commands of R2 Signaling

Operation	Command
Enter R2 signaling configuration mode	**cas-custom** *ds0-group-number*
Configure the number of the numbers collected before the caller number or the caller identity required	**caller-digits** *number*
Recover the default value of the number of the numbers collected	**no caller-digits**
Set the debounce time of the line signaling	**debounce-time** *number*
Recover the default value of the debounce time of the line signaling	**no debounce-time**
Specify a command by default	**default**
Set the inversion mode of line signal	**invert-abcd** A-bit B-bit C-bit D-bit
Recover the default value of the inversion mode of line signal	**no invert-abcd**
Set the code of KA signal	**ka** *number*
Recover the default value of the code of KA signal	**no ka**
Set the code of KD signal	**kd** *number*
Recover the default value of the code of KD signal	**no kd**
Set the latency of sending seizure acknowledgement signal	**seizure-ack-time** *millseconds*
Recover the default value of the latency of sending seizure acknowledgement signal	**no seizure-ack-time**
Set E1 trunk routing mode	**select-mode** [**max** | **maxpoll** | **min** | **minpoll**]
Set the time interval to wait for various signals	**timeouts** { **kb** | **kd** | **nextnum** | **ringing** | **sendasw** } *value*
Recover the default value of the time interval to wait for various signals	**no timeouts** { **kb** | **kd** | **nextnum** | **ringing | sendasw** }
Set the direction of E1 trunk	**trunk-direction timeslots** *timeslot*-**list { in | out | dual }**
Recover the default value of the direction of E1 trunk	**no trunk-direction timeslots** *timeslot-list*
Set the signal value of C and D signal bits	**unused-abcd** *A-bit B-bit C-bit D-bit*
Recover the default value of the signal value of C and D signal bits	**no unused-abcd**

By default, **comfort-noise** (i.e., enable comfort-noise setting) command becomes effective, and **non-linear** (i.e., enable non-linear processing procedure) command becomes effective.

The default value of the configuration command **caller-digits** (the number required to be collected before the caller number) is 1, and that for **debounce-time** (the debounce-time of line signaling) is 40ms, and **invert-abc**d (the inversion mode of line signaling) disabled, i.e., the value is 0 0 0 0. The default value of command **ka** (the code of KA signal) is 1, and that for **kd** (the code of KD signal) is 3, the **seizure-ack-time** (the latency of sending seizure acknowledgement signal) 100ms. The default value of the command **select-mode** (E1 trunk routing mode) is min, and that of the command **timeouts kb** (the time interval waiting for receiving KB signal) is 5000ms, and **timeouts kd** (the time interval waiting for receiving KD signal) 5000ms. The default value of the command **timeouts nextnum** (the time interval waiting for receiving next MFC compelled digital signal) is 5000ms, and that for **timeouts ringing** (the time waiting for the end of the ring) is 30000, and **timeouts sendasw** (the time interval waiting for sending answer signal) 500. The default value of command **trunk-direction** (the direction of E1 trunk) is dual, and that for **unused-abcd** (set the signal value of signal bit C and D) is 1111.

3.2.7 Configuring the Basic Parameters of ISDN PRI Interface

If DSS1 subscriber signaling of ISDN PRI interface is adopted between the router and the switch, the integrated transmission of voice and data is supported, in other words, in one E1 trunk connecting the router and the switch, voice signal and data signal occupy different B channels for transmission respectively. When the function of integrated transmission of voice and data is adopted, it is required to configure DDR dialing in the corresponding serial port of ISDN PRI group, so as to implement data transmission.

After ISDN PRI group is successfully configured, the system will, on one hand, generate the corresponding voice port of the PRI group according to the E1 port number where the current PRI interface lies: the voice port number is "E1 port number:15"; on another hand, the system will generate the corresponding serial port of PRI group according to the current serial port number: the number of the new port is "(the number of the serial port where PRI group lies + the total number of serial ports) : 15".

After the channel-group is successfully configured, the system will create the corresponding serial port of the channel-group automatically. The number of the new serial port is "the number of the serial port where the channel-group lies + the total number of the serial port)".

Please use commands controller e1 and interface serial in global configuration mode, and perform other configurations in E1 controller interface configuration mode.

Table VC-3-7 Configuration Commands of ISDN PRI Interface

Operation	Command
Enter E1 controller interface configuration mode	**controller e1** *port*
Create channel-group for specified TS	**channel-group** *channel-group-no* **timeslots** *timeslots-list*
Delete the specified channel-group	**no channel-group** *channel-group-no*
Set clock source	**clock** { **line** [**primary**] | **internal** }
Cancel clock source	**no clock**
Configure framing mode	**framing** { **crc4** | **no-crc4** }
Configure line coding mode	**linecode** { **ami** | **hdb3** }
Start loopback test	**loopback**
Disable loopback test	**no loopback**
Create PRI group	**pri-group** [**timeslots** *timeslots-list*]
Delete the specified PRI group	**no pri-group**
Enter the corresponding serial port of channel-group	**interface serial** *serial-no :channel-group-no*
Enter the corresponding serial port of ISDN PRI group	**interface serial** *serial-no* **:15**

By default, **no channel-group** (i.e. the system has not created channel-group for the time slots initially.) command becomes effective, and **no loopback** (i.e. disable loopback test) command becomes effective, and **no pri-group** (i.e. the system does not create any PRI group initially.) command becomes effective.

The default value of configuration command **clock** (clock source) is line, and **framing** (framing mode) no-crc4, and **linecode** (line coding mode) hdb3.

3.2.8 Configuring Voice Port (ISDN PRI Interface)

Before entering voice port (ISDN PRI interface) configuration mode, first the ISDN PRI group needs to be created, so that the system will create the voice port corresponding to the PRI group automatically.

Please perform voice-port configuration in global configuration mode and perform other configurations in voice port configuration mode.

Table VC-3-8 Configuration Commands of ISDN Voice Port

Operation	Command
Enter voice port configuration mode	**voice-port** *port-number* **:15**
Enable comfort noise setting	**comfort-noise**
Disable comfort noise setting	**No comfort-noise**
Establish PLAR mode connection for voice port	**connection plar** *telephone-number*
Delete the PLAR connection of the voice port	**No connection plar**
Configure the description information of the port	**description** *string*
Delete the description information of the port	**No description**
Enable echo cancellation function or set the time coverage of echo cancellation sampling	**echo-cancel** { **enable** | **coverage** *coverage-time* }
Cancel echo cancellation function or recover the default value of the time coverage of echo cancellation sampling	**no echo-cancel** { **enable** | **coverage** }
Configure voice input gain	**input gain** *value*
Recover the default value of voice input gain	**no input gain**
Set echo cancellation to use non-linear processing procedure	**non-linear**
Cancel echo cancellation's use of non-linear processing procedure	**no non-linear**
Configure voice output attenuation	**output attenuation** *value*
Recover the default value of voice output attenuation	**no output attenuation**
Disable the voice port	**shutdown**
Enable the voice port	**no shutdown**

By default, **comfort-noise** (i.e. enable comfort noise setting) command becomes effective, **no connection plar** (i.e. the system has not established PLAR mode connection initially.) command becomes effective, and **non-linear** (i.e. start non-linear processing procedure) command becomes effective.

The default value of configuration command **echo-cancel** (enable echo cancellation) is enable, and e**cho-cancel coverage** (the time coverage of echo cancellation sampling) 16ms, and **input gain** (voice input gain) 0, and **output attenuation** (voice output attenuation) 0.

3.3 Monitoring and Maintenance of E1 Voice

I. Maintaining the MFC Channel and Circuit of the Specified TS

MFC channel is used to bear R2 register signaling, while the circuit is used to bear the actual incoming and outgoing calls. You can perform maintenance operations such as open, block and query to the MFC channel of the specified TS. You can perform operations such as open, block, query and reset to the trunk circuit of the specified TS. The operations of open and block are reverse process to each other.

Please use **cas-custom** command in E1 controller interface configuration mode and perform other configurations in R2 signaling configuration mode.

Table VC-3-9 Operation & Maintenance Commands for MFC Channels and TSs

Operation	Command
Enter R2 signaling configuration mode	**cas-custom** *ds0-group-number*
Perform maintenance and operation to the MFC channel of the specified TS	**mfc** { **block** | **open** | **query** } **timeslots** *timeslots-list*
Perform maintenance and operation to the trunk circuit of the specified TS	**ts** { **block** | **open** | **query** | **reset** } **timeslots** *timeslots-list*

II. show Command Related to E1 Voice

Please use the following **show** commands to monitor in privileged mode.

Table VC-3-10 The show Commands of E1 Voice

Operation	Command
Show the attribute of E1 controller port	**show controller e1** *port-number*
Show the configuration of voice port	**show voice-port** *port-number* : { *ds0-group-number* | **15** }
Show the interface ISDN status	**show isdn status** [**interface** *interface-name*]
Show the call statistics related to R2 signaling in RCV module	**show rcv statistic r2**
Show the call statistics of R2 signaling	**show r2 call-statistics**
Show the relevant information of VoIP	**show voip** { **downqueue** *e1vi-bno* | **phy-statistic** *e1vi-bno* **| upqueue** *e1vi-bno* | **version** *vpu-bno* }

1) Show the attribute of E1 controller port

Quidway# show controller e1 0

E1 1-0 is up.

Applique type is Channelized E1 - 120 OHM balanced

Framing is NO-CRC4, Line Code is HDB3, Source Clock is Internal.

The above packets indicate that: E1 port is activated; the impedance of the trunk is 120; the framing mode is no-crc4; the line code is HDB3; the clock is internal clock.

2) Show the configuration of voice port

Quidway# show voice-port 0:0

```
The voice port was ds0
connection type is PLAR, connection number:2001
The voice port's descrition:e1-port
echo cancel enable
echo cancel coverage 16
comfort noise enable
```

The above packets indicate that: the E1 voice port 0:0 is in DS0 group mode; PLAR connection is adopted and the connection number is 2001; the voice port description is e1-port; the echo cancellation function is enabled and the time coverage of echo cancellation sampling is 16ms; comfort noise function is enabled.

Quidway# show voice-port 1:15

```
 The voice port was pri
 this voice port was not set connection
 The voice port's descrition:
 echo cancel enable
 echo cancel coverage 16
 music threshold is -70
 input gain 0
 output attenuation 0
 non-linear
 initial timeouts 10
 inter-digits timeouts 10
```

The above packets indicate: the voice port is ISDN PRI mode; PLAR connection is not adopted; voice port description is not specified; echo cancellation function is enabled; the time coverage of echo cancellation sampling is 16ms; both input gain and output attenuation are 0dB; echo cancellation uses non-linear processing procedure; the time set for waiting for the first digit is 10s; the dial time interval between each number is 10s.

3) Show interface ISDN status

Quidway# show isdn status interface serial 1:15

```
Serial1:15 :
Layer 2 Status:
 TEI = 0, State = AWAITING_ESTABLISHMENT
Layer 3 Status:
 0 Active Layer 3 Call(s)
```

The above packets indicate that: the serial port corresponding to ISDN PRI interface is serial1:15; Layer 2 protocol in on status of waiting for the setup of connection; there is no activated call on layer 3.

4) Show the call statistics related to R2 signaling in RCV module

Quidway# show rcv statistic r2

```
Statistic between RCV and R2 :
 {
    Send_R2_ConnectReqAck_SUCCESS       :  0
    Send_R2_ConnectReqAck_FAIL          :  0
    Send_R2_ActiveAck_SUCCESS           :  0
    Send_R2_ActiveAck_FAIL              :  0
    Send_R2_Onhook                      :  0
    Send_R2_Offhook                     :  0
    Recv_R2_ConnectReq                  :  0
    Recv_R2_Active_TD_IN                :  0
    Recv_R2_Active_TD_OUT               :  0
    Recv_R2_Active_ELSE                 :  0
    Recv_R2_Release                     :  0
```

```
    Recv_R2_Alert_AP_ALERTING          :  0
    Recv_R2_Alert_ELSE                 :  0
    Recv_R2_Unknow                     :  0
  }
```

The packets above show the interactive information between RCV module and R2 signaling, including the successful and failed number of the packets sent about the connection request acknowledgement, the successful and failed number of the packets sent about the activation acknowledgement, the number of the packets sent about onhook and offhook, the number of the connection request packets received, the number of the activation packets received, the number of the packets received about release, alert, unknown and etc.

5) Show the call statistics of R2 signaling

Quidway# show r2 call-statistics

```
r2 signalling call statistics
        30 drop from state TK_BLOCKED_BY_PEER
       1 drop from state TKI_WAIT_CALLED_NUM
       2 drop from state TKI_WAIT_VPU_ACTIVE_ACK
       2 drop from state TKI_CALLED_ONHOOK
       1 drop from state TKO_SEND_CALLED_NUM
       2 drop from state TKO_RELEASE_GUARD
```

The above packets show the call statistics related to R2 signaling: the block of the opposite end causes the drop of 30 calls; waiting for the caller number causes the drop of 1 incoming call; waiting for the activation acknowledgement of the voice channel causes the drop of 2 incoming calls; the onhook of the called number causes the drop of 2 incoming calls; sending the called number causes the drop of 1 outgoing call; releasing guard signal causes the drop of 2 outgoing calls.

6) Show the related information of VoIP

Quidway# show voip down-queue 5

```
 V = 0,I = 0,P = 0,C = 0,E = E1VI_NULL_EVENT, B = 0
 V = 0,I = 1,P = 0,C = 0,E = E1VI_NULL_EVENT, B = 0
……
 V = 0,I = 255,P = 0,C = 0,E = E1VI_NULL_EVENT, B = 0
    E1VI board 5 down interrupt queue is empty :
```

The above packets show the contents of the downstream interrupted queue between E1 voice board and router motherboard: V denotes valid bit, I is the serial number, P port number, C channel number, E event, and B blocked bit. The packets shown by **show voip up-queue** is the same as that of **show voip down-queue**.

Quidway# show voip version 0

```
   [Slot 1] VI_NULL Hardware Version is 1.0, Driver Version is 1.0
```

The packets above show the hardware version and driver version of VI board.

III. debug Commands Related to E1 Voice

Please use the following debug commands in privileged mode for monitoring and maintenance.

Table VC-3-11 debug Commands of E1 Voice

Operation	Command
Enable the debugging information output between RCV module and base layer R2 module	**debug rcv r2**
Enable the debugging information output between VPP module and base layer R2 module	**debug vpp r2**
Enable the output of the corresponding debugging information of R2 module	**debug r2** { **all** | **dl controller** *e1-port-no timeslots-list* | **error** | **event** | **fail-reason** | **fsm controller** *e1-port-no timeslots-list* | **mfc controller** *e1-port-no timeslots-list* | **rcv** | **warning** }

3.4 Typical Configuration Examples of E1 Voice

3.4.1 Router Connected to PBX through E1 Voice Port

I. Networking requirement

The telephones in Beijing and Shenzhen communicate with each other directly via IP network using routers with voice function. The FXS (POTS) interface of Beijing router is connected to the telephone directly and is connected to PBX exchange through E1 voice port. The Shenzhen router is connected to PBX exchange only through E1 voice port. The communications signaling adopts R2 signaling and adopts single stage dialing mode.

II. Networking Diagram

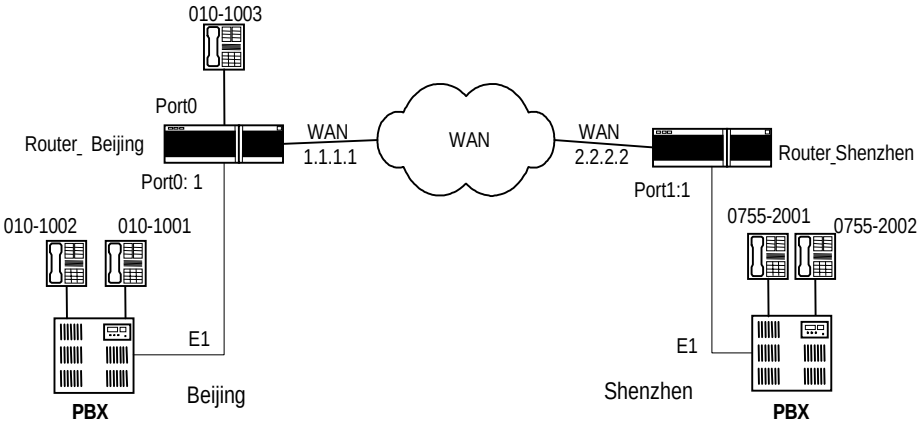

Figure VC-3-2 Router Connected to PBX in E1 Mode (Single stage dialing)

III. Configuration Procedure

1) Parameters configuration of the Beijing-side router

! Configure DS0 group

Quidway(config)# controller e1 0

```
Quidway(config-if-E1-0)# ds0-group 1 timeslots 1-31 type r2-digital
! Set up the POTS dial-peer on FXS interface (telephone number 010-1003)
Quidway(config)# dial-peer voice 1003 pots
! Configure the destination pattern of the POTS dial-peer on FXS interface
Quidway(config-peer-pots1003)# destination-pattern 0101003
! Configure the POTS peer on FXS interface to correspond with logical port
Quidway(config-peer-pots1003)# port 0
! Create POTS dial-peer on E1 interface (telephone number 010-1001)
Quidway(config)# dial-peer voice 1001 pots
! Configure the destination pattern of the POTS dial-peer on E1 interface
Quidway(config-peer-pots1001)# destination-pattern 0101001
! Configure the POTS peer on E1 interface to correspond with logical port
Quidway(config-peer-pots1001)# port 0:1
! Create VoIP dial-peer
Quidway(config)# dial-peer voice 0755 voip
! Configure the destination pattern of VoIP dial-peer
Quidway(config-peer-voip755)# destination-pattern 0755....
! Configure VoIP peer to correspond with logical port
Quidway(config-peer-voip755)# session target ipv4:2.2.2.2
```

2) The parameter configuration of the Shenzhen-side router is similar to that of Beijing-side.

```
! Configure DS0 group
Quidway(config)# controller e1 1
Quidway(config-if-E1-1)# ds0-group 1 timeslots 1-31 type r2-digital
! Create the POTS dial-peer on E1 interface (tel: 0755-2001 or 2002, etc.)
Quidway(config)# dial-peer voice 2001 pots
! Configure the destination pattern of POTS dial-peer on E1 interface
Quidway(config-peer-pots2001)# destination-pattern 0755....
! Configure the POTS peer on E1 interface to correspond with logical port
Quidway(config-peer-pots2001)# port 1:1
! Create VoIP dial-peer
Quidway(config)# dial-peer voice 010 voip
! Configure the destination pattern of VoIP dial-peer
Quidway(config-peer-voip10)# destination-pattern 010....
```

! Configure VoIP peer to correspond with logical port

Quidway(config-peer-voip10)# session target ipv4:1.1.1.1

3.4.2 Router Connected to PBX in ISDN PRI Mode

I. Networking requirement

The telephones in Beijing and Shenzhen communicate with each other directly via IP network using routers with voice function. The FXS (POTS) interface of Beijing router is connected to the telephone directly and is connected to PBX exchange through E1 voice port. The Shenzhen router is connected to PBX exchange only through E1 voice port. The routers in both places are connected to the exchange by adopting ISDN PRI interface DSS1 subscriber signaling and adopts single stage dialing mode.

II. Networking diagram

The networking diagram is similar to VC-3-2, except that ISDN PRI interface DSS1 subscriber signaling is adopted between PBX and the router.

III. Configuration procedure

1) Parameter configuration of the Beijing-side router

! Configure ISDN PRI group

Quidway(config)# controller e1 0

Quidway(config-if-E1-0)# pri-group

! Create POTS dial-peer on FXS interface (telephone number 010-1003)

Quidway(config)# dial-peer voice 1003 pots

! Configure the destination pattern of the POTS dial-peer on FXS interface (tel: 010-1003)

Quidway(config-peer-pots1003)# destination-pattern 0101003

! Configure the POTS peer on FXS interface to correspond with the logical port (telephone number 010-1003)

Quidway(config-peer-pots1003)# port 0

! Create the POTS dial-peer on ISDN PRI interface (telephone number 010-1001)

Quidway(config)# dial-peer voice 1001 pots

! Configure the destination pattern of POTS dial-peer on ISDN PRI interface (tel: 010-1001)

Quidway(config-peer-pots1001)# destination-pattern 0101001

! Configure the POTS peer on ISDN PRI interface to correspond with logical port (tel: 010-1001)

Quidway(config-peer-pots1001)# port 0:15

! Create VoIP dail-peer

Quidway(config)# dial-peer voice 0755 voip

! Configure the destination pattern of the VoIP dial-peer

Quidway(config-peer-voip755)# destination-pattern 0755....

! Configure VoIP peer to correspond with logical port

Quidway(config-peer-voip755)# session target ipv4:2.2.2.2

2) The parameter configuration of the Shenzhen-side router is similar to that of Beijing.

! Configure ISDN group

Quidway(config)# controller e1 1

Quidway(config-if-E1-1)# pri-group

! Create the POTS dial-peer on ISDN PRI interface (tel: 0755-2001 or 2002, etc.)

Quidway(config)# dial-peer voice 2001 pots

Configure the destination pattern of the POTS dial-peer on ISDN PRI interface (tel: 0755-2001 or 2002, etc.)

Quidway(config-peer-pots2001)# destination-pattern 0755....

! Configure the POTS peer on ISDN PRI interface to correspond with logical port (tel: 0755-2001 or 2002, etc.)

Quidway(config-peer-pots2001)# port 1:15

! Create VoIP dial-peer

Quidway(config)# dial-peer voice 010 voip

! Configure the destination pattern of VoIP dial-peer

Quidway(config-peer-voip10)# destination-pattern 010....

! Configure VoIP peer to correspond with logical port

Quidway(config-peer-voip10)# session target ipv4:1.1.1.1

3.4.3 Two-stage Dialing Configuration

I. Networking requirement

The telephones in Beijing and Shenzhen communicate with each other directly via IP network using routers with voice function. The FXS (POTS) interface of Beijing router is connected to the telephone directly and is connected to PBX exchange through E1 voice port. The Shenzhen router is connected to PBX exchange only through E1 voice port. The communication signaling adopts R2 signaling. The subscribers of Beijing PBX exchange adopt two-stage dialing to dial to Shenzhen: first dial 163, then dial the called number according to the prompt tone in turn; Single stage dialing is adopted to dial to Beijing from Shenzhen, i.e. dial the “called number” directly.

II. Netwoking diagram

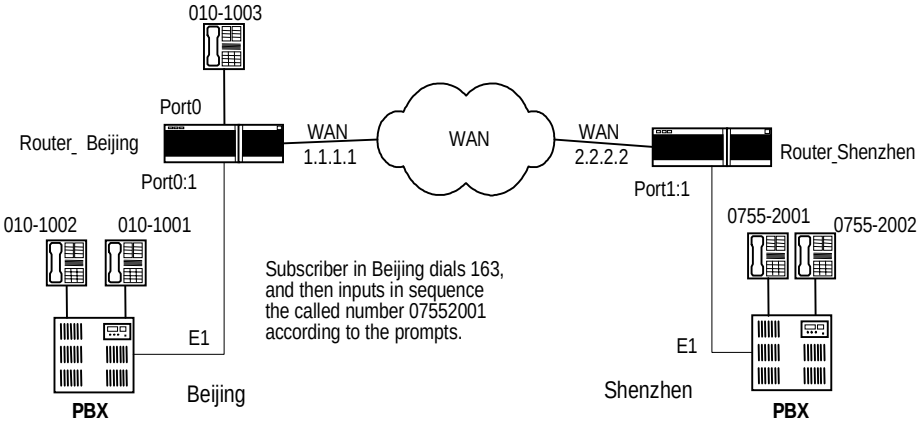

Figure VC-3-3 Router Connected to PBX in E1 Mode (Two-stage dialing)

III. Configuration procedure

1) Configuration of Beijing-side PBX exchange

First modify the configuration of Beijing-side PBX exchange, so that PBX will not delete the access number 163, ensuring that PBX sends the number 163 to Beijing-side router.

2) Parameter configuration of Beijing-side router

! Configure DS0 group

Quidway(config)# controller e1 0

Quidway(config-if-E1-0)# ds0-group 1 timeslots 1-31 type r2-digital

! Create the POTS dial-peer on FXS interface (telephone number 010-1003)

Quidway(config)# dial-peer voice 1003 pots

! Configure the destination pattern of the POTS dial-peer on FXS interface

Quidway(config-peer-pots1003)# destination-pattern 0101003

! Configure the POTS peer on FXS interface to correspond with logical port

Quidway(config-peer-pots1003)# port 0

! Create the POTS dial-peer on E1 interface (Tel: 010-1001)

Quidway(config)# dial-peer voice 1001 pots

! Configure the destination pattern of the POTS dial-peer on E1 interface

Quidway(config-peer-pots1001)# destination-pattern 0101001

! Configure the POTS peer on E1 interface to correspond with logical port

Quidway(config-peer-pots1001)# port 0:1

! Configure two-stage dialing

Quidway(config-peer-pots1001)# incoming called-number 163

! Create VoIP dial-peer

Quidway(config)# dial-peer voice 0755 voip

! Configure the destination pattern of VoIP dial-peer

Quidway(config-peer-voip755)# destination-pattern 0755....

! Configure VoIP peer to correspond with logical port

Quidway(config-peer-voip755)# session target ipv4:2.2.2.2

3) Configuration of Shenzhen-side PBX exchange

Modify the configuration of Shenzhen-side PBX exchange, so that PBX deletes access number 163, ensuring that PBX only send the called number input by the subscriber to Shenzhen-side router.

4) The parameter configuration of Shenzhen-side router is the same as that of Shenzhen-side router specified in section 3.4.1.

3.4.4 Transmission of Data and Voice Simultaneously

I. Networking requirement

The telephones in Beijing and Shenzhen communicate with each other directly via IP network using routers with voice function. The FXS (POTS) interface of Beijing router is connected to the telephone directly and is connected to PBX exchange through E1 voice port. The Shenzhen router is connected to PBX exchange only through E1 voice port. The communications signaling adopts R2 signaling. The routers in Beijing and Shanghai are connected through PSTN network and implement data transmission in DDR mode.

II. Networking diagram

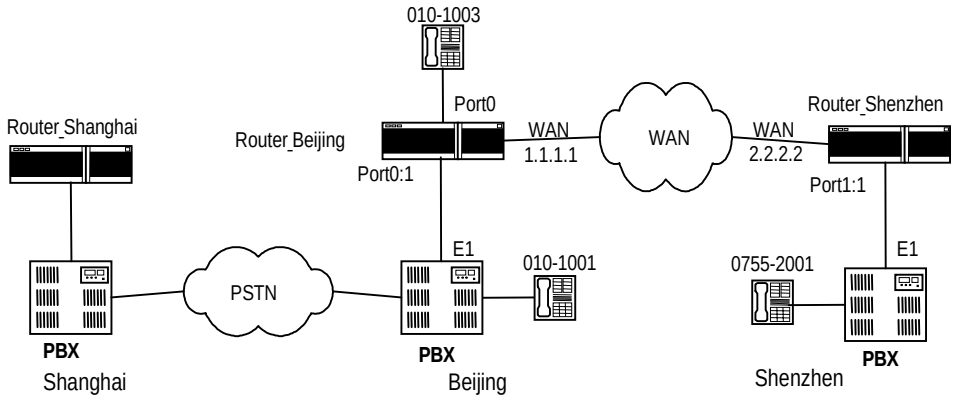

Figure VC-3-4 Integrated Transmission of Data and Voice

III. Configuration procedure

1) Parameter configuration of Beijing-side router

First perform voice configuration following the configuration procedure of Beijing-side router specified in section 3.4.2 step by step, and then configure DDR dialing in the corresponding port of ISDN PRI interface. Please refer to the relevant DDR sections for details.

2) Parameter configuration of Shanghai-side router

Configure DDR dialing in the port corresponding to Beijing-side router. Please refer to the relevant DDR sections for details.

3) Parameter configuration of Shenzhen-side router

Please perform voice configuration according to parameter configuration of Shenzhen-side router specified in section 3.4.2.

3.5 Fault Diagnosis and Troubleshooting of E1 Voice

Fault 1: Failure in establishing connection when switch-side subscriber calls router-side subscriber

Troubleshooting: please follow the following steps:

- First, use **show running** command to check that all the TSs are used when configuring signaling. Please make sure that the TSs the exchange uses is the same as the TSs configured for the router. Connection cannot be established, if the TSs that the exchange uses for outgoing calls are not used in the configuration of the router.
- If there is no dial tone in the call duration, please check that the exchange has sent the outgoing trunk office code to the router and that office code and access number are configured for the telephone number on the router. Generally, connection cannot be established, if the exchange also sends the outgoing trunk office code and the telephone number on the router-side does not add the office code or is not configured with access number. You can either delete the outgoing trunk office code in the exchange-side configuration, or configure access number on router-side.

Fault 2: Using R2 signaling, the router fails to establish connection with subscribers on the exchange-side.

Troubleshooting: please follow the following steps:

First, use **show running** command to check that the trunk mode of the router corresponds with that of the exchange configuration. In other words, if the exchange-side is outgoing trunk, the router-side should be incoming trunk or bi-directional trunk; if the exchange-side is incoming trunk, the router-side should be out-going trunk or bi-directional trunk. If the trunk mode of the router-side is incoming trunk, the subscribers on router-side can only call in, and cannot call out.

Chapter 4 GK Client Configuration

4.1 Overview of GK Client

IP telephone uses Internet as the medium to transmit voice information. IP telephone GateWay (GW for short) lies between Public Switched Telephone Network (PSTN) and Internet access sites. It compresses the voice signal on PSTN network and transports it to the opposite end IP telephone gateway via Internet. Meanwhile, it receives the IP packet from Internet and decompresses it to restore to voice signal of PSTN network. The implementation of IP telephone function on router expands the function of the router, which indicates the trend of the gradual expansion from data service to voice service.

As defined in ITU-T recommendation, GateKeeper (GK for short) is a H.323 entity that can provide such functions as address translation, admission control, bandwidth control and management, area management, security check, call control signaling and call management, and sometimes routing control and billing functions, for the H.323 terminal, GW or some Multipoint Control Unit (MCU) of Local Area Network or Wide Area Network. In an area managed by GK, to all the calls, GK not only provides call service control and also serves as the central control point.

According to the composition of the entity that implements complete GK function, it can be classified into Client end and Server end. Taking router as its hardware medium, GK Client entity generally performs the configuration of IP voice gateway function for the router through the command line interface, and interacts with GK Server by RAS signaling, thus enable GK Server to provide services such as address translation, admission control, bandwidth management, and the management of router IP voice gateway. GK Server can be implemented on SUN workstation or routers.

4.2 Configuration of GK Client

4.2.1 Configuration Task List of GK Client

The configuration tasks of GK Client include:

- Configure one interface as H.323 gateway interface
- Activate or deactivate GK Client function
- Configure alias of the gateway
- Configure the GK Server name and address corresponding to the gateway
- Configure tech-prefix
- Configure GK interconnection mode

4.2.2 Configuring One Interface as H.323 Gateway Interface

The router communicates with GK Server as voice gateway device. It needs to specify the interface that communicates with GK server for the router. The interface specified is H.323 gateway interface. Ethernet port, serial port, etc., can all become H.323 gateway

interface. Only after one interface is specified as H.323 gateway interface, can the function of CK Client be activated and can GK Client register to GK Server.

Please perform the following configurations in interface configuration mode.

Table VC-4-1 Specifying One Interface as H.323 Gateway Interface

Operation	Command
Specify one interface as H.323 gateway interface	**h323-gateway voip interface**
Cancel one interface as H.323 gateway interface	**no h323-gateway voip interface**

By default, no interface is specified as H.323 gateway interface.

4.2.3 Activating or Deactivate GK Client Function

Only when one interface is successfully configured as H.323 gateway interface, can GK Client function be activated. When the H.323 gateway interface is re-specified or the relevant parameters (such as gateway alias and corresponding Gatekeeper name) of other gateways are modified, you should activate GK Client function anew, so that the information related to Client stored in GK Server is updated timely.

Please perform the following configurations in global configuration mode.

Table VC-4-2 Activate or Deactivate GK Client Function

Operation	Command
Activate GK Client function	**gateway**
Deactivate GK Client function	**no gateway**

By default, GK Client function is deactivated.

4.2.4 Configuring Gateway Alias

Gateway alias is used to register at GK Server and identify gateway. One gateway can have only one alias.

Please perform the following configurations in interface configuration mode.

Table VC-4-3 Configure Gateway Alias

Operation	Command
Configure gateway alias	**h323-gateway voip h323-id** *namestring*
Delete gateway alias	**no h323-gateway voip h323-id** [*namestring*]

By default, the gateway alias is blank, i.e. no gateway alias configured.

4.2.5 Configure the GK Server Name and Address

When the GK Client of the router is activated, GK Client will automatically register the relevant information of the gateway to GK Server. Therefore, it needs to configure

information of GK server, such as the IP address and name, to find the right GK Server device,.

Please perform the following configurations in interface configuration mode.

Table VC-4-4 Configure the GK Server Name and Address Corresponding with the Gateway

Operation	Command
Configure the GK Server and IP address corresponding with the gateway	**h323-gateway voip id** *gk-name* **ipaddr** *gk-ipaddress* [*ras-port*]
Delete the GK Server and IP address corresponding with the gateway	**no h323-gateway voip id** [*gk-name* [**ipaddr** *gk-ipaddress* [*ras-port*]]]

By default, no GK Server name and IP address are specified corresponding with the gateway. When using the command to configure, the default value of RAS communication port of GK Server is 1719.

4.2.6 Configuring Tech-Prefix

Tech-prefix is used mainly for the convenience of identifying the gateway type of GK Server. One gateway can be configured with 10 tech-prefixes at most.

Please perform the following configurations in interface configuration mode.

Table VC-4-5 Configure Tech-Prefix

Operation	Command
Configure tech-prefix	**h323-gateway voip tech-prefix** *string*
Delete tech-prefix	**no h323-gateway voip tech-prefix** [*string*]

By default, there is not any tech-prefix.

4.2.7 Configuring GK Interworking Mode

As the device produced by different IP telephone device manufactures are different in their specific implementations of H.323 protocol, there is problem of interworking between the gateways and gatekeepers (GK Server) and between gatekeepers made by different manufacturers. If the voice gateway of the router is to communication with GK Server made by other manufacturers in the normal way, the matched interworking mode needs to be adopted. So far in this case, there are two manufacturers of GK Server involved, i.e., Cisco Inc., and Huawei Technologies.

Please perform the following configurations in interface configuration mode.

Table VC-4-6 Configure GK Interworking Mode

Operation	Command
Configure GK interworking mode	**h323-gateway voip support-mode** { **cisco** | **huawei** }
Recover the default value of GK interworking mode	**no h323-gateway voip support-mode**

Be default, the GK interworking mode is cisco mode.

4.3 Typical Configuration Examples of GK Client

I. Networking requirement

The telephones in Beijing and Shenzhen communicate with each other directly via IP network using routers with voice function, and perform the dynamic resolution from the telephone number to IP address by virtue of GK.

The serial port 0 of Beijing-side router is H.323 gateway interface. The IP address of serial port 0 is 1.1.1.1; the alias of the interface is Beijing-gsw; the name of the corresponding gatekeeper is gk-center; the address of the gatekeeper is 3.3.3.3; the RAS port number is 1719, and the tech-prefix is specified as 1#. The serial port 1 of Shenzhen-side router is H.323 gateway interface; the IP address is 2.2.2.2; the alias of the interface is shenzhen-gw; the other configurations are the same as those of Beijing-side.

II. Networking diagram

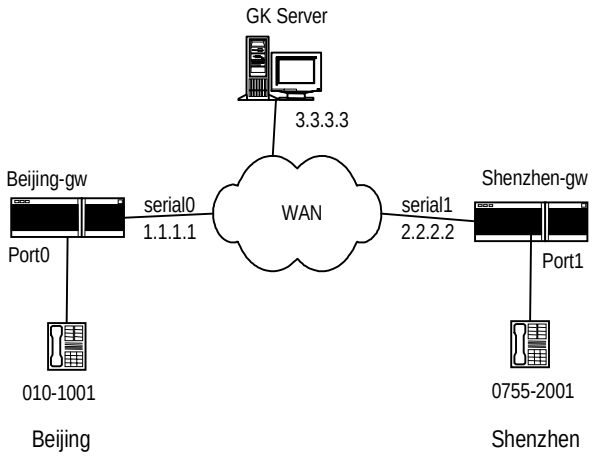

Figure VC-4-1 Networking Mode of GW and GK Combination

III. Configuration Procedure

1) Parameter configuration of Beijing-side router

! Create the POTS dial-peer on FXS interface

Quidway(config)# dial-peer voice 1001 pots

Quidway(config-peer-pots1001)# destination-pattern 0101001

```
Quidway(config-peer-pots1001)# port 0
! Create VOIP dial-peer
Quidway(config)# dial-peer voice 0755 voip
Quidway(config-peer-voip755)# destination-pattern 0755....
Quidway(config-peer-voip755)# session target ras
! Specify Serial0 as H.323 gateway interface
Quidway(config-if-Serial0)# ip address 1.1.1.1 255.255.255.0
Quidway(config-if-Serial0)# h323-gateway voip interface
! Configure gateway alias and the corresponding GK name and IP address
Quidway(config-if-Serial0)# h323-gateway voip h323-id beijing-gw
Quidway(config-if-Serial0)# h323-gateway voip id gk-center ipaddr 3.3.3.3 1719
! Configure tech-prefix
Quidway(config-if-Serial0)# h323-gateway voip tech-prefix 1#
! Configure GK interworking mode
Quidway(config-if-Serial0)# h323-gateway voip support-mode huawei
! Activate GK Client function
Quidway(config)# gateway
Quidway(config-gateway)#
```

2) Parameter configurations of Shenzhen-side are similar to those of Beijing-side

```
! Create POTS dial-peer on FXS interface
Quidway(config)# dial-peer voice 2001 pots
Quidway(config-peer-pots2001)# destination-pattern 07552001
Quidway(config-peer-pots2001)# port 1
! Create VOIP dial-peer
Quidway(config)# dial-peer voice 010 voip
Quidway(config-peer-voip10)# destination-pattern 010....
Quidway(config-peer-voip10)# session target ras
! Specify Serial1 as H.323 gateway interface
Quidway(config-if-Serial1)# ip address 2.2.2.2 255.255.255.0
Quidway(config-if-Serial1)# h323-gateway voip interface
! Configure gateway alias and the corresponding GK name and IP address
Quidway(config-if-Serial1)# h323-gateway voip h323-id shenzhen-gw
Quidway(config-if-Serial1)# h323-gateway voip id gk-center ipaddr 3.3.3.3 1719
! Configure tech-prefix
```

Quidway(config-if-Serial1)# h323-gateway voip tech-prefix 1#

! Configure GK interworking mode

Quidway(config-if-Serial1)# h323-gateway voip support-mode huawei

! Activate GK Client function

Quidway(config)# gateway

Quidway(config-gateway)#

4.4 Fault Diagnosis and Troubleshooting of GK Client

Fault 1: The register of GW on GK Server end fails.

Troubleshooting: Please follow the following steps:

- First, use **ping** command to check that it can interwork with GK Server on network layer.
- Use **show running-config** command to check that **gateway** command takes effect.
- Check that GK Server end gatekeeper is activated.

Check that GK Server end has configured the area.

Chapter 5 IPHC Configuration

5.1 Overview of IPHC

IPHC (IP Header Compression) is the method to classify and compress packet such as IP, TCP and UDP, according to a series of header compression algorithms specified in relevant RFC documents, so as to enhance the transmission rate of voice, video and large packet over low-speed network. Currently, IPHC is mainly applied to the serial links running such protocols as PPP, FR and HDLC and carrying large amount of voice information.

As described in RFC2507, the packets need to be compressed can be classified into the following categories:

1) IP header + TCP header
2) IP header + UDP header
3) IP header + UDP header + RTP header

Among them, (RTP) Realtime Transmit Protocol is an application layer protocol lies above TCP/UDP, which is mainly used to transmit audio, video and simulated data information.

The implementation of IPHC depends on the various existing compression algorithms, whose main concepts are to compress the header since many fields of the headers do not change or change regularly in the course of one-time connection. It divides header into TCP and NON_TCP type, and further divides them into smaller categories. Extracting the unchanged fields or the fields that change regularly from the header of the same packet type, it does not transmit or only transmit the changed values of those fields, thus achieving the purpose of compressing the length of the whole packet.

IPHC defines the two ends of the link as compressor and non-compressor end respectively. The packet processing procedure is described as below:

Compressor: According to the classification method in RFC2507 document, after it classify and compresses the packets, the compressor notifies the decompressor through different packet protocol numbers and makes the decompressor perform different compression in accordance with the corresponding protocol number. If the compressor receives fault-reporting packet CONTEXT_STATE sent from the decompressor, it will mark some location digits in the context storage table according to the information in the packet to identify the faulty packet flow and will performs faulty processing accordingly. For example, when the next packet arrives, it will transmit packets to the decompressor in the complete format to help the latter update context storage table and to implement re-synchronization, etc.

Decompressor: It performs decompression according to the different types of packets transmitted from the compressor, and restores them into complete packets. If it finds that there is fault in packet decompression process, it will either discard the faulty packet or generate CONTEXT_STATE fault-reporting packet according to the actual conditions.

By using IP header compression on low-speed serial link, it can implement:

- Enhance the packet Interactive Response Speed
- Reduce the transmission cost of header, enabling small packet to achieve high link transmission quality and saving bandwidth resource
- Reduce the packet discard rate on lossy links

5.2 IPHC Configuration

5.2.1 Configuration Task List of IPHC

The configuration tasks of IPHC include:

- Enable/disable RTP header compression
- Configure the maximum connection number of RTP header compressions
- Configure the maximum connection number of TCP header compressions
- Configure the enabling of the Cisco-compatible RTP header compression
- Configure the removal of udp_chk field in the UDP header.

5.2.2 Enable/disable RTP header compression

When RTP header compression is enabled, TCP header compression will be enabled accordingl. If the RTP header compression is disabled, the TCP header compression will also be disabled.

Please make the following configuration in the interface configuration mode.

Table VC-5-1 Enable/Disable RTP header compression

Operation	Command
Enable RTP header compression	**ip rtp header-compression**
Disable RTP header compression	**no ip rtp header-compression**

By default, the interface will not perform RTP header compression on the packet.

It should be pointed out for notice here,

1) The subscriber must configure RTP header compression command on both ends of the links at the same time.
2) After TCP header compression is enabled, fast forwarding will not be performed on the packet compressed.
3) After the configuration is completed, only when the **shutdown** and **no shutdown** operation are performed on the interface can the configuration take effect.

5.2.3. Configure the Max. Connection Number of RTP Header Compressions

The subscriber can specify the maximum connection number on an interface that performs RTP header compression.

Please perform the following configurations in interface configuration mode.

Table VC-5-2 Configure the maximum connection number of RTP header compression

Operation	Command
Configure the maximum connection number of RTP header compression	**ip rtp compression-connections** *number*
Restore the default value of the maximum connection number of RTP header compression	**no ip rtp compression-connections**

By default, the maximum connection number of TCP header compression that the interface allows is 16. The value ranges from 4 to 1000.

Notice: After the configuration completes, please perform one “shutdown” and “no shutdown” operation to take effect the configuration.

5.2.4 Configure the Max. Connection Number of TCP Header Compressions

The subscriber can specify the maximum connection number on an interface that performs TCP header compression.

Please perform the following configurations in interface configuration mode.

Table VC-5-3 Configure the maximum connection number of TCP header compression

Operation	Command
Configure the maximum connection number of TCP header compression	**ip tcp header-compression**
Restore the default value of the maximum connection number of TCP header compression	**no ip tcp header-compression**

By default, the maximum connection number of TCP header compression that the interface allows is 16. The value ranges from 4 to 256.

Notice: After the configuration completes, please perform one “shutdown” and “no shutdown” operation to take effect the configuration.

5.2.5 Configure the Cisco-compatible RTP header compression

Please perform the following configurations in interface configuration mode.

Table VC-5-4 Enable/Disable the Cisco-compatible RTP header compression

Operation	Command
Enable the Cisco-compatible RTP Header Compression	**ip rtp header-compression cisco-format**
Disable the Cisco-compatible RTP Header Compression	**no ip rtp header-compression cisco-format**

By default, Cisco-compatible RTP header compression is enabled.

5.2.6 Configure the deleting of udp_chk field from UDP header

The udp_chk field in UDP header can be set to 0, in other words, ignore UDP checksum field when performing header compression. In this way, 2-byte length in the header is saved.

Please perform the following configurations in interface configuration mode.

Table VC-5-5 Configure Deleting/Resetting the udp_chk Field in UDP Header

Operation	Command
Delete the udp_chk field in UDP header	**ip rtp header-compression delete-udpchk**
Reset the udp_chk field in UDP header	**no ip rtp header-compression delete-udpchk**

By default, the udp_chk field in UDP packet field is set to 0.

5.3 Monitoring and Maintenance of IPHC

Table VC-5-6 Monitoring and Maintenance of IPHC

Operation	Command
Show the statistics of TCP header compression	**show ip tcp header-compression** [*interface-type interface-number*]
Clear the storage table items of TCP header compression	**clear ip tcp header-compression** [*interface-type interface-number*]
Show the statistics of RTP header compression	**show ip rtp header-compression** [*interface-type interface-number*]
Clear the storage table items of RTP header compression	**clear ip rtp header-compression** [*interface-type interface-number*]
Enable the debugging information of TCP header	**debug ip tcp head-compression**
Enable the debugging information of RTP header	**debug ip rtp head-compression**

1) Show the statistics of TCP header compression.

Quidway# show ip tcp header-compression serial 0

```
TCP/IP header compression statistics:
Interface Serial0:
Rcvd: 0 total, 0 compressed, 0 errors
      0 dropped, 0 buffer copies, 0 buffer failures
Sent: 430 total 429 compressed,
      15122 bytes saved, 139318 bytes sent
      1.10 efficiency improvement factor
Connect:16 rx slots, 16 tx slots, 1 long searches, 1 misses
      99% hit ratio, five minute miss rate 0 misses/5mins, 0 max.
```

2) Show the statistics of RTP header compression.

Quidway# show ip rtp header-compression serial 0

```
RTP/UDP/IP header compression statistics:
  Interface Serial0:
    Rcvd: 0 total, 0 compressed, 0 errors
          0 dropped, 0 buffer copies, 0 buffer failures
    Sent: 430 total 429 compressed,
          15122 bytes saved, 139318 bytes sent
          1.10 efficiency improvement factor
    Connect: 16 rx slots, 16 tx slots, 1 long searches, 1 misses
         99% hit ratio, five minute miss rate 0 misses/5mins, 0 max.
```

The above information displays such parameters as the number of RTP packet received and transmitted on Sercial0, the number of the compressed RTP packets, the number of the bytes saved and the efficiency improvement factors.

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