InfiLINK XG – CLI commands

Technical User Manual

Software Version:

Last updated: 6/26/2015

About This Manual

This manual provides technical information on the configuration of **InfiLINK XG** series devices using the **CLI**-interface (guidelines for the use of all the commands and options). The manual provides also step-by-step guidelines for the routine tasks and basic scenarios like setting up a radio link, switch configuration, settings of GPS/GLONASS receiver, as well as recommendations for radio link parameters optimization, etc.

This manual is designed for individuals who prefer using a **CLI**-interface for configuring and managing **InfiLINK XG** series devices. It is intended for the following audiences:

- Customers with technical knowledge of and experience with IP networks
- Network administrators, who install, configure and manage **InfiLINK XG** series devices.

Table of Contents

Table of Figures

List of Tables

1. INTRODUCTION

1.1. Document structure

This manual contains the following chapters:

- **Introduction** – this chapter provides information about purposes and structure of the document
- **InfiLINK XG general description** – this chapter contains general description of **InfiLINK XG** and functions of its ports
- **Switch configuration** – this chapter provides description of the commands that are used for switch configuration, as well as configuration examples. Descriptions include: selection of operation mode, VLAN, STP, QoS settings, switch statistics collection.
- **GPS/GLONASS-receiver configuration** – this chapter contain descriptions of the commands for the management by built-in GPS/GLONASS-receiver, which provide selection of trace level, GPS/GLONASS-receiver statistics and status.
- **Modem configuration** – this chapter contains descriptions of the commands for enabling/disabling of radio interface and radio link parameters configuration:
  - selection of node type (Master/Slave), setting of link distance and channel width, downlink/uplink ratio configuration, settings of central frequencies and air frame period;
  - selection of strategies for traffic prioritization and modulation scheme selection;
  - getting statistics and device configuration review

  In addition, this chapter provides step-by-step guidelines for initial configuration of the devices, their installation and monitoring.

1.2. Document marks

CAUTION

All caution warnings are marked with a special warning sign. One should pay attention to the content of the Caution section.

HINT

All hints are marked with a special **hint** sign. Hints usually contain useful comments to the described section of the document.

2. InfiLINK XG general description

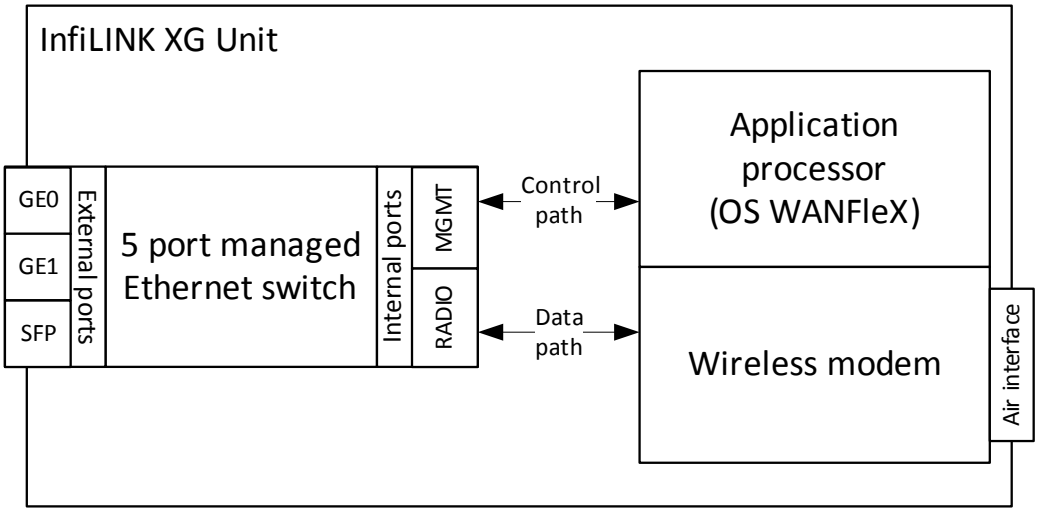

Figure 1 – InfiLINK XG block diagram

InfiLINK XG operates as a managed Ethernet switch with five ports:

- **GE0** and **GE1** – external copper Gigabit Ethernet ports 1000BASE-T (IEEE 802.1ab)
- **SFP** – an external optical Gigabit port for plugging of the optical SFP transceiver module
- **RADIO** – an internal port of the switch connected with the external radio interface of the device
- **MGMT** – an internal interface for the device management

3. Switch configuration

3.1. Default settings

- The access to the device is performed through any external port
- IP-address of the unit: 10.10.10.1/24
- By default the switch operates in **isolate** mode, i.e. all the ports are isolated from each other, even if they are located in the same VLAN
- All the ports operate in **trunk** mode with **native VLAN 1** for untagged traffic
- Radio interface is up and operates within the switch as a regular port
- **DHCP**-client is enabled on the management interface **MGMT**

3.2. Command description

3.2.1. PORT command

Use this command for the built-in switch management.

Syntax:

#1> port [arguments]

```
   port [-scheme=SCHEME] [-mgmt=PORT_SET] [-radio=PORT_SET]
   port -d1q[=[disabled|enabled]]
   port -vlan={RANGELIST} [{-priority=PRIO|-nopriority}]
   port -vlan={RANGELIST} [-stp] [-nostp] [{-spriority=STPPRIO|-
nospriority}] [-sforward[=enable|disable]]
   port -vlan={RANGELIST} -remove={RANGELIST}
   port [PORT_SET] [-access=TAG] [-native=TAG] [-mode={access|trunk}]

   port [PORT_SET] [-allow={RANGELIST}] [-disallow={RANGELIST}]
   port [PORT_SET] [-limit={RATE_LIMIT}] [-nolimit] [-
qosmode={wrr|st3|st23|strict}]
   port [PORT_SET] stat|clear|vtt|stt [VID]|fdb-show|dump

  RANGELIST: RANGE[,RANGE...]
      RANGE: {TAG[-TAG]|all}
       PRIO: {0..7}    - DOT1P frame priority
 RATE_LIMIT: {0..1000} - port egress rate limit in Mbit/sec
    STPPRIO: {0..15} | {0,4096,8192...61440}
   Port set <PORT_SET>:
            enumeration of {[ge]0..[ge]1,s[fp],m,r}|*, for example 0,ge1,m
   Adjacency scheme <SCHEME>:
            {isolate, transparent}
```

Command arguments:

The switch can operate in one of the following modes: **isolate** or **transparent**.

In **isolate** mode, packet switching is based on the port isolation rules. External ports are isolated from each other and traffic from each of them is redirected to the

internal ports according to the port isolation rules, so that any direct traffic between the external ports is impossible. This is the basic mode, used by default, including situations when there are no any **VLAN** settings or **802.1Q**-support is disabled in **transparent** mode.

In **transparent** mode, direct traffic transmission between external ports (without involving the internal ones) is possible; packet switching is performed according to the VLAN-tags and internal “port - VLAN-tag” correspondence table, if it exists.

The following command allows you to select one of the switch modes - **isolate** or **transparent**:

- **port [-scheme=SCHEME]**

If you need to configure the port isolation rules for traffic redirection from external physical interfaces **GE0, GE1** and/or **SFP** to the interfaces **RADIO** or **MGMT**, use the following command:

- **port [-mgmt=PORT_SET] [-radio=PORT_SET]**

If you need to disable the switching rules based on **802.1Q**-tags, even if the **transparent** mode is selected (and to enable switching based on the port isolation rules), use the command:

- **port -d1q=disabled**

In order to add to the system the **VLANs** with the numbers **from 1 to 4094**, use the command:

- **port -vlan={RANGELIST}**

Example:

```
port -vlan=50,52,60-64
```

adds **VLANs 50,52,60,61,62,63,64**.

If you want to remove any previously created **VLANs** from the system, use the command:

- **port -remove={RANGELIST}**

If you need to set for the selected **VLANs** the priority according to **802.1p** ranging **from 0 to 7**, use the command:

- **port -vlan={RANGELIST} {-priority=PRIO}**

Example:

```
port -vlan=50 -priority 7
```

sets the priority **7 (Network control)** to the **VLAN 50**.

In order to remove the priority of the selected **VLANs**, perform the command:

- **port -vlan={RANGELIST} {-nopriority}**

You can enable on the switch the support of **PVST+** (Per-VLAN Spanning Tree Plus) protocol – the special version of **STP**, which allows creating a separate **spanning tree** for each **VLAN**.

In order to enable **STP** support for the selected VLANs, use the command:

- **port -vlan={RANGELIST} [-stp]**

In order to disable **STP** support for the selected VLANs, use the command:

- **port -vlan={RANGELIST} [-nostp]**

In order to set the **bridge priority** for **STP** in the selected **VLAN** ranging **from 0 to 61440** in increments of **4096** (or **from 0 to 16** in increments of **1**), use the command:

- **port -vlan={RANGELIST} {-spriority=STPPRIO}**

Example:

```
port -vlan=50 -spriority=4096
```

sets the bridge priority **4096** for **VLAN 50.**

In order to remove the **bridge priority** for **STP** in the selected **VLAN**, use the command:

- **port -vlan={RANGELIST} {-nospriority}**

If you need to enable/disable the forwarding of **STP** packets in the selected **VLAN**, use the corresponding command:

- **port -vlan={RANGELIST} [-sforward[=enable|disable]]**

Ports of the switch can operate in one of the two operation modes:

- **access** mode (allows untagged traffic only) and
- **trunk** mode (allows tagged traffic only). If you need to allow both tagged and untagged traffic through the port, you can configure the ***native VLAN*** option that defines the only **VLAN** for receiving of all incoming untagged traffic in **trunk** mode (**VLAN 1** is configured as a **Native VLAN** for all the ports of the switch by default).

In order to select **access** or **trunk** mode for the port, use the command:

- **port [PORT_SET] [-mode={access|trunk}]**

If you want to define **VLANs** for the port operation in **access** mode, use the command:

- **port [PORT_SET] [-access=TAG]**

Example:

```
port 0 -access=50 -mode=access
```

sets the **access mode** for the port **GE0** and defines **VLAN 50** for operation of this port.

If you want to define **VLANs** for the port operation in **trunk** mode, use the command:

- **port [PORT_SET] [-allow={RANGELIST}]**

Example:

```
port 1 -allow=50-55 -mode=trunk
```

sets the **trunk mode** for the port **GE1** and allows operations with **VLAN 50,51,52,53,54,55**.

If you need to set **VLAN** for operation as a **Native VLAN** for the port in **trunk** mode, use the command:

- **port [PORT_SET] [-native=TAG]**

In order to remove the selected **VLANs** from the port, use the command:

- **port [PORT_SET] [-disallow={RANGELIST}]**

If you need to set on the selected port the limit for outgoing traffic (traffic shaper) in Mbps, ranging **from 1 to 100** in increments of **1** or **from 100 to 1000** in increments of **10**, use the command:

- **port [PORT_SET] [-limit={RATE_LIMIT}]**

Example:

```
port 0,1 -limit=120
```

sets the limit of **120 Mbps** on the ports **GE0** and **GE1**.

In order to remove the limits of throughput on the port, use the command:

- **port [PORT_SET] [-nolimit]**

In order to select the **QoS** policy for the port (**WRR** is used by default), use the following command:

- **port [PORT_SET] [-qosmode={wrr|st3|st23|strict}]**

Use these commands to get **statistics data** and information about **current parameters** of the device operation:

- **port [PORT_SET] stat|clear|vtt|stt [VID]|fdb-show|dump**

In order to display statistics for the port, use the command:

- **port [PORT_SET] stat**

In order to clear statistics for the port, use the command:

- **port [PORT_SET] clear**

If you want to view the **VLAN-based switching matrix**, **STP** status and **VLAN** priorities, use the command:

- **port vtt**

If you want to view the information about operation of **STP** in the selected **VLAN** and on each of the associated ports, use the command:

- **port stt [VID]**

Example:

```
#1> port stt 30
STP state of VID 30:
 ID:       1000000043507A2A5 Priority: 4096  ID ext: -1
 ROOT:     1000000043507A2A5 Priority: 4096  ID ext: 0
 Ports:
  Name  Prio    Cost    PVer    Role      State
 ====== ==== ========== ==== ========== ==========
 ge1     128         55 RSTP DISABLED   DISCARDING
 sfp     128         55 RSTP DISABLED   DISCARDING
```

If you want to view MAC-addresses in the switching matrix (**FDB**) of the selected port, use the command:

- **port [PORT_SET] fdb-show**

In order to view general information about the port operation: traffic shaper limits, **QoS** policy, port status, and data transfer rate, use the command:

- **port [PORT_SET] dump**

Example:

```
#console>port dump
  Port R-limit QOS Mode Link   Speed
  ==== ======= ======== ==== =========
    0  ------- wrr        UP  100 Mbps
    1  ------- wrr      down
    s  ------- wrr      down
    r      140 wrr        UP   26 Mbps
    m  ------- wrr      ---- ---------
```

3.3. Configuration examples

Configure the switch for operation in **isolate** mode. It is the default mode. If you need to switch from **transparent** mode, use the command:

- **port -scheme= isolate**

Configure the port isolation rules for traffic redirection from external physical interfaces **GE0**, **GE1** and/or **SFP** to the interfaces **RADIO** or **MGMT**:

Assign access to the **management** interface through the **GE0** port:

- **port -mgmt=0**

Assign the port **GE1** for data transfer to the port **RADIO**:

- **port -radio=1**

Configure the switch for operation in **transparent** mode.

See **VLAN-based switching matrix** with default settings below:

```
port vtt
        VID  0 1 2 r m STP Prio
        ==== = = = = = === ====
           1 N N N N N  -  ----
```

In order to switch to **transparent** mode, execute the command:

- **port -scheme=transparent**

Configuring of the switch starts with adding **VLANs**, which are necessary for data transfer and device management:

```
port -vlan=30,100
port vtt
        VID  0 1 2 r m STP Prio
        ==== = = = = = === ====
           1 N N N N N  -  ----
          30 t t t t t  -  ----
         100 t t t t t  -  ----
```

Set the parameters of processing of tagged or/and untagged traffic for each port.

Set **access** of untagged packets to **VLAN 30** on the management interface **MGMT**:

```
port m -access=30 -mode=access
port vtt
        VID  0 1 2 r m STP Prio
        ==== = = = = = === ====
           1 N N N N -  -  ----
          30 t t t t A  -  ----
         100 t t t t -  -  ----
```

Set **access** of untagged packets only to **VLAN 30** on the port **GE0**:

```
port 0 -access=30 -mode=access
port vtt
        VID  0 1 s r m STP Prio
        ==== = = = = = === ====
           1 - N N N -  -  ----
          30 A t t t A  -  ----
         100 - t t t -  -  ----
```

Set the **GE1** port for processing of tagged packets of the **VLAN 30** only (**trunk** mode):

```
port 1 -allow=30 -mode=trunk
port vtt
        VID  0 1 s r m STP Prio
        ==== = = = = = === ====
           1 - - N N -   -  ----
          30 A t t t A   -  ----
         100 - - t t -   -  ----
```

Set the port **SFP** for processing of tagged packets of the **VLAN 100** only (**trunk** mode):

```
port s -allow=100 -mode=trunk
port vtt
        VID  0 1 s r m STP Prio
        ==== = = = = = === ====
           1 - - - N -   -  ----
          30 A t - t A   -  ----
         100 - - t t -   -  ----
```

Set the port **RADIO** for processing of tagged packets of the **VLANs 30** and **100** (**trunk** mode):

```
port r -allow=30,100 -mode=trunk
port vtt
        VID  0 1 s r m STP Prio
        ==== = = = = = === ====
          30 A t - t A   -  ----
         100 - - t t -   -  ----
```

4. GPS/GLONASS-receiver configuration

4.1. Command description

4.1.1. GPS command

Use this command to handle the GPS/GLONASS-receiver.

Syntax:

#1> gps [options] [command]

```
Options:
  -t=<level>  - turn trace level (1, 2 or 0 - turn trace off)
  -a[=(0:1)]  - turn the power on the antenna amplifier
  -r[=(0:1)]  - set reset signal
  -p=<port>   - set TCP port for service (2323 by default)
  -s=<baudrate|0>  - set baud rate for GPS NMEA port (0 - set 115200)
Command:
  start       - start GPS service
  stop        - stop  GPS service
  coordinates - show  GPS coordinates
  console     - map GPS NMEA port to stdin/stdout
  tcp         - map GPS NMEA port to TCP service
  stat        - show GPS statistics
  clear       - clear GPS statistics
```

Options:

If you need to configure event logging, you can choose the required trace level, using the following option:

- **-t=<level>**

The following **trace levels** are available (from maximum to minimum details):

- **Level 2** – to log all the NMEA-messages from the GPS/GLONASS-receiver.
- **Level 1** – to log only the messages about discovering / loss of the GPS/GLONASS-receiver, about the changing of the quantity of detected satellites or about substantial changes of coordinates, etc.
- **Level 0** – event logging is off.

If you need to enable / disable the power supply to the antenna amplifier (if one is available), you can set the corresponding value, using the following option:

- **-a[=<value>]**
  - **<value>=1** – to enable the power supply (is used by default, if the value is not specified)
  - **<value>=0** – to disable the power supply

CAUTION

*Please note, that **tcp** and **console** commands and **-r, -p** and **-s** options are used for diagnostics and debugging on emergency by specialists only.*

Commands:

To start the operation of **GPS** service, use the following command:

- **start**

To stop the operation of **GPS** service, use the following command:

- **stop**

If you need to view statistics of GPS/GLONASS-receiver operation (without the status information), use the following command:

- **stat**

In order to clear the statistics, use the following command:

- **clear**

If you need to view the information about the status of GPS/GLONASS-receiver and its operation statistics, you can use the following command:

- **[coordinates]**

Example of status information and statistics outputs:

```
console> gps coordinates
Satellites: 8
LAT/LONG:   56.811911/60.547041
Altitude:   275.89
HDOP:       0.92
FIX:        3D, GLONASS
Total GPS      time: 17:43:19
Total nonvalid time: 00:00:01(0%)
Number of losses: 0
Now coordinates are valid last 17:43:18
Satellites histogram:
       ^
       |
   2.0 +
       |
   3.0 +
       |
   4.0 +
       |
   5.0 +
       | <1%
   6.0 +
       | 1%
   7.0 +
       |||||||||||||||||||||||||||||||||||||||||||||||||| 99%
       v
SATmin= 5 SATmax= 10
```

- **Satellites —** quantity of currently visible satellites;

- **LAT/LONG —** geographical coordinates of the receiver in degrees
  - **LAT** (latitude) — latitude from -90.0000000° to +90.0000000°
  - **LONG** (longitude) — longitude from -180.0000000° to +180.00000°;
- **Altitude —** altitude in meters;
- **HDOP —** horizontal dilution of precision;

CAUTION

It is recommended to use values of "**HDOP**" parameter up to 1.5 for reliable global timing synchronization)

- **FIX —** *NO FIX|2D|3D*, *<unknown>|GPS|GLONASS|GPS+GLONASS* – the current position-fix status in the following view: **<current fix mode>, <system>.** The following values of **<current fix mode>** are available:
  - **NO FIX** - coordinates are not fixed,
  - **2D** – only latitude and longitude are fixed,
  - **3D** – latitude, longitude and altitude are fixed;

The following values of **<system>** (currently used GNSS) are available:

- **GPS**,
- **GLONASS**,
- **GPS+GLONASS**;

The next block of information is the statistics (to obtain these data without information about status of GPS/GLONASS-receiver you can use **gps stat** command instead).

- **Total GPS time —** total time of **GPS** utility operation since it was started by **gps start** command
- **Total nonvalid time** – total time during which the information about coordinates was unavailable
- **Number of losses** — quantity of cases when the information about coordinates had become unavailable
- **Now coordinates are valid last …** - time of **GPS** utility operation since last coordinates discovering.
- **Satellites histogram** - the histogram of visible satellites quantity.
- **SATmin и SATmax —** minimum and maximum of visible satellites respectively (since the last time you cleared the statistics).

5. Modem configuration

5.1. Command description

5.1.1. IFC RADIO command

Use this command to enable or disable radio interface of the system.

Syntax:

#1> ifc radio {up | down}

5.1.2. XG command

Use this command to review and update air link parameters.

Syntax:

#1> xg [arguments]

```
#1> xg
usage:
   xg -type {master | slave}

 Radio frame params related
   xg -tdd-sync-src {freerun | gnss}
   xg -dlquota {1..99/1}
   xg -sframelen {1 | 2 | 5 | 10}
   xg -max-distance {0..120000/1}
   xg -cell-id {0..15/1}

 Radio front end related
   xg      -freq-dl      {channel-width==10:4905..5995/10      |      channel-
width==20:4910..5990/10 | channel-width==40:4920..5980/20}
   xg      -freq-ul      {channel-width==10:4905..5995/10      |      channel-
width==20:4910..5990/10 | channel-width==40:4920..5980/20}
   xg -txpwr {0..27/1}
   xg -channel-width {10 | 20 | 40}

 Modulation related
   xg -amc-strategy {normal | conservative | aggressive}
   xg -max-mcs {1..10/1}

 DFS/RSSI scan/Radar detection

 Ethernet datapath related
   xg -qos-strategy {normal | conservative | aggressive | off}

 Supplementary

alias:
   xg -freq <val> => xg -freq-dl <val> -freq-ul <val>

   xg -appendconf-v2-start
   xg -appendconf-v2 <encoded web config>
   xg -appendconf-v2-end
```

```
   xg  [-grids-carrier-ix=<grids-carrier-ix>]  [-grids-band=<grids-band>]  -
grids {<freq_start>[-<freq_end>[/<step>]],...}
   xg  [-grids-carrier-ix=<grids-carrier-ix>]  [-grids-band=<grids-band>]  -
grids=

   xg stat [-phy] [-1]
   xg stat -clear
   xg capabilities

   xg config
   xg config -self
   xg config -peer-exported
   xg config -defaults
```

Command arguments:

Point-to-point link can be set between a **Master** and a **Slave** unit only. In order to choose InfiLINK XG device type, use the command:

- **xg -type {master | slave}**

Example:

```
xg -type master
```

In order to setup TDD synchronization parameters, use the command:

- **xg -tdd-sync-src {freerun | gnss}**
  - **freerun** - unsynchronized frame start.
  - **gnss** - synchronization from built-in GPS/GLONASS receiver.

CAUTION

GNSS option is effective for Master unit only.

CAUTION

Before enabling **gnss** option make sure that built-in **GNSS**-receiver is configured properly. Use **gps** command to configure or check the status (use values of **HDOP** up to 1.5)

Possibility of the frequency re-use depends on the antenna types, placement, direction, link distances, etc.

CAUTION

Please note that the following settings must be equal for the co-located units:

- All co-located units must be **Masters**
- Downlink/uplink ratio
- Air frame period
- Maximal distance
- Channel width

If you need to set a **downlink/uplink ratio**, use the following command, specifying as a value the size of downlink subframe relative to the whole frame (e.g. “xg -dlquota 70” should be specified for downlink/uplink ratio of 70/30):

- **xg -dlquota {1..99}**

Actual downlink/uplink ratio might be different due to internal system limitations. The system chooses closest available ratio automatically. The current value of this ratio can be checked in the output of **xg capabilities** command.

Example:

```
xg -dlquota 70
```

In order to set **air frame period** in milliseconds, use the command:

- **xg -sframelen {1, 2, 5, 10}**

Example:

```
xg –sframelen 10
```

The shorter air frame period, the lower latency, but also the higher overheads. Using longer frame periods cuts down overheads, but increases latency.

In order to specify **maximum link distance** in meters, use the command:

- **xg -max-distance {0..55800/1}**

Example:

```
xg -max-distance 5000
```

The specified value must be no lower actual link distance, and it is recommended keep it as close as possible to the actual distance to avoid unnecessary overheads. The recommended sequence of configuration is to set this parameter well above the actual distance and after the units have been deployed fine-tune it based on the measured distance value, taken from **xg stat** output.

In order to avoid connection of the unit to a wrong node (if several co-located units are using the same center frequency), it is recommended to specify different **ID** values for different link. Both ends of the same link must have the same **ID**.

In order to specify **ID** value, use the command:

- **xg -cell-id {0..15/1}**

Example:

```
xg -cell-id 15
```

If you need to configure **downlink center frequency** (applicable to the models supporting split-frequency/H-FDD operation), use the command:

- **xg -freq-dl {channel-width==10:4905..5995/10 | channel-width==20:4910..5990/10 | channel-width==40:4920..5980/20}**

The range of available values and increment size for each of the channel widths is specified in braces.

Example:

```
xg -freq-dl 5200
```

In order to configure **uplink center frequency** (applicable to the models supporting split-frequency/H-FDD operation), use the command:

- **xg -freq-ul {channel-width==10:4905..5995/10 | channel-width==20:4910..5990/10 | channel-width==40:4920..5980/20}**

The range of available values and increment size for each of the channel widths is specified in braces.

Example:

```
xg -freq-ul 5400
```

If you need to configure **downlink/uplink center frequency** (sets the same frequency channel to both uplink and downlink), use the command:

- **xg -freq**

Example:

```
xg -freq 5200
```

If you need to set the limits on the available operation frequencies (for example, if there are some legal or other restrictions for usage of some part of hardware supported frequencies), you can configure a **custom frequency grid.**

In order to set a **custom frequency grid** (within physical/license limits of a specific model), define the **grid** individually for each **band** of each **carrier** as a list of sub-bands, using the command:

- **xg [-grids-carrier-ix=<grids-carrier-ix>] [-grids-band=<grids-band>] -grids {<freq_start>[-<freq_end>[/<step>]],...}**

or as a sequence of frequencies:

- **xg [-grids-carrier-ix=<grids-carrier-ix>] [-grids-band=<grids-band>] -grids=**

In order to set a **channel width** in MHz, use the command:

- **xg -channel-width {10, 20, 40}**

In order to set a **transmit power** level in dBm, use the command:

- **xg -txpwr {0..27/1}**

There are three possible variants of **AMC strategy**:

- **conservative** assumes using higher **CINR** thresholds in order to minimize error rates;
- **aggressive** strategy of using lower **CINR** thresholds in order to use higher modulation levels for increasing the throughput;
- **normal** represents the balance between the two above-mentioned.

In order to select **AMC strategy**, use the command:

- **xg -amc-strategy {normal | conservative | aggressive}**

In order to set the **highest modulation level** for AMC algorithm, use the command:

- **xg -max-mcs {1..10}** – one of the ten supported **MCSs** (from **QPSK** to **QAM1024**)

There are four possible variants of **traffic prioritization strategy**:

- **aggressive** - maximal throughput with a minor priority packet loss allowed;
- **conservative** - no priority packet loss with small decline in the peak throughput;
- **normal** - the balance between the two above-mentioned;
- **off** - no prioritization.

In order to select **traffic prioritization strategy**, use the command:

- **xg -qos-strategy {normal | conservative | aggressive | off}**

If you want to view link statistics, use the command:

- **xg stat [-phy] [-1]**
  - **-phy** - the system displays in-depth physical layer link statistics;
  - **-1** - the system displays a single snapshot of statistics data.

Sample command output:

```
#console>xg stat
Wireless Interface Statistics
Interface Status: UP
+--------------------------------------+--------------------------------------+
|          Receive Statistics          |         Transmit Statistics          |
+--------------------------------------+--------------------------------------+
|Air Frames Received   137926          |Air Frames Transmitted 70356          |
|Packets Received      2               |Packets Transmitted    3              |
+--------------------------------------+--------------------------------------+

Wireless Link Statistics
+----------------------+--------------+
|Wireless Link status  |Up            |
|Measured Distance     |16 meters     |
|Channel Width         |40 MHz        |
|DL/UL Ratio           |50:50         |
+----------------------+--------------+
+---+-----------+--------------+---------------+---------------+--------------+
|  Device Type  |        Master (local)        |        Slave (remote)        |
+---+-----------+--------------+---------------+---------------+--------------+
|Tx Capacity    |         156549 kbps          |         143503 kbps          |
+---+-----------+--------------+---------------+---------------+--------------+
|               |                Carrier 0 (carrier status Up)                 |
+---+-----------+--------------+---------------+---------------+--------------+
|Tx Frequency   |           5600 MHz           |           5600 MHz           |
|AMC Mode       |             Auto             |             Auto             |
+---+-----------+--------------+---------------+---------------+--------------+
|               |   Stream 0   |   Stream 1    |   Stream 0    |   Stream 1   |
+---+-----------+--------------+---------------+---------------+--------------+
|TX |Tx Power   |9.87 dBm      |9.89 dBm       |10.18 dBm      |10.16 dBm     |
+---+-----------+--------------+---------------+---------------+--------------+
|RX |Rx MCS     |QAM256 6/8 (7)|QAM64 5/6 (6)  |QAM256 6/8 (7) |QAM64 5/6 (6) |
|   |CINR       |30 dB         |28 dB          |31 dB          |30 dB         |
|   |RSSI       |-36 dBm       |-36 dBm        |-37 dBm        |-37 dBm       |
|   |Acc TBER   |0.0e0 (0.0%)  |0.0e0 (0.0%)   |0.0e0 (0.0%)   |0.0e0 (0.0%)  |# Acc
TBER - accumulated transmission block error rate
```

In order to clear statistics, use the command:

- **xg stat -clear**

If you need to get information about radio subsystem capabilities, use the command:

- **xg capabilities**

Command outputs example:

```
#console>xg capabilities
Radio capabilities

General properties
Radio module name: RMU-55-05:41049
Antenna methods supported: MIMO
Duplex types supported: TDD
Frame periods supported: 1, 2, 5, 10 ms
Channel widths available: 10, 20, 40 MHz

Number of carriers: 1
Carrier 0 frequency range: 4900..6000 MHz
Carrier 0 Tx power range: 0..27/1 dBm

Carrier 0 configuration (Channel width 40 MHz, allocated DL/UL ratio 50:50 (28:28 air blocks), frame
period 1 ms, ttg/rtg (3:3 air blocks), qos strategy: normal):
+--------------+------------------------------+------------------------------+------------------------------+
| MCS          | Modulation                   | DL/UL capacity, kbps         |Total rate, kbps              |
+--------------+------------------------------+------------------------------+------------------------------+
| 1            | QPSK 1/2                     | 26091/26091                  |57344                         |
```

```
| 2            | QPSK 3/4                    | 39137/39137                 |86016                          |
| 3            | QAM16 1/2                   | 52183/52183                 |114688                         |
| 4            | QAM16 3/4                   | 78274/78274                 |172032                         |
| 5            | QAM64 4/6                   | 104366/104366               |229376                         |
| 6            | QAM64 5/6                   | 130457/130457               |286720                         |
| 7            | QAM256 6/8                  | 156549/156549               |344064                         |
| 8            | QAM256 7/8                  | 182640/182640               |401408                         |
| 9            | QAM256 30/32                | 195686/195686               |430080                         |
| 10           | QAM1024 8/10                | 208732/208732               |458752                         |
+--------------+-----------------------------+-----------------------------+-------------------------------+
Lower..upper central frequencies: 4910..5990 MHz
Frequency grid (default): 4920-5980/20 MHz
Frequency list (54 channels):
4920, 4940, 4960, 4980, 5000, 5020, 5040, 5060, 5080, 5100, 5120, 5140, 5160, 5180, 5200, 5220,
5240, 5260, 5280, 5300, 5320, 5340, 5360, 5380, 5400, 5420, 5440, 5460, 5480, 5500, 5520, 5540,
5560, 5580, 5600, 5620, 5640, 5660, 5680, 5700, 5720, 5740, 5760, 5780, 5800, 5820, 5840, 5860,
5880, 5900, 5920, 5940, 5960, 5980 MHz
```

In order to view the configuration of the local unit, use the command:

- **xg config –self**

In order to view the configuration of the remote unit, use the command:

- **xg config -peer-exported**

The outputs of the command can be used for synchronization of the settings on the unit (see **1.4.2. Initial configuration, installation and monitoring guidelines** for details).

The outputs have the following view:

```
xg -appendconf-v2-start
xg -appendconf-v2 <encoded web config>
xg -appendconf-v2-end
```

In order to view the default configuration, use the command:

- **xg config –defaults**

5.2. Initial configuration, installation and monitoring guidelines

- **Step 1**

Perform site survey

- Determine line of sight conditions and obstacles along the path
- Perform spectrum analysis in order to estimate its occupation and interference situation and to determine available channels
- Use available link planning tools to estimate link performance and required configurations for antennas, to choose channel width, Tx power, etc.

- **Step 2**

Pre-configure the units in the lab

- Configure one unit as a **Master** node and another as a **Slave** node
- Set channel width, center frequencies and downlink/uplink ratio of frequency channels, air frame period, maximum distance (well above estimated link distance), Tx power, etc.

CAUTION

Please note that the following settings must be **equal** on the both sides of the link:

- Link ID
- Downlink/uplink frequency channels
- Channel width
- Downlink/uplink ratio
- Air frame period

Otherwise, the units will not link up.

HINT

In order to synchronize the settings of the units, copy from one unit and paste to another one the **Peer exported config** lines shown in the **xg** command outputs. See the **configuration example** below.

Configuration example:

```
#Peer exported config:
 xg -appendconf-start
 xg -appendconf IC1kbHF1b3RhIDcwIC1zZnJhbWVsZW4gMTAgLW1heC1kaXN0YW5jZSAyNzU
 xg -appendconf wIC1ydGctbWFudWFsLWVuYWJsZSAwIC1jZWxsLWlkIDAgLWZyZXEtZGwgNj
 xg -appendconf M4MCAtZnJlcS11bCA2MzgwIC10eHB3ciAxNSAtdHhnYWluIC0zMiAtY2hhb
 xg -appendconf m5lbC13aWR0aCAxMCAtYW1jLW1vZGUgYXV0byAtYW1jLXN0cmF0ZWd5IGFn
 xg -appendconf Z3Jlc3NpdmUgLXRlc3QtYW1jLW9mZnNldCAtMyAtdGVzdC1hbWMtb2Zmc2V
 xg -appendconf 0LWVuYWJsZSAxIC1tYXgtbWNzIDkgLXFvcy1zdHJhdGVneSBub3JtYWwgLX
 xg -appendconf JsbS12ZXJib3NpdHktbGV2ZWwgMg==.36caaf5c9d9ebc2433482ac4565b
 xg -appendconf 241e
 xg -appendconf-end
```

- Save the configuration, reboot both units, and check if they link up after reboot.

- **Step 3**

Perform initial alignment

- Install both units on the masts and direct them roughly at each other
- Switch them on and check that the wireless link is established, using **RF** link led indicators
- Perform rough alignment, using built-in led indicators of signal strength
- Perform fine alignment, using **xg stat** outputs. Try to maximize **CINR** and **Absolute RSSI** values.

HINT

If **Absolute RSSI** value goes above **-40 dBm**, decrease **Tx power** of the remote unit in order to keep it within **-40..-50 dBm** for performance maximization.

Step 4

Optimize link performance

- Adjust **Maximal link distance** parameter based on the measured distance.

HINT

Check measured link distance, using **xg stat** outputs and adjust **xg –max-distance** settings by adding **200-300 m** to the measured value.

- Check the air block error rate **Acc TBER** in **xg stat** outputs and adjust **AMC strategy** if necessary. It is recommended to use **Normal** strategy initially and then adjust it based on target and actual **Acc TBER** values.

HINT

Acceptable error rate **Acc TBER** depends on the application. See examples in **Table 1** below.

Application	Acceptable error rate
TCP-based applications (web, FTP, etc.)	10^{-4}
Voice-over-IP	10^{-5}
UDP video (CCTV, IPTV, etc)	10^{-6}
TDM-over-IP	$10^{-7}..10^{-9}$

Table 1 - Acceptable error rates for different applications

- Select the most appropriate air frame period

HINT

The system supports frame period values ranging **from 1 to 10 ms.**

Frame with period of **1 ms** gives the **lowest latency** (from **500 us** one-way).

Frame with period of **10 ms** has **lowest overheads.** As a result, it has **approximately 12% better maximal throughput** for the same MCS than one with period of 1 ms. Also, 10 ms frame provides **more stable performance** - it has significantly lower distance penalty compared to 1 ms: at 100 km the maximal throughput decreases by 7% at 10 ms and by 75% at 1 ms.