



Configuring PTP

Precision Time Protocol (PTP) is a protocol that defines a method to distribute time around a network. PTP support is based on the IEEE 1588-2008 standard.

This module describes the concepts around this protocol and details the various configurations involved. For information on PTP commands, see *System Management Command Reference for Cisco ASR 9000 Series Routers*.

Table 1: Feature History for Configuring PTP on Cisco IOS XR Software:

Release	Modification
Release 4.2.0	This feature was introduced.
Release 4.3.1	Support for PTP in Ethernet link bundles was added.
Release 5.3.2	Support for the RSP IEEE 1588 port was added for the PIDs A9K-RSP880-TR, A9K-RSP880-SE.
Release 6.0.1	Support for the RSP IEEE 1588 port was added for the PIDs A9K-RSP440-SE, A9K-RSP440-TR, A9K-RP-SE, A9K-RP-TR.

This module contains the following topics:

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Overview

The Precision Time Protocol (PTP), as defined in the IEEE 1588 standard, synchronizes with nanosecond accuracy the real-time clocks of the devices in a network. The clocks are organized into a master-slave hierarchy. PTP identifies the port that is connected to a device with the most precise clock. This clock is referred to as the master clock. All the other devices on the network synchronize their clocks with the master and are referred to as members. Constantly-exchanged timing messages ensure continued synchronization. PTP ensures that the best available clock is selected as the source of time (the grandmaster clock) for the network and that other clocks in the network are synchronized to the grandmaster.

Table 2: PTP Clocks

Network Element	Description
Grandmaster (GM)	A network device physically attached to the primary time source. All clocks are synchronized to the grandmaster clock.
Ordinary Clock (OC)	<p>An ordinary clock is a 1588 clock with a single PTP port that can operate in one of the following modes:</p> <ul style="list-style-type: none"> • Master mode—Distributes timing information over the network to one or more slave clocks, thus allowing the slave to synchronize its clock to the master. • Slave mode—Synchronizes its clock to a master clock. You can enable the slave mode on up to two interfaces simultaneously in order to connect to two different master clocks.
Boundary Clock (BC)	<p>The device participates in selecting the best master clock and can act as the master clock if no better clocks are detected.</p> <p>Boundary clock starts its own PTP session with a number of downstream slaves. The boundary clock mitigates the number of network hops and results in packet delay variations in the packet network between the Grand Master and Slave.</p>
Transparent Clock (TC)	A transparent clock is a device or a switch that calculates the time it requires to forward traffic and updates the PTP time correction field to account for the delay, making the device transparent in terms of time calculations.

PTP consists of two parts:

- The port State machine and Best Master Clock Algorithm: This provides a method to determine the ports in the network that will remain passive (neither master nor slave), run as a master (providing time to other clocks in the network), or run as slaves (receiving time from other clocks in the network).
- Delay-Request/Response mechanism and a Peer-delay mechanism: This provides a mechanisms for slave ports to calculate the difference between the time of their own clocks and the time of their master clock.



Note Cisco ASR 9000 Series routers do not support Peer-delay mechanism.

The implementation of PTP on Cisco IOS XR software is designed to operate effectively in Telecommunication networks, which are different from the networks for which PTP was originally designed.

PTP is configurable on Gigabit Ethernet interfaces (1G, 10G, 40G, and 100G), Bundle Ethernet interfaces, and sub-interfaces. PTP is not configurable on LAG Ethernet sub-interfaces.

Frequency and Time Selection

The selection of the source to synchronize the backplane clock frequency is made by frequency synchronization, and is outside of the scope of PTP. The Announce, Sync, and Delay-request frequencies must be the same on the master and slave.

Delay-Response Mechanism

The Delay Request-response mechanism (defined in section 11.3 of IEEE Std 1588-2008) lets a slave port estimate the difference between its own clock-time and the clock-time of its master. The following options are supported:

- One-step mechanism - The timestamp for a Sync message is sent in the Sync message itself.
- Two-step mechanism - The timestamp for a Sync message is sent later in a Follow-up message.

When running a port in Slave state, a router can send Delay-request messages and handle incoming Sync, Follow-up, and Delay-response messages. The timeout periods for both Sync and Delay-response messages are individually configurable.

Hybrid Mode

Your router allows the ability to select separate sources for frequency and time-of-day (ToD). Frequency selection can be between any source of frequency available to the router, such as: BITS, GPS, SyncE or IEEE 1588 PTP. The ToD selection is between the source selected for frequency and PTP, if available (ToD selection is from GPS, DTI or PTP). This is known as hybrid mode, where a physical frequency source (BITS or SyncE) is used to provide frequency synchronization, while PTP is used to provide ToD synchronization.

Frequency selection uses the algorithm described in ITU-T recommendation G.871, and is described in the *Configuring Frequency Synchronization* module in this document. The ToD selection is controlled using the time-of-day priority configuration. This configuration is found under the source interface frequency synchronization configuration mode and under the global PTP configuration mode. It controls the order for which sources are selected for ToD. Values in the range of 1 to 254 are allowed, with lower numbers indicating higher priority.

Port States

State machine indicates the behavior of each port. The possible states are:

State	Description
INIT	Port is not ready to participate in PTP.
LISTENING	First state when a port becomes ready to participate in PTP: In this state, the port listens to PTP masters for a (configurable) period of time.
PRE-MASTER	Port is ready to enter the MASTER state.
MASTER	Port provides timestamps for any Slave or boundary clocks that are listening.

State	Description
UNCALIBRATED	Port receives timestamps from a Master clock but, the router's clock is not yet synchronized to the Master.
SLAVE	Port receives timestamps from a Master clock and the router's clock is synchronized to the Master.
PASSIVE	Port is aware of a better clock than the one it would advertise if it was in MASTER state and is not a Slave clock to that Master clock.

GPS ToD Support for NMEA

National Marine Electronics Associations (NMEA) 0183 is a standard protocol used by GPS receivers to transmit data and is responsible for creating a standard uniform interface for digital data exchange between different marine electronic products. NMEA provides protocol strings to send out GPS updates. GPRMC is one such NMEA string that provides exact data and time (Greenwich time), latitude, longitude, heading, and speed. Router receives GPS ToD messages in serial ASCII stream through the RS422 interface in three formats - NTP Type 4, Cisco, and GPRMC. The timing data is extracted from this stream.



Note

Cisco ASR 9000 Series Routers can support ToD in NMEA or GPRMC format. Currently, this is supported only on RS422.



Note

You can refer to the below support information in context of the current release and see relevant *Release Notes* for more information on supported features and hardware.

Supported hardware are:

- A9K-RSP440-SE/TR
- A9K-RSP880-SE/TR
- A99-RP2-SE/TR

PTP Support Information

This table lists different types of support information related to PTP:

Transport Media	<ul style="list-style-type: none"> • UDP over IPv4 • Ethernet • IPv6
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Messages	<ul style="list-style-type: none"> • Signaling • Announce • Sync • Follow-up • Delay-request • Delay-response • Management
Transport Modes	<ul style="list-style-type: none"> • Unicast: This is the default mode. All packets are sent as unicast messages. • Mixed: Announce and Sync messages are sent as multicast messages. Signaling, Delay-request, and Delay-response messages are sent as unicast messages. • Multicast: All packets are sent as multicast messages.

PTP Hardware Support Matrix



Note The table also contains support details of upcoming releases. You can read this table in context of the current release and see relevant *Release Notes* for more information on supported features and hardware.

This table provides a detailed information on the supported hardware:

Hardware Variant	1588/PTP	Cisco IOS XR	Cisco IOS XR 64 bit	Comments
A9K-8X100GE-L-SE/TR (10GE and 100GE)	Default & G.8265.1	5.3.3	6.3.2 6.4.1	PTP over Ethernet does not work on 100G ports on Cisco IOS XR until 6.4.1. Support was introduced in 6.4.1.
	G.8275.1 & G.8275.2	6.2.1	6.3.2 6.4.1	
	G.8273.2	6.2.1	6.3.2	
	PTP Multiprofile	6.5.1	6.5.1	

A9K-RSP880-SE/TR	1588/PTP Default & G.8265.1	5.3.3	6.3.2 6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	6.2.1	6.3.2 6.4.1	
	1588/PTP G.8273.2	6.2.1	6.3.2 6.4.1	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-8X100GE-L-SE/TR (40-GE)	1588/PTP Default & G.8265.1	6.0.1	6.3.2 6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	6.2.1	6.3.2 6.4.1	
	1588/PTP G.8273.2	NA	NA	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-4X100GE-SE/TR A9K-8X100GE-SE/TR	1588/PTP Default & G.8265.1	6.2.1	6.4.1	PTP over Ethernet does not work on 100G ports on Cisco IOS XR until 6.4.1. Support was introduced in 6.4.1. In 6.2.1, only G.8275.1 PTP profile is supported on the cards; No support for G.8273.2 PTP profile.
	1588/PTP G.8275.1 & G.8275.2	6.2.1	6.4.1	
	1588/PTP G.8273.2	6.4.1	6.4.1	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-MOD400-SE/TR & A9K-MOD200-SE/TR with Legacy MPAs	1588/PTP Default & G.8265.1	6.1.3	6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	6.2.2	6.4.1	-
	1588/PTP G.8273.2	-	-	-
	PTP Multiprofile	6.5.1	6.5.1	-

A9K-MOD400-SE/TR & A9K-MOD200-SE/TR with MPA 20x10GE , A9K-MPA-1X100GE and A9K-MPA-2X100GE	1588/PTP Default & G.8265.1	6.1.3	6.4.1	PTP over Ethernet does not work on 100G ports on Cisco IOS XR until 6.4.1. Support was introduced in 6.4.1. In 6.2.2, only G.8275.1 PTP profile is supported on the cards. No support for G.8273.2 PTP profile until 6.5.1.
	1588/PTP G.8275.1 & G.8275.2	6.2.2	6.4.1	
	1588/PTP G.8273.2	6.5.1	6.5.1	
	PTP Multiprofile	6.5.1	6.5.1	
A99-12X100GE	1588/PTP Default & G.8265.1	6.3.2	6.3.2	-
	1588/PTP G.8275.1 & G.8275.2	6.3.2	6.3.2	
	1588/PTP G.8273.2	NA	-	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-24X10GE-1GSE/TR A9K-48X10GE-1GSE/TR	1588/PTP	6.2.2	6.3.2	-
	Default & G.8265.1	6.3.1		
	1588/PTP G.8275.1 & G.8275.2	6.2.2 6.3.1	6.3.2	
	1588/PTP G.8273.2	6.3.1	6.3.2	
	PTP Multiprofile	6.5.1	6.5.1	
A99-RSP-SE/TR (Cisco ASR 9910 Series Routers)	1588/PTP Default & G.8265.1	6.3.1	6.3.2	-
	1588/PTP G.8275.1 & G.8275.2	6.3.1	6.3.2	
	1588/PTP G.8273.2	6.4.1	6.3.2	
	PTP Multiprofile	6.5.1	6.5.1	

A9K-RSP880-LT-SE/TR	1588/PTP Default & G.8265.1	6.2.2	6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	6.2.2	6.4.1	
	1588/PTP G.8273.2	6.4.1	6.4.1	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-RSP440-TR/SE	1588/PTP Default & G.8265.1	4.3.4	NA	Enhanced Ethernet linecards do not support G.8273.2 with G.8275.1 PTP profile. .
A99-RP-SE	1588/PTP G.8275.1 & G.8275.2	NA	NA	
Enhanced Ethernet Linecards	1588/PTP G.8273.2	NA	NA	
A99-RP2-TR/SE	1588/PTP Default & G.8265.1	5.3.3	6.3.2 6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	6.2.1	6.3.2 6.4.1	
	1588/PTP G.8273.2	NA	NA	
Cisco ASR 9001 Series Routers	1588/PTP Default & G.8265.1	4.3.4	NA	Enhanced Ethernet based hardware does not support G.8273.2 with G.8275.1 PTP profile.
	1588/PTP G.8275.1 & G.8275.2	NA	NA	
	1588/PTP G.8273.2	NA	NA	

Cisco ASR 9901 Series Routers	1588/PTP Default & G.8265.1	NA	6.4.1	-
	1588/PTP G.8275.1 & G.8275.2	NA	6.4.1	
	1588/PTP G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.1	
A99-RSP-SE/TR (Cisco ASR 9906 Series Routers)	1588/PTP Default & G.8265.1	6.3.1	6.3.2	-
	1588/PTP G.8275.1 & G.8275.2	6.3.1	6.3.2	
	1588/PTP G.8273.2	6.4.1	6.3.2	
	PTP Multiprofile	6.5.1	6.5.1	
A9K-RSP5-SE	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	
A9K-RSP5-TR	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	

A99-RP3-SE	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	
A99-RP3-TR	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	
A9K-8X100GE-X-TR	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	
A9K-16X100GE-TR	1588/PTP Default & G.8265.1	NA	6.5.15	NA
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	
A9K-32X100GE-TR	1588/PTP Default & G.8265.1	NA	6.5.15	-
	1588/PTP G.8275.2	NA	6.5.15	
	1588/PTP G.8275.1 & G.8273.2	NA	6.6.1	
	PTP Multiprofile	NA	6.5.15	

Restrictions

- PTP Grandmaster (GM) is not supported with all the PTP profiles.

- RSP IEEE 1588 port on RSP/RP is not supported.
- Two-step clock operation is recommended over one-step clock operation for a PTP Master.
- 1 Pulse per Second (1PPS) output is not supported on Cisco ASR 9000 Series Routers.

ITU-T Telecom Profiles for PTP

Cisco IOS XR software supports ITU-T Telecom Profiles for PTP as defined in the ITU-T recommendation. A profile consists of PTP configuration options applicable only to a specific application.

Separate profiles can be defined to incorporate PTP in different scenarios based on the IEEE 1588-2008 standard. A telecom profile differs in several ways from the default behavior defined in the IEEE 1588-2008 standard and the key differences are mentioned in the subsequent sections.

The following sections describe the ITU-T Telecom Profiles that are supported for PTP.

G.8265.1 Profile

G.8265.1 profile fulfills specific frequency-distribution requirements in telecom networks. Features of G.8265.1 profile are:

- *Clock advertisement*: G.8265.1 profile specifies changes to values used in Announce messages for advertising PTP clocks. The clock class value is used to advertise the quality level of the clock, while the other values are not used.
- *Clock Selection*: G.8265.1 profile also defines an alternate Best Master Clock Algorithm (BMCA) to select port states and clocks is defined for the profile. This profile also requires to receive Sync messages (and optionally, Delay-Response messages) to qualify a clock for selection.
- *Port State Decision*: The ports are statically configured to be Master or Slave instead of using FSM to dynamically set port states.
- *Packet Rates*: The packet rates higher than rates specified in the IEEE 1588-2008 standard are used. They are:
 - Sync/Follow-Up Packets: Rates from 128 packets-per-second to 16 seconds-per-packet.
 - Delay-Request/Delay-Response Packets: Rates from 128 packets-per-second to 16 seconds-per-packet.
 - Announce Packets: Rates from 8 packets-per-second to 64 packets-per-second.
- *Transport Mechanism*: G.8265.1 profile only supports IPv4 PTP transport mechanism.
- *Mode*: G.8265.1 profile supports transport of data packets only in unicast mode.
- *Clock Type*: G.8265.1 profile only supports Ordinary Clock-type (a clock with only one PTP port).
- *Domain Numbers*: The domain numbers that can be used in a G.8265.1 profile network ranges from 4 to 23. The default domain number is 4.
- *Port Numbers*: All PTP port numbers can only be 1 because all clocks in a this profile network are Ordinary Clocks.

G.8265.1 profile defines an alternate algorithm to select between different master clocks based on the local priority given to each master clock and their quality levels (QL). This profile also defines Packet Timing Signal Fail (PTSF) conditions to identify the master clocks that do not qualify for selection. They are:

- PTSF-lossSync condition: Raised for master clocks that do not receive a reliable stream of Sync and Delay-Resp messages. Cisco IOS XR software requests Sync and Delay-Resp grants for each configured master clock to track the master clock with this condition.
- PTSF-lossAnnounce condition: Raised for master clocks that do not receive a reliable stream of Announce messages.
- PTSF-unusable condition: Raised for master clocks that receives a reliable stream of Announce, Sync, and Delay-Resp messages, but not usable by slave clocks. Cisco IOS XR software does not use this condition.

Hardware variant-specific behavior

The profile G8265.1 displays the following behavior on these hardware variants A9K-RSP5-SE, A9K-RSP5-TR, A99-RP3-SE, and A99-RP3-TR:

- Configuring either a master or slave clock type is mandatory.
- G.8265.1 is only a frequency synchronization profile and the servo state is displayed as `FREQ_LOCKED` and the PTP slave interface remains as slave. Phase synchronization is not supported.
- G.8265.1 profile supports only PTP pure mode and not PTP hybrid mode.

Configuring PTP

Prerequisite

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

PTP Interface and Profile Configuration

When a global PTP profile is attached to an interface, its values are used as default settings for that interface. When additional settings are configured under an interface itself, these settings override the defaults in that profile. When no profile is attached to an interface, the configuration on the interface is used to determine the PTP settings for that interface.

When configuring PTP, use one of the following approaches:

- Create a profile (or multiple profiles) containing all the default settings to use on all PTP interfaces. Override any settings that differ for particular interfaces by using the interface configuration under the interfaces themselves.
- Configure all settings separately for each interface, without using any global profiles. Use this approach if the interfaces do not have consistent settings, or if you are configuring only a small number of PTP interfaces.

Configuring Frequency Synchronization and Quality Settings for PTP

This procedure describes the steps involved to configure frequency and quality settings for PTP on a router.

1. To enable frequency synchronization on the router, use **frequency synchronization** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# frequency synchronization
```

2. To configure ITU-T quality parameters, use **quality itu-t option *option* generation *number*** command in the frequency synchronization configuration mode.

- **option 1:** Includes PRC, SSU-A, SSU-B, SEC, and DNU. This is the default option.
- **option 2 generation 1:** Includes PRS, STU, ST2, ST3, SMC, and DUS.
- **option 2 generation 2:** Includes PRS, STU, ST2, ST3, TNC, ST3E, SMC, and DUS.



Note

The **quality option** configured here must match the **quality option** specified in the **quality receive** and **quality transmit** commands.

```
RP/0/RSP0/CPU0:router(config-freqsync)# quality itu-t
option 2 generation 2
```

Verification

To display the frequency synchronization selection, use **show frequency synchronization selection** command.

```
RP/0/RSP0/CPU0:router# show frequency synchronization selection
Node 0/RSP1/CPU0:
=====
Selection point: T0-SEL-B (3 inputs, 1 selected)
  Last programmed 06:49:27 ago, and selection made 06:49:15 ago
  Next selection points
    SPA scoped      : None
    Node scoped     : T4-SEL-C CHASSIS-TOD-SEL
    Chassis scoped: LC_TX_SELECT
    Router scoped  : None
  Uses frequency selection
  Used for local line interface output
  S  Input                               Last Selection Point      QL  Pri  Status
  == =====
  1  Sync1 [0/RSP1/CPU0]                 n/a                       PRC  1   Locked
    HundredGigE0/5/0/2                 0/5/CPU0 ETH_RXMUX 1     PRC  1   Available
    Internal0 [0/RSP1/CPU0]             n/a                       SEC  255  Available

Selection point: T4-SEL-A (1 inputs, 1 selected)
  Last programmed 06:49:27 ago, and selection made 06:49:15 ago
  Next selection points
    SPA scoped      : None
    Node scoped     : T4-SEL-C
    Chassis scoped: None
    Router scoped  : None
  Uses frequency selection
  S  Input                               Last Selection Point      QL  Pri  Status
```

```

== =====
1 HundredGigE0/5/0/2      0/5/CPU0 ETH_RXMUX 1      PRC      1 Available

Selection point: T4-SEL-C (2 inputs, 1 selected)
Last programmed 06:49:15 ago, and selection made 06:49:15 ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: None
  Router scoped  : None
Uses frequency selection
Used for local clock interface output
S  Input                Last Selection Point                QL  Pri  Status
== =====
1  Sync1 [0/RSP1/CPU0]   0/RSP1/CPU0 T0-SEL-B 1      PRC  1  Locked
   HundredGigE0/5/0/2   0/RSP1/CPU0 T4-SEL-A 1      PRC  1  Available

Selection point: CHASSIS-TOD-SEL (1 inputs, 1 selected)
Last programmed 6d04h ago, and selection made 6d04h ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: None
  Router scoped  : None
Uses time-of-day selection
S  Input                Last Selection Point                Pri  Time  Status
== =====
1  Sync1 [0/RSP1/CPU0]   0/RSP1/CPU0 T0-SEL-B 1      100  Yes  Available

Node 0/3/CPU0:
=====
Selection point: ETH_RXMUX (0 inputs, 0 selected)
Last programmed 9w6d ago, and selection made 9w6d ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: T0-SEL-B T4-SEL-A
  Router scoped  : None
Uses frequency selection

Selection point: LC_TX_SELECT (1 inputs, 1 selected)
Last programmed 9w6d ago, and selection made 9w6d ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: None
  Router scoped  : None
Uses frequency selection
Used for local line interface output
S  Input                Last Selection Point                QL  Pri  Status
== =====
24 Sync1 [0/RSP1/CPU0]   0/RSP1/CPU0 T0-SEL-B 1      PRC  1  Available

Node 0/5/CPU0:
=====
Selection point: ETH_RXMUX (1 inputs, 1 selected)
Last programmed 06:49:27 ago, and selection made 06:49:27 ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: T0-SEL-B T4-SEL-A
  Router scoped  : None
Uses frequency selection
S  Input                Last Selection Point                QL  Pri  Status

```

```

== =====
1 HundredGigE0/5/0/2 n/a PRC 1 Available

Selection point: LC_TX_SELECT (1 inputs, 1 selected)
Last programmed 6d04h ago, and selection made 6d04h ago
Next selection points
  SPA scoped : None
  Node scoped : None
  Chassis scoped: None
  Router scoped : None
Uses frequency selection
Used for local line interface output
S Input Last Selection Point QL Pri Status
=====
24 Sync1 [0/RSP1/CPU0] 0/RSP1/CPU0 T0-SEL-B 1 PRC 1 Available

```

Configuring Global Profile

This procedure describes the steps involved to create a global configuration profile for a PTP interface that can then be assigned to any interface as required.

1. To enter the PTP configuration mode, use **ptp** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# ptp
```

2. To configure a PTP profile, use **profile** command in the ptp configuration mode.

```
RP/0/RSP0/CPU0:router(config-ptp)# profile tp64
```

3. To configure frequency for a Sync message for the given PTP profile, use **sync frequency rate** command in the ptp-profile configuration mode.

```
RP/0/RSP0/CPU0:router(config-ptp-profile)# sync frequency 16
```

4. To configure delay-request frequency for the given PTP profile, use **delay-request frequency rate** command in the ptp-profile configuration mode.

```
RP/0/RSP0/CPU0:router(config-ptp-profile)# delay-request frequency 16
```

Verification

To display the configured PTP profile details, use **show run ptp** command.

```
RP/0/RSP0/CPU0:router# show run ptp
```

```

Wed Feb 28 11:16:05.943 UTC
ptp
clock
  domain 24
  profile g.8275.1 clock-type T-BC
!
profile slave
  transport ethernet
  sync frequency 16
  announce interval 1
  delay-request frequency 16

```

```

!
profile master
  transport ethernet
  sync frequency 16
  announce interval 1
  delay-request frequency 16
!
profile slave1
  transport ethernet
  sync frequency 64
  announce interval 1
  delay-request frequency 64
!

```

Configuring PTP Slave Interface

This procedure describes the steps involved to configure a PTP interface to be a Slave.

1. To configure an interface, use **interface** *type interface-path-id* command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# interface TenGigE 0/1/0/5
```

2. To enter the PTP configuration mode for the given interface, use **ptp** command in the interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if)# ptp
```

3. To configure a PTP profile (or specify a previously defined profile), use **profile** *name* command in the ptp interface configuration mode.



Note

Any additional commands entered in ptp-interface configuration mode overrides the global profile settings.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# profile tp64
```

4. To configure the transport mode for all PTP messages in the given PTP profile, use **transport** *mode_type* command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# transport ipv4
```

5. To configure timeout for PTP announce messages in the given PTP profile, use **announce** *interval interval-value* command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# announce interval 1
```

6. To configure the port state, use **port state** command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# port state slave-only
```

7. To configure IPv4 or IPv6 address for PTP master, use **master** *ipv4|ipv6 address* command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# master ipv4 192.168.2.1
```



```
RP/0/RSP0/CPU0:router(config-if-ptp)# master ipv6 2001:DB8::1
```

8. To return to the interface configuration mode, use **exit** command.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# exit
```

9. To configure a gateway for the given interface, use **ipv4 address address mask** command in the interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if)# ipv4 address 1.7.1.2 255.255.255.0
```

Verification

To verify the port state details, use **show run interface interface-name** command.

```
RP/0/RSP0/CPU0:router# show run interface TenGigE 0/1/0/5
```

```
Fri Aug 3 19:57:14.184 UTC
interface TenGigE 0/1/0/5
  ptp
  profile tp64
  transport ipv4
  port state slave-only
  master ipv4 192.168.2.1
  !
  announce interval 1
  !
  ipv4 address 1.7.1.1 255.255.255.0
  !
```

Configuring PTP Master Interface

This procedure describes the steps involved to configure a PTP interface to be a Master.

1. To configure an interface, use **interface type interface-path-id** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# interface TenGigE 0/1/0/5
```

2. To enter the PTP configuration mode for the given interface, use **ptp** command in the interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if)# ptp
```

3. To configure a PTP profile (or specify a previously defined profile), use **profile name** command in the ptp interface configuration mode.



Note

Any additional commands entered in PTP interface configuration mode override settings in this profile.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# profile tp64
```

4. To configure the transport mode for all PTP messages in the given PTP profile, use **transport mode_type** command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# transport ipv4
```

5. To configure timeout for PTP announce messages in the given PTP profile, use **announce interval interval-value** command in the ptp interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# announce interval 1
```

6. To return to the interface configuration mode, use **exit** command.

```
RP/0/RSP0/CPU0:router(config-if-ptp)# exit
```

7. To configure a gateway for the given interface, use **ipv4 address address mask** command in the interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-if)# ipv4 address 1.7.1.2 255.255.255.0
```

Verification

To verify the port state details, use **show run interface interface-name** command.

```
RP/0/RSP0/CPU0:router# show run interface TenGigE 0/1/0/5
```

```
Fri Aug 3 13:57:44.366 PST
interface TenGigE 0/1/0/5
 ptp
  profile tp64
  transport ipv4
  !
  announce interval 1
  !
  ipv4 address 1.7.1.2 255.255.255.0
  !
```

Configuring Clock Interface for a PTP Master

This procedure describes the steps involved to configure a Clock interface for a Master.

1. To configure a clock interface, use **clock-interface sync value location node** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# clock-interface sync 1 location 0/RSP0/CPU0
```

2. To configure port parameters for the given clock interface, use **port-parameters dti** command in the clock-interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-clock-if)# port-parameters dti
```

3. To enable frequency synchronization, use **frequency synchronization** command in the clock-interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-clock-if)# frequency synchronization
```

4. To configure selection input for the given clock interface, use **selection input** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# selection input
```

5. To configure priority for the clock interface, use **priority number** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# priority 1
```

6. To configure wait-to-restore time for the clock interface, use **wait-to-restore number** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# wait-to-restore 0
```

7. To disable SSM packets for the clock interface, use **ssm disable** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# ssm disable
```

8. To configure quality settings for the clock interface, use **quality receive exact itu-t option number generation number PRS** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive exact itu-t option 2  
generation 2 PRS
```

Verification

To display the current running configuration of an interface, use **show run clock-interface** command.

```
RP/0/RSP0/CPU0:router# show run clock-interface sync 1 location 0/RSP0/CPU0

clock-interface sync 1 location 0/RSP0/CPU0
port-parameters
    dti
!
frequency synchronization
    selection input
    priority 1
    wait-to-restore 0
    ssm disable
    quality receive exact itu-t option 2 generation 2 PRC
!
RP/0/RSP0/CPU0:router#
```

Configuring PTP Hybrid Mode

This procedure describes the steps involved to configure router in a hybrid mode. You can do this by selecting PTP for Time-of-Day (ToD) and another source for frequency.

1. To enable frequency synchronization on the router, use **frequency synchronization** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# frequency synchronization
```

2. To configure a SyncE source, create an interface to be a SyncE input. This can be configured using **interface** command in the configuration mode.

**Note**

The time-of-day-priority setting specifies that SyncE to be used as a ToD source if there is no source available with a lower priority.

```
RP/0/RSP0/CPU0:router(config)# interface GigabitEthernet 0/1/0/0
RP/0/RSP0/CPU0:router(config-if)# frequency synchronization
RP/0/RSP0/CPU0:router(config-if-freqsync)# selection input
RP/0/RSP0/CPU0:router(config-if-freqsync)# time-of-day-priority 100
RP/0/RSP0/CPU0:router(config-if-freqsync)# commit
```

3. To configure PTP as the source for ToD, enable PTP on the router using **ptp** command in command in the configuration mode. ToD priority values can range from 1 (highest priority) to 254 (lowest priority).

```
RP/0/RSP0/CPU0:router(config)# ptp
RP/0/RSP0/CPU0:router(config-ptp)# time-of-day-priority 1
RP/0/RSP0/CPU0:router(config)# commit
```

4. To configure a PTP interface, use **interface** command in configuration mode. To enable this interface as a PTP Master, use **master** command in ptp-interface configuration mode.

```
RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/1/0/1
RP/0/RSP0/CPU0:router(config-if)# ipv4 address 10.0.0.1/24
RP/0/RSP0/CPU0:router(config-if)# ptp
RP/0/RSP0/CPU0:router(config-if-ptp)# master ipv4 10.0.0.2
RP/0/RSP0/CPU0:router(config-if-ptp)# commit
```

Verification

To display the frequency synchronization selection, use **show frequency synchronization selection** command.

```
RP/0/RSP0/CPU0:router# show frequency synchronization selection
Node 0/RSP1/CPU0:
=====
Selection point: T0-SEL-B (3 inputs, 1 selected)
  Last programmed 06:49:27 ago, and selection made 06:49:15 ago
  Next selection points
    SPA scoped      : None
    Node scoped     : T4-SEL-C CHASSIS-TOD-SEL
    Chassis scoped  : LC_TX_SELECT
    Router scoped   : None
  Uses frequency selection
  Used for local line interface output
  S   Input                               Last Selection Point          QL  Pri  Status
  ==  =====
=====
```

```

1 Sync1 [0/RSP1/CPU0]      n/a                PRC    1    Locked
  HundredGigE0/5/0/2       0/5/CPU0 ETH_RXMUX 1        PRC    1    Available
  Internal0 [0/RSP1/CPU0]   n/a                SEC   255   Available

```

Selection point: T4-SEL-A (1 inputs, 1 selected)

Last programmed 06:49:27 ago, and selection made 06:49:15 ago

Next selection points

```

SPA scoped    : None
Node scoped   : T4-SEL-C
Chassis scoped: None
Router scoped : None

```

Uses frequency selection

S	Input	Last Selection Point	QL	Pri	Status
1	HundredGigE0/5/0/2	0/5/CPU0 ETH_RXMUX 1	PRC	1	Available

Selection point: T4-SEL-C (2 inputs, 1 selected)

Last programmed 06:49:15 ago, and selection made 06:49:15 ago

Next selection points

```

SPA scoped    : None
Node scoped   : None
Chassis scoped: None
Router scoped : None

```

Uses frequency selection

Used for local clock interface output

S	Input	Last Selection Point	QL	Pri	Status
1	Sync1 [0/RSP1/CPU0]	0/RSP1/CPU0 T0-SEL-B 1	PRC	1	Locked
	HundredGigE0/5/0/2	0/RSP1/CPU0 T4-SEL-A 1	PRC	1	Available

Selection point: CHASSIS-TOD-SEL (1 inputs, 1 selected)

Last programmed 6d04h ago, and selection made 6d04h ago

Next selection points

```

SPA scoped    : None
Node scoped   : None
Chassis scoped: None
Router scoped : None

```

Uses time-of-day selection

S	Input	Last Selection Point	Pri	Time	Status
1	Sync1 [0/RSP1/CPU0]	0/RSP1/CPU0 T0-SEL-B 1	100	Yes	Available

Node 0/3/CPU0:

=====

Selection point: ETH_RXMUX (0 inputs, 0 selected)

Last programmed 9w6d ago, and selection made 9w6d ago

Next selection points

```

SPA scoped    : None
Node scoped   : None
Chassis scoped: T0-SEL-B T4-SEL-A
Router scoped : None

```

Uses frequency selection

Selection point: LC_TX_SELECT (1 inputs, 1 selected)

Last programmed 9w6d ago, and selection made 9w6d ago

Next selection points

```

SPA scoped    : None
Node scoped   : None
Chassis scoped: None
Router scoped : None

```

Uses frequency selection

Used for local line interface output

S	Input	Last Selection Point	QL	Pri	Status
---	-------	----------------------	----	-----	--------

```

24 Sync1 [0/RSP1/CPU0]          0/RSP1/CPU0 T0-SEL-B 1      PRC      1  Available

Node 0/5/CPU0:
=====
Selection point: ETH_RXMUX (1 inputs, 1 selected)
Last programmed 06:49:27 ago, and selection made 06:49:27 ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: T0-SEL-B T4-SEL-A
  Router scoped  : None
Uses frequency selection
S  Input          Last Selection Point          QL  Pri  Status
== =====
1  HundredGigE0/5/0/2  n/a                      PRC   1  Available

Selection point: LC_TX_SELECT (1 inputs, 1 selected)
Last programmed 6d04h ago, and selection made 6d04h ago
Next selection points
  SPA scoped      : None
  Node scoped     : None
  Chassis scoped: None
  Router scoped  : None
Uses frequency selection
Used for local line interface output
S  Input          Last Selection Point          QL  Pri  Status
== =====
24 Sync1 [0/RSP1/CPU0]  0/RSP1/CPU0 T0-SEL-B 1      PRC   1  Available

```

Configuring GPS Settings for a Grand Master Clock

This procedure describes the steps involved to configure GPS settings for a PTP Grandmaster clock.

1. To configure a clock interface, use **clock-interface sync port-number location interface-location** command in the configuration mode.

```
RP/0/RSP0/CPU0:router(config)# clock-interface sync 2 location 0/RSP0/CPU0
```

2. To configure port parameters for the given clock interface, use **port-parameters** command in the clock-interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-clock-if)# port-parameters
```

3. To configure GPS input parameters, use **gps-input tod-format gprmc pps-input ttl** command.

```
RP/0/RSP0/CPU0:router(config-clk-parms)# gps-input tod-format
gprmc pps-input ttl
```

4. To return to the clock-interface configuration mode, use **exit** command.

```
RP/0/RSP0/CPU0:router(config-clk-parms)# exit
```

5. To enable frequency synchronization, use **frequency synchronization** command in the clock-interface configuration mode.

```
RP/0/RSP0/CPU0:router(config-clock-if)# frequency synchronization
```

6. To configure selection input for the given clock interface, use **selection input** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# selection input
```

7. To configure priority for the clock interface, use **priority number** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# priority 10
```

8. To configure wait-to-restore time for the clock interface, use **wait-to-restore number** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# wait-to-restore 0
```

9. To disable SSM packets for the clock interface, use **ssm disable** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# ssm disable
```

10. To configure quality settings for the clock interface, use **quality receive exact itu-t option number generation number PRS** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive exact itu-t option 2  
generation 2 PRS
```

Verification

To verify the configured GPS parameters , use **show run clock-interface** command.

```
RP/0/RSP0/CPU0:router# show run clock-interface sync 2 location 0/RSP0/CPU0

clock-interface sync 2 location 0/RSP0/CPU0
port-parameters
gps-input tod-format gprmc pps-input ttl
!
```

Configuration Examples

Slave Configuration Example

The following example shows a PTP slave configuration:

```
interface TenGigE 0/1/0/5
 ptp
  profile tp64
  transport ipv4
  port state slave-only
  master ipv4 1.7.1.2
  !
 announce interval 1
```

```
!
ipv4 address 1.7.1.1 255.255.255.0
!
```

Master Configuration Example

This example shows a PTP master configuration:

```
ptp
 profile tp64
 transport ipv4
 announce interval 1
!
ipv4 address 1.7.1.2 255.255.255.0
!
```

GPS Configuration Example

This example shows the GPS configuration for PTP.

```
clock-interface sync 2 location 0/RSP0/CPU0
port-parameters
 gps-input tod-format gprmc pps-input ttl
!
frequency synchronization
 selection input
 priority 2
 wait-to-restore 0
 ssm disable
 quality receive exact itu-t option 2 generation 2 PRS
!
!
```

PTP Hybrid Mode Configuration Example

This example shows the configuration of PTP hybrid mode:

```
ptp
 time-of-day priority 10
!
interface GigabitEthernet0/1/1/0
 ptp
 transport ipv4
 port state slave-only
 master ipv4 192.168.52.38
!
 sync frequency 64
 announce interval 1
 delay-request frequency 64
!
interface GigabitEthernet 0/1/0/1
```



```
ipv4 address 192.168.52.41 255.255.255.0
speed 100
frequency synchronization
selection input
priority 10
wait-to-restore 0
ssm disable
time-of-day-priority 100
!
```

