

VIAVI

QG 2 Multi-Sync Gateway

Users Guide

1.20

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About this User Guide

This prefix explains how to use this User Guide and includes the following topics:

- “Purpose and scope” on page iv
- “Assumptions” on page iv
- “Related Information” on page iv
- “Conventions” on page iv
- “Safety and compliance information” on page vi
- “Technical assistance” on page vii

Purpose and scope

This manual is intended to help you use the capabilities of the Qg 2 Multi-Sync Gateway.

This manual includes task-based instructions that describe how to configure, use, and troubleshoot the test capabilities available on your instrument assuming it is configured and optioned to support the capabilities.

Assumptions

This manual is intended for novice, intermediate, and experienced users who want to use their instrument effectively and efficiently. We are assuming that you have basic computer experience and are familiar with basic telecommunication concepts, terminology, and safety.

Related Information

This manual is application-oriented and contains information about using these instruments to test service carried on each of the listed networks. It includes an overview of testing features, instructions for using the instruments to generate and transmit traffic over a circuit, and detailed test result descriptions. This manual also provides contact information for VIAVI's Technical Assistance Center (TAC).

Conventions

This manual uses conventions and symbols, as described in the following tables.

Table 1 Text formatting and other typographical conventions

Item(s)	Example(s)
Buttons, keys, or switches that you press or flip on a physical device.	Press the On button. – Press the Enter key. – Flip the Power switch to the on position.
Buttons, links, menus, menu options, tabs, or fields on a PC-based or Web-based user interface that you click, select, or type information into.	Click Start – Click File > Properties . – Click the Properties tab. – Type the name of the probe in the Probe Name field.
Directory names, file names, and code and output messages that appear in a command line interface or in some graphical user interfaces (GUIs).	\$NANGT_DATA_DIR/results (directory) – test_products/users/ defaultUser.xml (file name) – All results okay. (output message)

Table 1 Text formatting and other typographical conventions (Continued)

Item(s)	Example(s)
Text you must type exactly as shown into a command line interface, text file, or a GUI text field.	<ul style="list-style-type: none"> – Restart the applications on the server using the following command: \$BASEDIR/startup/npiu_init restart <p>Type: a:\set.exe in the dialog box.</p>
References to guides, books, and other publications appear in <i>this typeface</i> .	Refer to <i>Newton's Telecom Dictionary</i> .
Command line option separators.	<code>platform [a b e]</code>
Optional arguments (text variables in code).	<code>login [platform name]</code>
Required arguments (text variables in code).	<code><password></code>

Table 2 Symbol conventions

	This symbol indicates a note that includes important supplemental information or tips related to the main text.
	This symbol represents a general hazard. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents an alert. It indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.
	This symbol represents hazardous voltages. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk of explosion. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol represents a risk of a hot surface. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk associated with fiber optic lasers. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol, located on the equipment, battery, or the packaging indicates that the equipment or battery must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Table 3 Safety definitions

Term	Definition
DANGER	Indicates a potentially hazardous situation that, if not avoided, <i>will</i> result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.
WARNING	Indicates a potentially hazardous situation that, if not avoided, <i>could</i> result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.
CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury and/or damage to equipment. It may be associated with either a general hazard, high voltage, or risk of explosion symbol. See Table 2 for more information. When applied to software actions, indicates a situation that, if not avoided, could result in loss of data or a disruption of software operation.
ALERT	Indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.

Safety and compliance information

The following sections describe the safety and compliance information for the Qg 2 Multi-Sync Gateway.

California Proposition 65

California Proposition 65, officially known as the Safe Drinking Water and Toxic Enforcement Act of 1986, was enacted in November 1986 with the aim of protecting individuals in the state of California and the state's drinking water and environment from excessive exposure to chemicals known to the state to cause cancer, birth defects or other reproductive harm.

For the VIAVI position statement on the use of Proposition 65 chemicals in VIAVI products, see the Hazardous Substance Control section of the VIAVI Policies & Standards web page.

Federal Communications Commission (FCC)

The equipment was tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

The authority to operate this equipment is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by VIAVI.

Product Environmental Compliance

VIAVI is committed to compliance with all applicable laws and regulations controlling the use of hazardous substances in its products, as well as the disposal of equipment (including batteries) and waste packaging. For details, see the VIAVI Policies & Standards web page or contact the VIAVI WEEE Program Management team at Global.WEEE@ViaviSolutions.com.

EU REACH

Article 33 of EU REACH regulation (EC) No 1907/2006 requires product suppliers to provide information when a substance included in the list of Substances of Very High Concern (SVHC) is present in a product above a certain threshold.

For information about the presence of REACH SVHC in VIAVI products, see the Hazardous Substance Control section of the VIAVI Policies & Standards web page.

Technical assistance

If you require technical assistance, call 1-844-GO-VIAVI. For the latest TAC information, go to <https://support.viavisolutions.com>.

Revision History

Table 1 Revisions

Rev	Date	Comment
1.0		Initial Release
1.1	2018-04-24	Released with SW v12.1.4
1.2	2018-06-20	Released with SW v12.1.6
1.3	2018-09-14	Released with SW v12.1.8
1.4	2018-11-05	Released with SW v12.1.10
1.5	2019-01-15	Released with SW v12.1.11
1.6	2019-02-08	Released with SW v12.1.12
1.7	2019-04-12	Released with SW v12.1.15
1.8	2019-05-18	Released with SW v12.1.16
1.9	2019-08-07	Released with SW v12.1.17
1.10	2019-11-29	Released with SW v12.1.19
1.11	2020-02-21	Released with SW v12.1.20
1.12	2020-04-13	Released with SW v12.1.21
1.13	2020-11-02	Released with SW v12.1.23
1.14	2020-12-15	Released with SW v12.1.24
1.15	2021-04-20	Released with SW v12.1.25
1.16	2021-08-06	Released with SW v12.1.26
1.17	2021-10-28	Released with SW v12.1.27
1.18	2022-12-15	Released with SW v12.2.1
1.19	2023-02-28	Released with SW v12.2.3
1.20	2024-01-01	Released with SW v12.2.4

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Introduction

This chapter discusses the following topics:

- “Overview” on page 2
- “Interfaces” on page 2
- “Typical applications” on page 3
- “Oscillator options” on page 3
- “PTP slave capacity” on page 4
- “Components block diagram” on page 4

Overview

The Qg 2 is a small form factor, highly accurate Multi-Sync Gateway that provides IEEE 1588-2008 PTP Grand Master and Boundary Clock functionality. IEEE 1588-2008 PTP is also known as PTP Version 2.

Figure shows the Qg 2.

Figure 1 Qg 2



Qg 2 gets its time from the built-in GNSS receiver or 1PPS/ToD input or IEEE 1588-2008 PTP as input references. PTP algorithms are leveraged to deliver stringent timing for frequency and phase profiles. Outputs include IEEE 1588-2008 PTP, selectable FREQ Out, 1PPS, and Time of Day (ToD). Qg 2 will provide holdover depending on the chosen built-in oscillator.

Remote control and monitoring are provided over SSH, Web Interface and SNMP (v2, v3).

Interfaces

Qg 2 Interfaces are shown in [Figure 2](#) and [Figure 3](#).

Figure 2 Qg 2 front panel

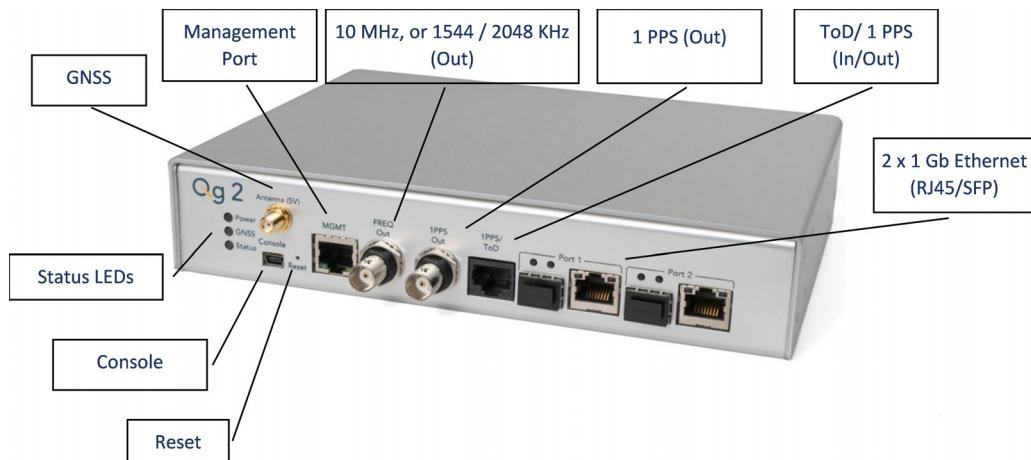
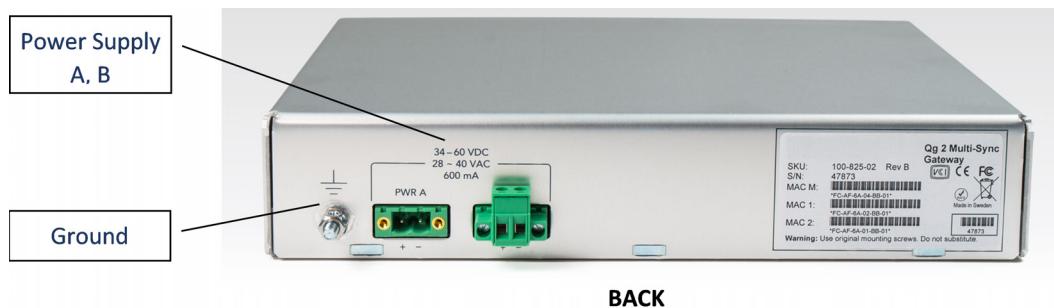


Figure 3 Qg 2 rear panel



Typical applications

Qg 2 is a small form factor IEEE-1588-2008 PTP Edge Grand Master and Boundary Clock that can be used for smart grid transmission and distribution substations. This Multi-Sync Gateway platform is designed for small cell clusters, C-RAN, and edge applications.

Oscillator options

The following oscillator options are available:

- Standard — OCXO oscillator, 4-hour holdover for 1.5 μ sec accuracy
- Superior — Super OCXO oscillator, 8-hour holdover for 1.5 μ sec accuracy

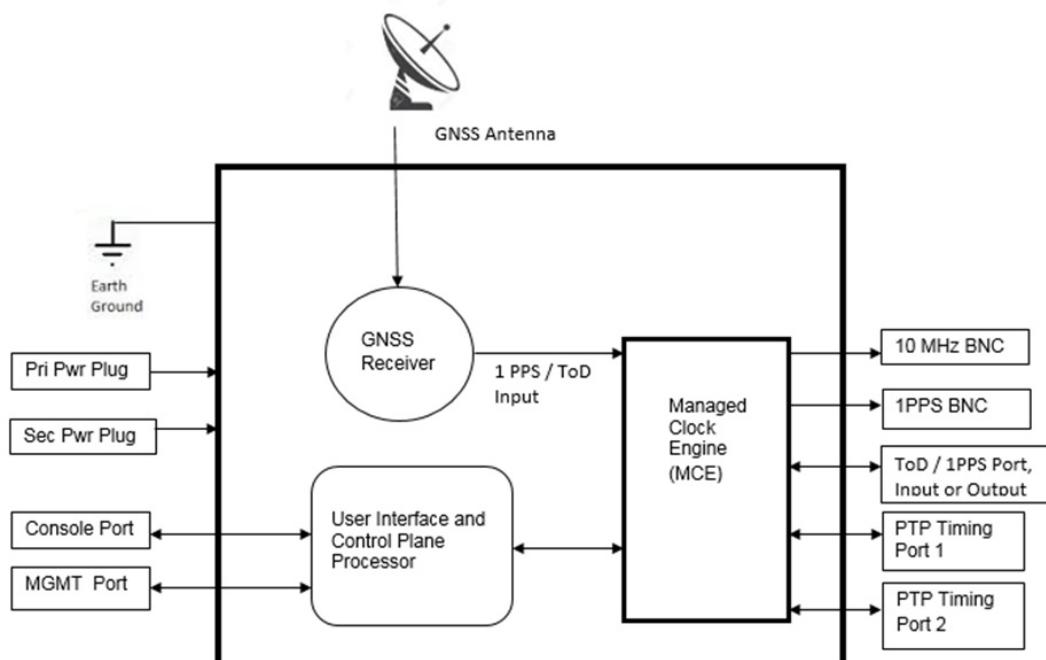
PTP slave capacity

The Qg 2 has variants that can support different unicast slave capacity (32, 128, 256...) slaves at up to 128 sync / delay packets per second when the MCE is operated as a master clock depending on the product SKU. The variants are configured at the factory and cannot be field upgraded at present. Contact information for ordering the Qg 2 with the supportable slave capacities is presented in the Contact Section of this User Guide on page 109. Section 10 of this User Guide presents all the variants available.

Components block diagram

[Figure 4](#) shows a block diagram that defines the main components of the Qg 2 system.

Figure 4 Qg 2 components block diagram



[Table 1](#) describes the components.

Table 1 Qg 2 components

Component	Description
Managed Clock Engine (MCE)	A full packet network-based synchronization engine supporting IEEE 1588-2008 Precise Time Protocol. The MCE is where IEEE 1588-2008 PTP packet communication processing runs, and port / BNC provisioning is applied. GNSS signals and User Interface Processor (UIP) commands are sent to the MCE.

Table 1 Qg 2 components

Component	Description
User Interface and Control Plane Processor	Supports all user access and connectivity to the entire system. The Processor supports DHCP, HTTP webpage/CLI access, SSH, SFTP, XML and SNMP (v2, v3).
GNSS Receiver	GPS Receiver combined with either a Beidou or Glonass or Galileo Receiver with external antenna input. The selection of the constellation is user configurable.

Installation

This chapter discusses the following topics:

- “[Installation overview](#)” on page 8
- “[Security recommendations](#)” on page 8
- “[Environmental requirements](#)” on page 8
- “[Packaging list and unpacking](#)” on page 8
- “[Rack mounting the Qg 2](#)” on page 9
- “[Power and ground connections](#)” on page 9
- “[Input/Output Signal Connections](#)” on page 10
- “[Connecting the GNSS antenna](#)” on page 11
- “[Applying Power](#)” on page 11

Installation overview

Review the information in this chapter before installing the Qg 2. If difficulties are encountered during installation, contact VIAVI Solutions Customer Support.

Security recommendations

The Qg 2 Management port and PTP Timing ports should be installed behind the company's firewall to prevent public access. Additionally, the PTP Timing ports should be connected to a Local Area Network (LAN) or Wide Area Network (WAN) dedicated to transporting PTP timing messages.

Environmental requirements

The Qg 2 operating temperature is 0°C to 50° C (-32°F to 122° F). Use only shielded cable for all signal wiring, including I/O, clocks and Ethernet. Use the Ground connector to appropriately ground the Qg 2 to earth ground.

Packaging list and unpacking

The Qg 2 box contains the following:

- The Qg 2 Multi-Sync Gateway
- 48V DC power adapter

GNSS antenna, mounting bracket and console cable can optionally be supplied by the local distributor.

The Qg 2 is packaged to be protected from normal shock, vibration, and handling damage during shipment. The following procedure describes how to unpack and inspect the box contents.

To unpack and inspect the box contents

- 1 Wear a properly grounded protective wrist strap or suitable ESD protection.
- 2 Inspect the shipping box for signs of damage. If the box appears to be damaged, notify both the carrier and your VIAVI Solutions distributor. Retain the shipping box and packaging material for the carrier to inspect.
- 3 Open the box, being careful to cut only the packaging tape.
- 4 Locate and save the printed packaging list and paperwork that is included in the box.
- 5 Remove the Qg 2 from the box and place the unit on an anti-static surface.
- 6 Locate and set aside additional parts which may be contained in the box.
- 7 Remove and dispose of the anti-static packaging from the Qg 2 and parts.

- 8 Verify that the model and serial number shown on the packaging list agrees with the model and serial number on the Qg 2. The model number can be found on a label affixed on the back of Qg 2. Contact your Viavi Solutions distributor if the model or serial number do not match.

Rack mounting the Qg 2

The Qg 2 is half of a 19-inch rack, and occupies 1.75 in (4.5 cm, 1RU) of vertical rack space. An optional mounting bracket can be provided by the local distributor.



WARNING

When rack mounting the Qg 2, use the original mounting screws provided with the mounting bracket so that the Qg 2 case will not be damaged. Do not substitute other mounting screws.

Power and ground connections

The following sections describe the Power and Ground connections

Power

The Qg 2 uses two VDC power sources, primary and backup. One or both power sources can be used. The power source can be 34 - 60 VDC. The VDC power connector uses two power feed lines, PWR A and PWR B. Qg 2 comes equipped with 2 Phoenix connectors to supply PWR A and PWR B and the user needs to connect the two terminals of it to their DC +/- supplies. The Qg 2 can also be powered by two VAC power sources, with 28 - 40 VAC supply.



NOTE

All operation, test and performance references and specifications that VIAVI Solutions Inc. makes in its Qg 2 customer documents, on its label, and to certification authorities are based on actual measurements ONLY when operated with the power supplies that VIAVI Solutions provides or offers as an optional accessory. If operated with other brands and/or different specifications of power supplies, VIAVI Solutions will NOT guarantee proper operation of the Qg 2, functionality or its compliance with the stated standards.

Ground

The Qg 2 ground is a 4 mm ground stud and is identified with the international ground marking as shown on Figure 3. This ground wire should be routed to earth ground.

Input/Output Signal Connections

The following sections describe the Input/Output signal connections.

Management

Using a standard CAT5 cable, connect the cable to the port labelled MGMT of the front panel to your network. The data rate is 10/100 Base-T shielded RJ45 receptacle. The Management port supports both forms of IP address assignment, static or DHCP.

Console

A mini-USB connector labeled Console is available for Qg 2 to have a serial connection to a PC or laptop. The user can connect to Qg 2 console via terminal emulation applications on PC such as Tera Term, PuTTY, minicom or Procomm to access the CLI over the serial port.

FREQ Out

BNC connector to port labeled FREQ Out to provide synchronized selectable frequencies output from Qg 2. The FREQ Out is DC Blocked.

Timing outputs, 1PPS

A configurable 1PPS is provided on a BNC connector, labeled 1PPS. Connect the 1PPS signal output to a frequency counter or any other measuring device.

Timing inputs/outputs, ToD / 1PPS

An RJ45 port is provided, labeled ToD/1PPS. These ports are configurable to provide input or output for ToD / 1PPS. Both, the ToD format and the 1PPS signal are configurable. Refer to [2] for details of the timing ports physical/electrical characteristics.

PTP Port 1 and Port 2

One shielded RJ45 copper port and one SFP port is provided in parallel for Port 1. Likewise, one shielded RJ45 copper port and one SFP port is provided in parallel for Port 2. These ports provide PTP protocol messages to the timing network. See Gateway and Boundary clock Section of this User Guide for information on how the PTP Port 1 and Port 2 perform when the Clock Type Mode is configured as Gateway

or Boundary clock. Selecting the Clock Type Mode is described in PTP :: Clock Section of this User Guide.

Connecting the GNSS antenna

Connect a suitable GNSS antenna, making sure the antenna has a clear view of the sky. When the GNSS receiver has good reception, the GNSS LED will be green. Qg 2 provides 5.0 VDC bias to power remote active antennas.

The GNSS antenna connector is a female SMA with external threads. Once the GNSS antenna is connected to Qg 2 antenna port, the GNSS operation can be configured and monitored in the Interface :: GNSS Section of this User Guide.

Applying Power

Qg 2 does not have a power switch, so power should not be applied until the Ground connector is installed and connected to earth ground. To avoid accidental power up of the Qg 2, please re-check and ensure all connections are made including the Ground connector, before enabling external power to Qg 2.



NOTE

When using the 48 V power supply 99-905-04 for the Japanese and China markets on a 100 - 120 V mains voltage, the included power supply needs to first be connected to the wall socket and then to the Qg 2 for proper operation.

Getting Started

This chapter discusses the following topics:

- “Logging In With the Console” on page 14
- “Set up IP address” on page 14
- “Remote Network Access to Qg 2” on page 14

Logging In With the Console

Log into Qg 2 using the mini-USB console. Default set-up is 115200 baud, 8 bits, no parity, and one stop bit. Login is admin and password are admin. Terminal emulation software like Tera Term, PuTTY, minicom and Procomm can be used for this purpose.

Set up IP address

The Management port IP address assigned to the Qg 2 can be viewed using the mini-USB console.

At the factory, the Qg 2 Management port IP is statically assigned to 192.168.2.100 with netmask of 255.255.255.0. This static IP address will be set after doing a restore to factory default configuration.

To configure the Management port IP address for customer network

- 1 Connect the Qg 2 mini-USB console port to a PC and run a terminal emulator application (Tera Term, PuTTY, minicom, Procomm, etc.) to login to the Qg 2. Login credentials are provided in the Qg 2 Basic Commands section. Use the "network configure" command to configure the Management port IP parameters. The Network Configure Command section provides CLI command details for setting the Management port IP address, subnet mask and Gateway IP.
- 2 With the Management port IP address configured successfully, the IP address can be entered into a browser URL field to access the Qg 2 Login page, with login credentials (admin/admin).

Remote Network Access to Qg 2

Qg 2 can be accessed remotely over IP network via the Management IP Interface. These are some of the methods to access Qg 2 remotely:

HTTP/Web access

Qg 2 can be accessed over the web from any standard browser (IE, Chrome, Firefox, Safari, etc.). This provides a Graphical User Interface (GUI) for the user to configure or monitor Qg 2 operations.

The following web browsers / versions are supported by the Qg 2 HTTP server:

- Internet Explorer / v11.0.31
- Chrome / v63.0.3239.132
- Firefox / v56.0
- Safari / v11.0.3

Secure Shell (SSH) access

SSH offers a secure shell for users to do remote login to Qg 2 using terminal emulation software. After login, the user can use Qg 2 CLI to send commands. Note that only SSH and not Telnet access is allowed for remote shell login.

SNMP (v2, v3)

Qg 2 can be one of many managed devices on the network with an Element Management System (EMS) or Network Management System (NMS) as the centralized server. Currently, only SNMP is supported for PTPBASE-MIB specification from Timing Over IP Connections and Transfer of Clock (TICTOC) Working Group. The text format of PTPBASE-MIB can be obtained from Viavi Support. This MIB is based on RFC8173 from TICTOC Working Group (<https://datatracker.ietf.org/doc/html/rfc8173>)

Web Interface

This chapter discusses the following topics:

- “[Web Interface Overview](#)” on page 18
- “[Login](#)” on page 18
- “[Change Password](#)” on page 18
- “[Home](#)” on page 19
- “[Interface Page](#)” on page 23
- “[PTP Page](#)” on page 34
- “[Dataset](#)” on page 45
- “[Configuration Page](#)” on page 49
- “[Alarms/Events Page](#)” on page 50
- “[Security Page](#)” on page 52
- “[SNMP Page](#)” on page 54

Web Interface Overview

The following sections describe the Qg 2 Web Interface. A topic for each page in the web interface is provided, with an explanation of each tab, button and selection on each page. The Login Webpage and Home Webpage are presented as a starting point for accessing the Web Interface.

Login

[Figure 5](#) shows the Login webpage.

Figure 5 Login webpage

The screenshot shows a login form titled "Viavi Solutions Qg 2". At the top left is the Viavi logo. Below it is a horizontal line with the word "VIAVI" above it. The main form area has a light gray background. It contains two input fields: "Username" and "Password", both with placeholder text " ". Below these fields is a "Change Password" hyperlink. At the bottom are two buttons: a dark blue "Login" button and a white "Clear" button with black text.

The Login webpage contains the following entries and buttons:

- Username — (Factory default: "admin")
- "Password" — (Factory default: "admin")
- Change Password hyperlink — selects Change Password webpage
- Login button — Apply Username and Password to login
- Clear button — Clear Username and Password

Change Password

[Figure 6](#) shows the Change Password page.

Figure 6 Change Password page

Old Password

New Password

Confirm New Password

Cancel Change Password

Submit

Clear

The Change Password page contains the following entries and buttons:

- Old Password — Enter current password
- New Password — Enter new password
- Confirm New Password — Re-enter new password

In the case of a forgotten or lost password, the Qg 2 can be reset to factory defaults to recover the default password. The Hard Reset Button section of this User Guide describes how to reset the Qg 2 to factory defaults. When the Qg 2 completes the reboot, the password will be reset back to "admin". Prior to doing a Hard Reset, saving the current configuration of the Qg 2 is recommended, and then reloading the configuration after reboot has completed.

Home

Figure 7 shows the Home page.

Figure 7 Home page

Profile: G8275.2

Clock Type: Ordinary Clock

EEC Option: Option-1

Operating Mode: GNSS Only

Network Type: Managed

Synchronous Ethernet: GM - GNSS Source

Stop Engine

Clock ID: FC AF 6A FF FE 2 B8 B0

Time Source: GPS

PTP Sync: Locked-Synchronizing

GNSS Status: 1PPS Stable-To-O Stable

UTC Time: 2023-12-30 08:26:56

PTP Time: 2023-12-30 08:27:34.083110896

Local Time: 2023-12-30 08:26:57 GMT

Local TZ: (GMT +0:00) UTC, GB

Daylight Saving

Enable DayLight Saving

Month: Jan

Week: Last

Day: Sun

Hour: 00

Min: 00

Start Time: Jan

End Time: Jan

Apply

Clear

Prior to starting the Timing Engine, some basic configurations are needed to define the clock, the mode of operation and user deployment scenario. These basic configurations are provided inside the box at the top of the Home page.

The following selections are available:

- (PTP) Profile dropdown selections
 - Default profile (1588_V2)
 - Telecom profile
 - G8275.1 (frequency + phase, L2 multicast, requires full on-path timing network support)
 - G8275.2 (frequency + phase, L3 unicast, for partial timing network)
 - G8265.1 (frequency only from packet network)
- Power profile
 - Power_V1 (IEEE C37.238-2011)
 - Power_V2 (IEEE C37.238-2017)
 - Power Utility (IEC61850-9-3:2016)
- SMPTE profile
 - ST 2059-2:2015 - SMPTE Profile for Use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications
- Operating Mode dropdown selections
 - PTP Only
 - GNSS Only
 - GNSS Primary, PTP Secondary
 - PTP Primary, GNSS Secondary
 - PTP only, GNSS debug (experimental, for VIAVI Solutions internal use ONLY)
- Clock Type drop-down selections:
 - Ordinary Clock (Grandmaster, Master, Slave)
 - Boundary Clock (one port is Slave, and the other port is Master)
- Network Type drop-down selections (to optimize for user network conditions):
 - Unmanaged (networks with unknown packet delay variation)
 - Managed (networks with distinct floor of minimum packet delay variation)
 - Full on-path (networks as specified in G.8275.1 to comply with G.8273.2 for frequency response specification. NOTE: The slave Start and Main Time Constant values will be optimized to 100 and 1 when Full on-path support is configured)

- EEC Option dropdown menu (EEC = Ethernet Equipment Clock, with accuracy within ± 4.6 ppm)
 - Option-1 (for 2048 kbps network hierarchy, min BW = 1Hz, max BW = 10Hz, Europe)
 - "Option-2 (for 1544 kbps network hierarchy, min BW = none, max BW = 0.1Hz, N America)
 - "eEEC Option-1 (enhanced EEC bandwidth with Option-1)
 - "eEEC Option-2 (enhanced EEC bandwidth with Option-2)

NOTE

eEEC bandwidth option that can be combined with Option-1 (Europe) or Option-2 (N America).

- Synchronous Ethernet dropdown menu
- OFF (Synchronous Ethernet is disabled, no clock recovery from either port, no ESMC processing or transmit, only PTP operation)
 - GM - GNSS Source (no clock recovery from ports, ref frequency from 1PPS used for SyncE out (Ethernet Tx clock, ESMC/QL out on both ports), plus PTP operation)
 - BC - Ref input port-1 (SyncE in (recovered clock, input ESMC/QL) from port-1, SyncE out on port-2, plus PTP operation. For G8275.2 profile, SyncE out is disabled)
 - BC - Ref input port-2 (SyncE in (recovered clock, input ESMC/QL) from port-2, SyncE out on port-1, plus PTP operation. For G8275.2 profile, SyncE out is disabled)

NOTE

The above configurations that are encapsulated in the box on Home webpage need to be configured BEFORE starting the timing engine. These configuration parameters in the box defines the basic mode of operation in customizing for customer deployment and application.

Once the engine is stopped to change the profile or other configuration within this box, some of the timing engine related configuration may get reset to default values.

Synchronous Ethernet is supported only for the following Operating Modes:

- PTP Only, and
- GNSS Only

- Start Engine/Stop Engine
 - Click the button to start Clock Engine if engine is stopped or stop it if it is already running. While the engine start is in progress, a label will display "Applying configuration and starting the engine - please wait!!" at the top of the screen.
- Clock ID

This is this Qg 2 node's PTP Clock-Id.

- Time Source
 - GNSS
 - "PTP"
 - "HAND SET"
- Soon after booting up, Qg 2's timing engine will be configured with the build time of the software instead of it being unknown or arbitrary. This will be updated once it finds a time reference (GNSS or PTP)
- PTP Sync (Status / State)
 - Status can be "Locked" or "Unlocked".
 - State can be:
 - Free Running - no reference clock source, using internal oscillator.
 - Syntonizing - 1PPS reference but no reference ToD source, frequency only
 - Synchronizing - (1PPS + ToD) or PTP reference source, timing synchronized to that.
 - Holdover - Lost reference source, timing continues with earlier reference.
- Qg 2 Sync States are described in detail in the Qg 2 Clock Sync States Section of this User Guide.
- GNSS Status (1PPS / ToD)
 - Stable
 - Unstable
 - N/A if the operating mode is PTP-only as there is no GNSS reference
- UTC Time
 - Format YYYY-MM-DD HH:MM:SS
 - This is also known as Greenwich Mean Time (GMT) or Zulu time.
- PTP Time
 - Format YYYY-MM-DD HH:MM:SS:<fraction of a second>
- Local Time
 - Format YYYY-MM-DD HH:MM:SS <xxT>
 - Can be customized to local time zone using "Local TZ" configuration
 - Default setting is the same as UTC Time (i.e.. "GMT")
- Local TZ (time zone)

User can select one of many pull-down options to select the appropriate time-zone for the local time.

 - (GMT +0:00) UTC, GMT, WET
 - (GMT -11:00) MIT
 - (GMT -10:00) HST
 - :
:
– (GMT +11:00) SST
 - (GMT +12:00) NST

- Daylight Saving
 - Enable Daylight Saving
 - Start Time: Month [Jan-Dec], Week [1..4, last], Day [Sun - Sat], Hour [0-23], Min [0, 15, 30, 45]
 - End Time: Month [Jan-Dec], Week [1..4, last], Day [Sun - Sat], Hour [0-23], Min [0, 15, 30, 45]
- Logout button
 - Logs the user out of the Qg 2 server.

Interface Page

The following sections describe the Interface page. The following drop-down options are available:

- PTP Timing Ports
- MGMT Port
- GNSS
- ToD/1PPS Output

PTP Timing ports

[Figure 8](#) shows the PTP Timing Ports tab.

Figure 8 PTP Timing ports tab

[Table 2](#) describes the displays, selections, entries, and buttons.

Table 2 PTP Timing ports tab

Labels	Access	Description
PTP Timing Ports — Port 1		

Table 2 PTP Timing ports tab

Labels	Access	Description
DCHP	Read/ Write	Enables and disables DHCP for dynamic IP assignment.
Ipv4 Address	Read/ Write	Four dot separated octets (0-255) for static IP assignment.
Subnet Mask	Read/ Write	Four dot separated octets (0-255) for static IP assignment.
Gateway IP	Read/ Write	Four dot separated octets (0-255) for static IP assignment.
Auto Negotiation	Read/ Write	Drop down menu for IEEE 802.3 Ethernet link auto-negotiation. Drop down menu options: <ul style="list-style-type: none"> – On – 1000 Full Duplex – 1000 Half Duplex – 100 Full Duplex – 100 Half Duplex – 10 Full Duplex – 10 Half Duplex NOTE — Synchronous Ethernet is supported only for 1000 Full Duplex ports
Link State	Read Only	Link Up/Link Down status with Mbps Data Rate and Full Duplex I/O
IPv6 Address	Read Only	(Link local) IPv6 address used when PTP::Port::Network Protocol is IPv6.
MAC	Read Only	Six colon separated hexadecimal MAC address display

PTP Timing Ports — Port 2

DHCP	N/A (DHCP supported only for Port 1)	
IPv4 Address	Read/ Write	Four dot separated octets (0-255)
Subnet Mask	Read/ Write	Four dot separated octets (0-255)
Gateway IP	Read/ Write	Four dot separated octets (0-255)
Link State	Read Only	Link Up/Link Down Status with Mbps Data Rate and Full Duplex I/O
IPv6 Address	Read Only	(Link local) IPv6 address used when PTP::Port::Network Protocol is IPv6
MAC	Read Only	Six colon separated hexadecimals

Table 2 PTP Timing ports tab

Labels	Access	Description
Apply/Clear		
Apply Button	Write Only	Click for selection and Timing Port settings to be applied to Qg 2
Clear Button	Write Only	Click to clear the recent changes
VLAN Configuration — Port 1		
Type	Read/ Write	<p>Select:</p> <ul style="list-style-type: none"> – Off: Send and receive untagged frames only – None: Send untagged frames, receive untagged frames and priority tagged frames – VLAN: With Priority 0, send priority tagged frames, receive untagged and priority tagged frames.
VLAN ID (0-4094)	Read/ Write	Set VLAN ID
Priority (0-7)	Read/ Write	Set VLAN priority.
VLAN Configuration — Port 2		
Type	Read/ Write	<p>Select Off / None / VLAN</p> <ul style="list-style-type: none"> – Off: Send and receive untagged frames only. – None: Send untagged frames, receive untagged frames and priority tagged frames. – VLAN: With Priority 0, send priority tagged frames, receive untagged and priority tagged frames. – VLAN: With VLAN ID and Priority 1 to 7, send and receive VLAN-tagged frames only
VLAN ID (0-4094)	Read/ Write	Set VLAN ID
Priority (0-7)	Read/ Write	Set VLAN Priority
Apply/Clear		
Apply Button	Write Only	Click for selection and VLAN settings to be applied to Qg 2
Clear Button	Write Only	Click to clear recent changes
Forwarding		

Table 2 PTP Timing ports tab

Labels	Access	Description
PassThrough	Read/ Write	Enable: All packets (including user data) received on the PTP port(s) that is not destined for this Qg 2 will be forwarded from one PTP port to another PTP port. Disable: Only (PTP) traffic destined for this Qg 2 will be processed. All other traffic will not be forwarded to the other port and will be dropped/terminated.

Ping		
IP Address	Read/ Write	Four dot separated octets (0-255) IP to ping
Ping Button	Write Only	Click to ping the entered IPv4 address (support for IPv6 in a future release)

MGMT Port

[Figure 9](#) shows the MGMT Port tab.

Figure 9 MGMT Port tab

The screenshot shows the MGMT Port tab selected in the left sidebar. The main panel displays the following configuration:

- DHCP:** Disable
- IPv4 Address:** 10.7.7.200
- Subnet Mask:** 255.255.255.0
- Gateway IP:** 10.7.7.1
- Link State:** UP
- MAC:** fc:af:6a:04:bb:b0

Below the configuration fields, there is a "Ping" section with an "IP Address" input field and a "Ping" button.

Table 3 describes the MGMT Port tab.

Table 3 MGMT Port tab

Labels	Access	Description
MGMT Port		
DHCP	Read/ Write	Enable / Disable DHCP for dynamic IP assignment
Ipv4 Address	Read/ Write	Four dot separated octets (0 – 255) for static IP assignment
Subnet Mask	Read/ Write	Four dot separated octets (0 – 255) for static IP assignment
Gateway IP	Read/ Write	Four dot separated octets (0 – 255) for static IP assignment
Link State	Read Only	Link UP/Link DOWN Status
MAC	Read Only	Six colon separated hexadecimal MAC address display
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2 MGMT port
Clear button	Write Only	Click to clear the latest changes
Ping		
IP Address	Read/ Write	Four dot separated octets (0-255) IP to ping
Ping Button	Write Only	Click to ping the entered IPv4 address (support for IPv6 in a future release)

GNSS

Figure 10 shows the GNSS tab.

Figure 10 GNSS tab

The screenshot shows the VIAVI Multi-Sync Gateway web interface. The top navigation bar includes Home, Interface (selected), PTP, Configuration, Alarms/Events, Security, System, and SNMP. The left sidebar has links for PTP Timing Ports, MGMT Port, GNSS (selected), ToD/1PPS output, and SFP Info. The main content area is titled "GNSS Input configuration". It contains the following settings:

1PPS Status	Stable
ToD Status	Stable
Constellation	GPS Only
1PPS IN	Enable
ToD IN	Enable
Antenna Delay (ns)	0
ToD IN - Format	NMEA
ToD IN - Void Flag Handling	Holdover
Active Clock Class Mapping	6
Holdover Clock Class Mapping	7
Freerun Clock Class Mapping	52
Source*	Internal
External Source Baud Rate	9600

At the bottom right are "Apply" and "Clear" buttons. A note at the bottom states: "*Enabling GNSS External Input interface will disable ToD output interface".

[Table 4](#) describes the GNSS tab.

Table 4 GNSS tab

Labels	Access	Description
GNSS		
1PPS Status	Read Only	1 pulse per second (1PPS) Stable or Unstable
ToD Status	Read Only	Time of Day (ToD) Stable or Unstable
Constellation	Read/ Write	Selection of one GNSS constellation option: – GPS Only – GPS + Glonass – GPS + Beidou – GPS + Galileo
1PPS IN	Read/ Write	Enable/Disable of 1PPS from external GNSS Receiver
ToD IN	Read/ Write	Enable/Disable of ToD from external GNSS Receiver
Antenna Delay (ns)	Read/ Write	Calibration for cable delay in nano-seconds. Range [0 – 2147483647]

Table 4 GNSS tab

Labels	Access	Description
ToD IN - Format	Read/ Write	Format of ToD message: – NMEA – ASCII – China Mobile
ToD IN – Void Flag Handling	Read/ Write	Option for handling Void (V) flag in RMC data in GNSS message. Options are: – Ignore: Ignore the Void flag in RMC and treat as Active (A) – Syntonize: Do not ignore but accept 1PPS only as valid. – Holdover: Do not ignore Void flag and treat as not Active
Active Clock Class Mapping	Read/ Write	GNSS Active (A) clock class. The allowed Clock Class settings are defined in IEEE Std 1588-2008, section 7.6.2.4 and Table 5.
Holdover Clock Class Mapping	Read/ Write	GNSS Holdover clock class. The allowed Clock Class settings are defined in IEEE Std 1588-2008, section 7.6.2.4 and Table 5.
Freerun Clock Class Mapping	Read/ Write	GNSS Freerun clock class. The allowed Clock Class settings are defined in IEEE Std 1588-2008, section 7.6.2.4 and Table 5.
Source	Read/ Write	GNSS ToD/1PPS source: – Internal – External NOTE — Selecting External will disable ToD and 1PPS outputs as the same interface, input and output, is used for both.
External Source Baud Rate	Read/ Write	GNSS ToD Baud Rate: – 4800 – 9600
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2.
Clear Button	Write Only	Click to clear the latest changes

NOTE

By default, Qg 2 software will set the default configuration of GNSS Clock Class Mapping as: 6 for Active, 7 for Holdover, and 52 for Freerun. This is correct when the Engine Operating Mode (on the Home webpage) is set to GNSS-Only.

Please follow **TABLE LINK** in setting up the GNSS Clock Class Mapping for the different Engine Operating Modes. This is important, to ensure proper operation of the timing engine in different operating modes.

[Table 5](#) describes GNSS Clock Class Mapping configurations.

Table 5 GNSS Clock Class Mapping configuration.

Operating Mode	Clock Class Mapping			Comment
	Active	Holdover	Freerun	
PTP Only	6	7	52	Don't care - use default
GNSS Only	6	7	52	Use default
GNSS Primary, PTP Secondary	6	7	187	Freerun => 187
PTP Primary, GNSS Secondary	6	7	187	Freerun => 187
PTP only, GNSS debug	6	7	52	Use default

[Figure 11](#) shows the GNSS Visible Satellite Info tab.

Figure 11 GNSS Visible Satellite Info tab

The screenshot shows the VIAVI web interface with the 'Interface' tab selected. On the left, there's a sidebar with tabs for 'PTP Timing Ports', 'MGMT Port', 'GNSS' (which is highlighted in blue), 'ToD/1PPS output', and 'SFP Info'. The main content area has a header 'Visible Satellite Info' and a sub-header 'GNSS Input configuration'. It displays the following information:

PRN	Constellation	Used	Elevation	Azimuth	SNR
23	GPS	*	75	258	48
18	GPS	*	66	20	47
46	GPS	-	46	191	49
15	GPS	*	44	77	48
29	GPS	*	39	143	46
10	GPS	*	38	235	48
16	GPS	*	28	286	43
26	GPS	*	24	256	42
27	GPS	*	20	316	44
13	GPS	*	18	49	42
5	GPS	*	8	50	41

NOTE

The Visible Satellite Info field is updated as constellations/satellites come into view. If the user configures a different new constellation at run-time, some of the old information may still be displayed. This is cleared on reboot.

ToD/1PPS Output

Figure 12 shows the ToD/1PPS Output tab.

Figure 12 ToD/1PPS Output tab

The screenshot shows the VIAVI web interface with the 'Interface' tab selected. The 'TOD/1PPS output' section is highlighted. Configuration fields include:

- PTP Timing Ports: 1PPS ToD State (Stop), 1PPS Period (us) (1000000), 1PPS Pulse Width (us) (100000).
- MGMT Port: 1PPS Mode (Always), 1PPS Error Tolerance (ns) (0), 1PPS Auto Restart (ON), TOD Delay (ns) (0).
- GNSS: TOD Format (NMEA), TOD Subformat (NMEA Only) (Both), TOD Void Flag Handling (Holdover), NMEA Timezone (None).
- SFP Info: TOD OUT Baud Rate (9600).

Buttons at the bottom right: Apply, Clear.

[Table 6](#) describes the ToD/1PPS Output tab.

Table 6 ToD/1PPS Output options

Label	Access	Description
GNSS		
1PPS State	Read/Write	Stop/Start control of 1PPS output
1PPS Period (us)	Read/Write	1PPS pulse period in micro-seconds. Typically, one second but can be configured to be different. Range: 1000000 to 4294967295 (or ~ 1hour)
1PPS Pulse Width (us)	Read/Write	1PPS pulse width in micro-seconds. Range: 250 to (1PPS Period minus 250)
1PPS Mode	Read/Write	1PPS Mode options: – Sync – Holdover – Always

Table 6 ToD/1PPS Output options

Label	Access	Description
1PPS Error Tolerance (ns)	Read/Write	<p>1PPS Error Tolerance Range: 0 to 4294967295</p> <p>If the 1PPS mode is Always, the Error Tolerance is simply ignored.</p> <p>For Sync and Holdover modes, the error tolerance has the following effects:</p> <ul style="list-style-type: none"> – If the Error Tolerance is zero, then the ToD/1PPS signal is started/stopped as soon as the MCE enters/leaves corresponding Sync/Holdover states. – If the Error Tolerance is non-zero, and the MCE is in the Holdover state, the ToD/1PPS signal is stopped as soon as either the estimated error becomes larger than the Error Tolerance or the MCE exits the Holdover state.
1PPS Auto Restart	Read/Write	1PPS Auto Restart ON/OFF control
1PPS Delay (ns)	Read/Write	<p>Delay between 1PPS and the following ToD message string to be put out</p> <p>Range: 0 to 2147483647</p>
ToD Format	Read/Write	<p>Format of ToD to be output. The options are:</p> <ul style="list-style-type: none"> – NMEA – ASCII – China Mobile
ToD Subformat (NMEA Only)	Read/Write	<p>ToD Subformat options are:</p> <ul style="list-style-type: none"> – RMC – ZDA – Both
ToD Void Flag Handling	Read/Write	<p>Void Flag generation in RMC message when:</p> <ul style="list-style-type: none"> – Never – Free-run – Holdover
NMEA Timezone	Read/Write	<p>The Timezone options for ToD output are:</p> <ul style="list-style-type: none"> – None – TZ – TZ + DST

Table 6 ToD/1PPS Output options

Label	Access	Description
TOD OUT Baud Rate	Read/Write	Select TOD OUT Baud Rate: – 4800 – 9600 – 14100 – 19200 – 28800 – 38400 – 57600 – 115200

Apply/Clear

Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes

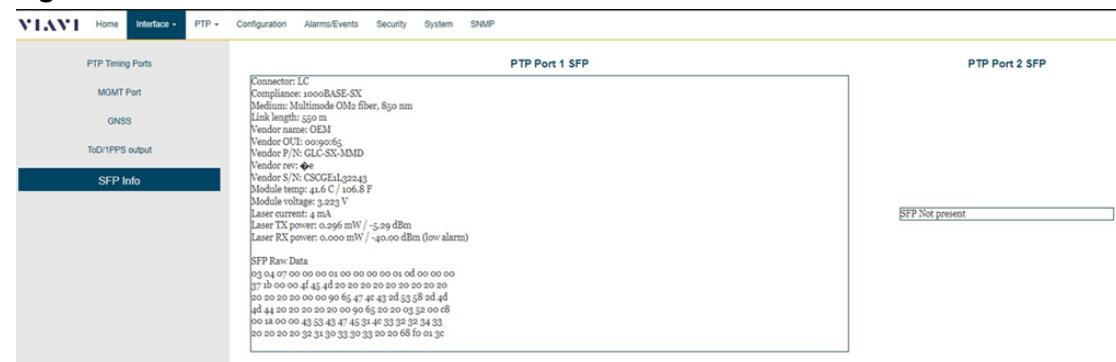
SFP Info

The SFP Information tab displays PTP ports optical module transceiver details as provided by the module vendor.

NOTE
Depending on the specific SFP or vendor, some or all information may not be displayed.

Figure 13 shows the SFP Info tab.

Figure 13 SFP Info tab



PTP Page

The following PTP dropdown selections are available:

- Config
- Clock
- Port
- Unicast
- Unicast Nodes
- Time
- SNTP

Config

[Figure 14](#) shows the PTP Config tab.

Figure 14 PTP Config tab

The screenshot shows the VIAVI web interface with the PTP Config tab selected. The left sidebar lists several configuration categories: Clock, Port, Unicast, Unicast Nodes, Dataset, Time, and SNTP. The 'Config' category is currently active. The main content area is titled 'PTP Config' and contains three input fields: 'Main Time Constant (s)' with a value of 100, 'Startup Time Constant (s)' with a value of 0, and 'Quality Threshold (ns)' with a value of 1500. Below these is a 'Timing Output' section with a dropdown menu set to '10 MHz'. At the bottom right of this section are two buttons: 'Apply' and 'Clear'.

[Table 7](#) describes the selections, entries, and buttons.

Table 7 PTP Configuration options

Label	Access	Description
PTP Config		
Main Time Constant (s)	Read/Write	The main Time Constant used for the PTP servo after the servo has synchronized. Range: 1 to 2147483647
Startup Time Constant (s)	Read/Write	The startup Time Constant used for the PTP servo before the servo has synchronized. Range: 1 to 2147483647

Table 7 PTP Configuration options

Label	Access	Description
Quality Threshold (ns)	Read/ Write	Maximum variation allowed in the sync and delay request direction, respectively, before packets are ignored.
Timing Output		
Frequency Out	Read/ Write	Select Timing Frequency Output: 1544 kHz, 2048 kHz, and 10 MHz.
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes

See **LINK TO PTP (Slave) Servo Config** for more information about the PTP (Slave) Servo configuration parameters.

PTP Clock

[Figure 15](#) shows the PTP Clock tab.

Figure 15 PTP Clock tab

Table 8 describes the PTP Clock tab.

Table 8 PTP Clock tab

Label	Access	Description
Clock		
User Description	Read/ Write	(Optional) User-provided description to identify this Qg 2's clock. Normal ASCII characters can be used – letters, numbers, and special characters. Note — The following characters are not allowed: <ul style="list-style-type: none">– ; (semi-colon)– (space)– \$ (dollar sign)
Clock Type Mode	Read/ Write	Selection of PTP clock for this Qg 2 device. The options are: <ul style="list-style-type: none">– Ordinary Clock– Boundary Clock

Table 8 PTP Clock tab

Label	Access	Description
Slave Only Mode	Read/ Write	Enable/Disable control for PTP Slave-only mode. In this mode, the PTP ports will always remain in Slave or Listening mode.
Two Step	Read/ Write	ON/OFF control of PTP two-step mode.
Clock Class	Read/ Write	PTP Clock class
Clock Accuracy	Read Only	PTP Clock accuracy
Clock Variance	Read Only	PTP Clock variance
Clock Priority 1	Read Only	PTP Clock priority 1
Clock Priority 2	Read Write	PTP Clock priority 2
Domain Number	Read Write	Configure the PTP Clock domain number
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes

Additional PTP Profile-specific parameters or options may be shown. See “[PTP Profiles](#)” on page 91 for more information about PTP Profiles.

Port

[Figure 16](#) shows the Port tab.

Figure 16 Port tab

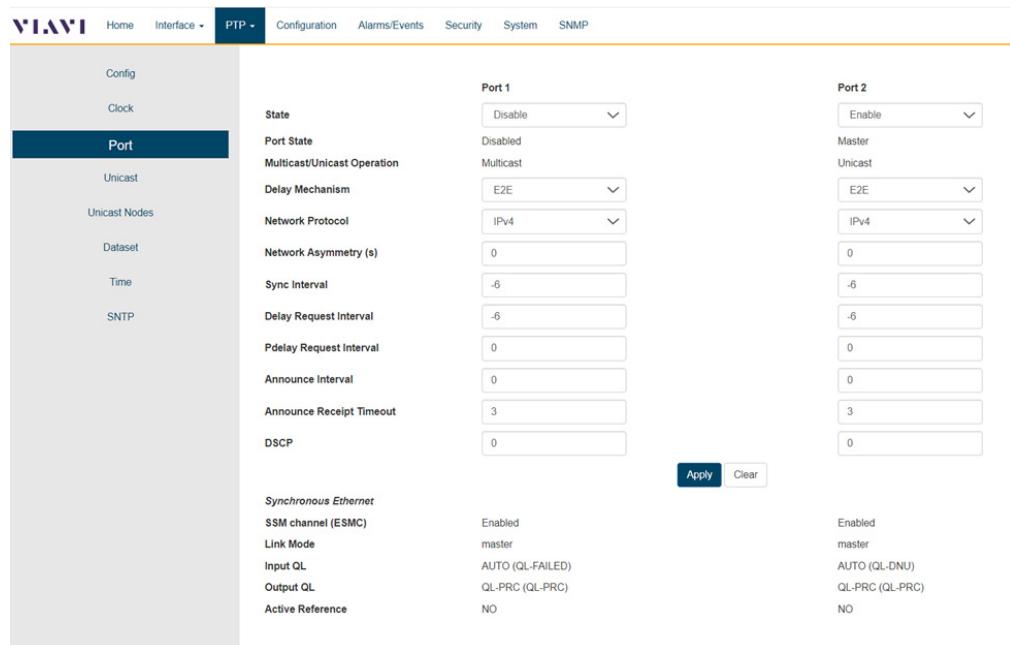


Table 9 describes the Port tab.

NOTE

The following configurations are per PTP port.

Table 9 Port tab

Label	Access	Description
Port 1 and Port 2		
State	Read/ Write	Select PTP port operational state: – Disable – Enable
Port State	Read only	PTP Port state. The Clock Engine maintains the following states, and the port can be in one of these states. The states are {Undefined, Initializing, Faulty, Disabled, Listening, Pre Master, Master, Passive, Uncalibrated, Slave}

Table 9 Port tab

Label	Access	Description
Multicast/Unicast Operation	Read Only	PTP port operational mode status – Unicast or Multicast
Delay Mechanism	Read/Write	Configuration of PTP delay mechanism: End-to-End (E2E) or Peer-to-Peer (P2P)
Network Protocol	Read/Write	Configure PTP's underlying network protocol. The options are: <ul style="list-style-type: none">– IPv4 (PTP over UDP/IPv4)– IPv6 (PTP over UDP(6)/IPv6)– ETH (PTP over L2 Ethernet)
Network Asymmetry (s)	Read/Write	Configure Network Asymmetry delay to compensate for difference between the forward and return paths from this PTP slave port to PTP master as it may not be same or symmetric. The units are in seconds and can be configured as decimal. For e.g., to configure +1 usec asymmetry, this field should be set to 0.000001 seconds.
	Read/Write	Configure the PTP Sync packet interval. The unit is in log to the base 2. For example, value = -5 is 32 packets/second, or value = 0 is 1 packet /second, or value = 2 is 1 packet in 4 seconds The range is -8 to +2
Delay Request Interval	Read/Write	Configure PTP Delay Request interval. The unit is in log to the base 2. For example, if: <ul style="list-style-type: none">– value = -5 is 32 packets/second, or– value = 0 is 1 packet /second, or– value = 2 is 1 packet in 4 seconds Range is -7 to +7
Pdelay Request Interval	Read/Write	Configure PTP Peer Delay Request Interval. The unit is in log to the base 2. For example, if: <ul style="list-style-type: none">• value = -5 is 32 packets/second, or• value = 0 is 1 packet /second, or• value = 2 is 1 packet in 4 seconds The range is -7 to +7
Announce Interval	Read/Write	Configure PTP Announce Interval. The unit is in log to the base 2. For example, if: <ul style="list-style-type: none">– value = -4 is 16 packets/second, or– value = 0 is 1 packet /second, or– value = 2 is 1 packet in 4 seconds The range is -4 to +5

Table 9 Port tab

Label	Access	Description
Announce Receipt Timeout	Read/Write	Configure Announce Receipt Timeout in seconds. The range is +2 to +10
DSCP	Read/Write	Differentiated Service Code Point (DSCP) settings for PTP frames for network-wise QoS treatment.
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes
Synchronous Ethernet		
SSM Channel (ESMC)	Read Only	ESMC channel is enabled or disabled
Link Mode	Read Only	IEEE 802.3 link mode: Master or Slave or none
Input QL	Read Only	Input QL on Rx ESMC message on this port
Output QL	Read Only	Output QL on Tx ESMC message on this port
Active Reference	Read Only	Following an active reference clock (frequency)

Table 10 provides further details about **L2 Multicast DA** options.

Table 10 L2 Multicast DA option descriptions

Selection	Send	Receive
Forwardable	Announce/sync/delay to FW address pdelay to NF	Both FW and NF
Non-forwardable	Send all messages to NF	Both FW and NF
Forwardable only	Send all messages to FW	Only FW
Non-forwardable only	Send all messages to NF	Only NF

FW = Forwardable DA (MAC Address: 01-1B-19-00-00-00)
NF = Non-Forwardable DA (MAC Address: 01-80-C2-00-00-0E)

Unicast

Figure 17 shows the Unicast tab.

Figure 17 Unicast tab

[Table 11](#) describes the Unicast tab.

Table 11 Unicast tab

Label	Access	Description
Port 1 and Port 2		
Unicast Operation	Read/ Write	Control of Unicast operation. The options are:
		<ul style="list-style-type: none"> – DISABLED – MASTER – SLAVE – BOTH – MIXED
Negotiation	Read/ Write	Control for unicast negotiation, ON/OFF
Transmission Duration (s)	Read/ Write	Unicast transmission duration The range is 60 – 3600 seconds
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes
MIXED Mode		

Table 11 Unicast tab

Label	Access	Description
pDelay	Read/ Write	Auto: pDelay responses are multicast or unicast, depending on pDelayReq Unicast: pDelay request and responses are always unicast.
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes
Add Unicast Peer Address		
Peer Address	Read/ Write	Unicast peer address to use to peer delay mechanism
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes
Add Master Node		
Network Address	Write Only	IPv4 address of Master node to be added, four dot separate octets (0- 255) or Ethernet address, six dash separated double hexadecimal numbers (NN-NN-NN-NN-NN-NN)
ClockID [optional]	Write Only	Master Clock ID – optional field. Enter eight colon separated double hexadecimal numbers (NN:NN:NN: NN:NN:NN:NN).
Clock Priority	Write Only	Clock priority Range is 0 – 255
Sync Interval	Write Only	Configure the PTP Sync packet interval. The unit is in log to the base 2. For example, value = -5 is 32 packets/second, or value = 0 is 1 packet /second, or value = 2 is 1 packet in 4 seconds The range is -8 to +2
Delay Request Interval	Write Only	Configure PTP Delay Request interval. The unit is in log to the base 2. For example, value = -5 is 32 packets/second, or value = 0 is 1 packet /second, or value = 2 is 1 packet in 4 seconds Range is -7 to +7

Table 11 Unicast tab

Label	Access	Description
Add Master Node Button	Write Only	Click for selection and settings to be applied to the Qg 2
Delete Master Node		
Network Address	Write Only	IPv4 address of Master node to be deleted, four dot separate octets (0- 255) or Ethernet address, six dash separated double hexadecimal numbers (NN-NN-NN-NN-NN-NN)
Delete Master Node Button	Write Only	Click for selection and settings to be applied to the Qg 2

NOTE

The Sync Interval and Delay Request Interval are expressed in exponents of 2, with the Webpage entries being converted to intervals between messages in seconds or fractions of seconds. For example:

- An entry of 0 represents an interval of 1 second between messages.
- An entry of -5 represents an interval of 1/32 seconds between messages, or 32 messages per second.

Unicast Nodes

Figure 18 shows the Unicast Nodes tab.

Figure 18 Unicast Nodes tab

The screenshot shows the VIAVI PTP configuration interface. The top navigation bar includes Home, Interface (selected), Configuration, Alarms/Events, Security, System, and SNMP. On the left, a sidebar lists Config, Clock, Port, Unicast, and SNTP. The Unicast node is selected, highlighted in blue. The main content area displays two sections: Port 1 (disabled) and Port 2 (Unicast Slave Node List). The Port 2 section shows a table with one row for a slave node.

#	Network Address	Clock ID	Announce Interval	Sync Interval	Delay Request Interval
1	10.10.10.141	FC:AF:6A:FF:FE:02:E8:DC	0	-4	-4

[Table 12](#) describes the Unicast Nodes tab.

Table 12 Unicast Nodes tab

Label	Access	Description
Port 1 and Port 2		
Unicast Master Node List	Read Only	<p>Display Master Node List in a table format with the following information:</p> <ul style="list-style-type: none"> – Table Entry Number – Network Address – Clock ID – Priority – Sync Interval – Delay Request Interval – Announce granted state – Sync granted state – Delay response granted state
Unicast Slave Node List	Read Only	<p>Display Slave Node List in a table format with the following information:</p> <p>Table Entry Number Network Address Clock ID Announce Interval Sync Interval Delay Request Interval</p>

Dataset

There are two sub-tabs on the Dataset tab:

- PTP profile dataset
- PTP (non-profile) dataset

PTP profile dataset



NOTE

This tab provides profile specific information as shown below (G8275.2 profile, for example). This information will be different based on what PTP profile has been chosen.

[Figure 19](#) shows the PTP profile dataset sub-tab.

Figure 19 PTP profile dataset sub-tab

G8275.2	
Local priority	1
Max. Steps Removed	255
Port dataset	
Port number	1
Master only	FALSE
Port priority	1
PTSF	FALSE
L2 multicast	FORWARDABLE
Port number	2
Master only	FALSE
Port priority	1
PTSF	FALSE
L2 multicast	FORWARDABLE

PTP (non-profile) dataset

Figure 20 shows the PTP (non-profile) dataset sub-tab.

Figure 20 PTP (non-profile) dataset sub-tab

Default dataset	
Two step clock	FALSE
Clock identity	FC-AF-6A-FF-FE-2-BB-B0
Number of ports	2
Clock quality	6
Clock class	6
Clock accuracy	0x21 (within 100 ns)
Offset scaled log	65535
Priority 1	127
Priority 2	128
Domain number	44
Slave only	FALSE

Current dataset	
Steps removed	0
Offset from master	sec: 0 nsec: 00000000
Mean path delay	sec: 0 nsec: 00000000

Parent dataset	
Parent Port identity:	FC-AF-6A-FF-FE-2-BB-B0*
Port number	0
Parent Stats	False
Observed parent offset	65535
Observed parent clock	2147483647
phase change rate	FC-AF-6A-FF-FE-2-BB-B0*
Grandmaster identity	FC-AF-6A-FF-FE-2-BB-B0*
Grandmaster clock quality	6
Clock class	6
Clock accuracy	0x21 (within 100 ns)
Offset scaled log	65535
variance	65535
Grandmaster priority1	127
Grandmaster priority2	128

Time

Figure 21 shows the Time tab.

Figure 21 Time tab

Config	UTC Time	2023-12-31 15:11:23
Clock	UTC Offset	37
Port	Holdover Limits (us)	1.50
Unicast		<input type="button" value="Apply"/> <input type="button" value="Clear"/>
Unicast Nodes	On Board Oscillator	OCXO 4 hrs
Dataset	Holdover duration (based on above HO limit)	4.00 hrs
Time		
SNTP		

Table 13 describes the Time tab.

Table 13 Time tab

Label	Access	Description
UTC Time	Read Only	Display UTC time in the following format: YYYY-MM-DD HH:MM:SS
UTC Offset	Read Only	UTC offset in seconds.
Holdover Limits (us)	Read/Write	Set the holdover limits. This time limit is used to determine the Holdover Duration Spec Achieved. The time limit value is the Qg 2 user's maximum allowed error above the Quality Threshold setting on the PTP :: Config web page for the Qg 2 to remain in Holdover.
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes
On-board Oscillator		
On Board Oscillator	Read Only	Display OCXO and specified holdover duration

Table 13 Time tab

Label	Access	Description
Holdover Duration Specs Achieved with Current XO and Holdover Limit Settings	Read Only	Display holdover duration based on the Holdover Limits (us) setting

SNMP

The SNMP tab is for setting up a Simple Network Time Protocol (SNMP) version 4 server. SNTP is a subset of Network Time Protocol used to synchronize computer systems in the network. SNTP synchronizes clients time with the server, that has already been synchronized by a source such as a from GNSS, PTP master or manually set, using date command using connectionless User Datagram Protocol in IP networks. This requires that there be an IP address configured on both the PTP ports before enabling SNTP.

[Figure 22](#) shows the SNMP tab.

Figure 22 SNMP tab

The screenshot shows the VIAVI Multi-Sync Gateway User Interface. The top navigation bar includes Home, Interface (with a dropdown), Configuration, Alarms/Events, Security, System, and SNMP. The left sidebar has links for Config, Clock, Port, Unicast, Unicast Nodes, Dataset, and Time. The main content area is titled 'SNTP Server' and contains the following configuration fields:

Clock	Operating Mode	Stopped
Port	Broadcast Interval (log)	4
Unicast	Broadcast TTL	1

At the bottom right of the main area are 'Apply' and 'Clear' buttons. Below the main content area, the sidebar shows 'SNTP' is selected.

[Table 14](#) describes the SNMP page.

Table 14 SNMP page

Label	Access	Description
Time		

Table 14 SNMP page

Label	Access	Description
Operating Mode	Read/ Write	<ul style="list-style-type: none"> – Stopped: To stop / disable SNTP server – Unicast: To operate in unicast mode. Only IP unicast requests are answered – Manycast: To operate in Manycast mode. IP unicast & multicast (224.0.1.1) requests are answered – Broadcast: Periodic SNTP replies are broadcasted (224.0.1.1) – Mixed: This is combination of Manycast and Broadcast
Broadcast Interval (log)	Read/ Write	Configure the Broadcast packet interval. The unit is in log to base 2. For example: value = 0 is 1 packet /second, or value = 3 is 1 packet in 8 seconds The range is 0 to 16
Time To Live	Read/ Write	Configure ttl value in broadcast packets. By default, the value is set to 1. The range is 1 to 255
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2
Clear Button	Write Only	Click to clear the latest changes

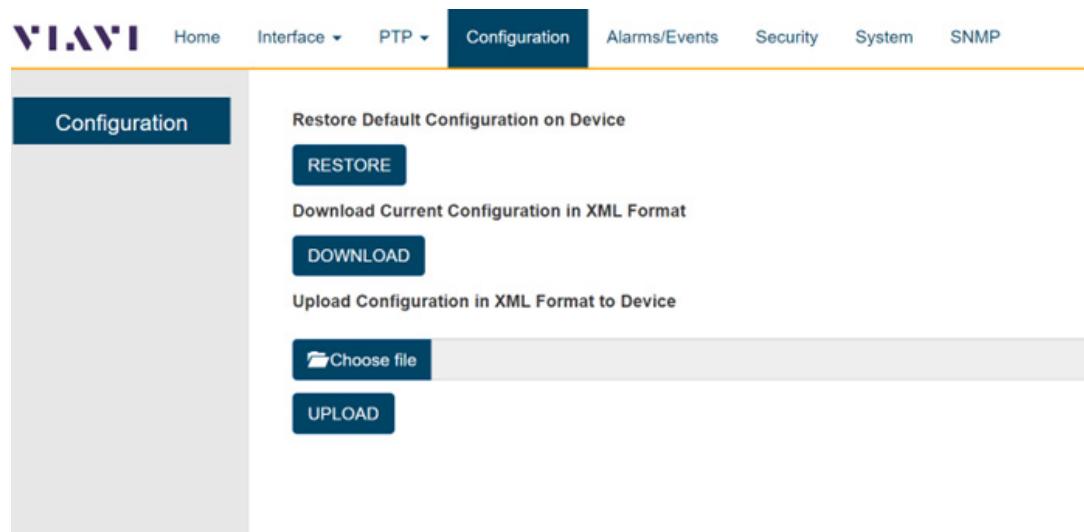
Configuration Page

The Configuration page supports the following:

- Restore Default Configuration
- Download Configuration
- Upload Configuration

[Figure 23](#) shows the Configuration page.

Figure 23 Configuration page



[Table 15](#) describes the Configuration page.

Table 15 Configuration page

Label	Access	Description
Restore Default Configuration on Device		
RESTORE button	Write Only	Click to restore Qg 2 Factory Default configuration.
Download Current Configuration in XML Format		
DOWNLOAD button	Write Only	Download current Qg 2 configuration into browser's default download folder. Downloaded in XML format.
Upload Configuration in XML Format to Device		
Choose file button		Browser button to navigate through the Host PC where the browser is running to select previously saved Qg 2 file to upload.
UPLOAD button	Write Only	Click to start the upload configuration option.

Alarms/Events Page

The Alarms/Events page provides hardware alarm states and an event log generated by the Qg 2 Software.

[Figure 24](#) shows the Alarms/Events page.

Figure 24 Alarms/Events page

Alarms/Events	Alarm Name	Current Status	Last Failure	Failure Count
System/Internal Error		Not Active	Not Occurred	0
GNSS Lock/Unlock		Locked	Not Occurred	0
PTP Sync Lock		Locked	12/31/2023 15:04:24	1
PTP Sync State		Synchronizing	Not Occurred	0
PTP Port 1 Link		Up	Not Occurred	0
PTP Port 2 Link		Up	Not Occurred	0

The Alarms section lists all the Qg 2 Alarms and their current status. [Table 16](#) lists the alarms.

Table 16 Alarms/Events

Alarm	Description
System Internal Error	Any power or hardware component error detected
GNSS Lock/Unlock	When GNSS goes from Lock to Unlock state
PTP Sync Lock	When PTP engine goes from Lock to Unlock state
PTP Sync State	When PTP engine state goes out of Synchronizing
PTP Port 1 Link	Link goes from UP to DOWN
PTP Port 2 Link	Link goes from UP to DOWN

Each Alarm entry will have the Alarm's Name, the Alarm's Current Status, the Alarm's Last Occurrence and the number of times the Alarm has occurred since Qg 2 startup. The timestamp of last occurrence is UTC time.

The Clear Alarms button will clear Alarms that are no longer in a fault state, and the "Last Cleared At" time (in UTC) will be displayed on the page.

The Events section will display the event Log that is maintained by Qg 2 software. The information it maintains include operations like configuration changes, reboot, software upgrade, as well as any asynchronous events detected from hardware or operation like link loss, synchronization status change, etc. For each event, a timestamp is also shown. The timestamps in the log are based on the Qg 2 generated UTC time.

Security Page

The Security page provides control for https; a secure way of accessing the Qg2 over the web. The web access or GUI for Qg 2 is over http protocol which can be either:

- Non-Secure (http) — Mainly for inside customers' secure or internal network. SSL certificate is not required.
- Secure (https) — For improved security, or in public network – encrypted with or without a proper Secure Sockets Layer (SSL) certificate issued or signed from a public certified authority (CA) for authentication against man-in-the-middle or similar security risks.

Figure 25 shows the Security page.

Figure 25 Security page

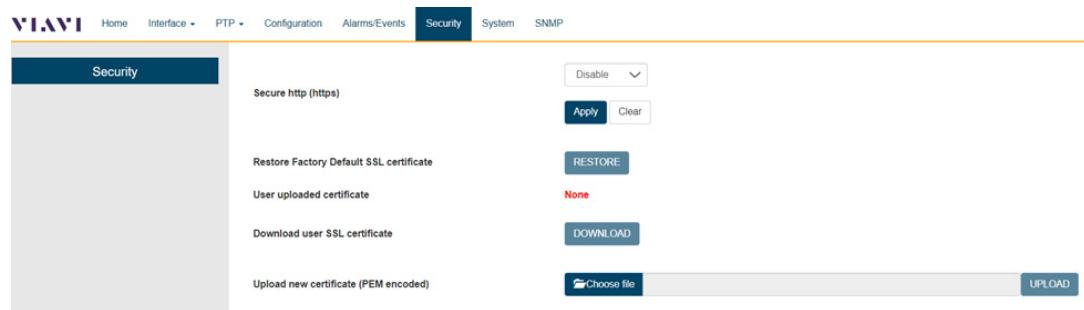


Table describes the Security page.

Table 17 Security page

Labels	Access	Description
System		
Software Version	Read Only	Version of Qg 2 software.
Oscillator	Read Only	OCXO 4 hours or OCXO 8 hours
GNSS Receiver	Read Only	GNSS Receiver information
Timing Engine FW Version	Read Only	Version of firmware that is running on the Viavi Solutions' internal Managed Clock Engine
Timing Engine FPGA Version	Read Only	Version of FPGA that is running on the Viavi Solutions' internal Managed Clock Engine
MAC Address	Read Only	MAC address of port 1
SWM Serial Number	Read Only	Serial number for Service and Software Maintenance (SWM) processing

Table 17 Security page

Labels	Access	Description
Unit Serial Number	Read Only	Serial number of this unit. On some of the older units, the value in this field is the same as the above “SWM Serial Number”
System Up Time	Read Only	Time since last reboot
SWM License Key	Read Only	Installed Software and Support Maintenance (SWM) License key
Install new SWM License	Read/Write	Installed Software and Support Maintenance (SWM) License key
Activate button	Write Only	To install the new SWM license key
Software Upgrade		
From Local File button	Read/Write	Browser button to navigate through the Host PC where the browser is running to select previously downloaded Qg 2 software
Protocol	Read/Write	Only SFTP option is supported. NOTE — The image file is expected to be in the home directory on SFTP server
Server IP	Read/Write	IPv4 address of SFTP server
SW Image Filename	Read/Write	Software file to be used for the upgrade
Server Login Username	Read/Write	Login credentials for SFTP server
Server Password	Read/Write	Login credentials for SFTP server
Start SW Upgrade button	Write Only	Clicking the button initiates upgrade process
Clear button	Write Only	Click to clear the latest changes
Software Upgrade Status	Read Only	Display bar to show the upgrade progress
System Logs		
Download	Write Only	Download the Qg 2 MCE Event Log to the Host PC. The log file is encrypted and is solely for VIAVI Solutions internal use for debug.
System Power		

Table 17 Security page

Labels	Access	Description
Reboot button	Write Only	Reboot the Qg 2 system
Shutdown button	Write Only	Shutdown of the Qg 2 in controlled and sequential steps that will protect the Qg 2 memory storage. Using this button is recommended prior to disconnecting physical power to the Qg 2.



IMPORTANT NOTE ON Qg 2 SOFTWARE UPGRADE:

Due to a software issue that was discovered later and fixed in 12.1.20 version, please follow this procedure for doing Qg 2 software upgrades:

- 1 Stop the Engine before doing the software upgrade (for all versions as a safe measure)
- 2 To upgrade from a version prior to 12.1.20 to another version:
 - Reboot Qg 2 from Systems webpage
 - Do NOT change any configuration after Qg 2 software comes up
 - Upgrade to new Qg 2 software version of choice



IMPORTANT NOTE ON Qg 2 SOFTWARE DOWNGRADE:

Due to incompatibility, downgrading from a version that is 12.1.25 or higher, to a version that is lower than 12.1.25 is NOT supported. Doing so will have undesirable effects and should be avoided.



IMPORTANT NOTE ON Qg 2 SOFTWARE UPGRADE AND SWM:

With 12.2.1 release, Viavi Solutions has enabled a license key mechanism for Software and Support Maintenance (SWM). Without a valid license, the user would not be able to upgrade from 12.2.1 to a higher version. They are free to use all the previously released versions including 12.2.1 release without renewing the license but to use any new features or enhancements or fixes that has been put in a later than 12.2.1 release, a valid license will be required. Viavi Solutions' technical support will also be restricted in future to 12.2.x versions.

SNMP Page

The SNMP page provides SNMP (v2, V3) Management Server configuration.

[Figure 26](#) shows the SNMP page.

Figure 26 SNMP page

User Name	Privilege	Auth Protocol	Auth Password	Priv Protocol	Priv Password
	Read-Only	MD5		DES	

Table describes the SNMP page.

Table 18 SNMP page

Label	Access	Description
SNMPv2		
Read-Only Community	Read/ Write	Community string – usually ‘public’ or ‘private’
SysName	Read/ Write	Administratively assigned name for this Qg 2 node in the network
SysLocation	Read/ Write	Location of this Qg 2 node
SysContact	Read/ Write	Contact information for support for this Qg 2 node
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2.
Clear Button	Write Only	Click to clear the latest changes.
SNMPv3		
Engine-Id	Read Only	Unique Engine-Id specific to a Qg 2 unit
SNMP v3 user	Read/ Write	Add/Delete SNMP users

Table 18 SNMP page

Label	Access	Description
User Name	Read/ Write	User name to be added (or deleted)
Privilege	Read Only	Read-Only (as specified in PTPMIB)
Auth Protocol	Read/ Write	Selection of authorization protocol: MD5 or SHA (applicable only when adding a new user)
Auth Password	Write Only	Authorization password – should be at least 8 characters. (applicable only when adding a new user)
Priv Protocol	Read Only	Selection of privacy protocol: MD5 or SHA (applicable only when adding a new user)
Priv Password	Write Only	Privacy password – should be at least 8 characters. (applicable only when adding a new user)
Apply/Clear		
Apply Button	Write Only	Click for selection and settings to be applied to the Qg 2.
Clear Button	Write Only	Click to clear the latest changes.

Command Reference

This chapter discusses the following topics:

- “[Qg 2 Basic Commands](#)” on page 58
- “[Show Commands](#)” on page 59
- “[System Commands](#)” on page 60
- “[SWM License Commands](#)” on page 62
- “[Network Commands](#)” on page 63
- “[HTTPS Restore command](#)” on page 64
- “[Date Command](#)” on page 65
- “[Reboot Command](#)” on page 66
- “[Monitoring Log Command](#)” on page 66
- “[webui Command](#)” on page 67

Qg 2 Basic Commands

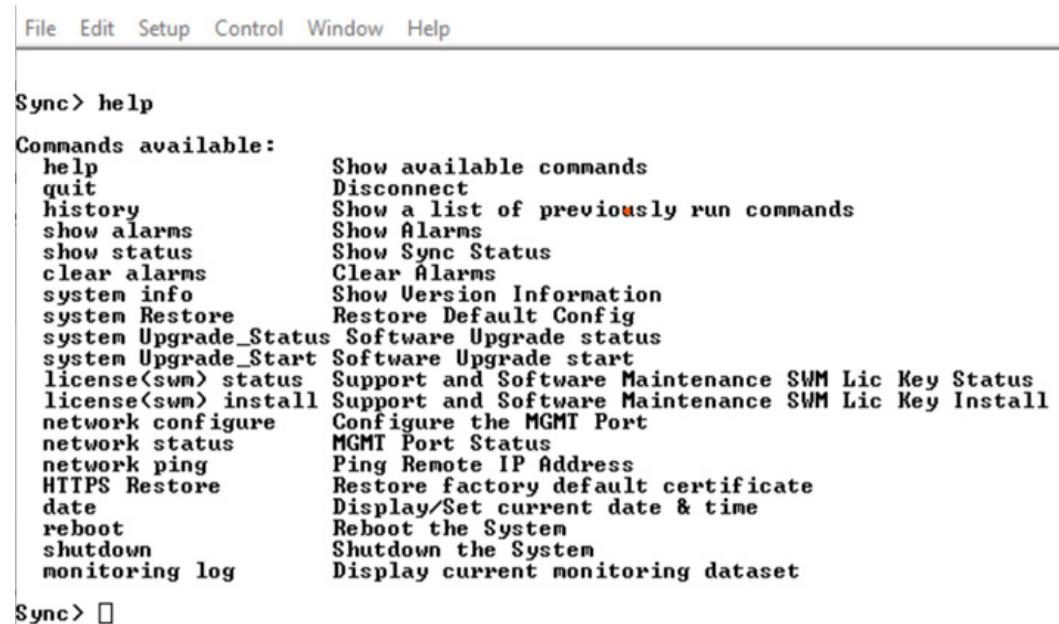
The login credentials for accessing Qg 2 CLI shell is admin/admin. This is a list of the available commands related to the control and monitoring of the Qg 2. The CLI commands are case insensitive.

Help command

After logging in, the user can enter “help” to get a list of commands and descriptions to be displayed on the command terminal.

[Figure 27](#) shows the available help commands.

Figure 27 Help commands



File Edit Setup Control Window Help

```
Sync> help
Commands available:
  help          Show available commands
  quit          Disconnect
  history        Show a list of previously run commands
  show alarms    Show Alarms
  show status    Show Sync Status
  clear alarms   Clear Alarms
  system info    Show Version Information
  system Restore Restore Default Config
  system Upgrade_Status Software Upgrade status
  system Upgrade_Start Software Upgrade start
  license(swm) status Support and Software Maintenance SWM Lic Key Status
  license(swm) install Support and Software Maintenance SWM Lic Key Install
  network configure Configure the MGMT Port
  network status  MGMT Port Status
  network ping    Ping Remote IP Address
  HTTPS Restore   Restore factory default certificate
  date           Display/Set current date & time
  reboot         Reboot the System
  shutdown       Shutdown the System
  monitoring log Display current monitoring dataset

Sync> □
```

History command

To view the history of previously entered commands, enter “history”.

[Figure 28](#) shows the available history commands.

Figure 28 History commands



File Edit Setup Control Window Help

```
Sync> history
Command history:
  0. help
  1. show alarms
  2. show status

Sync>
Sync>
```

Quit command

To terminate the command session and log out, enter “quit”.



NOTE

Pressing Control-C will have the same effect as the “quit” command.

Show Commands

The “show” command can be used to show alarms or clock status.

Show Alarms command

This command displays any active Qg 2 alarms. If no alarms are present, the Alarm Name and State columns will be blank.

[Figure 29](#) shows the “show alarms” command.

Figure 29 show alarms command

The screenshot shows a software interface with a menu bar (File, Edit, Setup, Control, Window, Help) and a command-line prompt (Sync>). The command 'show alarms' is entered, and the output is displayed in a table:

Alarm Name	Current Status	Last Failure	Failure count
System/Internal_Error*	Not Active	Not Occurred	0
GNSS Lock/Unlock	Locked	Not Occurred	0
PTP Sync Lock	Locked	10/29/2021 06:48:25	1
PTP Sync state	SYNCHRONIZING	Not Occurred	0
PTP Port1 Link	Up	Not Occurred	0
PTP Port2 Link	Down	Not Occurred	0

*Internal hardware error

Sync>

Show Status command

This command shows the Managed Clock Engine’s Sync information – Qg 2 Sync Status and Qg 2 Sync State:

- Qg 2 Sync Status can be either LOCKED or UNLOCKED.
- Qg 2 Sync State can be one of the following:
 - FREE RUNNING
 - SYNTONIZING
 - SYNCHRONIZING
 - HOLDOVER
- GNSS 1PPS Status can be either Stable or Unstable
- GNSS ToD Status can be either Stable or Unstable

[Figure 30](#) shows the “show status” command.

Figure 30 “show status” command

The screenshot shows a software interface with a menu bar at the top: File, Edit, Setup, Control, Window, Help. Below the menu is a command-line window with the prompt "Sync>". The output of the "show status" command is displayed, showing the following system status:

```
Sync> show status
PTP Sync Status      : LOCKED
PTP Sync State       : SYNCHRONIZING
GNSS 1PPS Status    : Stable
GNSS ToD Status     : Stable

Sync>
```

System Commands

The following sections describe the System commands.

System Info command

The “system info” command displays the following system information:

- Qg 2 firmware version
- On-board oscillator type
- Managed Clock Engine Firmware version
- Number of PTP slaves supported
- GNSS module type

Figure 31 shows the “system info” command.

Figure 31 “system info” command

The screenshot shows a software interface with a menu bar at the top: File, Edit, Setup, Control, Window, Help. Below the menu is a command-line window with the prompt "Sync>". The output of the "system info" command is displayed, showing the following system information:

```
Sync> system info
FW Version: 12.1.27
XO: OCXO 4 hrs
Timing Engine FW Version: v2.1.3
Timing Engine FPGA Version: 2.8
PTP Slave Capacity: MAX
GNSS Receiver: GPS Only

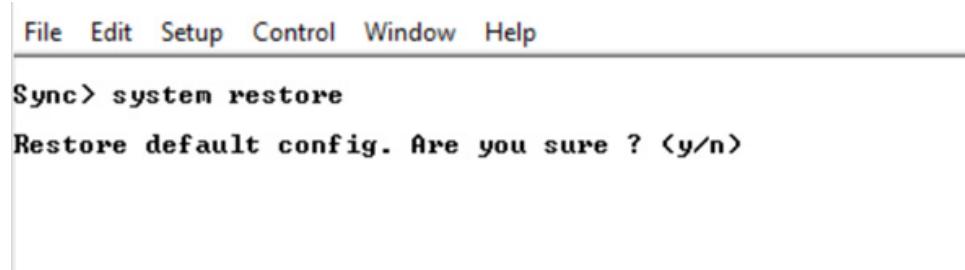
Sync>
```

System Restore command

The Qg 2 “system restore” command restores the factory default configuration.

Figure 32 shows the “system restore” command.

Figure 32 “system restore” command



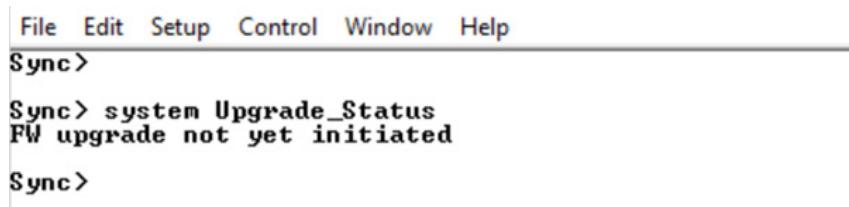
The screenshot shows a software interface with a menu bar at the top. The menu bar includes File, Edit, Setup, Control, Window, and Help. Below the menu bar, the text "Sync> system restore" is displayed. Underneath that, the text "Restore default config. Are you sure ? <y/n>" is shown, indicating a confirmation prompt for restoring the default configuration.

System Upgrade_Status command

The Qg 2 System Firmware Upgrade Status will be displayed if the upgrade was initiated previously from either CLI or through Web User Interface.

Figure 33 shows the “system Upgrade_Status” command.

Figure 33 “system Upgrade_Status” command



The screenshot shows a software interface with a menu bar at the top. The menu bar includes File, Edit, Setup, Control, Window, and Help. Below the menu bar, the text "Sync>" is displayed. Underneath that, the text "Sync> system Upgrade_Status" is shown, followed by "FW upgrade not yet initiated". At the bottom, the text "Sync>" is repeated.

System Upgrade_Start command

The “system Upgrade_Start” command will perform firmware upgrade when the following inputs are provided:

- File transfer protocol, 1 or 2 (for FTP or SFTP)

 **NOTE**
Option 1 (FTP) has been deprecated and is not available anymore.

- Hostname, as either IP address or DNS name
- File name containing the upgrade FW

Figure 34 shows the “system Upgrade_Start” command.

Figure 34 “system Upgrade_Start” command

```
File Edit Setup Control Window Help

Sync>
Sync> system Upgrade_Start
Usage:
system Upgrade_Start <protocol:<1:FTP, 2:SFTP>> <hostname> <file name>
Sync> █
```

SWM License Commands

The following commands are related to the Software and Support Maintenance (SWM) license key operations.

SWM License Status command

The “license (swm) status” command returns the current SWM license information.

[Figure 35](#) shows the “license (swm) status” command.

Figure 35 “license (swm) status” command

```
Sync> license<swm> status
SWM-License Key Status: QSWA-059612-1023-EDLN-MLXE-HABG <End Date: 10 / 2023>
Sync> █
```

SWM License Install command

The “license (swm) install” command enters a new SWM license key.

[Figure 36](#) shows the “license (swm) install” command.

Figure 36 “license (swm) install” command

```
Sync> license<swm> install
Usage:
license<swm> install ? or license<swm> install help
license<swm> install LLLL-LLLLL-LLL-LLLL-LLL-LLL

Sync> license<swm> install QSWA-059612-1023-EDLN-MLXE-HABG
SWM-License Installed successfully
Sync> █
```

Network Commands

The Network Command operate on the Management port. The user can set up the network parameters like enable/disable DHCP, static IPv4 address, netmask, and gateway addresses and display the current setting of it. By factory default, the Management port network parameters are set statically as follows:

- DHCP: Disabled
- IP Address: 192.168.2.100
- Netmask: 255.255.255.0
- Gateway: 0.0.0.0

Network Config command

This command lets the user configure Qg 2 Management port network parameters.

[Figure 37](#) shows the “network config” command.

Figure 37 “netwrk_config” command

```
File Edit Setup Control Window Help
Sync>
Sync> network config
Usage:
  network configure dhcp
  network configure ip <ip_addr> mask <netmask> gateway <gateway>
Sync>
```

Network Status command

The “network status” command returns the network status for the Management Port, PTP Timing Port-1, and PTP Timing Port-2.

[Figure 38](#) shows the “network status” command.

Figure 38 “network status” command

```
File Edit Setup Control Window Help
Sync> network status

MGMT Port
DHCP      : DISABLED
IPv4 Addr : 10.10.10.130
NetMask   : 255.255.255.0
Gateway   : 10.10.10.1
MAC       : fc:af:6a:04:bb:b0
Link      : UP

PTP Timing Port-1
IPv4 Addr : 10.10.10.65
NetMask   : 255.255.255.0
Gateway   : 10.10.10.1
IPv6 Addr : fe80:0000:0000:0000:feaf:6aff:fe02:bbb0
MAC       : fc:af:6a:02:bb:b0
Link      : 1000M/Full

PTP Timing Port-2
IPv4 Addr : 10.10.10.140
NetMask   : 255.255.255.0
Gateway   : 10.10.10.1
IPv6 Addr : fe80:0000:0000:0000:feaf:6aff:fe01:bbb0
MAC       : fc:af:6a:01:bb:b0
Link      : Down
```

Network Ping command

Send a ping message to a device on the network to test reachability. The results of the ping operation are displayed as “Ping Success” or “Ping Failed”.

The ping command takes an additional parameter “mgmt” or “ptp” to specify from which port the ping request needs to go out.

[Figure 39](#) shows the “network ping” command.

Figure 39 “network ping” command

```
File Edit Setup Control Window Help
Sync> network ping 10.0.1.1
Usage:
  network ping mgmt <ip_addr>
  network ping ptp <ip_addr>

Sync> network ping mgmt 10.0.1.1
Ping Success

Sync> network ping ptp 10.10.10.132
Ping Success
```

HTTPS Restore command

This command is provided in case of user uploading an incorrect file or wrongly formatted SSL certificate (PEM format) file via Qg 2 GUI. Executing this command gives the user to option to reset to factory default – removing the user uploaded SSL certificate file and restoring Viavi’s self-signed certificate. This is needed if a wrong user file is uploaded and the user is unable to access Qg 2 from their browser.

Figure 40 shows the “HTTPS Restore” command.

Figure 40 HTTPS Restore command

```
File Edit Setup Control Window Help
Sync> HTTPS Restore
User certificate, if any, will be removed & default certificate will be restored
Do you want to continue? [Y/N] : n
Abort.

Sync>
```

Date Command

This command is provided mainly for initial customer lab bring-up or for those deployments where there is no timing reference (like GNSS) but need Qg 2 to act as a Grandmaster to propagate time and synchronization over PTP to slave units. This command enables the user to set the date and time (ToD) on Qg 2 manually. The user can enter the wall-clock time for the present date and time with this command with the “set” option. The date command without any parameters will display the current ToD.

Figure 41 shows the “date” command.

Figure 41 “date” command

```
Sync> date set
Usage:
date
date set yyyy-mm-dd-hh-mm-ss [clock class] [clock accuracy] [clock variance]
Date entered will be taken as UTC Time
Clock class, accuracy and variance are optional parameters

Sync> date
UTC time: 2023-01-30 08:17:45 (+37 sec)
Clock: class = 52, Accuracy = 0xfe, Variance = 65535
```

NOTE

If there is a proper timing reference available (like GNSS time or a remote PTP master), then the time set by this command will be overwritten by the actual ToD received from the timing reference. This command is not needed for normal operation with a good timing reference.

NOTE

When setting the ToD with the date command, the PTP clock quality (class, accuracy and variance) can be optionally forced to specific values. Again, this is provided as a way to assist with lab testing instead of the default values in the timing engine (which can be displayed using the date command). Ideally, these values should reflect the clock quality of the reference clock source - for example, with GNSS lock, the clock class = 6, losing GNSS lock and going into holdover, the clock class = 7, and so on.

NOTE

After setting the date command manually, if GNSS or PTP master reference is available, then the clock quality parameters will be automatically updated as per the reference. The variance parameter is “sticky” in the sense that it will be set to whatever was provided with the date command earlier.

Reboot Command

The Reboot command is to provide for user initiated manual reboot of Qg 2 system.
Note that a firmware upgrade will automatically initiate reboot of the system.

Monitoring Log Command

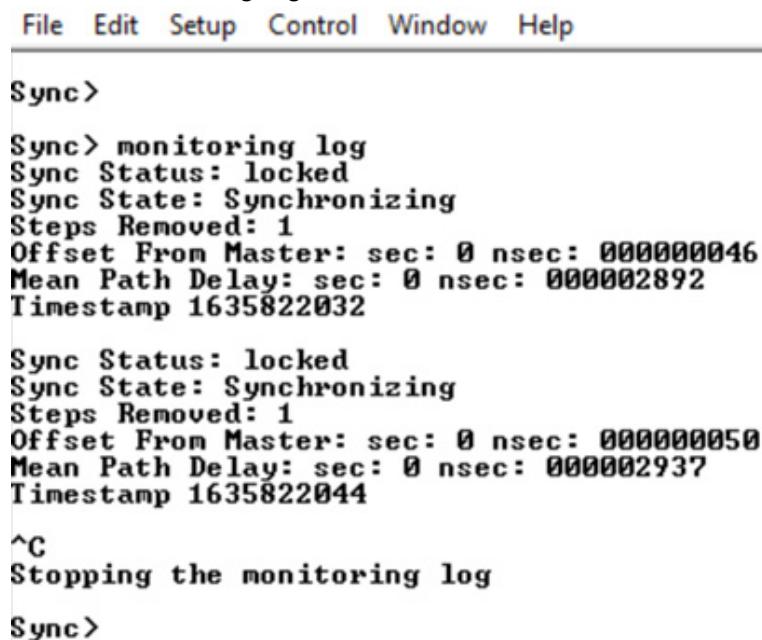
This command will start a log of the Managed Clock Engine's Sync information in PTP only and PTP primary and GNSS secondary mode. The data points are: Qg2 Sync Status, Qg2 Sync State, Steps removed, Offset from master (in ns), Mean path delay (in ns) and the timestamp.

The log will be printed out on the console every 10 to 13 seconds. To stop the log, the user will have to press “Ctrl + c”. Once “Ctrl + c” is pressed the console will print “Stopping the monitoring log” and a new command line will appear.

- Qg 2 Sync Status can be either LOCKED or UNLOCKED.
- Qg 2 Sync State can be one of the following:
 - FREE RUNNING
 - SYNTONIZING
 - SYNCHRONIZING
 - HOLD OVER

Figure 42 shows the “monitoring log” command.

Figure 42 “monitoring log” command



The screenshot shows a software interface with a menu bar at the top: File, Edit, Setup, Control, Window, Help. Below the menu is a command-line window. The command "Sync> monitoring log" is entered, followed by two sets of sync status information. Each set includes: Sync Status (locked or synchronized), Sync State (Synchronizing), Steps Removed (1), Offset From Master (sec: 0 nsec: 000000046 and 000000050), Mean Path Delay (sec: 0 nsec: 000002892 and 000002937), and a timestamp (1635822032 and 1635822044). After the second set, the command '^C' is entered, followed by the message "Stopping the monitoring log". Finally, "Sync>" appears again.

```
File Edit Setup Control Window Help
Sync>
Sync> monitoring log
Sync Status: locked
Sync State: Synchronizing
Steps Removed: 1
Offset From Master: sec: 0 nsec: 000000046
Mean Path Delay: sec: 0 nsec: 000002892
Timestamp 1635822032

Sync Status: locked
Sync State: Synchronizing
Steps Removed: 1
Offset From Master: sec: 0 nsec: 000000050
Mean Path Delay: sec: 0 nsec: 000002937
Timestamp 1635822044

^C
Stopping the monitoring log

Sync>
```

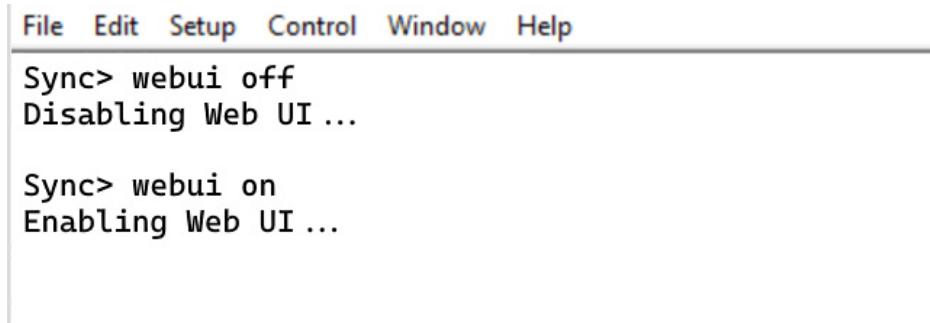
webui Command

The “webui” command is provided for those customers who are concerned about security vulnerabilities when the Qg 2 unit can be accessed over the web in deployment. This is for added security on top of secure HTTP and TLSv1.2 cipher mechanism that are used by default on Qg 2.

This command takes one additional parameter: on/off. By default, web UI is enabled (or webui is ON) which allows http/https web access to the Qg 2 unit. That can be turned off with the “webui off” command.

[Figure 43](#) shows the “webui” command.

Figure 43 “webui” command



A screenshot of a software application window titled "Sync>". The menu bar includes File, Edit, Setup, Control, Window, and Help. The main pane displays two command entries:

```
Sync> webui off
Disabling Web UI ...

Sync> webui on
Enabling Web UI ...
```


Troubleshooting and Safety

This chapter discusses the following topics:

- “[Troubleshooting and Safety Considerations](#)” on page 70
- “[Troubleshooting](#)” on page 70
- “[Safety Considerations](#)” on page 75

Troubleshooting and Safety Considerations

The following sections provide Qg 2 Troubleshooting and Safety Considerations. References are provided on how to get technical or sales assistance, and how to obtain manual updates.

Troubleshooting

This section provides some Qg 2 Troubleshooting practices and the indicators for when a problem may be present in the Qg 2 operation. Some of the indicators of Qg 2 problems are Front Panel LED states, Interface and PTP Webpage statuses and the Alarms/Events Tab Webpage.

Table 19

Symptom	Probable Cause	Recommended Action
Power LED is red	User Interface and Control Plane Processor has not completed its boot up process.	Wait for a few seconds for it to turn orange and then finally green when all of software has been brought up. It takes approximately 4 minutes for the LED to turn green when system is ready for operation.
	Power supply does not meet Qg 2 requirements.	Verify that the voltage from the Qg 2 power source meets the specifications in “Power” on page 9.
	Qg 2 Alarm condition is affecting power.	See “Alarms/Events Page” on page 50 for information about any Qg 2 alarms that might affect power.
GNSS LED is Off	Qg 2 has not completed its boot up process.	Wait approximately 4 minutes for software to complete booting.
	MCE running in PTP Only mode.	None. The LED is off when MCE is in PTP Only mode.

Table 19

Symptom	Probable Cause	Recommended Action
GNSS LED is Red	1 PPS Input Error on Front Panel RJ45 port	Verify that the input RJ45 connector is securely inserted in the port. Verify that the 1 PPS source is outputting a 1 PPS signal.
	ToD Input Error on Front Panel RJ45 port	Verify that the input RJ45 connector is securely inserted in the port.
		Verify that the ToD source is outputting a ToD signal.
	GNSS input signal from Antenna and cable is missing or weak.	Verify that the GNSS Antenna coax is securely plugged into the SMA port. Verify that the GNSS Antenna signal is present.
	Qg 2 Alarm condition is affecting 1 PPS or ToD Input.	See “ Alarms/Events Page ” on page 50 for information about any Qg 2 alarms that might affect 1 PPS or ToD Input.
Sync Status LED is Off	MCE Processor has not completed its boot up process.	Wait approximately 4 minutes for the MCE processor to complete booting.

Table 19

Symptom	Probable Cause	Recommended Action
Sync Status LED is Red	MCE is operating in GNSS Only mode and is not receiving the GNSS inputs.	Verify that the GNSS LED is Green.
	MCE is operating in PTP Only mode and is not receiving PTP Grand Master timing messages.	Verify that the PTP Port 1 or Port 2 is connected to a PTP Grand Master time source through the RJ45 or SFP connectors.
		Verify that the PTP Grand Master is providing PTP Timing messages.
	MCE is operating in GNSS Primary / PTP Secondary mode, or in PTP Primary / GNSS Secondary mode and is not receiving timing signals from either source.	Verify that the GNSS LED is Green.
		Verify that the PTP Port 1 or Port 2 is connected to a PTP Grand Master time source through the RJ45 or SFP connectors.
		Verify that the PTP Grand Master is providing PTP Timing messages.
	The user has selected external 1PPS / ToD inputs but has not connected the input sources.	On the Qg 2 Front Panel, connect the 1PPS / ToD RJ45 input source. On the Interface :: GNSS web page, Enable 1PPS In and ToD In.
	Qg 2 Alarm condition is affecting inputs from the GNSS or the PTP Grand Master.	See " Alarms/Events Page " on page 50 for information about any Qg 2 alarms that might affect timing input signals.

Table 19

Symptom	Probable Cause	Recommended Action
Sync Status LED is Amber	MCE is operating in GNSS Only mode and is not synchronized to the GNSS input.	Verify that the GNSS LED is Green.
	MCE is operating in PTP Only mode and is not synchronized to the PTP Grand Master.	Verify that the PTP Port 1 or Port 2 is connected to a PTP Grand Master time source through the RJ45 or SFP connectors.
		Verify that the PTP Grand Master is providing PTP Timing messages
	MCE synchronization loop control system has not converged to the input timing source.	Wait 2 to 15 minutes for the MCE to converge and synchronize to the input timing source.
Home Webpage – GNSS ToD Status Unstable/Unavailable	Qg 2 Alarm condition is affecting MCE synchronization.	See “ Alarms/Events Page ” on page 50 for information about any Qg 2 alarms that might affect MCE synchronization.
	GNSS input signal from Antenna and cable is missing or weak.	Wait approximately 2 minutes for the MCE processor to complete booting.
	GNSS Antenna / cable configuration does not meet requirements of the Antenna input Section.	Verify that the GNSS Antenna / cable meets requirements of the Antenna input Section.
	The user has selected external 1PPS / ToD inputs but has not connected the input sources	On the Qg 2 Front Panel, connect the 1PPS / ToD RJ45 input source. On the Interface :: GNSS web page, Enable 1PPS In and ToD In.
	Qg 2 Alarm condition is affecting inputs from the GNSS.	See “ Alarms/Events Page ” on page 50 for information about any Qg 2 alarms that might affect GNSS input signals.

Table 19

Symptom	Probable Cause	Recommended Action
Interface :: PTP Timing Ports Webpage – Link State not up	PTP Timing Port 1 or Port 2 IP address configuration is incorrect. Port 1 and Port 2 are in the same network / subnet as the MGMT port. Qg 2 Alarm condition is affecting Timing Ports Link State.	Verify that IP configuration for Port 1 and Port 2 is correct on the Interface :: PTP Timing Ports Webpage. Verify that the network routers/switches/hubs between the Qg 2 Port 1 and Port 2 and the timing network are properly connected. Make sure that the IP addresses of Port 1, Port 2 and MGMT port are on different networks/subnets. See “ Alarms/Events Page ” on page 50 for information about any Qg 2 alarms that might affect Timing Ports Link State.
Interface::MGMT Port Webpage – Link State not up	MGMT Port IP address configuration is incorrect. MGMT Port is on the same network / subnet as the timing ports.	Verify that IP configuration for MGMT Port is correct on the Interface :: MGMT Port Webpage. Verify that the network routers/switches/hubs between the Qg 2 MGMT Port and the management network are properly connected. Make sure that the IP address of the MGMT port and the addresses of Port 1 and Port 2 are on different networks/ subnets.
	Qg 2 Alarm condition is affecting MGMT Port Link State.	See “ Alarms/Events Page ” on page 50 for information about any Qg 2 alarms that might affect MGMT Port Link State.

Safety Considerations

The following safety consideration should be used when handling and installing the Qg 2.

- When installing or working on the Qg 2 equipment, ESD wrist straps should be worn.
- Use the specified power supply and ground for the Qg 2 equipment as stated in the Power and Ground Connections section.
- Refer to the Applying Power section when applying power to the Qg 2 equipment.
- When rack mounting the Qg 2 equipment, use the original mounting screws provided with the mounting bracket so that the Qg 2 case will not be damaged. Do not substitute other mounting screws.
- Only authorized personnel should open the Qg 2 equipment enclosure. Unauthorized access to the Qg 2 equipment could result in equipment damage and voiding the Qg 2 warranty.
- Use caution when installing the GNSS antenna near, under, or around high voltage lines. The GNSS antenna should be equipped with proper external lightning protection/grounding to avoid equipment damage should the antenna receive a lightning strike.
- If the Qg 2 is rack mounted, 1RU above the Qg 2 enclosure must be left unoccupied for heat dissipation.

Managed Clock Engine

This chapter discusses the following topics:

- “[Managed Clock Engine Overview](#)” on page 78
- “[Qg 2 Engine Modes](#)” on page 78
- “[GNSS Interface](#)” on page 79
- “[Qg 2 Clock Sync States](#)” on page 79
- “[Unicast Operations](#)” on page 81
- “[PTP Clocks](#)” on page 83
- “[Gateway and Boundary clock](#)” on page 84
- “[PTP \(Slave\) Servo Configuration Parameters](#)” on page 85
- “[SNTP](#)” on page 86
- “[PTP over IPv6](#)” on page 87

Managed Clock Engine Overview

The following sections describe the Managed Clock Engine.

Qg 2 Engine Modes

The Qg 2 Managed Clock Engine can operate in four different modes. The operational mode defines the functionality supported by the engine, Qg 2 clock behavior and its properties in different operating conditions. The operational mode is specified upon startup and can only be changed by restarting the engine on the Home Webpage.

- PTP Only
- GNSS Only
- GNSS Primary, PTP Secondary
- PTP Primary, GNSS Secondary

In addition to these four modes, a Slave Only mode is supported. The clock can be switched to the Slave Only mode and back at any time and from any of above operational modes. The Slave Only mode is selected on the PTP :: Clock Webpage.

There is also the PTP Only, GNSS debug mode for internal Viavi use only!

PTP Only mode

This is an ordinary PTP master-slave mode. The GNSS interface is disabled. In this mode, the clock normally acts as a PTP slave, but may also become a PTP master if no better clock exists on the network based on the Best Master Clock Algorithm (BMCA).

The clock class is initialized to value of DEFAULT (248).

GNSS Only mode

In this mode, the clock is a GNSS-clock and the GNSS is the only source of synchronization. The clock can never become a slave to another clock regardless of its clock class.

In this mode, the clock class is automatically controlled by the engine. The clock is initialized with class of DEFAULT (248), and when it locks to a stable GNSS signal it raises the class to PRC_SYNC (6). If the ToD-input signal is available as well, then the timescale is automatically switched to PTP and the clock class is PRC_SYNC (6).

Later, if the GNSS-signal is lost, the clock switches to the holdover mode and lowers its class to PRC_HOLDOVER (7). If after the holdover period, the GNSS-signal is still not available the clock downgrades its class PRC_DEGRADATION_A (52) and stays as the PTP master in the free running mode. If a better clock exists on the network based on BMCA, the clock will switch to the PTP passive state.

GNSS Primary, PTP Secondary mode

This mode is almost the same as the previous mode, Mode GNSS Only, but after the holdover duration the clock degrades its class to PRC_DEGRADATION_B (187), so clock can potentially become a PTP slave if a better clock appears on the network.

This mode means that the Qg 2 clock has the GNSS-signal as its primary source of synchronization and the PTP as a backup source, i.e. when no GNSS-signal present.

PTP Primary, GNSS Secondary Mode

This mode is designed for unstable GNSS-reception environments, where the node having a better signal reception becomes a PTP master and all others become PTP slaves, even if they have their own GNSS-signal.

The clock is initialized with class DEFAULT (248) and the class is not changed by the engine while operating. Instead after detecting the stable GNSS-signal the engine increases the priority2 member of the Default Dataset (lowers its value) by some small margin, which might depend on the reception quality. That clock which has a higher priority2 (better GNSS signal reception) becomes the PTP master on the network and all others synchronize with it.

GNSS Interface

The Qg 2 supports GNSS L1 input signals from a GNSS antenna. Signal frequency is 1575.42 MHz for GPS; 1561.098 MHz for Beidou; and 1602.0 MHz for Glonass. The status and configuration of GNSS interface can be accessed via the Interface :: GNSS Webpage.

Qg 2 Clock Sync States

Qg 2 clock at any instance of time can be in one of four following sync states:

- FREE RUNNING
- SYNTONIZING
- SYNCHRONIZING
- HOLDOVER
- UNKNOWN/ERROR

FREE RUNNING State

The Qg 2 clock comes into this state upon initialization. The Qg 2 clock time is not set, the clock class is DEFAULT (248), clock accuracy is UNKNOWN (0xFE).

The timescale is PTP, the UTC offset is initially set to 37 secs, leap flags are FALSE. In Free Running state, the clock frequency comes from the on-board oscillator.

SYNTONIZING State

This state is only possible when the 1PPS-input signal from the GNSS interface is available, but not the ToD-input signal and the clock become a PTP master.

When the Qg 2 engine is running in GNSS Only mode or GNSS Primary PTP Secondary mode, the clock class is automatically changed to PRC_SYNC (6) and the clock accuracy is set to WITHIN_100_NS. In GNSS Primary, PTP Secondary mode, the clock class remains unchanged.

Note that the frequency can be traced, but not the time in this state. Once the ToD-input signal becomes available the clock switches to SYNCHRONIZING state.

SYNCHRONIZING State

The Qg 2 clock enters this state when it starts to synchronize its time and frequency with either a PTP or GNSS source. If the synchronization source is the GNSS, then both time and frequency are present and traceable. The timescale is changed to PTP, the clock class is changed to PRC_SYNC (6) and the clock accuracy is set to WITHIN_100_NS.

If the ToD-input signal becomes unavailable, while the 1PPS-input is still present, the Qg 2 clock switches to SYNTONIZED state.

If the synchronization source is a PTP master, then the clock quality remains unchanged. The timescale is set according to what is distributed by the PTP master. If the timescale distributed is PTP then the UTC offset (if valid) and leap flags are also set to master's values and the time source is set to PTP.

HOLDOVER State

The Qg 2 clock enters this state when the synchronization source is lost. If the clock was synchronized with PTP master its clock class remains unchanged. Otherwise, the clock class is modified according to the engine's operational mode and the clock accuracy is changed based on the time spent in the holdover state.

There is a static parameter which defines the clock stability. Currently it is fixed to 1 ns/s for a temperature-stable environment. During the holdover state an estimated error value is calculated and the clock accuracy is set according to that value.

The maximum time the clock stays in holdover state is defined by the holdover duration. By default, this value is set to 1000 seconds which gives about 1 microsecond error at the end of holdover duration. After holdover duration, the clock switches to the FREE RUNNING state, and its accuracy is reset to UNKNOWN (0xFE).

UNKNOWN/ERROR State

The Qg 2 clock has entered a failed or error condition and the sync state is unknown.

Unicast Operations

By default, unicast operations are disabled and the Qg 2 port operates in multicast mode. After unicast mode is enabled no multicast communications are possible.

The PTP port can be switched to unicast operations and back at any time using the PTP :: Port and PTP :: Unicast Sections of this User Guide.

Unicast Master

A Qg 2 port in unicast master state can support:

- Slave nodes which dynamically request unicast message transmission services from the master using the unicast negotiation mechanism.
- Slave nodes which do not support the unicast negotiation and simply rely on the reception of unicast messages from the master.

To accept unicast negotiation requests from slave nodes the master needs to be configured as follows:

- Unicast negotiation must be enabled.
- Slave acceptance filter must be populated. Note that in the current design, the slave acceptance filter is not user configurable and it is set to accept all slaves.

To provide message transmission services to slave nodes which do not support the unicast negotiation the master needs to be manually configured with the list of static slave nodes.

Enabling Master Unicast Negotiation

The unicast negotiation state is controlled by the PTP :: Unicast Section of this User Guide.

When unicast negotiation is enabled the master accepts unicast transmission requests from negotiation-capable nodes. If a node is allowed by the acceptance filter and if enough resources are available the master grants message transmission services to that node.

If unicast negotiation is disabled no new requests are accepted, but all existing grants remain serviced until they are either expired or cancelled.

Maintaining Master's Slave Acceptance Filter

Note: In the current implementation, the slave acceptance filter is not user configurable and it is set to accept all slaves. In that respect, the following documentation on slave acceptance filter is only for academic purpose.

The slave acceptance filter is a mechanism to control which slave nodes may obtain unicast services from the master. If the filter table is empty no services will be granted to any node. The PTP :: Unicast Section of this User Guide is used to manipulate the slave acceptance filter.

As the result of the filter table modification, if a node becomes unacceptable or message rates of any active grants becomes beyond the newly configured limits, all affected grants will be canceled.

Maintaining Master's List Of Static Slaves

Note: In the current implementation, this is not supported. To provide unicast services to slaves which do not support the unicast negotiation the master maintains a list of static slave nodes.

When a node is in this list the master can send Announce and Sync messages to that node and can reply to Delay Request messages received from that node.

PTP :: Unicast Section of this User Guide is used to monitor and manipulate the static slave node list.

Unicast BOTH mode of operation

The PTP port on Qg 2 can be configured to automatically assume either the role of a unicast Master or an unicast Slave when the port mode is unicast BOTH. For example, if a port is in unicast Master mode and has GNSS reference and if the GNSS reference is lost, it can switch over to unicast Slave to another GM in the network. It is important to note that it is mutually exclusive, and cannot assume both, unicast Master and unicast Slave role at the same time as the case would be in a single-armed boundary clock.

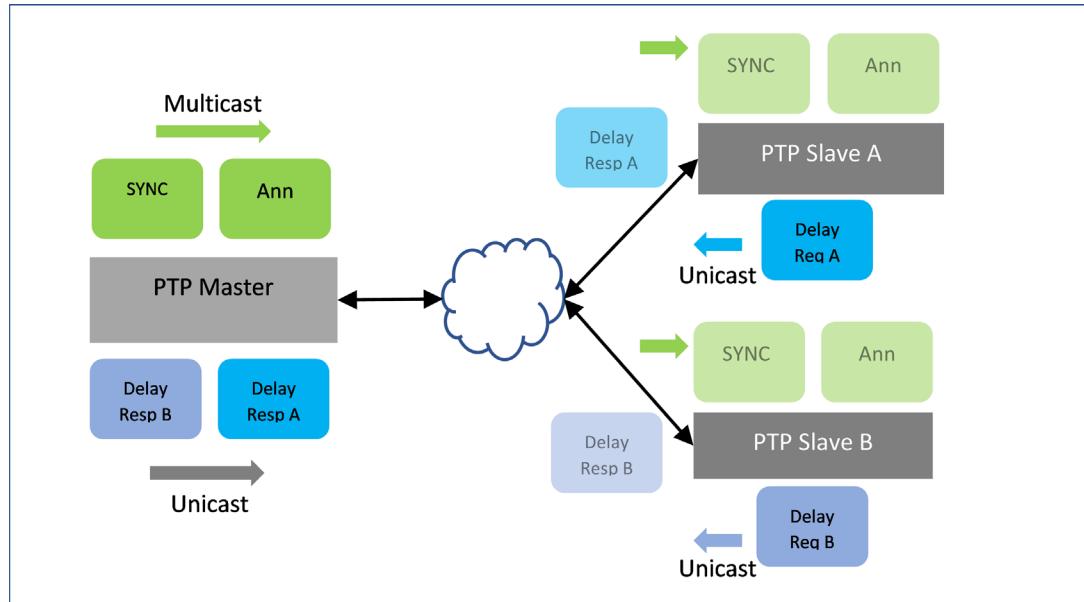
Unicast MIXED mode of operation

The MIXED mode of operation is also referred to as PTP hybrid mode. In this mode, the Announce and Sync messages are sent as a multicast, but the delay mechanism is in unicast mode. The advantage of doing so is two-fold in a network of single master and many slaves that are being serviced by that Master:

- The Master does not have to replicate the Announce and Sync (and Follow-up) messages for each slave in its time domain or in the network,
- Each slave does not have to receive, process and drop DelayReq and DelayResponse messages from other slaves in the network.

[Figure 44](#) shows the MIXED mode of operation.

Figure 44 MIXED mode of operation



The delay mechanism can be end-to-end (E2E) as shown in the figure or can be peer-to-peer (P2P). In P2P, typically the peer delay mechanism (i.e., sending a Peer Delay Request and getting a Peer Delay Response) is typically over multicast. But, in the case of MIXED mode and with P2P delay mechanism enabled, then the peer unicast addresses may be used and need to be statically configured.

The MIXED mode of operation is used in the broadcast industry with SMPTE profile.

Monitoring Unicast Operations

Monitoring the status of master unicast operations can be done on the PTP :: Unicast Nodes and PTP :: Dataset Sections of this User Guide.

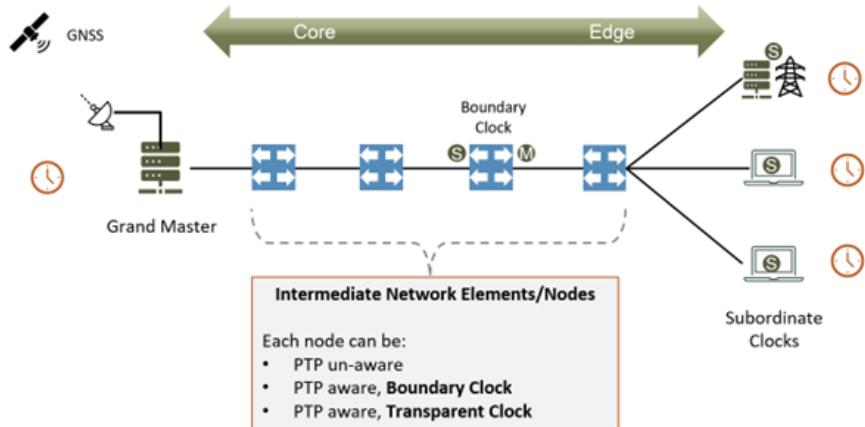
PTP Clocks

IEEE 1588 v2 standard specifies different types of clocks that are used to propagate timing and synchronization. The grandmaster, master and slave (or subordinate) clocks are generally grouped as ordinary clocks. Intermediate switches and routers in the network can either be a Transparent Clock (TC) or Boundary Clock (BC). BCs are preferable to TCs as they provide more accuracy and can easily scale in large networks. Using a hierarchical architecture and using divide and conquer principle, a single grandmaster does not have to serve large number of slaves.

[Figure 45](#) shows PTP Clocks.

Figure 45 PTP Clocks

PTP Clocks – GM, BC, TC, SC



Gateway and Boundary clock

The Qg 2 Multi-Sync Gateway has the capability of using both of its Ethernet ports (Port 1 and Port 2) as PTP ports. This opens the possibility of using the Qg 2 as a two-port gateway or boundary clock.

Gateway Clock

The Gateway Clock (GC) can be considered as an Ordinary Clock (OC) with two ports, with one port configured as a master and the other port configured as a slave.

Another capability of the Qg 2 is for both ports to be configured as master ports. In that configuration, each port would have its own IP address and be associated with different subnets. However, both ports would have the same PTP Clock Identity. With each port connected to different subnets, the ports can serve as GM for the slaves on the two different subnets. The slaves on the two separate subnets would then use the BMCA to select the best GM from which to recover the PTP time messages.

The Boundary Clock

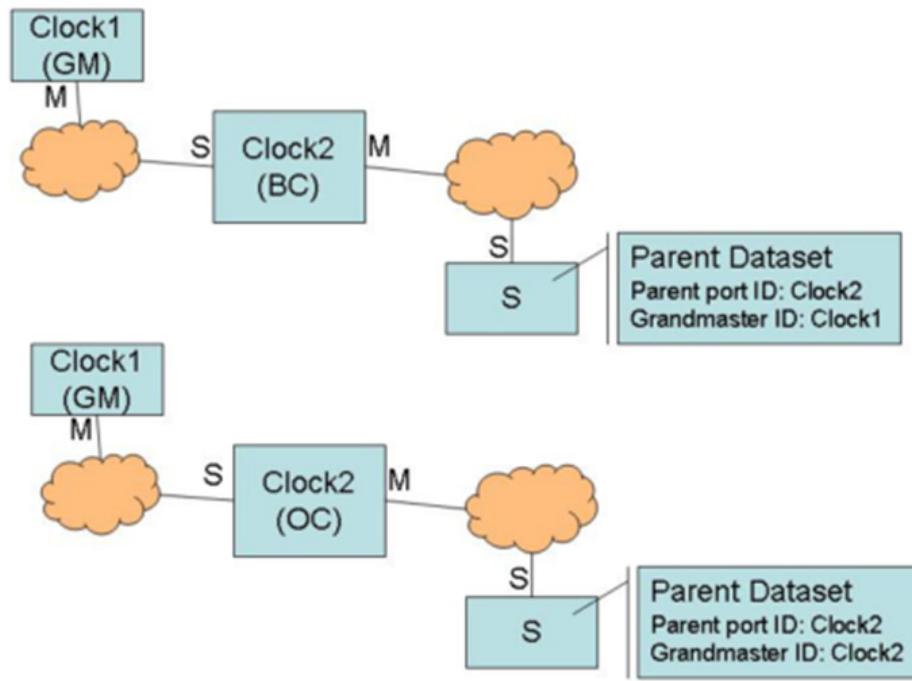
The Boundary Clock (BC) has one port defined as a master port and the second port as a slave port receiving PTP messages from an external Grand Master (GM) Clock. The PTP Clock Webpage is used to set the Qg 2 clock as a boundary clock, described in PTP :: Clock Section of this User Guide.

The following figure illustrates the difference between a Gateway Clock and a Boundary Clock. The slaves connected to a Gateway Clock will only recognize the Gateway Clock as a Grand Master and not any other upstream masters. In the following figure, the slaves connected to the Gateway Clock will not recognize the Clock 1 (GM). The slaves

that are connected to the Boundary Clock will recognize Clock 1 (GM) as the Grand Master.

[Figure 46](#) shows the difference between the Gateway and Boundary Clocks.

Figure 46 Gateway Clock (GC) vs. Boundary Clock (BK)



PTP (Slave) Servo Configuration Parameters

The following sections describe PTP (Slave) Servo configuration parameters.

Main Time Constant

The main time constant used by the PTP Servo (slave) algorithm, in seconds. A longer time constant makes the oscillator frequency change more slowly and less responsive to changes in a network environment, such as the temperature or the network delays. For networks with low packet delay variation a short time constant (e.g., 30 sec) can be used. For networks with unknown or high traffic load, a longer time constant (e.g., 300 sec) would be a better setting. A longer time constant requires a more stable oscillator to be effective. For example, a time constant above 500 sec requires the Qg 2 super OCXO. The default value is 100 sec.

Startup Time Constant

The time constant used during the period of obtaining a preliminary synchronization (startup phase), in seconds. If this field is set to 0 the main time constant will be used. This parameter can help to shorten the synchronization time when a long main time constant is required. But values that are too short may lead to unwanted oscillations which increase the total time required to synchronize and eliminate any positive effects of shorter startup time constant. The default value is 0.

Quality Threshold

Defines the maximum allowed time variation in nanoseconds before the slave goes into holdover. The time variation is based on a statistical measurement of time error between the source input time and the slave's formulated time, where the source input time is the GNSS or ToD + 1PPS input. The default value is 1500 nsec.

Network Type

The Network Type selection is used to adjust the loop control algorithm behavior according to the underlying network characteristics. There are three types of networks currently supported: Unmanaged, Managed and Full on-path.

“Unmanaged” selection is used for a network with unknown or unspecified packet delay and delay variation or with packet delay distribution that may dramatically change its characteristics over time.

“Managed” selection is used for a network where the packet delay and delay variation distribution are specified and that always has a distinct “floor”. That “floor” may vary over the time, but the distribution limitations provided by the “floor” should still be present.

“Full on-path” selection is used along with G.8275.1 profile, where all network elements in the network participate in PTP protocol.

Frequency Out

The syntonized frequency that will be output on the FREQ Out port on the Qg 2 Front Panel. The valid options are 10MHz (default), 1.544MHz (T1 frequency) and 2.048 MHz (E1 frequency).

SNTP

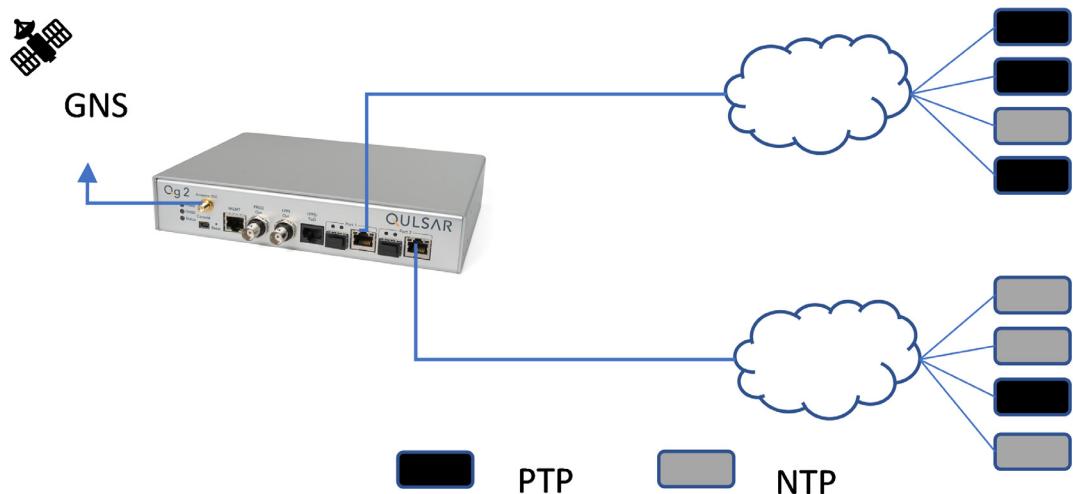
Besides PTP timing protocol, Qg 2 supports SNTP (Simple Network Time Protocol) for those applications where very high precision (i.e., sub-microsecond accuracy) synchronization is not a requirement. Many client devices and their operating systems

synchronize to a NTP server. Qg 2 can operate as a Stratum-1 NTP server to provide of this time. In this regard, Stratum-1 NTP server is the same as SNTP server.

Qg 2 can operate as a PTP grandmaster or as a NTP Stratum-1 server, by getting time reference from GNSS and distributing that over the network to PTP slaves or NTP clients. If SNTP is enabled, then Qg 2 can service both, PTP slaves as well as NTP clients.

[Figure 47](#) shows support of PTP slaves and NTP clients.

Figure 47 Support of PTP slaves and NTP clients



PTP over IPv6

Internet Protocol version 6 (IPv6) expands the number of network address bits from 32 bits (in IPv4) to 128 bits, which provides more than enough globally unique IP addresses.

- IPv6 Address:

The IPv6 128-bit addresses are represented as a series of eight 16-bit hexadecimal fields separated by colons in the format: n:n:n:n:n:n:n:n. For example,

2023:0000:130F:0000:0000:09C0:080F:130B

For easier implementation, leading zeros in each field are optional. This is the same address without leading zeros:

2023:0:130F:0:0:9C0:80F:130B

One can also use two colons (::) to represent successive hexadecimal fields of zeros, but this short version can be used only once in each address:

2023:0:130F::09C0:080F:130B

- IPv6 Prefix:

An IPv6 address prefix represents a block of address space or a network. The prefix is a combination of an IPv6 prefix (address) and a prefix length. It takes the form ipv6-prefix/prefix-length.

IPv6 addresses can be broken into prefixes of varying length. The prefix length is a decimal value that specifies the number of the leftmost bits in the address that make up the prefix. The prefix length follows a forward slash and, in most cases, identifies the portion of the address owned by an organization. All remaining bits (up to the right-most bit) represent individual nodes or interfaces.

For example, 2023:db8:0000:0000:250:af:34ff:fe26/64 has a prefix length of 64.

The first 64 bits of this address (2023:db8:0000:0000) are the prefix. The rest (250:af:34ff:fe26) identify the interface.

From Qg 2 SW release version 12.2.2 onwards, additional configuration support is available to support PTP over IPv6 for the 2 PTP Timing Ports. Prior to 12.2.2 release, only a fixed link local IPv6 address derived from PTP port MAC address was supported.

With version 12.2.2 (and onwards), the IPv6 stack on Qg 2 embedded system has been enhanced to support configurable 128 bit IPv6 addresses in different address notations that are commonly used, along with setting the prefix length (1 – 128 bits), and the gateway address. Both, with PTP over IPv6 both, multicast and unicast IPv6 addresses are supported

The configuration of the IPv6 related address parameters can be configured from Interface::PTP Timing Ports webpage. This is a per port configuration.

The selection of PTP over IPv6 is done by setting it on PTP::Port::Network Protocol configuration parameter. This is a per port configuration.

As prior to 12.2.2 release, IPv6 link local address continues to be supported.



NOTE

Please note that dynamic assignment of IPv6 address for the PTP timing ports (via DHCP6) is not supported currently.

Network Architecture and Deployment

This chapter discusses the following topics:

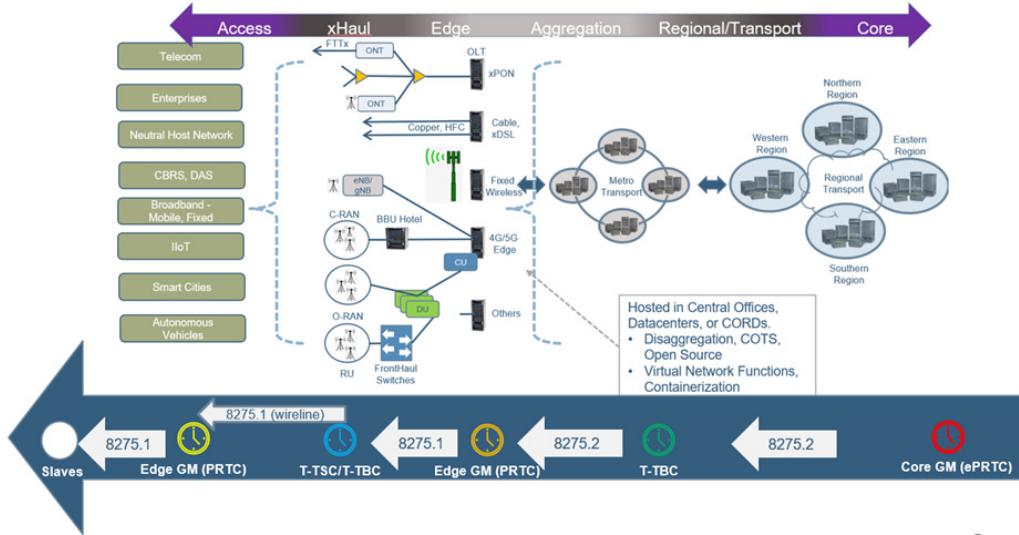
- “Network Operator or Carrier perspective” on page 90
- “PTP Profiles” on page 91
- “Synchronous Ethernet (SyncE)” on page 95
- “5G and Synchronization” on page 101
- “Qg 2 for 5G Deployment” on page 102

Network Operator or Carrier perspective

Figure 48 shows the carrier's perspective of the network with a view of the synchronization requirements. The left side of the drawing is more on the customer/applications side which require synchronization while the core of the network is on the right. Traditionally, from TDM world to packet world, the synchronization flow is hierarchical, starting from the core and propagating down to the endpoints.

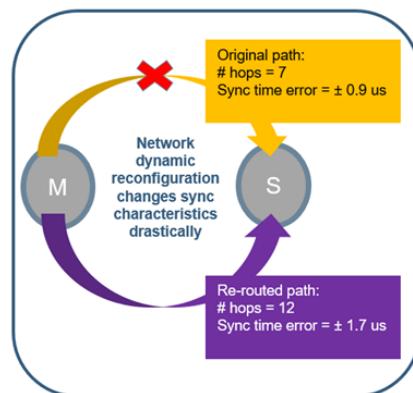
Figure 48 Network Topology - synchronization overview

Network topology – Synchronization Overview



For tighter precision, this method of propagation is changing with more Grandmasters put in the network path and the Grandmasters are moving to the edge. Timing and synchronization over large segments of network has its challenges, especially when higher layer protocols and traffic engineering (TE) methods can dynamically re-route traffic based on network conditions.

Figure 49 Network dynamic reconfiguration changes



With fewer hops, a good accuracy and precision can be maintained. Conceptually, this is like how low-latency applications require caching or mirroring of data locally on-site or at the edge. The figure shows how network dynamic reconfiguration could impact the sync characteristics at the endpoint (PTP slave).

PTP Profiles

Qg 2 provides the flexibility and ease for customers to select one of the many PTP profiles provided to set the Qg 2 timing engine mode of operation. In the current release, both ports will be set to the same profile and not independently.

There are many different PTP profiles that have been specified based on specific industries like Telecom, Power, Broadcasting, Enterprise, etc. while a few others are being created. These profiles will put some restrictions on some of the configuration parameters that are part of the IEEE 1588 to make it simpler and targeted towards specific industry and deployment. Typically, the profile dictates the PTP domain value range, PTP over L2 (Ethernet) or IP/UDP, multicast or unicast or mixed mode, message rates, announce timeout, delay mechanism, datasets, etc. are customized per profile. This covers most of it but for some of the profiles some additional parameters also need to be specified.

With Qg 2, the user can select one of these PTP profiles for the timing engine to operate in. To make it user friendly, once the profile is selected, internally Qg 2 software will set up the most of the PTP profile specific parameters to default values for that profile and it is up to the customer if they want to customize it further (like a power user).

The following sections describe the PTP profiles that Qg 2 currently supports. More profiles will be added in future releases and this documentation will be updated accordingly.

IEEE 1588 Default Profile

The profile specified by IEEE 1588 Standard. It uses domain 0, PTP over IPv4/UDP and multicast mode of operation.

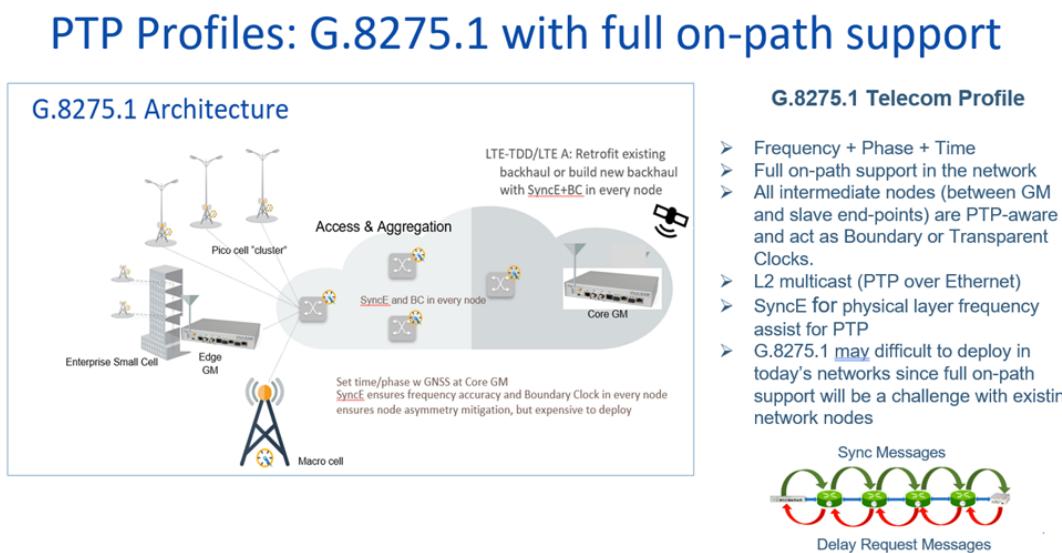
G.8275.1 Telecom Profile

A Telecom profile specified by ITU-T and is recommended for new deployment or green-field networks comprising switches. It is expected that every node or element in the network is PTP-aware, or in other words, the network has full on-path support. This is used in conjunction with Synchronous Ethernet (SyncE) which provides the physical layer frequency synchronization. G.8275.1 uses L2 (Ethernet) multicast as PTP transport layer. This is a better option as using the physical layer assist for frequency and phase/time from PTP over packet network as it gives the best of both worlds.

With G.8275.1 profile and SyncE, a slave or the network is congruent if the PTP source and SyncE source is traced back to the same Grandmaster. If they are not, then it is said to be non-congruent. In either case, the SyncE frequency reference that is used by the slave should be traceable as specified in the Quality Level (QL) value in the ESMC messages.

[Figure 50](#) shows the details of G.8275.1 telecom profile.

Figure 50 Details of G.8275.1 telecom profile



In PTP::Clock page, additional configuration parameters are provided that are specific to G.8275.1 profile as shown in [Figure 51](#).

Figure 51 G.8275.1 profile - additional configuration parameters

G8275.1 Profile	
Clock Local Priority	<input type="text" value="1"/>
Max Steps Removed	<input type="text" value="255"/>
PTP Ports Priority	<input type="text" value="1"/>
Master Only	<input type="button" value="Disable"/> <input type="button" value="Enable"/>
<input type="button" value="Apply"/> <input type="button" value="Clear"/>	

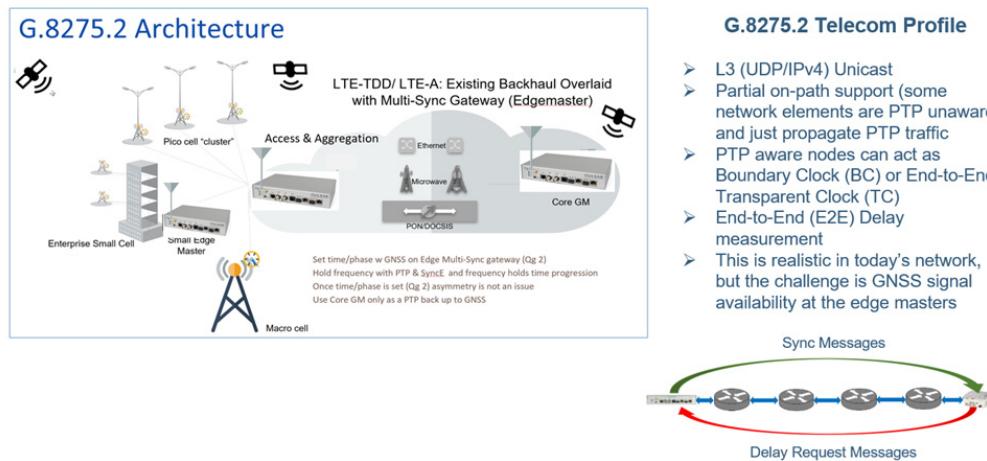
G.8275.2 Telecom Profile

A Telecom profile specified for legacy (brownfield) networks that work in conjunction with the older networks which can comprise switches and routers. This profile is used where there are network elements which are not PTP-aware and do not participate in PTP protocol processing. They act as pass-through elements but introduce additional delays which the endpoints or slaves need to compensate for, to maintain timing precision. Since the sync path traverses over routers, this profile specifies PTP over UDP/IPv4 or UDP/IPv6 and unicast mode of operation.

[Figure 52](#) shows the details of G.8275.2 telecom profile.

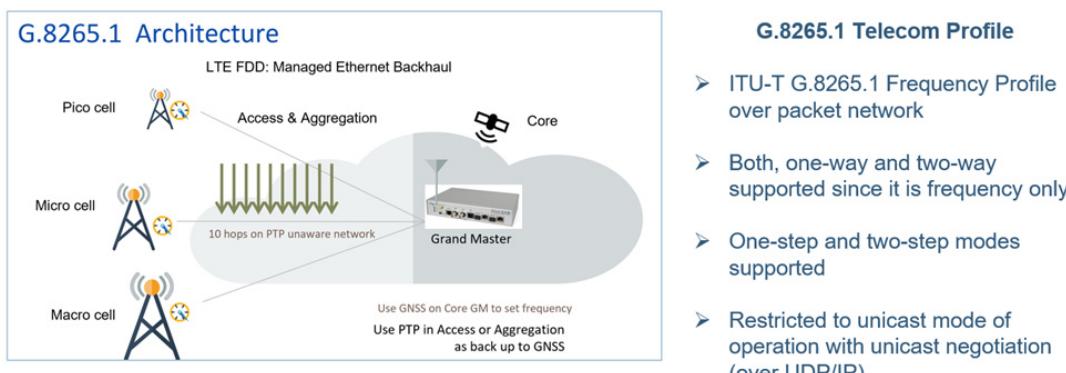
Figure 52 G.8275.2 PTP profile

PTP Profiles: G.8275.2 with partial timing support



In PTP::Clock page, additional configuration parameters are provided that are specific to G.8275.2 profile as shown in [Figure 53](#).

Figure 53 G.8275.2 profile - additional configuration parameters



This profile is specified for the power industry mainly in power system protection, control, automation, and data communication applications. This specific Power V1 is according to the IEEE C37.238-2011 standard. It uses PTP over L2 multicast, P2P delay mechanism and one of the salient features of this profile is that it uses priority tagging for VLAN (i.e., VLAN-id = 0, priority = 4).

In PTP::Clock page, additional configuration parameters are provided that are specific to Power Profile v1 as shown in [Figure 54](#).

Figure 54 Power Profile v1 - additional configuration parameters

POWER-V1 Profile

GrandMaster ID	<input type="text" value="3"/>
GM Inaccuracy (ns)	<input type="text" value="0"/>
Network Inaccuracy (ns)	<input type="text" value="0"/>

Apply **Clear**

Power version-2 profile

This is version 2, 2017 edition of the power industry standards, IEEE C37.238-2017. One of the main differences from the 2011 edition is that there is no restriction on VLAN priority tagging on the PTP ports.

In PTP::Clock page, additional configuration parameters are provided that are specific to Power Profile v2 as shown in [Figure 55](#).

Figure 55 Power Profile v2 - additional configuration parameters

POWER-V2 Profile

GrandMaster ID	<input type="text" value="0"/>
GM Inaccuracy (ns)	<input type="text" value="0"/>
Network Inaccuracy (ns)	<input type="text" value="0"/>

Apply **Clear**

This profile is specified as in Power Utility (IEC/IEEE 61850-9-3:2016) standard: Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation. In many aspects, this is very similar to Power v2 profile mentioned earlier.

In PTP::Clock page, additional configuration parameters are provided that are specific to Power Utility profile as shown in [Figure 56](#).

Figure 56 Power Utility Profile - additional configuration parameters

POWER-UTILITY Profile

GrandMaster ID	<input type="text" value="0"/>
GM Inaccuracy (ns)	<input type="text" value="0"/>
Network Inaccuracy (ns)	<input type="text" value="0"/>

Apply **Clear**

SMPTE Profile

SMPTE 2059 is a standard from the Society of Motion Picture and Television Engineers (SMPTE) that describes how to synchronize video equipment over an IP network. The standard is based on IEEE 1588-2008. SMPTE 2059 is published in two parts on 9 April 2015:

- SMPTE 2059-1 – Defines signal generation based on time information delivered by the IEEE 1588 protocol
- SMPTE 2059-2 – Defines an operating profile for the IEEE protocol optimized to the needs of media synchronization.

The new television standard as specified by ATSC 3.0 uses SMPTE and for synchronization via IEEE 1588 v2. ATSC 3.0, also known by the moniker NextGen TV, is a major version of the ATSC standards for television broadcasting created by the Advanced Television Systems Committee (ATSC).

In PTP::Clock page, additional configuration parameters are provided that are specific to SMPTE profile as shown in [Figure 57](#).

Figure 57 SMPTE Profile - additional configuration parameters

The screenshot shows a configuration interface for the SMPTE Profile. At the top is a header labeled "SMPTE Profile". Below it are several input fields and dropdown menus:

- "System Frame Rate (Base)": A text input field containing the value "0".
- "Frame Rate Frac": A dropdown menu set to "Disable (Divisor 1.0)".
- "Time Code Drop": A dropdown menu set to "Off".
- "Time Code Color": A dropdown menu set to "Off".
- "Jam Event": A dropdown menu set to "None".
- "Jam Event Time*": An empty text input field.

At the bottom of the interface are two buttons: "Apply" and "Clear".

Synchronous Ethernet (SyncE)

The following sections describe Synchronous Ethernet (SyncE.)

What is Synchronous Ethernet?

Synchronous Ethernet feature is to help in providing frequency syntonization over packet based networks using Ethernet. It provides a mechanism to distribute frequency from Ethernet packet network to Time Division Multiplexed(TDM) circuits and nodes. For this, the (natively asynchronous) Ethernet physical layer is utilized in a fashion like (natively synchronous) SONET/SDH networks, with clock recovery and the assist of a

new IEEE 802.3 slow-protocol packet called Ethernet Synchronization Messaging Channel (ESMC). This ESMC message is to convey the reference clock quality and traceability information in the form of Quality Level (QL). The SyncE feature is considered a physical layer characteristic unlike PTP which is in higher-layer software.

In current and next generation networks, there is need for time and not just frequency synchronization. That is, a combination of frequency, phase and time-of-day synchronization is required and expected to be delivered in a reliable and resilient fashion. Synchronous Ethernet can provide a stable frequency and can also be used as a local short-term holdover clock for maintaining time.

The Synchronous Ethernet standard is specified in ITU-T G.8262 and ESMC message in ITU-T G.8264.

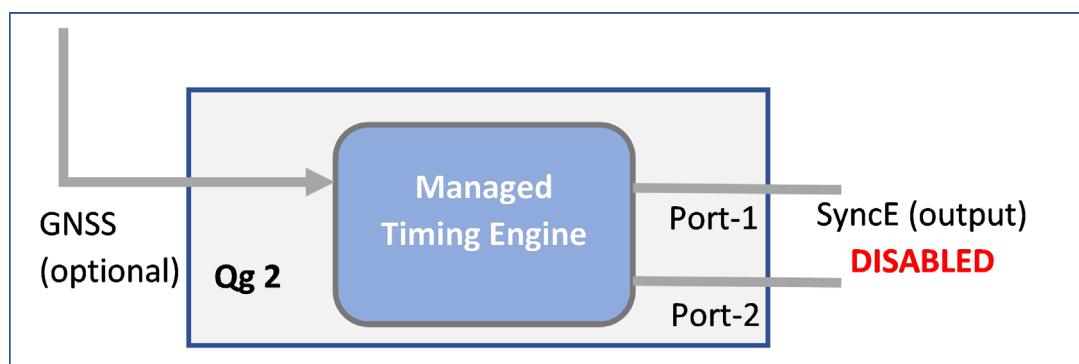
SyncE feature in Qg 2

Synchronous Ethernet feature is a configurable option on Qg 2 that can be enabled or disabled from the Home webpage, depending on the customer use-case and deployment. There are 4 main modes of operation in which SyncE feature can be deployed as described below. The PHY's used in Qg 2 support SyncE in terms of supporting clock recovery on Ethernet Rx and being able to provide 125MHz clock externally for Ethernet Tx. This is supported with native RJ45 (1000BASE-T) PTP port interfaces and with optical 1GE SFP modules. SyncE is currently not supported on Copper SFPs.

SyncE in OFF mode

Figure 58 shows SyncE OFF mode.

Figure 58 SyncE OFF mode

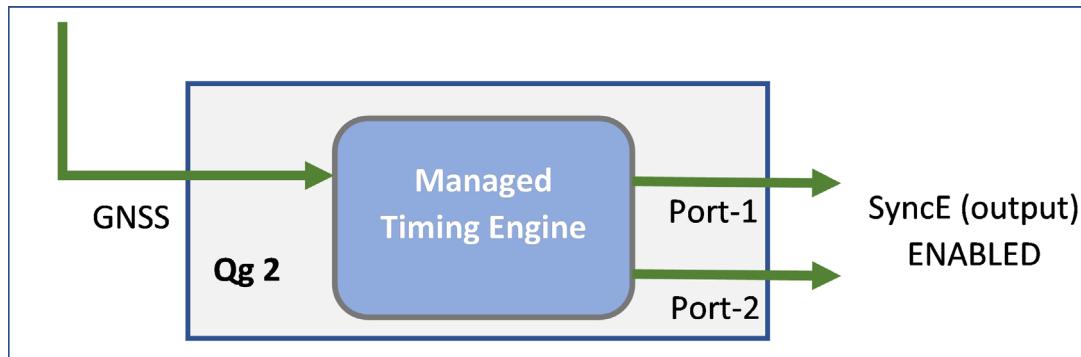


In this mode of operation, Synchronous Ethernet feature is turned off completely. Any incoming ESMC packets will be ignored and not processed, and no generation of outgoing ESMC packets. No clock recovery is done on Ethernet Rx. Frequency, along with phase and time are extracted from GNSS or PTP. This applies to both PTP ports.

SyncE in Master Mode

Figure 59 shows SyncE in Master Mode.

Figure 59 SyncE in Master Mode



In this mode of operation, Qg 2 is in GNSS-only operating mode where it gets 1PPS and ToD signals from a GNSS receiver (internal or external to Qg 2), which was originally extracted from GNSS L1 signal. In this mode, the frequency, phase and time references are extracted from GNSS signal, and SyncE is output on both ports for frequency with ESMC/QL message distribution to next downstream L2 network node. The outgoing QL enumeration is PRC (for EEC Option-1) or PRS (for EEC Option-2) when locked to GNSS.

SyncE in Boundary Clock Mode

In Boundary Clock mode, SyncE feature can be enabled when engine is operating in PTP-only mode. In this mode, one of the PTP ports operates as a PTP-slave synchronizing to a PTP master upstream, while the other PTP port operates as a PTP-master distributing time and sync downstream to other PTP slaves.

There are some differences that should be noted when using L2 (Ethernet multicast) based PTP profile like G8275.1 and L3 based PTP profile like G8275.2.

SyncE in Boundary Clock Mode for G8275.1 Telecom Profile

G8275.1 profile is specified for PTP clock distribution in a Layer-2 Ethernet multicast network. This network is expected to have full on-path support, i.e., every node is PTP-aware and participates in the PTP protocol. When Qg 2 is put in Boundary Clock mode in this network, the input SyncE from upstream is used as frequency reference and used directly for SyncE distribution on downstream port, after getting cleaned up by the internal PLL in the clock engine.

On Qg 2 Home webpage, the SyncE selection provides the flexibility of specifying upstream port (PTP slave + SyncE reference input) and downstream port (PTP slave +SyncE output) and as shown in [Figure 60](#) and [Figure 61](#).

Figure 60 SyncE in BC mode for G8275.1, ref input on Port-1

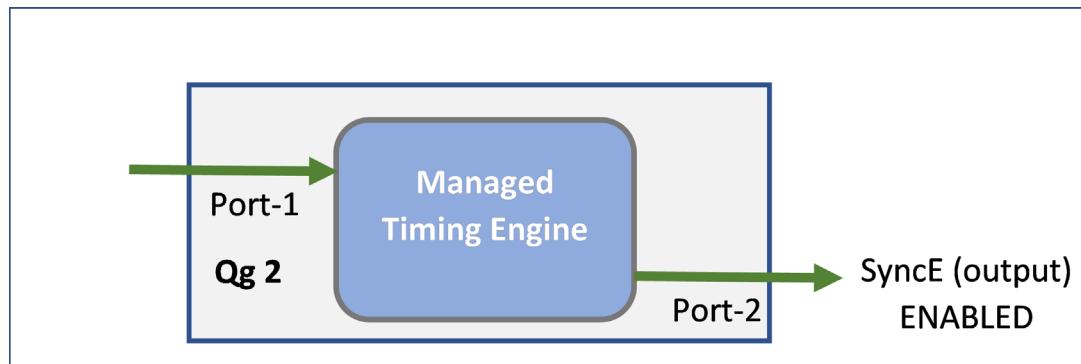
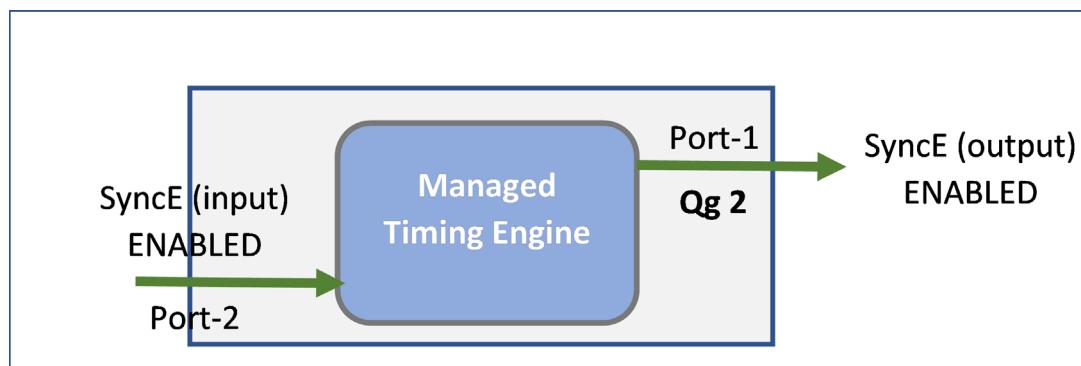


Figure 61 SyncE in BC mode for G8275.1, ref input on Port-2



SyncE in Boundary Clock Mode for G8275.2 Telecom Profile

G8275.2 profile is specified for L3 unicast network and is based on partial timing support from the network. This means that not all network nodes may participate in PTP protocol. In this mode, SyncE input frequency reference can be used as a frequency-assist for PTP. The physical layer (i.e., frequency) output is controlled by both, the input (from SyncE) and PTP engine. Unlike in G8275.1, here the physical layer output is NOT directly from input reference and hence not traceable and cannot be used for SyncE output distribution. SyncE output is disabled in this case.

Figure 62 and Figure 63 show the flexibility of specifying the ports for operation in this mode.

Figure 62 SyncE in BC mode for G8275.2, ref input on Port-1

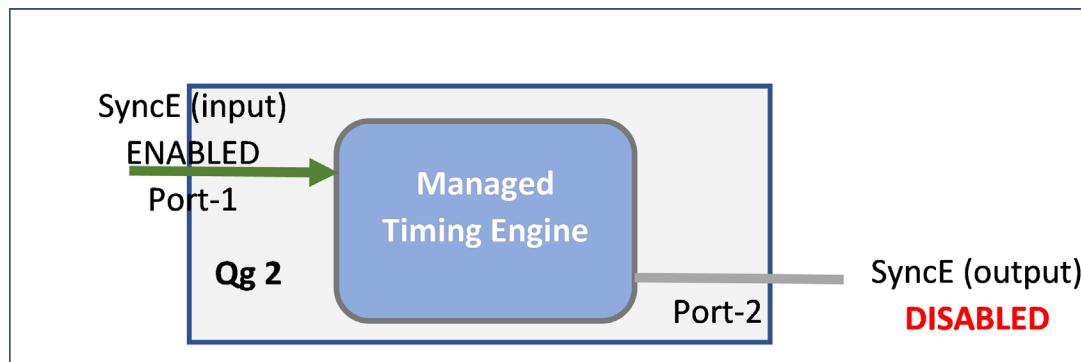
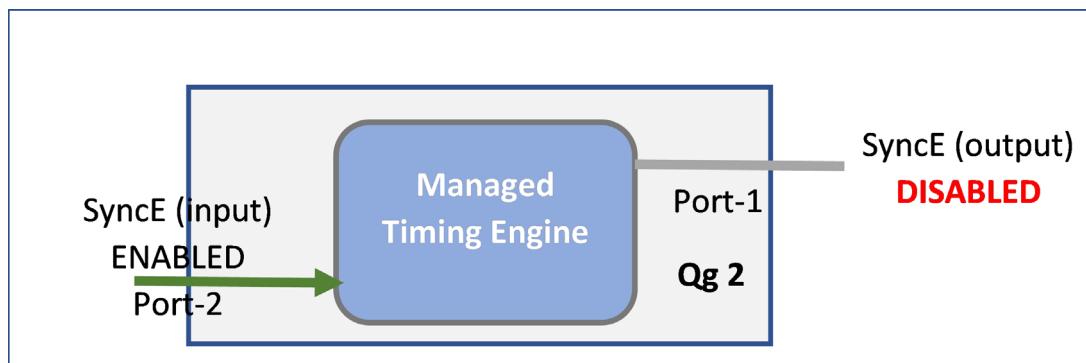


Figure 63 SyncE in BC mode for G8275.2, ref input on Port-2



SyncE status

The SyncE status is displayed at the bottom of PTP::Port webpage.

SyncE Status in GM mode

Figure 64 shows a sample status when the Qg 2 is operating as a GM and Port 1 is connected to a SyncE slave and Port 2 is not connected to a link partner (link down condition.)

Figure 64 GM SyncE status output on PTP::Port webpage

	Port 1	Port 2
<i>Synchronous Ethernet</i>		
SSM channel (ESMC)	Enabled	Enabled
Link Mode	master	none
Input QL	AUTO (QL-DNU)	AUTO (QL-FAILED)
Output QL	QL-PRC (QL-PRC)	QL-PRC (QL-DNU)
Active Reference	NO	NO

The following describes the different fields in this use case:

- SSM channel (ESMC) – it is enabled for both ports.
- Link Mode – This is applicable only for Copper/RJ45. This is as per 802.3 standard which specifies the physical media and the working characteristics of Ethernet. To work in conjunction with SyncE, link mode on Qg 2 ports will be (forced) set to master clock and 1000 Mbps full-duplex and auto-negotiation turned off. In the example above, there is a link on port-1 and its Link Mode set to “master”, while for port-2 there is no link, it shows as “none”.

- Input QL – This is the Quality level in the ESMC message received on that port (from its link partner).
 - For Port1, it indicates AUTO (QL-DNU)
 - For Port2, it indicates AUTO (QL-FAILED)In GM mode, the input QL processing in Qg 2 is set to AUTO to take the input from the port and feed it into the PLL as one of the inputs. What is shown in the parentheses is the actual value received.
- Port1, receives QL-DNU (DNU = do not use) from its link partner.
- Port2, since the link is down, it shows QL-FAILED.
- Output QL – In this use case, the frequency reference is coming from GNSS (or 1PPS) and not from either of the two Ethernet ports. The quality level for that is PRC (or PRS). This QL is what should be propagated downstream as the Qg 2 is a Grand Master.
 - For Port 1, the link is up and so the actual QL that is put in the outgoing ESMC message is QL-PRC as shown in the parentheses.
 - For Port 2, not that it matters since the link is down, the value that will be put in the ESMC message will be QL-DNU.
- Active Reference – this will indicate YES or NO to indicate the recovery of frequency on that Ethernet port. The YES would mean that the frequency is recovered from this port. In a BC clock mode of operation with SyncE enabled, it will indicate YES on the slave port where we get the frequency reference and NO on the other (master) port. In our sample use case of GM, it will show NO on both ports as the active reference is from GNSS (1PPS) and not from the Ethernet ports.

SyncE Status in BC mode

[Figure 65](#) shows a sample status of SyncE when the Qg 2 is operating as a BC, getting the SyncE reference from Port 1 and propagating it on Port 2.

Figure 65 BC SyncE status output on PTP::Port

	Port 1	Port 2
Synchronous Ethernet		
SSM channel (ESMC)	Enabled	Enabled
Link Mode	slave	master-slave
Input QL	AUTO (QL-PRC)	QL-DNU (QL-DNU)
Output QL	QL-DNU (QL-DNU)	AUTO (QL-PRC)
Active Reference	YES	NO

On port-2, a SFP optical module is used instead of the native RJ45 Copper port. The following explains the different fields for this use case:

- SSM channel (ESMC) – it is enabled for both ports. On Port1 it is recovered and on Port2 it is transmitted.

- Link Mode – this is as per 802.3 standard as mentioned in the previous GM use case.
 - Port1: The link mode is in alignment with SyncE as this is a SyncE slave port and getting the frequency reference from its link partner.
 - Port2: The link mode does not matter as it is not copper but is SFP optical. It is displayed as “master-slave”. If it had been Copper/RJ45, then it would have displayed as “master”.
- Input QL – This is the Quality level received on that port (from its link partner).
 - For Port1, it indicates AUTO (QL-PRC) indicating that incoming SyncE ESMC has QL-PRC. This is used as SyncE reference.
 - For Port2, it indicates AUTO (QL-DNU) indicating that incoming SyncE ESMC has QL-DNU.
- Output QL – This is the Quality level transmitted out on the port.
 - For Port1, QL-DNU is sent out. This is required on the port that is being used as SyncE reference to avoid any clock loops
 - For Port2, the AUTO indicates that we are transmitting QL that was received as reference. The actual value is QL-PRC, the frequency propagated from Port1 input.
- Active Reference - This will indicate YES or NO and pertains to recovery of frequency on a specific Ethernet port
 - For Port1, it is YES since the reference frequency is recovered here
 - For Port2, it is NO since the recovered frequency is not used as reference

SyncE – additional notes

Some additional notes regarding SyncE feature in Qg 2:

- Synchronous Ethernet is supported only for 1GE interface speed. If user had configured previously on Interfaces::PTP webpage for a different Auto-Negotiation and speed parameters, they will be reset to 1000Mbps Full-duplex.
- For other profiles besides G8275.1 and G8275.2, the SyncE operation will depend on whether the profile is specified for L2-multicast or L3-unicast. If L2-multicast, then it will follow G8275.1 operation, and if L3-multicast, it will follow G8275.2 operation.
- SyncE operation is valid only in association with Operating Modes, GNSS-only and PTP-only. Synchronous Ethernet field should be set to off for other operating modes.

5G and Synchronization

5G base stations are composed of the remote radio unit (RRU), distribution unit (DU), and the control unit (CU). For the proper functioning and getting optimal performance from RU, DU and CU in 5G RAN, precise timing and synchronization plays a crucial role. This applies from an end-to-end network perspective for new applications and services like network slicing that run on 5G network.

For 5G RAN, the typical sync and time error budget is +/-1.5us from the core to RAN over the air (OTA) interface. For specific deployments and network operation use case scenarios, a higher precision or sync accuracy may be required. For Time Alignment Error (TAE) within a cluster of RUs, all of which synchronizing from the same DU, it is +/-130ns. It should be noted that this budget is specified for synchronization and not latency.

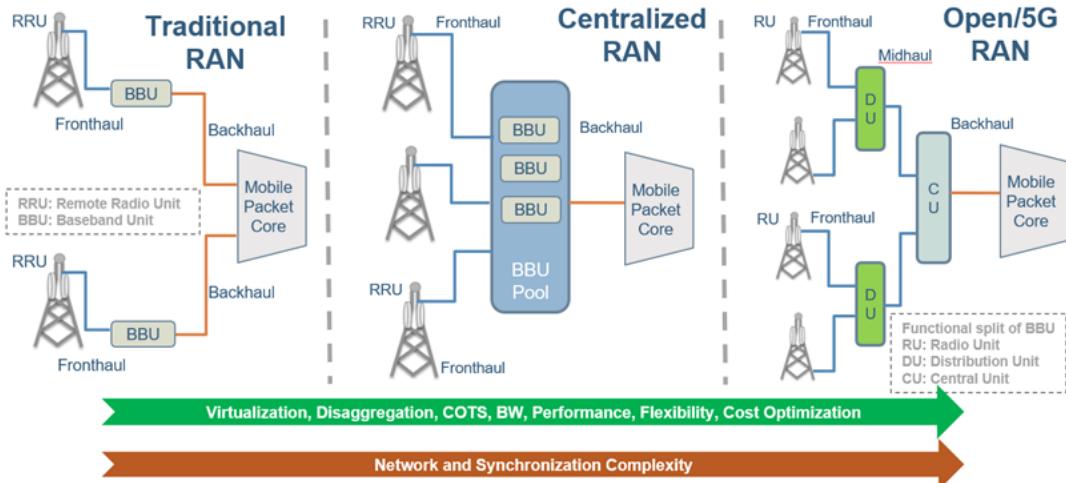
Open RAN, ORAN deployment scenarios

Qg 2 is a simple yet powerful and flexible stand-alone timing and synchronization solution for todays and next generation networks. Specifically with the advent of commercial off the shelf hardware (COTS), open source software and disaggregation concepts and technologies into Radio Access Network (RAN).

Figure 66 shows the RAN Architecture evolution. Prior to 5G, the RAN architecture was such that the base stations are co-located with the Radio tower and all the layer 1 (or PHY or Radio) including analog/digital conversions at or near the radio. In 5G, with massive MIMO, millimeter wave with shorter range radios, and more end applications, there will be more radios (small cells, and towers). This is needed to provide the necessary coverage. The radios need to be small, economical and efficient and located remotely for 5G. Centralized RAN, virtualized RAN and Open RAN are some of the new architectures that are gaining traction in this regard.

Figure 66 5G RAN Architecture evolution

RAN Architecture Evolution



Qg 2 for 5G Deployment

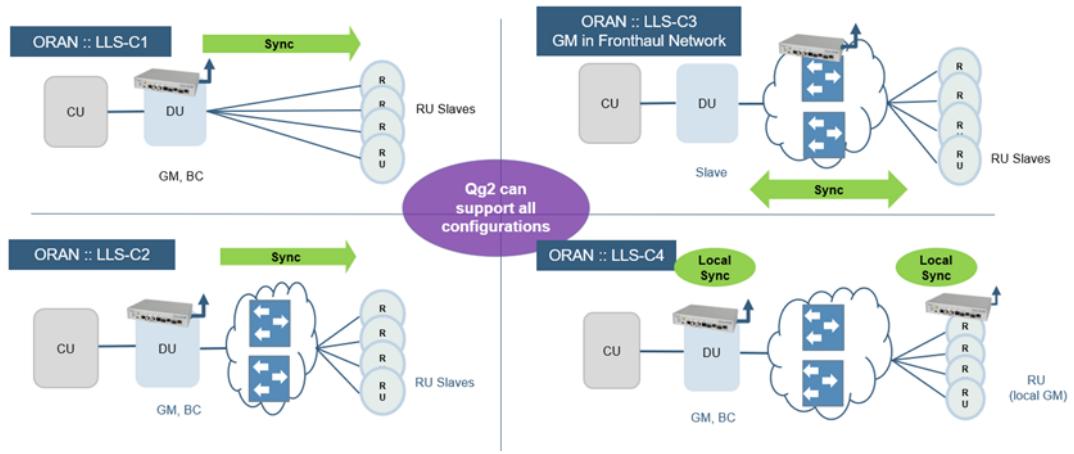
There is a lot of activity currently going on in 5G as the ecosystem evolves. Legacy vendors (Ericsson, Huawei, Nokia, etc.) working with the carriers in building and deploying a single-vendor solution. Additionally, a new host of companies have entered the 5G ecosystem. The basic driving factor for new players is that 5G is seen as a new technology that requires products from multi-vendors to be interoperable and there is

no single vendor “lock-in”. Most of the hardware is off-the-shelf and the software is open source which empowers smaller players to enter this market. Regardless of whether the network operator deploys a disaggregated multi-vendor or the legacy single-vendor infrastructure, precise timing and synchronization is critical.

[Figure 67](#) shows how Qg 2 can be deployed for the different configurations as specified in Synchronization plane (or S-plane) of ORAN Workgroup-4. The configurations are specified as LLS-C1 through LLS-C4, where LLS = low-level split. The recommendation by ORAN is to use G.8275.1 profile along with SyncE.

Figure 67 Qg 2 solution for ORAN S-Plane

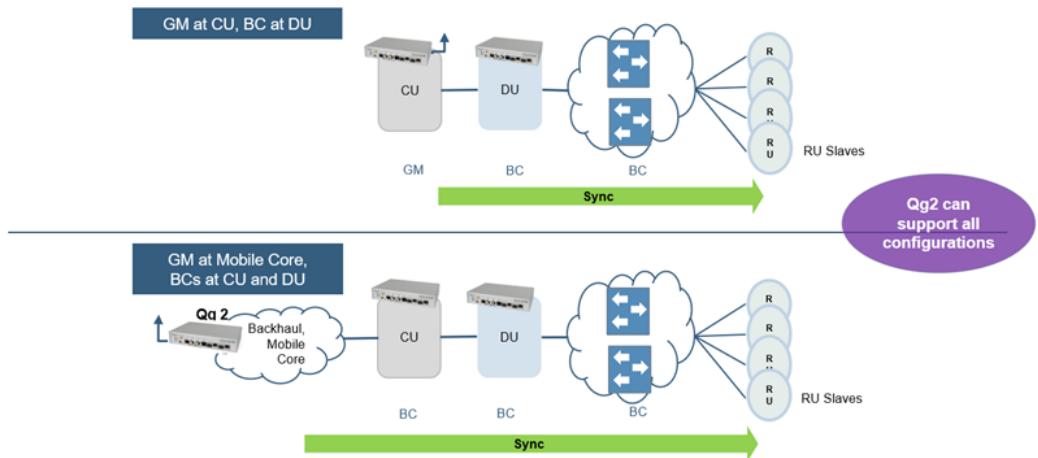
Versatile Qg 2 solution for 5G RAN (ORAN S-Plane)



[Figure 68](#) shows other deployment scenarios for using 5G legacy network architecture for synchronization.

Figure 68 Qg 2 solution for 5G RAN (legacy sync)

Versatile Qg 2 solution for 5G RAN (legacy sync)



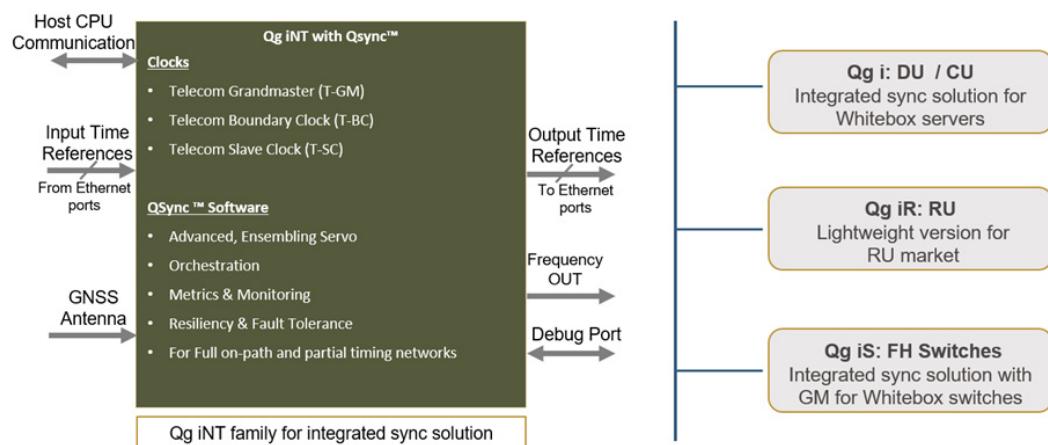
Integrated sync solutions from Viavi (Qg-iNT)

Qg 2 as a stand-alone is a flexible solution for different deployments. In addition, Viavi architecture and design as the reference model and can be easily customized for a PoC trial. The obvious advantage of this is to have a small footprint, less devices to manage and be part of vendor offering of complete solution. Precise timing and synchronization, especially to meet the requirements of 5G is complex requires expertise for an optimal solution.

Figure 69 shows Viavi's solution for the different components of 5G RAN.

Figure 69 Qg iNT solution

Qg iNT Sync Family with QSync™ for 5G RAN



Physical Interfaces

This chapter discusses the following topics:

- “Antenna Input” on page 106
- “Console” on page 106
- “Hard Reset Button” on page 106
- “Management interface” on page 107
- “Frequency Out port” on page 107
- “1PPS timing output” on page 107
- “Time-of-Day / 1PPS input/output” on page 107
- “PTP interface, Port 1 and Port 2” on page 107
- “LEDs” on page 108
- “Power” on page 110
- “Physical dimensions” on page 110
- “MTBF” on page 110

Antenna Input

SMA 50 ohm. Protected for shorted antenna. The Qg 2 provides 5.0 VDC bias to power remote active antennas that provide 40 dB gain. The antenna system supports cable length up to 50 meters with RG59/RG58 and 50 to 100 meters with LMR500/LMR600.

Console

The console port uses mini-USB serial terminal protocol. The connector is on the front panel and the default settings are as follows:

- Baud = 115.2K
- Data Bits = 8 bits
- Parity = None
- Stop Bits = 1
- Flow Control = None

Hard Reset Button

The Hard Reset Button provides 2 different functionalities depending on how it is used or pushed.

 **NOTE**

Using the Hard Reset Button should be a last resort consideration.

Hard Reset Button - Quick Push for Reboot

When Hard Reset Button is pushed and held for a short duration (approx. 1 or 2 seconds), it will reboot the unit. The current configuration of Qg 2 is preserved.

Hard Reset Button - Long Push for Factory Reset

When Hard Reset Button is pushed and held for a longer duration (at least 10 seconds), it will do a factory reset of the unit followed by a reboot. The current configuration of Qg 2 will NOT be preserved and the user should save and restore their configuration as needed.



CAUTION

Do NOT power cycle or do another reset of the Qg 2 until the long push button reset is finished and the system comes back in normal operation mode. This is indicated by the power LED turning green or Qg 2 log on Alarms/Events page indicates that it is ready for operation. Prematurely cutting off power or doing another reset after a long push button reset could potentially make the unit non-operational permanently and cannot be fixed in the field or customer site.

Management interface

Management port is 10/100BaseT RJ45. The Management port supports DHCP, HTTP Webpages, XML, SNMP (v2,v3), and SSH remote login.

Frequency Out port

BNC 50 ohm. 3.3V TTL DC blocked. Frequency Out selectable on the PTP :: Config Webpage.

1PPS timing output

BNC 50 ohm. 3.3V TTL output.

Time-of-Day / 1PPS input/output

ToD / 1PPS port is RJ45, input/output. The pin-outs for this RJ45 connector are defined in ITU-T G.703 Transmission Systems and Media, Digital Systems and Networks, Section 19. For more information about ITU-T G.703, see[2].

The Time-of-Day Input format is selectable on the Interface :: GNSS Webpage and the Time-of-Day Output format is selectable on the Interface :: ToD/1PPS Output Webpage. The selections for both input and output are NMEA, ASCII text and China Mobile.

PTP interface, Port 1 and Port 2

Two Electrical RJ45 ports and two SFP ports. Each RJ45 port can support triple-speed (10/100/1000 Mbps) and each SFP port can support 1GE.

For Port 1, the same PTP messages/packets will be present in both the RJ45 and SFP connections, but the data rates may be different depending on the speed of the network to which they are connected.

For Port 2, the same PTP messages/packets will be present in both the RJ45 and SFP connections, but the data rates may be different depending on the speed of the network to which they are connected.

SFP (and SFP+) optical modules for PTP Port 1 and 2

SFP optical modules can be plugged into the PTP ports for Ethernet connectivity instead of the electrical RJ45 ports. These ports have been designed for standard SFP 1GE modules and dual-rate SFP+ modules operating at 1GE speed.

Viavi has verified the operation with modules from leading vendors as shown below:

- Finisar: FTRJ8519P1BNL, FCLF-8521-3
- Intel: AFBR709DMZ-IN3
- Avago: AFBR-709DMZ
- Ubiquity: UF-MM-1G
- FiberStore (FS): H3C SFP-10GSR-85 (SFP+ dual-rate configured for 1GE)

NOTE

SFP Copper modules are also available and will work with Qg 2. The user should be aware that in that case, the PHY is inside the SFP Copper and in most cases will not fully support Synchronous Ethernet feature. In that case, we recommend using the native electrical RJ45 ports on Qg 2.

LEDs

The Qg 2 has 3 LEDs on the front panel which communicates the status of the Power, GNSS Signal and Sync Status. In addition, there are LEDs on the management and PTP network ports.

[Figure 20](#) describes the LEDs.

Table 20 LED descriptions

LED state	Description
Power	
Red	Any of the internal voltages are in alarm state. On power-on, this LED is red for 15-20 seconds before changing to amber color
Amber/Orange	Initial boot and OS load completed successfully. Loading Applications.

Table 20 LED descriptions

LED state	Description
Green	HW and SW Applications loaded and ready for normal operation
Green - blinking	Qg 2 software upgrade in progress – do NOT reboot or turn power off! Qg2 System webui tab or from CLI system Upgrade Status command will indicate the progress of the upgrade and if the upgrade failed then a reboot may be required.
Red - blinking	Previous attempt to upgrade software on Qg 2 failed
GNSS	
Off	MCE not running or MCE running in PTP only mode or software upgrade in progress
Red	1PPS Input Error or ToD Input Error
Green	Signal acquired, 1PPS Input or ToD Input Available
Sync Status	
Off	MCE not running or software upgrade in progress
Red	MCE running, Not Synchronized and engine state is FREE RUNNING
Amber	MCE running, Not Synchronized and engine state is SYNCHRONIZING, SYNTONIZING or HOLDOVER
Green	MCE running, Locked / Synchronized
Management Port	
Both off	No Link
Yellow only	10M Link
Green	100M Link
Yellow blinking	Traffic
PTP Port 1/2	
Both off	No link
Green only	100M link, blinking if traffic
Yellow only	1000M link, blinking if traffic
Both on	10M link, blinking if traffic

Power

The options are -48 VDC, (-34 to -60 VDC supply) or 28 – 40 VAC. 17-25W power consumption, depending on oscillator option. Table provides the estimated power consumption based on the oscillator used.

Table 21 Estimated power consumption based on oscillator option

Oscillator Option	Power Consumption
OCXO	17 watts
Super OCXO	25 watts

Physical dimensions

- Size: 218 (W) x 160 (D) x 43 (H) mm excluding connectors
- Weight: 1.01 kg

MTBF

The reliability prediction of the Qg 2 has been in accordance with the Telcordia Technologies Special Report SR-332, issue 2:

- MTBF (hours): 162k
- Environmental conditions: Ground, Benign and ambient temperature 40 °C.

Software Upgrade

This chapter discusses the following topics:

- “Software Releases” on page 112
- “Software Upgrade Mechanism” on page 112
- “Software Upgrade and SWM” on page 114

Software Releases

Viavi Solutions provides updated software to the customers on a regular basis in the form of software image releases. These images would typically include new features, enhancements and fixes for issues found. When a new software is released it includes:

- New Release Notes for that specific version
- Updated User Guide document (as needed)

Email notifications will go out to all the customers about the availability of the new release and the related collaterals (Release Notes, User Guide). They are also made available on Viavi Support portal for registered users to be able to access and download it.

The image is in an encrypted, binary format, which after downloading, is installed on the Qg 2 unit. The specifics of the mechanism will be addressed in the next section.

Software Upgrade Mechanism

The new version of Qg 2 software can be installed by one of the following methods. After successful installation (takes about 3 – 4 minutes), Qg 2 will automatically reboot and start a new session with the new software.

 **NOTE**

Do not power down or restart the unit during the upgrade process. Doing so may lead to undesirable results. If the installation encounters any error, appropriate notification is made to the user and a reboot may be necessary.

Software Upgrade via WebUI and SFTP (Secure FTP)

The software image should be placed on a server on the same network as Qg 2 management port. The image (or a soft link to it) should be in the /home/<user> folder if it is a Linux server.

From Qg 2 System webpage, the IP address of the SFTP server, the user credentials and the image filename should be provided and followed by pressing the Start SW Upgrade button as shown in Figure.

Figure 70 System page - software upgrade via FTP

The screenshot shows a configuration form for a software upgrade. At the top, a note says "[Note: A valid SWM license is required to upgrade]". Below it, there are two main sections: "From Local File" and "Protocol". Under "From Local File", there is a "Choose File" button with the message "No file chosen" and a link "- OR -". Under "Protocol", a dropdown menu is set to "SFTP". The form also includes fields for "Server IP" (10.0.1.61), "SW Image Filename*" (Qg2v12.1.77new18.fw), "Server Login Username" (johndoe), and "Server Password" (represented by five dots). At the bottom right are "Start SW Upgrade" and "Clear" buttons. Below the form is a "Software Upgrade Status" bar.

The Software Update Status bar at the bottom will show the progress of the upgrade.

Software Upgrade via WebUI and local disk

There is another option besides SFTP to install the new image from the webpage. If the release image is downloaded on a PC, and with the browser connected to Qg 2 unit over the network, then the installation can be easily accomplished. The image download from the local PC to remote Qg2 is done over HTTP(s). By clicking the “Browse” button and navigating to the location of the image and selecting it and then pressing the Start SW Upgrade button will start the installation.

The Software Update Status bar at the bottom will show the progress of the upgrade.

Software Upgrade via CLI

Using the CLI shell, the new software can be installed, as shown below. The option “2” provided in the command line of system Upgrade_Start tells Qg 2 software to use SFTP. That is the only option available from CLI. Option 1 is for FTP which has been deprecated and is not supported any longer.

Figure 71 shows the software upgrade using CLI.

Figure 71 Software upgrade via CLI

```
File Edit Setup Control Window Help  
  
Last login: Tue Dec 13 02:38:39 2022 from 10.0.8.2  
  
Sync> system Upgrade_Start 2 10.0.1.61 Qg2v12.1.77new19.fw  
Enter user name for FTP/SFTP server:johndoe  
Enter Password for FTP/SFTP server<max 20 char>:
```

Software Upgrade and SWM

With the release of 12.2.1 software, Viavi introduced the Software and Support Maintenance (SWM) license key mechanism. The license key is valid for a year and can be renewed by contacting Viavi Support. The SWM license key for a specific Qg 2 unit can be obtained by registered users on our support portal.

When a new software image is released(12.2.2 onwards), Qg 2 will first check if there is a valid SWM license key installed. If there is no license key or if the key has expired prior to this new release date, then it will prompt the user to renew the license and enter a new, valid SWM license key. Without which, the upgrade will not proceed.

The following sections show how to retrieve the information and install a new and valid SWM license key.

SWM on System webpage

The figure below shows the current license key (when installed) and an option to enter a new license key in case the previous one has expired.

[Figure 72](#) shows the SWM license.

Figure 72 SWM license on System page

Serial Number	59612
System Up Time	24 minutes
SWM License Key	QSWA-059612-1023-EDLN-MLXE-HABG (End Date: 10 / 2023)
Install new SWM Lic	<input type="text"/>
Activate	

SWM license on CLI

The SWM license information can be obtained and a new license key installed from CLI.

Figure shows the SWM license installation by CLI.

Figure 73 SWM license installation via CLI

```
Sync> license<srm> status
SWM-License Key Status: QSWA-059612-1023-EDLN-MLXE-HABG <End Date: 10 / 2023>

Sync> license<srm> install QSWA-059612-1023-EDLN-MLXE-HABG
SWM-License Installed successfully

Sync> □
```

Glossary

The following acronyms and abbreviations are used throughout the document.

Term	Description
1PPS	Pulse Per Second
1RU	1 Rack Unit, 1.75 inches or 44.45 millimeters
API	Application Program Interface
ASCII	American Standard Code for Information Interchange
BaseT	Megabits / second Transferred over CAT5 cable
BC	Boundary Clock
BMCA	Best Master Clock Algorithm
BNC	Bayonet Neill-Concelman connector
CAT5	Category 5 cable
CLI	Command Line Interface
C-RAN	Cloud-Radio Access Network
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Service
DST	Daylight Savings Time
E2E	End to End delay measurement mechanism
ESD	Electrostatic Discharge
ETH	Layer 2 network communication for PTP messages
FTP	File Transfer Protocol
FW	Firmware
GC	Gateway Clock
GM	Grand Master

Term	Description
GNSS	Global Navigation Satellite System
GPS	Global Position System
HMI	Human Machine Interface
HTTP	HyperText Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LAN	Local Area Network
LED	Light-emitting Diode
MAC	Media Access Control address
Mbps	Megabits per second
MGMT Port	Management Port
MHz	Megahertz Frequency
Mini-USB	Mini Universal Serial Bus
MCE	Managed Clock Engine
NMEA	National Marine Electronics Association
NV	Nonvolatile Memory
OC	Ordinary Clock
OCXO	Oven Controlled Crystal Oscillator
P2P	Peer to Peer delay measurement mechanism
PLL	Phase Locked Loop
PoE	Power over Ethernet
PTP	Precise Time Protocol
PWR	Power
RF	Radio Frequency
RU	Rack Unit
RMC	Recommended Minimum data for GPS, Sentence C from NMEA
SFP	Small Form-Factor Pluggable transceiver
SFTP	SSH File Transfer Protocol or Secure File Transfer Protocol
SMA	SubMiniature version A connector
SNMP	Simple Network Management Protocol

Term	Description
SSH	Secure Shell cryptographic network protocol
ToD	Time of Day
TTL	Transistor-transistor Logic
TZ	Time Zone
UDP	User Datagram Protocol, IPv4. Layer 3 network communication
UDP6	User Datagram Protocol, IPv6. Layer 3 network communication
UIP	User Interface Processor
UTC	Coordinated Universal Time
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
WAN	Wide Area Network
XML	eXtensible Markup Language
ZDA	Data and Time from GPS, NMEA standard

End User License Agreement

End User License Agreement (2024-2025)

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