

Precision Time Protocol

Precision Time Protocol (PTP) is a time synchronization protocol defined in IEEE 1588 for nodes distributed across a network. With PTP, it is possible to synchronize distributed clocks with an accuracy of less than 1 microsecond via Ethernet networks. In addition, PTP's hardware timestamping feature provides timestamp information in the ERSPAN Type III header that can be used to calculate packet latency among edge, aggregate, and core switches.

PTP is a distributed protocol that specifies how real-time PTP clocks in the system synchronize with each other. These clocks are organized into a master-slave synchronization hierarchy with the grandmaster clock, which is the clock at the top of the hierarchy, determining the reference time for the entire system. Synchronization is achieved by exchanging PTP timing messages, with the members using the timing information to adjust their clocks to the time of their master in the hierarchy. PTP operates within a logical scope called a PTP domain.

A PTP system can consist of a combination of PTP and non-PTP devices. PTP devices include ordinary clocks, boundary clocks, and transparent clocks. Non-PTP devices include ordinary network switches, routers, and other infrastructure devices.

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Functionality

PTP supports the following functionality:

- Multicast and unicast PTP transport—In the multicast transport mode, PTP uses multicast destination IP address 224.0.1.129 as per IEEE 1588 standards for communication between devices. For the source IP address, it uses the user configurable global IP address under the PTP domain. In the unicast transport mode, PTP uses configurable unicast source and destination IP addresses that can be configured under

an interface. In both, the unicast and the multicast modes, PTP uses UDP ports, 319 for event messages and 320 for general messages communication between devices.

- PTP multicast configuration is supported only under physical interface for L2 or L3.
- PTP unicast configuration is supported only under physical interface for L2 or L3.
- PTP is not supported with virtual interfaces such as Port-channel, SVI, and tunnel only when configured on associated physical interfaces. When PTP unicast is configured on L2/L3 Port-Channel members, the unicast source IP configuration is derived from the PTP VLAN SVI primary IP or L3 Port-Channel primary IP respectively.
- PTP encapsulation over UDP over IP—PTP uses UDP as the transport protocol over IP. In both, the unicast and multicast modes, PTP uses UDP ports 319 for event messages and 320 for general messages communication between devices. L2 encapsulation mode is not supported.
- PTP profiles—PTP supports default (1588) , AES67, and SMPTE 2059-2 profiles. They all have different ranges of sync and delay request intervals. For information on the default profile, refer to IEEE 1588. For more information on AES67 and SMPTE 2059-2, refer to the respective specifications.
- Path delay measurement—We support delay request and response mechanism to measure the delay between the master and slave devices. Peer delay request and response mechanism is not supported.
- Message intervals—You can configure the interval at which the announce, sync, and delay request messages needs to be sent between devices.
- Best master clock (BMC) selection—BMC algorithm is used to select master, slave, and passive states of the PTP enabled interfaces based on the Announce message received as per 1588 specification.
- PTP Offload - This feature distributes the PTP functionality to the line cards and allows scaling of the number of PTP sessions that are supported on the system. This feature is available for Cisco Nexus 9500 platform switches with N9K-X97160YC-EX line card, 9700-FX, 9636C-R, 9636Q-R, 9624D-R2, and 9636C-RX line cards.
- High Availability - Stateful restarts are not supported for PTP. After a reboot or a supervisor switchover, the running configuration is applied. For more information on high availability, see the Cisco Nexus 9000 Series NX-OS High Availability and Redundancy Guide.
- Mixed Mode - PTP supports Mixed mode for delivering PTP messages, which is detected automatically by Cisco Nexus device, based on the type of **delay_req** message received from connected client and no configuration is required. In this mode when slave sends **delay_req** in unicast message, master also replies with unicast **delay_resp** message.

PTP Offload

This feature distributes the PTP functionality to the line cards and allows scaling of the number of PTP sessions that are supported on the system. This feature is available for Cisco Nexus 9500 platform switches with 9700-EX, 9700-FX, 9636C-R, 9636Q-R, 9624D-R2, and 9636C-RX line cards.

Clocks

Clock Types

The PTP device type is configurable and can be used to set the clock type. The following clocks are common PTP devices:

- Ordinary clock - Communicates with the network based on a single physical port, similar to an end host. An ordinary clock can function as a grandmaster clock.
- Boundary clock - Typically has several physical ports, with each port behaving like a port of an ordinary clock. However, each port shares the local clock, and the clock data sets are common to all ports. Each port decides its individual state, either master (synchronizing other ports connected to it) or slave (synchronizing to a downstream port), based on the best clock available to it through all of the other ports on the boundary clock. Messages related to synchronization and establishing the master-slave hierarchy terminate in the protocol engine of a boundary clock and are not forwarded.
- Transparent clock - Forwards all PTP messages like an ordinary switch or router but measures the residence time of a packet in the switch (the time that the packet takes to traverse the transparent clock) and in some cases the link delay of the ingress port for the packet. The ports have no state because the transparent clock does not need to synchronize to the grandmaster clock. There are two kinds of transparent clocks:
  - End-to-end transparent clock - Measures the residence time of a PTP message and accumulates the times in the correction field of the PTP message or an associated follow-up message.
  - Peer-to-peer transparent clock - Measures the residence time of a PTP message and computes the link delay between each port and a similarly equipped port on another node that shares the link. For a packet, this incoming link delay is added to the residence time in the correction field of the PTP message or an associated follow-up message.
- Grandmaster clock - In a single PTP domain, the Grandmaster (GM) node acts as a primary clock source for the entire PTP network. The primary source for GM node will be taken either from internal GNSS system or external GNSS system. GM node can’t synchronize time or frequency from other PTP node i.e. GM node can’t have any slave ports, all ports act as only Master role.



Note PTP operates only in boundary clock mode. Cisco recommends deployment of a Grand Master Clock (10 MHz) upstream, with servers containing clocks requiring synchronization connected to the switch. End-to-end transparent clock and peer-to-peer transparent clock modes are not supported.

Clock Modes

The IEEE 1588 standard specifies two clock modes for the PTP supporting devices to operate in: one-step and two-step.

One-Step Mode:

In one-step mode the clock synchronization messages include the time at which the master port sends the message. The ASIC adds the timestamp to the synchronization message as it leaves the port. The master port operating in one-step mode is available for Cisco Nexus 9508-FM-R and 9504-FM-R fabric modules and Cisco Nexus 9636C-R, 9636Q-R, 9624D-R2, and 9636C-RX line cards.

The slave port uses the timestamp that comes as part of the synchronization messages.

Two-Step Mode:

In two-step mode the time at which the synchronization message leaves the port is sent in a subsequent follow-up message. This is the default mode.

Clocks

The following clocks are common PTP devices:

Ordinary clock

Communicates with the network based on a single physical port, similar to an end host. An ordinary clock can function as a grandmaster clock.

Boundary clock

Typically has several physical ports, with each port behaving like a port of an ordinary clock. However, each port shares the local clock, and the clock data sets are common to all ports. Each port decides its individual state, either master (synchronizing other ports connected to it) or slave (synchronizing to a downstream port), based on the best clock available to it through all of the other ports on the boundary clock. Messages related to synchronization and establishing the master-slave hierarchy terminate in the protocol engine of a boundary clock and are not forwarded.

Transparent clock

Forwards all PTP messages like an ordinary switch or router but measures the residence time of a packet in the switch (the time that the packet takes to traverse the transparent clock) and in some cases the link delay of the ingress port for the packet. The ports have no state because the transparent clock does not need to synchronize to the grandmaster clock.

There are two kinds of transparent clocks:

End-to-end transparent clock

Measures the residence time of a PTP message and accumulates the times in the correction field of the PTP message or an associated follow-up message.

Peer-to-peer transparent clock

Measures the residence time of a PTP message and computes the link delay between each port and a similarly equipped port on another node that shares the link. For a packet, this incoming link delay is added to the residence time in the correction field of the PTP message or an associated follow-up message.



Note PTP operates only in boundary clock mode. Cisco recommends deployment of a Grand Master Clock (10 MHz) upstream, with servers containing clocks requiring synchronization connected to the switch.

End-to-end transparent clock and peer-to-peer transparent clock modes are not supported.

Grandmaster clock

In a single PTP domain, the Grandmaster (GM) node acts as a primary clock source for the entire PTP network. The primary source for GM node will be taken either from internal GNSS system or external GNSS system. GM node can’t synchronize time or frequency from other PTP node i.e. GM node can’t have any slave ports, all ports act as only Master role.

Clock Modes

The IEEE 1588 standard specifies two clock modes for the PTP supporting devices to operate in: one-step and two-step. However, Nexus 3500 supports only two-step mode.

Two-Step Mode:

In two-step mode the time at which the synchronization message leaves the port is sent in a subsequent follow-up message. This is the default mode.

Process

The PTP process consists of two phases: establishing the master-slave hierarchy and synchronizing the clocks.

Within a PTP domain, each port of an ordinary or boundary clock follows this process to determine its state:

- Examines the contents of all received announce messages (issued by ports in the master state)
- Compares the data sets of the foreign master (in the announce message) and the local clock for priority, clock class, accuracy, and so on
- Determines its own state as either master or slave

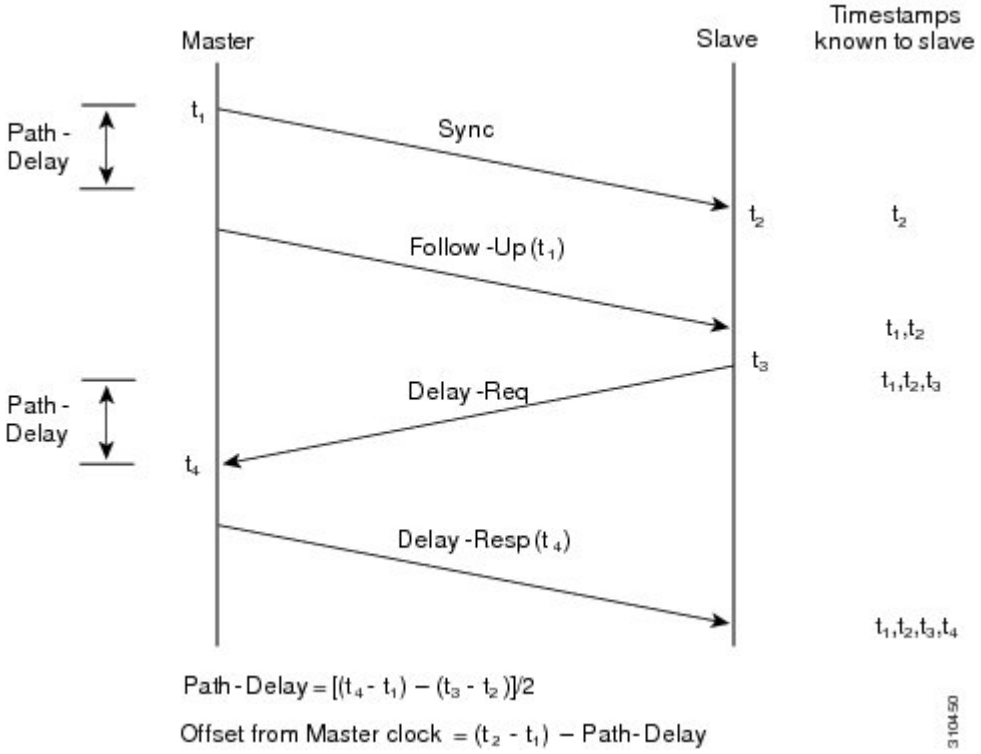
The ordinary and boundary clocks use **Sync**, **Delay_Req**, **Follow_Up**, **Delay_Resp** event messages to generate and communicate timing information.

These messages are sent in the following sequence:

1. The master sends a **Sync** message to the slave and notes the time, `t1` at which it was sent. For one-step **Sync** message carries the time when the message leaves the master and for two-step this time is sent in the subsequent **Follow-Up** event message.
2. The slave receives the **Sync** message and notes the time of reception, `t2`.
3. The master conveys to the slave the timestamp, `t1` by embedding the timestamp in a **Follow_Up** event message.
4. The slave sends a **Delay_Req** message to the master and notes the time, `t3` at which it was sent.
5. The master receives the **Delay_Req** message and notes the time of reception, `t4`.
6. The master conveys to the slave the timestamp, `t4` by embedding it in a **Delay_Resp** message.
7. After this sequence, the slave possesses all four timestamps. These timestamps can be used to compute the offset of the slave clock relative to the master, and the mean propagation time of messages between the two clocks.

   The following figure describes the event messages in the PTP process that generate and communicate timing information.

Figure 1: PTP Process



ITU-T Telecom Profiles

Cisco NX-OS 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:

Telecom Profile G.8275.1

Cisco's Telecom Profile G.8275.1 feature supports the ITU-T *G.8275.1 : Precision time protocol telecom profile for phase/time synchronization with full timing support from the network* standard. The G.8275.1 profile fulfills the time-of-day and phase synchronization requirements in telecom networks with all network devices participating in the PTP protocol. The G.8275.1 profile with SyncE provides better frequency stability for the time-of-day and phase synchronization.

Features of the G.8275.1 profile are:

- Synchronization Model: G.8275.1 profile adopts hop-by-hop synchronization model. Each network device in the path from master to slave synchronizes its local clock to upstream devices and provides synchronization to downstream devices.

- Clock Selection: G.8275.1 profile also defines an alternate BMCA that selects a clock for synchronization and port state for the local ports of all devices in the network is defined for the profile. The parameters defined as a part of the BMCA are:
  - Clock Class
  - Clock Accuracy
  - Offset Scaled Log Variance
  - Priority 2
  - Local Priority
  - Clock Identity
  - Steps Removed
  - Port Identity
- Port State Decision: The port states are selected based on the alternate BMCA.
- Alternate BMCA: It follows the alternate BMCA dataset comparison algorithm as defined in Rec. ITU-T G.8275.1/Y.1369.1 to select the GM for the node.
- Packet Rates: The nominal packet rate for Announce packets is 8 packets-per-second and 16 packets-per-second for Sync/Follow-Up and Delay-Request/Delay-Response packets.
- Transport Mechanism: G.8275.1 profile only supports Ethernet PTP transport mechanism.
- Mode: G.8275.1 profile supports transport of data packets only in multicast mode. The forwarding is done based on forwardable or non-forwardable multicast MAC address.
- Clock Type: G.8275.1 profile supports the following clock types:
  - Telecom Grandmaster (T-GM): Provides timing for other network devices and does not synchronize its local clock to other network devices.
  - Telecom Time Slave Clock (T-TSC): A slave clock synchronizes its local clock to another PTP clock, but does not provide PTP synchronization to any other network devices.
  - Telecom Boundary Clock (T-BC): Synchronizes its local clock to a T-GM or an upstream T-BC clock and provides timing information to downstream T-BC or T-TSC clocks.



Note Telecom Boundary Clock (T-BC) is the only clock type supported in Cisco NX-OS Release 9.3(5).

- Domain Numbers: The domain numbers that can be used in a G.8275.1 profile network ranges from 24 to 43. The default domain number is 24.

Telecom Profile G.8275.2

Cisco's Telecom Profile G.8275.2 feature supports the ITU-T G.8275.2 : *Precision time protocol telecom profile for phase/time synchronization with partial timing support from the network* standard. The G.8275.2

is a PTP profile for use in telecom networks where phase or time-of-day synchronization is required. It differs from G.8275.1 in that it is not required that each device in the network participates in the PTP protocol. Also, G.8275.2 uses PTP over IPv4 and IPv6 in unicast mode.

The G.8275.2 profile is based on the partial timing support from the network. Hence, nodes using G.8275.2 are not required to be directly connected. The G.8275.2 profile is used in mobile cellular systems that require accurate synchronization of time and phase. For example, the fourth generation (4G) of mobile telecommunications technology.

With upcoming technologies such as LTE-TDD, LTE-A CoMP, LTE MBSFN and Location-based services, eNodeBs (base station devices) are required to be accurately synchronized in phase and time. Having GNSS systems at each node is not only expensive, but also introduces vulnerabilities. The G.8275.2 profile meets the synchronization requirements of these new technologies.

PTP Ports

A port can be configured to change its role dynamically. If no role is assigned to a port, it can dynamically assume a primary, passive, or subordinate role based on the BMCA.

In G.8275.2, PTP ports are not tied to any specific physical interfaces, but are tied to a loopback (virtual) interface. Traffic from a PTP port is routed through any physical interface based on the routing decision. For a dynamic port, only one clock source can be configured.

Alternate BPCA

The BPCA (Best Primary Clock Algorithm, which is also known as Best Master Clock Algorithm (BMCA [RFCÂ 7273]) implementation in G.8275.2 is different from that in the default PTP profile. The G.8275.2 implementation specifies an alternate best primary clock algorithm (ABPCA), which is used by each device to select a clock to synchronize to, and to decide the port states of its local ports.

The following consideration apply to the G.8275.2 implementation of the BPCA:

- PrimaryOnly—A per port attribute, PrimaryOnly defines the state of the port. If this attribute is true, the port is never placed in the subordinate state.
- Priority 1—Priority 1 is always static in this profile and is set to 128. Priority 1 is not used in BPCA.
- Priority 2—Priority 2 is a configurable value and its range if from 0 to 255.
- Local Priority—Local priority is configured locally on clock ports to set the priority on nominated clocks. The default value is 128 and valid range is from 1 to 255.

Restrictions for Using the G.8275.2 Profile

- In the G.8275.2 profile, PTP is supported only in the none mode (default).
- A G.8275.2 PTP clock can have redundant clock sources configured (through multiple PTP ports). However, at any given time, a G.8275.2 PTP clock synchronizes to only one clock source, which is selected by BMCA.
- The G.8275.2 does not provide any recommendations for performance analysis and network limits for the clocks.

High Availability for PTP

Stateful restarts are not supported for PTP. After a reboot or a supervisor switchover, the running configuration is applied. For more information on high availability, see the Cisco Nexus 9000 Series NX-OS High Availability and Redundancy Guide.

Guidelines and limitations for PTP



Note

- For scale information, see the release-specific *Cisco Nexus 9000 Series NX-OS Verified Scalability Guide*.
- For PTP to function properly, you must use the latest SUP and line card FPGA versions. For information on upgrading FPGAs, access the Release Notes landing page and go to the FPGA/EPLD Upgrade Release Notes (NX-OS Mode Switches) section and locate the FPGA/EPLD Upgrade Release Notes for your software version. Refer to the Installation Guidelines topic.

General Guidelines

- PTP domain limits to a single domain per network.
- PTP can be enabled on the port-channel member ports.
- All management messages that are received from a slave port are forwarded to all PTP enabled ports. The management messages that are received from a slave port are not handled.
- To match PTP control packets using RACL, enable PIM on the L3 interface.
- Before downgrading from Cisco NX-OS Release 9.3(1) to Release 7.0(3)I7, you must unconfigure PTP offload. PTP offloading is not supported for Cisco Nexus 9000 platform switches on 9636PQ, 9564PX, 9464PX, and 9536PQ line cards for Cisco NX-OS Release 7.0(3)I7.
- PTP-capable ports do not identify PTP packets and do not time-stamp or redirect those packets unless you enable PTP on those ports.
- The Cisco Nexus 9504 and 9508 platform switches with 9636C-R, 9636C-RX, or 9636Q-R line cards, the master ports can operate in one-step mode.
- In a topology where PTP is enabled, when a profile is set on a GrandMaster device, and the redundant GrandMasters are deployed in the network; to change the profile on the GrandMaster, you must first shut down the port that is configured on the GrandMaster to the switches, then change the profile, and then re-enable the port. For example, moving from an AES7 profile to an SMPTE profile or conversely.
- The QoS TCAM region Ingress SUP [ingress-sup] must be set to 768 or higher for PTP IPv6 transport to work.
- There is no CLI profile command for 8275.2. This will be added only when the APTS is supported. The functions for this release work only in default mode.
- Beginning with Cisco NX-OS Release 10.3(5)M, transmit and receive scope for PTP over IPv6 multicast configuration is supported.
- On Cisco N9336C-SE1 switches, ports receive PTP Announce and Sync messages even when Spanning Tree Protocol (STP) blocks those ports. This behavior is expected.

Release Specific Guidelines

- *Cisco NX-OS Release 10.4(3)F*
  - New global and interface commands are introduced to set the transmit and receive scope for PTP over IPv6 multicast configuration. If upgrading the devices to 10.4(3)F or higher, peer devices running NX-OS should also be upgraded to 10.4(3)F or higher for PTP over IPv6 multicast to work.



Note If any devices are not upgraded, then configure the workaround CLI **test system internal ptp ipv6-mcast-ipv4-dmac int-name** in the devices which are upgraded to 10.4(3)F.

  - The following PTP profiles are supported on Cisco Nexus 9364C-H1 switch:
    - Default profile
    - Media profiles (AES67 and SMPTE 2059-2)
    - PTP telecom profile (only 8275-2)

- *Cisco NX-OS Release 10.4(2)F*
  - 8275.2 PTP profile is supported on Cisco Nexus 9300-FX3, 9332D-H2R, 93400LD-H1, and 9408 platform switches. The guidelines for this profile are as follows:
    - Supports Unicast negotiation (simple unicast is not supported)
    - Default role for a dynamic unicast port is dynamic. The negotiation is triggered by state transitions. Only one PTP peer can be configured
    - Introduced a new command - **ptp peer** <ipv4>/<ipv6> - to configure a ptp peer when the role is dynamic.
    - For information about DME, see Cisco Nexus NX-API References.
  - PTP Class C is now supported on N9K-C93400LD-H1 switches. The guidelines and limitations for this platform switches are as follows:
    - Only One-Step Mode is supported.
    - System can take a maximum of 30 minutes to achieve Class C level corrections
    - Both G.8275.1 and G.8275.2 Telecom profiles are supported, However, only Telecom Boundary Clock (T-BC) mode is supported.
  - Default PTP is supported on Cisco Nexus C93108TC-FX3 switch.

- *Cisco NX-OS Release 10.4(1)F*
  - PTP is supported on the Cisco Nexus 9804 switches and the following guidelines and limitations apply:
    - Only IPv4 transport is supported.
    - Only media profile is supported.

- Only supported clock distribution mode is one step. Two step mode is not supported.
- Other PTP features such as unicast and unicast negotiation are not supported.

- Cisco Nexus X98900CD-A and X9836DM-A line cards with Cisco Nexus 9808 and 9804 switches
- PTP is not supported on Cisco Nexus C9348GC-FX3PH switch.
- PTP is supported on Cisco Nexus C9348GC-FX3 switch.



Note Make sure that you increase COPP limit to have PTP state stable across PTP interfaces. For more information on configuration, see *CoPP Configuration Example* section in *Cisco Nexus 9000 Series NX-OS Security Configuration Guide.*

- ASIC-based time stamping on 1G PTP enabled ports is supported on N9K-C931806C-FX3 and N9K-C93108TC-FX3P platform switches. Thus, both 1G and 10G ports can run on ASIC mode now. However, all the 1G ports must be either in PHY mode (default) or in ASIC mode. A global command is introduced to enable this feature.
- PTP on media profile is supported on N9K-C9332D-H2R platform switch. A few guidelines and limitations for this platform switch are as follows:
  - Only multicast PTP with one-step is supported.
  - Unicast is not supported.
  - PTP is not supported on interface Ethernet 1/33 and Ethernet 1/34.
- PTP v1 packet forwarding feature is supported on Cisco Nexus N9K-C9408 and N9K-C9332D-H2R platform switches.
- The PTP Class C support for G.8275.1 Telecom profile feature is supported on Cisco Nexus 9408 and N9K-C9332D-H2R platform switches. A few guidelines and limitations for this platform switches are as follows:
  - The platform switches provide Class C support
  - Only One-Step Mode is supported
  - Ethernet transport is supported
  - System can take up to 30 minutes to achieve Class C level corrections
  - The G.8275.1 Telecom profile is supported, except the following:
    - Telecom Transparent Clock (T-TC)
    - Telecom Grand Master (T-GM)

- *Cisco NX-OS Release 10.3(5)M*

- New global and interface commands are introduced to set the transmit and receive scope for PTP over IPv6 multicast configuration. If upgrading the devices to 10.3(5)M or higher, peer devices running NX-OS should also be upgraded to 10.3(5)M or higher for PTP over IPv6 multicast to work.



Note If any devices are not upgraded, then configure the workaround CLI **test system internal ptp ipv6-mcast-ipv4-dmac int-name** in the devices which are upgraded to 10.3(5)M.

- *Cisco NX-OS Release 10.3(3)F*
  - 8275.2 Telecom profile is supported on Cisco Nexus 9300-FX3 platform switches. The following guidelines and limitations apply:
    - This feature allows ITU-T precision time protocol (PTP) profile for phase/time distribution with partial timing support from the network (unicast mode).
    - A command for G.8275.2 is added as the APTS is supported.
    - This feature also supports multiple unicast followers. Among the unicast followers, one is picked as an active unicast follower, while the rest configured unicast followers act as passive.
    - From this release onwards, dynamic role with unicast ports is supported.
    - For dynamic PTP unicast ports, the unicast-negotiation feature must be enabled.

- *Cisco NX-OS Release 10.3(2)F*
  - PTP GM functionality is supported on the Cisco Nexus N9K-C93180YC-FX3 platform switches.
  - PTP on media profile is supported on Cisco Nexus 9408 platform switches. A few guidelines and limitations for this platform switches are as follows:
    - Only multicast PTP with one-step is supported.
    - Other PTP features such as unicast and unicast negotiation are not supported.

- *Cisco NX-OS Release 10.3(1)F*
  - PTP Media Profile and One-Step Mode are supported on the Cisco Nexus 9808 platform switches. A few guidelines and limitations for this platform switches are as follows:
    - Only IPv4 transport is supported.
    - Only multicast PTP with one step is supported.
    - Other PTP features such as unicast and unicast negotiation are not supported.

- *Cisco NX-OS Release 10.2(3)F*
  - The PTP Support of up to 2000 Secondary Devices per Switch feature provides an option to support a maximum of 100 multicast secondary devices per port, with a system-wide support for a maximum of 2000 multicast secondary devices per switch. This feature is only supported on Cisco Nexus 9000-FX2 and 9000-FX3 platform switches.

- N9K-C9364D-GX2A - PTP is not supported on 1/65 and 1/66 ports
- N9K-C9348D-GX2A - PTP is not supported on 1/49 and 1/50 ports

- *Cisco NX-OS Release 10.2(2)F*
  - The PTPv1 and v2 co-existence feature is supported on the Cisco Nexus 9300-GX, 9300-GX2, and 9300-FX3 platform switches.
  - The PTP with jitter fix for 1G ports feature is supported on the Cisco N9K-C93108TC-FX3P platform switches.
  - The PTP unicast negotiation feature is also supported on Cisco Nexus 9300-EX, 9300-FX, 9300-FX2, 9300-GX, and 9300-GX2 platform switches.
  - The PTP IPv6 UDP transport feature is supported on the Cisco Nexus 9300-FX, 9300-FX2, 9300-GX, and 9300-GX2 platform switches.

- *Cisco NX-OS Release 10.2(1)F*
  - Unicast-negotiation is supported for IPv4 and IPv6 addresses with default profile on N9K-C93180YC-FX3S platform.
  - PTP IPv6 transport is supported on N9K-C93180YC-FX3S platform.
  - PTP is supported on the N9K-C9332D-GX2B platform switches. However, PTP is not supported on 1/33 and 1/34 ports.

- *Cisco NX-OS Release 10.1(2)F*
  - PTP is supported on the N9K-X9624D-R2 line cards.
  - PTP (IEEE 1588) is supported on the N9K-C9700-GX line card, as well as N9K-X97160YC-EX line card and N9K-C9700-FX line cards, used with N9K-C9504-FM-G and N9K-C9508-FM-G fabric modules.
  - PTP (IEEE 1588) is supported on the N9K-C9504-FM-G and N9K-C9508-FM-G platform switches.
  - Explicit carving of ing-sup (size of the ingress supervisor TCAM region) to 768 is not required for the PTP profile 8275-1.

- *Cisco NX-OS Release 9.3(7)F*
  - PTP G.8275.1 Telecom profile is supported on N9K-C93180YC-FX3 platform switch.

- *Cisco NX-OS Release 9.3(5)F*
  - CLI behavior for PTP commands has changed as follows:
    - Most PTP commands do not return errors if the same command is applied again.
    - Most PTP commands do not validate the parameters that are entered as "no" commands. For example, if the currently configured command is "ptp sync interval -3", "no ptp sync interval -1" is accepted for negation.
  - PTP is supported on Cisco Nexus 9300-GX platform switches.
  - PTP G.8275.1 Telecom profile is supported on N9K-C93180YC-FX3S platform switch.

- PTP is supported on N9K-C93108TC-FX3P platform switch. However, syncE is not supported.

- *Cisco NX-OS Release 9.3(3)F*
  - PTP is supported on Cisco Nexus 93360YC-FX2 and 93216TC-FX2 switches.

- *Cisco NX-OS Release 9.3(2)F*
  - For Cisco Nexus 9636C-R, 9636Q-R, 9636C-RX, and 96136YC-R line cards, the following PTP configuration commands are defaults:
    - **ptp offload**
    - **ptp clock-operation one-step**

    These default commands enable PTP to be distributed on the line cards and enable all PTP configured ports to run in one-step. We recommend using the default configuration for performance and scalability.

Note Changing the **ptp clock-operation** command to two step will disable the offload and PTP will then run centralized on the supervisor card.

  - PTP offload is automatically enabled when one-step mode is configured.

- *Cisco NX-OS Release 9.2(3)F*
  - PTP is available for Cisco Nexus 9504-FM-R platform switches.

- *Cisco NX-OS Release 9.2(1)F*
  - Cisco Nexus 9732C-EX, 9736C-EX, and 97160YC-EX line cards support PTP offloading.

Telecom Profile Guidelines

- PTP Telecom Profile is supported only on the Cisco Nexus 93180YC-FX3S switch and N9K-C93180YC-FX3 switch.
- Only PTP class B is supported for 25G and above port speed.
- Only Telecom Boundary Clock (T-BC) is supported.
- Cisco's Telecom Profile G.8273.2 feature is compliant with the ITU-T *G.8273.2 : Timing characteristics of telecom boundary clocks and telecom time slave clocks* standard with the exception that 1PPS output is not aligned with PTP.

Note Time of Day and PTP GM are not supported in Cisco NX-OS Release 9.3(5).

Timestamp Tagging (TTAG) Support for Platform Switches

- Cisco Nexus 9200 platform switches: beginning with Cisco NX-OS Release 7.0(3)I6(1)

- Cisco Nexus 9364C: beginning with Cisco NX-OS Release 7.0(3)I7(2)
- Cisco Nexus 9332C: beginning with Cisco NX-OS Release 9.2(3)
- Cisco Nexus 9300-EX platform switches: beginning with Cisco NX-OS Release 7.0(3)I6(1)
- Cisco Nexus 9300-FX platform switches: beginning with Cisco NX-OS Release 7.0(3)I7(3)
- Cisco Nexus 9300-FX2 platform switches: beginning with Cisco NX-OS Release 9.3(3)
- Cisco Nexus 9300-FX3 and -GX platform switches: beginning with Cisco NX-OS Release 9.3(5)
- Cisco Nexus 9500 platform switches with -EX and -FX line cards

PTP Support

- PTP transport over User Datagram Protocol (UDP) is supported. PTP over Ethernet is supported only on Cisco Nexus 9300-FX3 platform switches.
- PTP supports the multicast communication. PTP also supports the unicast communication and the unicast mode is optional.
- PTP supports boundary clock mode.
- The PTP correction-range, PTP correction-range logging, and PTP mean-path-delay commands are supported on the Cisco Nexus 9508-R line cards.
- Cisco Nexus 9000 series switches support mixed non-negotiated mode of operation on master PTP ports. That means when a slave client sends unicast delay request PTP packet, the Cisco Nexus 9000 responds with a unicast delay response packet. And, if the slave client sends multicast delay request PTP packet, the Cisco Nexus 9000 responds with a multicast delay response packet. For mixed non-negotiated mode to work, the source IP address used in the ptp source *IP address* configuration on the BC device must also be configured on any physical or logical interface of the BC device. The recommended best practice is to use the loopback interface of the device.
- Cisco Nexus 93108TC-EX and 93180YC-EX switches support PTP in mixed mode and unicast mode.

  The Cisco Nexus 9396 switch supports PTP mixed mode.
- PTP is supported with sync interval -3 only on Cisco Nexus 9508-R family line cards. Higher sync intervals are not supported.
- PTP unicast is supported only on the default vrf.
- PTP supports mixed mode for delivering PTP messages, which is detected automatically by a Cisco Nexus device based on the type of delay request message that is received from a connected client and no configuration is required.
- PTP supports unicast communication on Cisco Nexus 9508 switches with 9636C-R, 9636C-RX, and 9636Q-R line cards.
- PTP one-step mode is supported only in PTP offload mode for the Cisco Nexus 9504 and 9508 platform switches with 9636C-R, 9636C-RX, 9624D-R2, or 9636Q-R line cards.
- Each port can be individually configured with any of the supported PTP profiles. Different PTP profiles can coexist on an interface. Combination of the default of 1588 and SMPTE-2059-2 or AES67 profiles is supported.
- The platform switches are supported only on Class B and do not meet Class C support.

- One-step PTP is supported on the slave port of Cloudscale Nexus 9000 series switches, but not on master ports. Nexus 9000-R series switches support PTP one-step on all ports.
- When running PTP, without NTP, **clock protocol ptp** needs to be configured.

PTP Not Supported

- PTPv1 forwarding and feature VMCT are not supported if enabled at the same time.
- 1 Pulse per Second (1PPS) output is enabled by default. UTC/SMB port is in output mode. Note that 1PPS output is not supported.
- End-to-end transparent clock and peer-to-peer transparent clock modes are not supported.
- For Cisco Nexus 31108PC-V and 31108TC-V switches, PTP is not supported on ports running at 100G speed.
- PTP is not supported for stateful high availability.
- PTP is not supported for management interfaces.
- PTP unicast is not supported in offload mode.
- PTP configuration with UC and MC on either side is not supported on Cisco Nexus 9508 switches with 9636C-R, 9636C-RX, and 9636Q-R line cards.
- PTP is not supported on FEX interfaces.
- A combination of SMPTE-2059-2 and AES67 profiles is not supported on the same interface.
- PTP is not supported on N9K-C92348GC-X.

Default PTP Parameters

The following table lists the default settings for PTP parameters.

Table 1: Default PTP Parameters

Parameters	Default
PTP	Disabled
PTP version	2
PTP domain	0
PTP priority 1 value when advertising the clock	255
PTP priority 2 value when advertising the clock	255
PTP announce interval	1 log second
PTP announce timeout	3 announce intervals

Parameters	Default
PTP delay-request interval	• 0 log seconds • -1 log seconds for Cisco Nexus 3232C, 3264Q, and 9500 platform switches
PTP sync interval	• -2 log seconds • -3 log seconds for Cisco Nexus 3232C, 3264Q, and 9500 platform switches
PTP VLAN	gPTP supports only default vlan 1, and no other user configured VLANs.

Configure PTP

Configure PTP Globally

You can enable or disable PTP globally on a device. You can also configure various PTP clock parameters to help determine which clock in the network has the highest priority to be selected as the grandmaster.

Note For PTP to function properly, you must use the latest SUP and LC FPGA versions. For information on upgrading FPGAs, access the Release Notes landing page and go to the FPGA/EPLD Upgrade Release Notes (NX-OS Mode Switches) section and locate the FPGA/EPLD Upgrade Release Notes for your software version. Refer to the Installation Guidelines topic.

Note You must always set the clock protocol PTP vdc1 for the local clock to be updated by the PTP protocol, irrespective of the one-step or the two-step mode. You can verify the configuration using the **show running-config clock_manager** command.

Procedure

Step 1 Enter the global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Step 2 Enable or disable PTP on the device using the command [**no**] **feature ptp**

Example:

```
switch(config)# feature ptp
```

Note Enabling PTP on the switch does not enable PTP on each interface.

Make sure that only one of these features is configured: dot1x (**feature dot1x**) or NV overlay (**feature nv overlay**). A dynamic ifacl label is reserved when these features are configured. However, only two dynamic ifacl label bits are available. If both of these features are already configured, a dynamic ifacl label will not be available for PTP, and the feature cannot be enabled.

Step 3 Configure the device type as gPTP or boundary clock or ordinary clock grandmaster using the command [**no**] **ptp device-type** [**generalized-ptp** | **boundary-clock** | **ordinary-clock-grandmaster**]

Example:

```
switch(config)# ptp device-type generalized-ptp
```

Note The **generalized-ptp** option is available only for Cisco Nexus 9508 switches with an -R series line card .

Note Beginning with Cisco NX-OS Release 10.3(2)F, the ordinary clock grandmaster is available only for Cisco Nexus N9K-C93180YC-FX3 platform switches. For more information, refer to Configure PTP GM, on page 21 .

Step 4 Configure the optional commands as needed.

- Configure the domain number to use for this clock using the command [**no**] **ptp domain***number*

  PTP domains allow you to use multiple independent PTP clocking subdomains on a single network. The range for the *number* is from 0 to 127.

- Increase the number of PTP sessions by offloading some timers to the line card uisng the comand [**no**] **ptp offload**

  This step is required for one-step mode and optional for two-step mode.

Note Make sure that neither of these features are already configured: dot1x (**feature dot1x**) and NV overlay (**feature nv overlay**). A dynamic ifacl label is reserved when these features are configured. However, only two dynamic ifacl label bits are available. If either of these features are already configured, a dynamic ifacl label will not be available for PTP offload, and the feature cannot be enabled. Note that PTP (**feature ptp**) consumes one ifacl label.

Note Beginning with Cisco NX-OS Release 9.3(3), Cisco Nexus 9504 and 9508 platform switches with 9636C-R, 9636C-RX, or 9636Q-R line cards support offload only with one-step clock operation. PTP offload is automatically enabled or disabled when the one-step clock operation is enabled or disabled.

- Configure the PTP clock operation to the one-step mode using the command [**no**] **ptp clock-operation one-step**

  In this case, the timestamp message is sent as a part of the sync message. A followup message is not sent in this mode.

- Configure the priority1 value to use when advertising this clock using the command [**no**] **ptp priority1***value*

  This value overrides the default criteria (clock quality, clock class, and so on) for best master clock selection. Lower values take precedence. The range for the *value* is from 0 to 255.

Note For the switch to synchronize with an external Grand Master clock, the local switch PTP priority value must be configured higher than that of external Grand Master Clock priority.

- Configure the priority2 value to use when advertising this clock using the command [**no**] **ptp priority2***value*

  This value is used to decide between two devices that are otherwise equally matched in the default criteria. For example, you can use the priority2 value to give a specific switch priority over other identical switches. The range for the *value* is from 0 to 255.

Note For the switch to synchronize with an external Grand Master clock, the local switch PTP priority value must be configured higher than that of external Grand Master Clock priority.

Example:

```
switch(config)# ptp domain 1
switch(config)# ptp offload
switch(config)# ptp clock-operation one-step
switch(config)# ptp priority1 1
switch(config)# ptp priority2 1
```

Step 5 Configure support for PTP management packets using the command [**no**] **ptp management**

Example:

```
switch(config)# ptp management
switch(config-ptp-profile)#
```

This command is enabled by default. **no** : Disables support for management packets.

Step 6 Configure the optional commands as needed.

- Enable the PTP profile and enter the PTP profile configuration mode using the command [**no**] **ptp profile** { **8275-1** | **default** }

Note This command is supported beginning with Cisco NX-OS Release 9.3(5) and only on the N9K-C93180YC-FX3S platform switch. For more information, see Configure PTP Telecom Profile, on page 31 .

- Configure the PTP delay mean path/reverse path tolerance variation using the command [**no**] **ptp delay tolerance** { **mean-path** | **reverse-path** } *variation*

  mean-path : Ignore spikes in Mean Path Delay (MPD) as calculated by the PTP BMC algorithm.

  reverse-path : Ignore spikes in (t4-t3) as calculated by the PTP BMC algorithm.

  variation : Percentage that defines the tolerance for spikes. Use numeric values with a single decimal. Range is from 1.0 through 100.0.

Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

- Configure the switch to forward all PTPv1 packets based on the forwarding rule using the command **ptp forward-version1**

Note If you do not enable this command, all PTPv1 packets are passed on to the CPU and ultimately dropped.

This command is supported beginning with Cisco NX-OS Release 9.3(6).

- Enable PTP unicast sessions to transition to negotiated mode using the command **ptp unicast-negotiation**.

  This configuration is introduced in Cisco Nexus NX-OS Release 10.2(1)F and is supported on 93180YC-FX3S. From Cisco NX-OX Release 10.2(2)F onwards, this configuration is supported on Cisco Nexus 9300-EX, 9300-FX, 9300-FX2, 9300-GX, and 9300-GX2 platform switches.

  For more information, refer to the PTP Unicast-Negotiation section.

- Set the transmit scope for PTP over IPv6 multicast configuration using the command **ptp ipv6 multicast scope tx**<*scope*>

Note
- Transmit scope is a single value. This determines the scope of IPv6 multicast destination address (FF0'X') used by PTP packets transmitted by the switch.
- The default value is 1 (`0x1`).
- When interface level configuration is applied, it takes precedence over the corresponding global configuration.

- Set the receive scope for PTP over IPv6 multicast configuration using the command **ptp ipv6 multicast scope rx**<*scope*>

Note

- Receive scope can be a single value or multiple values or a range of values. This determines the acceptable scope (FF0'X') for received IPv6 multicast PTP packets.
- The default value is 1 through 0xE (`0x1-0xE`).
- When interface level configuration is applied, it takes precedence over the corresponding global configuration.

- Enable the PTP time distribution hold feature using the command [**no**] **ptp time distribution-hold** [**correction-threshold** <corr_limit>] [**delay-threshold** <max_delay_time>]

  correction-threshold — Holds the time distribution until the correction settles down to the specified correction value in nanoseconds.

  delay-threshold — Sets the maximum time limit in seconds to hold the time-distribution. However, if correction threshold is met before the delay threshold, the time distribution resumes.

  Default correction threshold is 300 nanoseconds. Default delay threshold is 300 seconds for TOR and 900 seconds for modular chassis.

  The maximum correction threshold is 100000 nanoseconds. The maximum delay threshold is 5000 seconds.

- Copy the running configuration to the startup configuration using the command **copy running-config startup-config**

Example:

```
switch(config)# ptp profile default
switch(config-ptp-profile)#

switch(config)# ptp delay tolerance mean-path 50.5
switch(config)#

switch(config)# ptp forward-version1
switch(config)#

switch(config)# ptp ipv6 multicast scope tx 0x2

switch(config)# ptp ipv6 multicast scope rx 0x1-0x5,0x8,0xA-0xE

switch(config)# ptp time distribution-hold correction-threshold 90000ns delay threshold
4000s

switch(config)# copy running-config startup-config
```

Configure PTP GM

Beginning with Cisco NX-OS Release 10.3(2)F, the following are the newly added CLIs to support PTP GM functionality:

Procedure

Step 1 Configure the device type as ordinary clock grandmaster using the command [**no**] **ptp device-typeordinary-clock-grandmaster**

Example:

```
switch(config)# ptp device-type ordinary-clock-grandmaster
```

Step 2 (Optional) Configure the **utc-offset** value for the PTP GM functionality using the command **ptp utc-offset** < *leap-seconds* > [**next-leapevent** < *date* > < *time* > **new-offset** < *new-leap-seconds* >]

Example:

```
switch(config)#
ptp utc-offset 37 next-leap-event 2022-04-30 23:59:59 new-offset
38
```

Default value is 37 seconds.

- **utc-offset** : UTC offset value to be added to GM clock.

  leap-seconds : Leap seconds value, range is 0–125 seconds. The default value is 37 seconds.

  next-leapevent : Optional keyword to configure time at which leap seconds change.

  date : Date at which leap seconds value changes in YYYY-MM-DD format.

  time : Time at which leap seconds value will change in HH:MM:SS format

  new-offset : New UTC offset value to be used after above configured **utc-offset** value.

  new-leap-seconds : New leap seconds value, range is 0–125 seconds. It can only be ± 1 of the configured **utc-offset** value.

Step 3 Enable the GNSS Time of Day (ToD) sync to system clock on the device using the command **clock protocol gnss**

Example:

```
switch(config)#
clock protocol gnss
```

Example:

Note For external GNSS configuration, refer to *Configuring GPS Settings for the Grandmaster Clock* section. For internal GNSS configuration, refer to Enable the GNSS receiver section.

Configure PTP on an Interface

After you globally enable PTP, it is not enabled on all supported interfaces by default. You must enable PTP interfaces individually.

Before you begin

Make sure that you have globally enabled PTP on the switch and configured the source IP address for PTP communication.

Procedure

Step 1 Enter global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Step 2 Specify the interface on which you are enabling the PTP and enter the interface configuration mode using the command **interface ethernet***slot/port*

Example:

```
switch(config)# interface ethernet 2/1
switch(config-if)#
```

Step 3 Enable or disable PTP on an interface using the command [**no**] **ptp**

Example:

```
switch(config-if)# ptp
```

Step 4 Configure the master clock that is assigned as the PTP role of the interface using the command **ptp multicast master-only**

Example:

```
switch(config)# ptp multicast master-only
switch(config)#
```



Note This command is deprecated in Cisco NX-OS Release 9.3(5) and is not supported in future releases.

Step 5 (Optional) Proceed with the following optionals commands as needed

- Display the PTP status using the command **show ptp brief**
- Display the status of the PTP port using the command **show ptp port interface***interface slot/port*
- Set the transmit scope for PTP over IPv6 multicast configuration using the command **ptp ipv6 multicast scope tx**<*scope*>

Note

- Transmit scope is a single value. This determines the scope of IPv6 multicast destination address (FF0'X') used by PTP packets transmitted by the switch.
- The default value is 1 (`0x1`).
- When interface level configuration is applied, it takes precedence over the corresponding global configuration.

- Set the receive scope for PTP over IPv6 multicast configuration using the command **ptp ipv6 multicast scope rx**<*scope*>

Note

- Receive scope can be a single value or multiple values or a range of values. This determines the acceptable scope (FF0'X') for received IPv6 multicast PTP packets.
- The default value is 1 through 0xE (`0x1-0xE`).
- When interface level configuration is applied, it takes precedence over the corresponding global configuration.
- Copy the running configuration to the startup configuration using the command **copy running-config startup-config**

Example:

```
switch(config-if)# show ptp brief
switch(config-if)# show ptp port interface ethernet 2/1
switch(config)# ptp ipv6 multicast scope tx 0x2
switch(config)# ptp ipv6 multicast scope rx 0x1-0x5,0x8,0xA-0xE
switch(config-if)# copy running-config startup-config
```

Configure PTP in Unicast Mode

Configure Unicast Mode for IPv4 or IPv6

Traditional PTP messages are delivered to the nodes that are capable of receiving PTP multicast messages. (For example, **announce**, **sync**, **delay_req**, **delay_resp** and **follow_up**). In Unicast mode, all PTP messages are delivered only to a particular PTP node. Multicast address is not used. In unicast mode, you can configure master/slave role and assign corresponding peer slave/master IP addresses.

Up to 8 master IPs can be configured for a slave unicast port and 64 slave IPs can be configured for a master port with a maximum 256 slave IP total for all ports. The following commands are used to configure the unicast slave IPs and unicast master IPs. Unicast packets are only sent to and received from these IPs. Packets received from other IPs are ignored.

For Cisco NX-OS Release 10.2(1)F and later:

```
IPv4 config
interface Ethernet1/34
ptp
ptp transport ipv4
ptp transmission unicast
ptp role master
ptp slave 10.10.10.2
ptp ucast-source 10.10.10.1

interface Ethernet1/35
ptp
ptp transport ipv4
ptp transmission unicast
ptp role slave
ptp master 10.10.10.1
ptp ucast-source 10.10.10.2

IPv6 config
interface Ethernet1/34
ptp
ptp transport ipv6
ptp transmission unicast
ptp role master
ptp slave 2012:a1:0:0:0:0:0:2
ptp ucast-source 2012:a1:0:0:0:0:0:1

interface Ethernet1/35
ptp
ptp transport ipv6
ptp transmission unicast
ptp role slave
ptp master 2012:a1:0:0:0:0:0:1
ptp ucast-source 2012:a1:0:0:0:0:0:2
```

For Cisco NX-OS Release 9.3(5) and later:

```
switch(config-if)# ptp
switch(config-if)# ptp transmission unicast
switch(config-if)# ptp role master
switch(config-if)# ptp slave 10.10.10.2

switch(config-if)# ptp
switch(config-if)# ptp transmission unicast
switch(config-if)# ptp role slave
switch(config-if)# ptp master 10.10.10.1
```

For Cisco NX-OS Release 9.3(4) and earlier:

```
switch(config-if)# ptp transport ipv4 ucast master
switch(config-if-ptp-master)# slave ipv4 10.10.10.2

switch(config-if)# ptp transport ipv4 ucast slave
switch(config-if-ptp-slave)# master ipv4 10.10.10.1
```

Assign Dynamic Role

Complete the following steps to assign a dynamic role:

Procedure

Step 1 Enter the global configuration mode command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Specify the interface on which you enable PTP and enter the interface configuration mode using the following command **interface ethernet***slot/port*

Example:

```
switch(config)# interface ethernet 2/1
                        switch(config-if)#
```

Step 3 Enable or disable PTP on the interface using the command [**no**] **ptp**

Example:

```
switch(config-if)# ptp
                        switch(config-if)#
```



Note This command is required prior to applying below unicast configuration commands on the interface.

Step 4 Configure the PTP transmission method that is used by the interface using the command **ptp transmission unicast**

Example:

```
switch(config-if)# ptp transmission unicast
                        switch(config-if)#
```

Step 5 Configure the PTP role of the interface using the command **ptp role dynamic**

Example:

```
switch(config-if)# ptp role dynamic
                        switch(config-if)#
```

dynamic : The dynamic clock is assigned as the PTP role of the interface.

Step 6 Set the IP address of the peer clock when the PTP role of the interface is set to dynamic using the command**ptp peer***ipv4-address*

Example:

```
switch(config-if)# ptp peer 10.10.10.1
                        switch(config-if)#
```

Assign Master Role

Complete the following steps to assign a master role:

Procedure

Step 1 Enter global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Specify the interface on which you enable PTP and enter the interface configuration mode using the command**interface ethernet***slot/port*

Example:

```
switch(config)# interface ethernet 2/1
                        switch(config-if)#
```



Note After configuring this command, for Cisco NX-OS Release 9.3(5) and later, skip to step 5. For Cisco NX-OS Release 9.3(4) and earlier, continue with step 3.

Step 3 Enable PTP master on a particular port (Layer 3 interface) using the command [**no**] **ptp transport ipv4 ucast master**

Example:

```
switch(config-if)# ptp transport ipv4 ucast master
                        switch(config-if-ptp-master)#
```

In the master sub-mode, you can enter the slave IPv4 addresses.

Step 4 Enter the slave IPv4 addresses using the command **slave ipv4**<*IP_address*>

Example:

```
switch-1(config)# interface ethernet 1/1
                        switch-1(config-if)# ptp transport ipv4 ucast master
                        switch-1(config-if-ptp-master)# slave ipv4 1.2.3.1
                        switch-1(config-if-ptp-master)# slave ipv4 1.2.3.2
                        switch-1(config-if-ptp-master)# slave ipv4 1.2.3.3
                        switch-1(config-if-ptp-master)# slave ipv4 1.2.3.4
                        switch-1(config-if-ptp-master)#
```

Maximum of 64 IP addresses are allowed per master, but this number varies and it depends on the sync interval configuration. The master sends announce, sync, follow-up, and delay_resp only to these slave addresses. You must make sure that the slave IP is reachable.



Note For Cisco NX-OS Release 9.3(4) and earlier, this concludes the procedure.

Step 5 Enable or disable PTP on an interface using the command [**no**] **ptp**

Example:

```
switch(config-if)# ptp
                        switch(config-if)#
```



Note Starting with 9.3(5), this command is required prior to applying below unicast configuration commands on the interface.

Step 6 Configure the PTP transmission method that is used by the interface using the command **ptp transmission unicast**

Example:

```
switch(config-if)# ptp transmission unicast
                        switch(config-if)#
```



Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Step 7 Configure the PTP role of the interface using the command **ptp role master**

Example:

```
switch(config-if)# ptp role master
                        switch(config-if)#
```

master : The master clock is assigned as the PTP role of the interface.



Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Step 8 Set the IP address of the slave clock when the PTP role of the interface is set to "master" using the command **ptp slave***ipv4-address*

Example:

```
switch(config-if)# ptp slave 10.10.10.2
                        switch(config-if)#
```



Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Assign Slave Role

Procedure

Step 1 Enter the global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Specify the interface on which you enable PTP and enter the interface configuration mode using the command**interface ethernet***slot/port*

Example:

```
switch(config)# interface ethernet 2/1
                        switch(config-if)#
```

Note After configuring this command, for Cisco NX-OS Release 9.3(5) and later, skip to step 5. For Cisco NX-OS Release 9.3(4) and earlier, continue with step 3.

Step 3 Enable PTP slave on a particular port (Layer 3 interface) using the command [**no**] **ptp transport ipv4 ucast slave**

Example:

```
switch(config-if)# ptp transport ipv4 ucast slave
                        switch(config-if-ptp-slave)#
```

In the slave sub-mode, you can enter the master IPv4 addresses.

Step 4 Enter the master IPv4 addresses using the command**master ipv4**<*IP_address*>

Example:

```
                        switch-1(config)# interface ethernet 1/1
                        switch-1(config-if)# ptp transport ipv4 ucast slave
                        switch-1(config-if-ptp-slave)# master ipv4 4.4.4.1
                        switch-1(config-if-ptp-slave)# master ipv4 4.4.4.2
                        switch-1(config-if-ptp-slave)# master ipv4 4.4.4.3
```

Note For Cisco NX-OS Release 9.3(4) and earlier, this concludes the procedure.

Step 5 Enable or disable PTP on an interface using the command [**no**] **ptp**

Example:

```
switch(config-if)# ptp
                        switch(config-if)#
```

Note Starting with 9.3(5), this command is required prior to applying below unicast configuration commands on the interface

Step 6 Configure the PTP transmission method that is used by the interface using the command **ptp transmission unicast**

Example:

```
switch(config-if)# ptp transmission unicast
                        switch(config-if)#
```

Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Step 7 Configure the PTP role of the interface using the command **ptp role slave**

Example:

```
switch(config-if)# ptp role slave
                        switch(config-if)#
```

slave : The slave clock is assigned as the PTP role of the interface.

Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Step 8 Set the IP address of the master clock when the PTP role of the interface is set to "slave" using the command **ptp master***ipv4-address*

Example:

```
switch(config-if)# ptp master 10.10.10.1
                        switch(config-if)#
```

Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Configure Unicast Source Address

Note For all releases up to, and including Cisco NX-OS Release 9.3(4), if the PTP configuration on the interface is changed from unicast to multicast or unicast slave to unicast master, you must reconfigure the unicast source address.

Beginning with Cisco NX-OS Release 9.3(5), if the PTP configuration on the interface is changed from unicast to multicast or unicast slave to unicast master, you do not need to reconfigure the unicast source address.

Complete the following steps to configure unicast source address:

Procedure

Step 1 Enter global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Specify the interface on which you enable the PTP and enter the interface configuration mode using the following command **interface ethernet***slot/port*

Example:

```
switch(config)# interface ethernet 2/1
                        switch(config-if)#
```

Step 3 Configure the PTP source address per interface level using the command[**no**] **ptp ucast-source** { <*ipv4-addr*> | <*ipv6-addr*> } [**vrf**<*vrf-name*>

Example:

```
switch(config-if)# ptp ucast-source 10.10.10.20
                        switch(config-if)#
```

This IP address is used only for unicast PTP messages. The PTP unicast source IP address must be reachable.

ipv4-address : The IPv4 address of the unicast source. This is used when transport is set to IPv4.

ipv6-address : The IPv6 address of the unicast source. This is used when transport is set to IPv6.

vrf*vrf-name* : If the IP address is in non-default VRF, use the vrf parameter to configure the VRF.

Configure PTP Telecom Profile

Configure Global PTP Telecom Profile

This procedure describes the steps involved to configure PTP telecom profile including the clock and its settings to be consistent with ITU-T Telecom Profiles for Frequency.

Before you begin

The QoS TCAM region Ingress SUP [ingress-sup] must be set to 768 or higher. Follow these steps:

1. Check the TCAM region by using the **show hardware access-list tcam region** command.
2. If the Ingress SUP region is not set to 768 or higher, then configure the Ingress SUP TCAM region using the command **hardware access-list tcam region ing-sup 768** . Copy the running configuration to the startup configuration (**copy running-config startup-config**) and reload the switch.

Procedure

Step 1 Enters global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Enable the global PTP feature using the command **feature ptp**

Example:

```
switch(config)# feature ptp
                        switch(config)#
```

Step 3 Configure the PTP operational mode for the switch using the command Profile Default: **mode** { **hybrid** | **non-hybrid** | **none** }

Example:

```
switch(config)# mode hybrid
                        switch(config-ptp-profile)#
```

The two operational modes for the switch are:

hybrid : The SyncE source acts as the PTP source.

default : The local/1588 clock acts as the PTP source.

Note

- This command is automatically configured when the **ptp profile** command is set. The configuration value cannot be changed. See #unique_127 unique_127_Connect_42_step_gtc_cts_tkb for more information.
- The only mode that the 8275-2 profile supports is none .

Step 4 Exit the PTP profile configuration mode and returns to the global configuration mode using the command **exit**

Example:

```
switch(config-ptp-profile)# exit
                        switch(config)#
```

Step 5 Configure the source IPv4 address for all the PTP packets in the multicast PTP mode using the command **ptp source***ip-address*

Example:

```
switch(config)# ptp source 10.10.10.20
                        switch(config)#
```

Step 6 Configure the priority value to use when advertising this clock using the command Profile Default: **ptp***priority valuevalue*

Example:

```
switch(config)# ptp priority1 128
                        switch(config)#

switch(config)# ptp priority2 128
                        switch(config)#
```

The priority value can be priority1 or priority2. This value overrides the default criteria (clock quality, clock class, etc.) for best master clock selection. Lower values take precedence. The default value is 128 and the range is from 0 to 255.

Note This command is automatically configured when the **ptp profile 8275-1 or 8275-2** global command is set. The configuration value cannot be changed. See #unique_127 unique_127_Connect_42_step_gtc_cts_tkb .

Step 7 Configure the peer delay request interval using the command **ptp pdelay-req-interval***value*

Example:

```
switch(config)# ptp pdelay-req-interval 0
                        switch(config)#
```

value : Range is from 0 through 5.

Step 8 Specify the PTP clock domain value using the command Profile Default: **ptp domain***value*

Example:

```
switch(config)# ptp domain 24
                        switch(config)#
```

The allowed domain number range for G.8275.1 profile is between 24 and 43. Default is 24. The allowed domain number range for G.8275.2 profile is between 44 and 63. Default is 44.

Note This command is automatically configured when the **ptp profile 8275-1** or **8275-2** global command is set. See #unique_127 unique_127_Connect_42_step_gtc_cts_tkb .

Configure PTP Telecom Profile 8275-1 on an Interface

This procedure describes the steps that are involved to configure PTP telecom profile 8275-1 for interfaces.

Note Some commands that are described in this procedure are automatically enabled and configured when the **ptp profile 8275-1** global command is set and PTP is enabled on the interface. See Configure Global PTP Telecom Profile, on page 31 for more information.

Before you begin

This procedure along with configuring frequency synchronization on the interface, constitutes the required interface settings for the "hybrid PTP" platform. For more information about the interface frequency synchronization configuration, see Configure Frequency Synchronization on an interface .

Procedure

Step 1 Enter the global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
                        switch(config)#
```

Step 2 Specify the interface on which you configure PTP telecom profile parameters and enter the interface configuration mode using the command **interface ethernet***slot* / *port*. Enable PTP on the interface using the command [**no**] **ptp**

Example:

```
switch(config)# interface ethernet 1/5
                        switch(config-if)#

switch(config-if)# ptp
                        switch(config-if)#
```

Step 3 Specify the transport mechanism that is used to send PTP packets using the command : Profile Default: **ptp transportethernet** and configure the PTP transmission method that is used by the interface using the command : Profile Default: **ptp transmission multicast**

Example:

```
switch(config-if)# ptp transport ethernet
                        switch(config-if)#

switch(config-if)# ptp transmission multicast
                        switch(config-if)#
```

For **ethernet** , PTP packets are carried only in Eth frame (Eth/ptp). For **multicast** , PTP uses multicast destination IP address 224.0.1.129 as per IEEE 1588 standards for communication between devices.

Note This command is automatically configured when the **ptp profile 8275-1** global command is set. For more information about the **ptp profile 8275-1** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 4 Configure the PTP role of the interface using the command : Profile Default: **ptp role dynamic**

Example:

```
switch(config-if)# ptp role dynamic
                        switch(config-if)#
```

For **dynamic** , the best master clock algorithm (BMCA) assigns the role.

Note This command is automatically configured when the **ptp profile 8275-1** global command is set. For more information about the **ptp profile 8275-1** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 5 Accept and respond to nonforwardable destination MAC address packets using the command **ptp destination-mac non-forwardable rx-no-match accept**

Example:

```
switch(config-if)# ptp destination-mac non-forwardable rx-no-match accept
                        switch(config-if)#
```

This is an optional step. These destination MAC addresses are used in the PTP messages that are exchanged between the GM clock, PTP-master clock, and PTP-slave clocks.

Step 6 Configure the value used in the BMCA's selection of the best master clock using the command Profile Default: **ptp cost***value* and configures the minimum interval that is allowed between PTP delay messages when the port is in the master state using the command Profile Default: **ptp delay-request minimum interval***log-seconds*

Example:

```
switch(config-if)# ptp cost 128
                        switch(config-if)#


switch(config-if)# ptp delay-request minimum interval -4
```

If all the parameters mentioned in the standard are the same, then this local priority is used.

Note This command is automatically configured when the **ptp profile 8275-1** global command is set. For more information about the **ptp profile 8275-1** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 7 Configure the interval between PTP announce messages on an interface or the number of PTP intervals before a timeout occurs on an interface using the command Profile Default: **ptp announce interval***log-seconds* and

configures the interval between PTP synchronization messages on an interface using the command Profile Default: **ptp sync interval***log-seconds*

Example:

```
switch(config-if)# ptp announce interval -3
switch(config-if)# ptp sync interval -4
```



Note This command is automatically configured when the **ptp profile 8275-1** global command is set. For more information about the **ptp profile 8275-1** command, see Configure Global PTP Telecom Profile, on page 31.

Step 8 Configure the number of PTP intervals before a timeout occurs on an interface using the command [**no**] **ptp announcetimeout***count*

Example:

```
switch(config-if)# ptp announce timeout 3
```

This is an optional step. The range for the PTP announcement interval timeout is from 2 to 4 intervals.

Step 9 To change the following commands in this interface configuration using the command [**no**] **ptp profile-override**

Example:

```
switch(config-if)# ptp profile-override
                       switch(config-if)#
```

This is an optional step that is disabled by default. When enabled, it allows you to change the following commands in this interface configuration:

- **ptp transport**
- **ptp announce interval**
- **ptp delay-request minimum interval**
- **ptp sync interval**
- **ptp cost** (8275-1 profile only)



Note When enabled, changes to the commands will not be reset to default if the global PTP profile is changed. Removing **ptp profile-override** resets the PTP configuration on the interface to the default values corresponding to the global profile.

Configure PTP Telecom Profile 8275-2 on an Interface

This procedure describes the steps that are involved to configure PTP telecom profile 8275-2 for interfaces.

Note Some commands that are described in this procedure are automatically enabled and configured when the **ptp profile 8275-2** global command is set and PTP is enabled on the interface. See Configure Global PTP Telecom Profile, on page 31 for more information.

Before you begin

This procedure along with configuring frequency synchronization on the interface, constitutes the required interface settings for the "hybrid PTP" platform. For more information about the interface frequency synchronization configuration, see Configure Frequency Synchronization on an interface .

Procedure

Step 1 Enter the global configuration mode using the command **configure terminal** and specify the interface on which you are configuring PTP telecom profile parameters and enter the interface configuration mode using the command **interface ethernet***slot* / *port*

Example:

```
switch# configure terminal
                        switch(config)#

switch(config)# interface ethernet 1/5
                        switch(config-if)#
```

Step 2 Enable the PTP on the interface using the command [**no**] **ptp** and specify the transport mechanism that is used to send PTP packets using the profile default command **ptp transportipv4**

Example:

```
switch(config-if)# ptp
                        switch(config-if)#

switch(config-if)# ptp transport ipv4
                        switch(config-if)#
```

Note This command is automatically configured when the **ptp profile 8275-2** global command is set. For more information about the **ptp profile 8275-2** command, see Configure Global PTP Telecom Profile, on page 31

Step 3 Configure the PTP transmission method that is used by default by the interface using the command **ptp transmission unicast** and configure the default PTP role of the interface using the command **ptp role dynamic**

Example:

```
switch(config-if)# ptp transmission unicast
                        switch(config-if)#

switch(config-if)# ptp role dynamic
                        switch(config-if)#
```

For **unicast**, PTP uses the configured master/slave/peer IP. For **dynamic** , the best master clock algorithm (BMCA) assigns the role.

Note This command is automatically configured when the **ptp profile 8275-2** global command is set. For more information about the **ptp profile 8275-2** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 4 Accept and respond to non-forwardable destination MAC address packets using the command **ptp destination-mac non-forwardable rx-no-match accept**

Example:

```
switch(config-if)# ptp destination-mac non-forwardable rx-no-match accept
                        switch(config-if)#
```

These destination MAC addresses are used in the PTP messages that are exchanged between the GM clock, PTP-master clock, and PTP-slave clocks.

Step 5 Configure the value used in the BMCA's selection of the best master clock using the command **ptp cost***value* and configure the minimum interval that is allowed between PTP delay messages when the port is in the master state using the command **ptp delay-request minimum interval***log-seconds*

Example:

```
switch(config-if)# ptp cost 128
                        switch(config-if)#


switch(config-if)# ptp delay-request minimum interval -4
```

If all the parameters mentioned in the standard are the same, then this local priority is used.

Note This command is automatically configured when the **ptp profile 8275-2** global command is set. For more information about the **ptp profile 8275-2** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 6 Configure the interval between PTP announce messages on an interface or the number of PTP intervals before a timeout occurs on an interface using the command **ptp announce interval***log-seconds*

Example:

```
switch(config-if)# ptp announce interval -3
```

Note This command is automatically configured when the **ptp profile 8275-2** global command is set. For more information about the **ptp profile 8275-2** command, see Configure Global PTP Telecom Profile, on page 31 .

Step 7 Configure the interval between PTP synchronization messages on an interface using the profile default command : **ptp sync interval***log-seconds*

Example:

```
switch(config-if)# ptp sync interval -4
```

Note This command is automatically configured when the **ptp profile 8275-2** global command is set. For more information about the **ptp profile 8275-2** command, see Configure Global PTP Telecom Profile, on page 31.

Step 8 Configure the number of PTP intervals before a timeout occurs on an interface using the command [**no**] **ptp announcetimeout***count*

Example:

```
switch(config-if)# ptp announce timeout 3
```

This is an optional step and the range for the PTP announcement interval timeout is from 2 to 4 intervals.

Step 9 To change any of the commands mentioned below you can use this command : [**no**] **ptp profile-override**

Example:

```
switch(config-if)# ptp profile-override
                        switch(config-if)#
```

This is an optional step that is disabled by default. You can enable it to change the following commands in this interface configuration:

- **ptp transport**
- **ptp announce interval**
- **ptp delay-request minimum interval**
- **ptp sync interval**
- **ptp cost** (8275-2 profile only)

Note When enabled, changes to the commands will not be reset to default if the global PTP profile is changed. Removing **ptp profile-override** resets the PTP configuration on the interface to the default values corresponding to the global profile.

Profile Defaults

The following table lists the ranges and default values for the commands that are automatically configured when the global command **ptp profile** is set. You cannot change the range for the affected global commands beyond those allowed by the configured profile. However, in the interface mode, they can be changed if the **ptp profile-override** command is set.

Note For Cisco NX-OS Release 9.3(5), only the Cisco Nexus 93180YC-FX3S switch supports either option in this command.

Table 2: Range and Default Values

Parameter	Scope or Configuration Mode	Default Profile's Supported Range of Values	Default Profile's Default Value	8275-1 Profile's Supported Range of Values	8275-1 Profile's Default Value	8275-2 Profile's Supported Range of Values	8275-2 Profile's Default Value	With 'ptp profile override' Configured on an Interface Supported Range of Values (Default is Based on Configured Profile)
mode	global	none	none	hybrid	hybrid	none	none	no change
domain	global	0 to 63	0	24 to 43	24	44 to 63	44	no change
priority1	global	0 to 255	255	128	128	128	128	no change
priority2	global	0 to 255	255	0 to 255	128	0 to 255	128	no change
cost	interface	Not configurable	Not configurable	0 to 255	128	0 to 255	128	0 to 255
transport	interface	ipv4, ipv6	ipv4	ethernet	ethernet	ipv4, ipv6	ipv4	ethernet, ipv4
transmission	interface	multicast, unicast	multicast	multicast	multicast	unicast	unicast	no change
role	interface	dynamic, master, slave	dynamic	dynamic	dynamic	dynamic, master, slave	dynamic	no change
announce interval	interface	0 to 4 0 to 4 with aes67 -3 to 1 with smpte-2059-2	1	-3	-3	-3 to 0	-3	-3 to 4 0 to 4 with aes67 -3 to 1 with smpte-2059-2

Parameter	Scope or Configuration Mode	Default Profile's Supported Range of Values	Default Profile's Default Value	8275-1 Profile's Supported Range of Values	8275-1 Profile's Default Value	8275-2 Profile's Supported Range of Values	8275-2 Profile's Default Value	With 'ptp profile-override' Configured on an Interface Supported Range of Values (Default is Based on Configured Profile)
delay-request minimum interval	interface	-1 to 6 -4 to 5 with aes67 -4 to 5 with smpte-2059-2	0	-4	-4	-4 to 0	-4	-4 to 6 -4 to 5 with aes67 -4 to 5 with smpte-2059-2
sync interval	interface	-3 to 1 -4 to 1 with aes67 -7 to 0 with smpte-2059-2	-2	-4	-4	-4 to 0	-4	-4 to 1 -4 to 1 with aes67 -7 to 0 with smpte-2059-2

Configure PTP Notifications

You can enable, disable, and customize notifications for the following significant PTP events:

- Change in the Grand Master (GM) clock
- Change in the Parent clock
- Change in the PTP state on a port
- High PTP clock corrections

The notifications are generated by the DME infrastructure based on information it receives from PTP.

Procedure

Step 1 Configure the system to send a change notification if any PTP clock changes using the command [**no**] **ptp notification type** *clock type*-**change**

Example:

```
switch(config)# ptp notification type <clock type>-change
                        switch(config)#
```

This step can be used to a notification for a grand master or a parent clock.

Step 2 Configure the system to send a notification if a port state change event occurs using the command [**no**] **ptp notification type port-state-change** [**category** { **all** | **master-slave-only** }] [**interval** { **immediate** | *seconds* [**periodic-notification** { **disable** | **enable** }] }]

Example:

```
switch(config)# ptp notification type port-state-change category master-slave-only
                        switch(config)#
```

- **category** : Specifies which state changes must occur for a notification to be sent.
  - **all** : Every port state change is reported.



Note Using the **all** option results in many notifications.

  - **master-slave-only** : Port state changes from and to the master-slave state are only reported.

- **interval***seconds* : Port state change notifications are sent at the configured interval: from 1-300 seconds with a granularity of 1 sec.
  - **periodic-notification** : Determines if periodic notifications are sent even if a port state change has not occurred during the configured interval.

    disable : A port state change notification is reported only if the current state is not the same as the previously reported state. Any intermediate state changes during the configured periodic interval are ignored. For example, if a port is a MASTER at time X, and changes to DISABLED and then back to MASTER by the time X+periodic-interval occurs, then no notification is generated for the intervening events.

    enable : Port state change notifications are sent at the configured interval, irrespective of a change in the port state.

- **interval immediate** : A port State Change Notification is sent when the state changes.

Step 3 Configure the system to send a high-correction notification if a PTP high correction event occurs using the command [**no**] **ptp notification type high-correction** [**interval** { *seconds* [**periodic-notification** { **disable** | **enable** }] | **immediate** }]

Example:

```
switch(config)# ptp notification type high-correction interval immediate
                        switch(config)#
```

A high correction event is when the correction exceeds the value that is configured in the **ptp correction-range** command (see the following optional step).

- **interval***seconds* : High-correction notifications are sent at the configured interval: 1–300 seconds with a granularity of 1 second.

- **periodic-notification** : Determines if periodic notifications are sent even if any high correction has not occurred during the configured interval.

  disable : Send a notification only if high correction events occurred during the configured periodic interval. This is the default setting.

  enable : Send a notifications irrespective of the number of high correction events during the configured periodic interval. If there are no such events, the payload indicates zero high correction events during the periodic interval.

- **interval immediate** : Send a notification as soon as a high correction event occurs.

The high correction notification contains the following attributes:

- highCorrectionCount
- lastHighCorrectionTime
- lastHighCorrectionValue

Step 4 Configure a threshold that, once exceeded, indicates that a PTP high correction has occurred using the command [**no**] **ptp correction-range** { *nanoseconds* | **logging** }

Example:

```
switch(config)# ptp correction-range 200000
                        switch(config)#
```

This is an optional step. Range is 10–1000000000. The default is 100000 (100 microseconds).

PTP Mixed Mode

PTP supports Mixed mode for delivering PTP messages, which is detected automatically by Cisco Nexus device, based on the type of **delay_req** message received from connected client and no configuration is required. In this mode when slave sends **delay_req** in unicast message, master also replies with unicast **delay_resp** message.

Configure PTP Interface to Stay in Master State

This procedure describes how to prevent an endpoint from causing a port to transition to a slave state.

Before you begin

- Make sure that you have globally enabled PTP on the switch and configured the source IP address for PTP communication.
- After you globally enable PTP, it is not enabled on all supported interfaces by default. You must enable PTP interfaces individually.

Procedure

Step 1 Enter global configuration mode using the command : **switch # configure terminal**

Step 2 Specify the interface on which you are enabling PTP and enters interface configuration mode using the command **switch(config) # interface ethernet***slot/port*

Step 3 Enable or disable PTP on an interface using the command **switch(config) # ptp**

Note After configuring this command, for Cisco NX-OS Release 9.3(5) and later, skip to step 5. For Cisco NX-OS Release 9.3(4) and earlier, continue with step 4.

Step 4 Configure the port to maintain the master state using the command **switch(config-if) #***ptpmulticastmaster-only* **ptpmulticastmaster-only**

Example:

```
switch(config)#
show ptp brief
PTP port status
-----------------------------------
Port                   State
----------------  -----------------
Eth1/1              Slave
switch(config)#
interface ethernet 1/1
switch(config-if)#
ptp multicast master-only

2001 Jan  7 07:50:03 A3-MTC-CR-1 %$ VDC-1 %$ %PTP-2-PTP_GM_CHANGE: Grandmaster clock has changed

               from 60:73:5c:ff:fe:62:a1:41 to 58:97:bd:ff:fe:0d:54:01 for the PTP protocol


2001 Jan  7 07:50:03 A3-MTC-CR-1 %$ VDC-1 %$ %PTP-2-PTP_STATE_CHANGE: Interface Eth1/1 change from

                 PTP_BMC_STATE_SLAVE to PTP_BMC_STATE_PRE_MASTER

2001 Jan  7 07:50:03 A3-MTC-CR-1 %$ VDC-1 %$ %PTP-2-PTP_TIMESYNC_LOST: Lost sync with  master clock


2001 Jan  7 07:50:07 A3-MTC-CR-1 %$ VDC-1 %$ %PTP-2-PTP_STATE_CHANGE: Interface Eth1/1 change from

                 PTP_BMC_STATE_PRE_MASTER to PTP_BMC_STATE_MASTER
```

Note This command is supported in Cisco NX-OS Release 9.3(4) and earlier. It is deprecated in Cisco NX-OS Release 9.3(5) and later.

For Cisco NX-OS Release 9.3(4) and earlier, this concludes the procedure.

Step 5 Configure the port to maintain the master state using the command **ptp role master**

Note This command is supported beginning with Cisco NX-OS Release 9.3(5).

Enable PTP Unicast-Negotiation

Enabling PTP unicast transmission is a pre-requisite for using unicast-negotiation.

Beginning with Cisco NX-OS 10.2(1)F release, the following are the newly added CLIs:

Procedure

Step 1 Create a default schema using the command **switch (config-ptp-ucast-negotiation)# schema** <*schema-name*>

A default schema will be created when unicast-negotiation is enabled and will be applied to all interfaces that have PTP-unicast enabled and to the master IPs currently configured. Schema name can be any string up to 31 characters.

Step 2 Configure the interval between PTP announce messages using the command **switch (config-ptp-ucast-nego-schema)# announce interval** <*log-seconds*>

The range varies from -3 to 0. Default value is -1.

Step 3 Configure the interval between PTP synchronization messages using the command **switch (config-ptp-ucast-nego-schema)# sync interval** <*log-seconds*>

This is an optional step. The range varies from -4 to 0. Default value is -3.

Step 4 Configure the interval allowed between PTP delay messages when the port is in master state using the command **switch (config-ptp-ucast-nego-schema)# delay-response interval** <*log-seconds*>

This is an optional step. The range varies from -4 to 0. Default value is -2.

Step 5 Configure the duration of any type of session using the command **switch (config-ptp-ucast-nego-schema)#** *type of session* **duration** <*seconds*> [**renew-offset** <*seconds*>]

This is an optional step which can be used to configure an announce, sync or delay-response session.

To set how soon the slave sends renewal request for the session use the command **renew-offset** <*seconds*> :

Default value is 10 which means, it will send renewal request 10 seconds before expiry of session (granted duration). The range is 60 to 1000. Default value is 300.

Step 6 Configure an acceptable range of values for any type of interval requests from slave using the command **switch (config-ptp-ucast-nego-schema)#** *type of interval request* **interval range** <*minimum-log-val*> <*maximum-log-val*>

This is an optional step which can be used to configure acceptable range of values for announce, sync or delay-response interval requests. Default for minimum-log-val is -3. Default for maximum-log-val is 0.

Step 7 Configure an acceptable range of values for any type of session duration requests from slave using the command**switch (config-ptp-ucast-nego-schema)#** *type of session duration request* **duration range**<*minimum-seconds*> <*maximum-seconds*>

This is an optional step which can be used to configure acceptable range of values for announce, sync or delay-response session duration requests. Default for minimum-seconds is 60. Default for maximum-seconds is 1000.

Step 8 To show the status of unicast-negotiation use the command, **show ptp unicast-negotiation** [*interface ethernet slot/port*]

Enhanced Multicast Scale

This feature is to be used only in specific deployment scenarios where higher scaling of PTP multicast secondary devices is required even though the ability to debug is very limited.

This feature has the following limitations:

- The high scale in the number of PTP slaves implies very high PTP control packet rate. As a result, copp rate needs to be increased appropriately. For more information about Configuring Control Plane Policing, refer to the appropriate version of the *Cisco Nexus 9000 Series NX-OS Security Configuration Guide* on cisco.com.
- PTP debugs should be completely disabled using the **no ptp debug all** command, along with various internal logs, for example, PTP internal syslogs. As a result, ability to debug issues will be very limited.
- We recommend that PTP secondary port should not share hardware MAC (port fifo) with any of the scaled PTP primary ports. Additionally, not more than 2 primary ports should be enabled per hardware MAC. The hardware MAC for ports on any given switch can be checked using the following command:

  show interface hardware-mappings
- In rare occasions, the corrections can spike to the milliseconds range.

Perform the following command to enable the scaling of PTP multicast secondary devices:

ptp enhanced-client-scale

To view the status of the above command, run the following command:

switch# **show run ptp** | **grep enhanced**

Timestamp Tagging

The timestamp tagging feature provides precision time information to track in real time when packets arrive at remote devices. Packets are truncated and timestamped using PTP with nanosecond accuracy. Using the TAP aggregation functionality on the switch, along with the Cisco Nexus Data Broker, you can copy the network traffic using SPAN, filter and timestamp the traffic, and send it for recording and analysis.

If you configure **ttag** on an interface, all incoming traffic will be tagged. If you configure **ttag-strip** on an interface all outgoing traffic with ttag will be removed.

Configure Timestamp Tagging

Note Configuring timestamp tagging is not supported on Cisco Nexus 9508 switches with 9636C-R, 9636C-RX, and 9636Q-R line cards.

Note

- When you use the ttag feature in a VXLAN EVPN multisite deployment, make sure that the ttag is stripped (**ttag-strip**) on BGW's DCI interfaces that connect to the cloud. To elaborate, if the ttag is attached to non-Nexus 9000 devices that do not support ether-type 0x8905, stripping of ttag is required. If no stripping is done, the non-Nexus devices will drop the packet.
- BGW back-to-back model of DCI does not require ttag stripping.
- For Cloudscale platforms, if a packet is received with a TTAG header (ethertype 0x8905), it will be preserved, unless **ttag-strip** is configured on the outgoing interface. After switching or routing, the packet egressing the switch will also have a TTAG header. For this to happen, the switch does not need to have any PTP or TTAG-related configuration. If the next hop would be a non-Cloudscale platform, such as a Catalyst switch - it might not recognize ether-type 0x8905, and could drop the packet.
- Cisco Nexus 9800 switches do not support routing of ether-type 0x8905 packets.

Procedure

Step 1 Enter the global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Step 2 Enter the interface configuration mode for the specified interface using the command **interface***type slot/port*

Example:

```
switch(config)# interface ethernet 2/2
switch(config-if)#
```

Step 3 Configure the timestamp tagging on the Layer 2 or Layer 3 egress interface using the command [**no**] **ttag**

Example:

```
switch(config-if)# ttag
```

This is required on the ingress port for the traffic that needs to be tagged when egressing the switch. This is not required on the egress port.

Configure TTAG Marker Packets and Time Interval

The ttag timestamp field attaches a 48-bit timestamp on the marker packet. This 48-bit timestamp is not a human familiar ASCII based timestamp. To make this 48-bit timestamp human readable, the ttag marker packet can be used to provide additional information to decode the 48-bit timestamp information.

Field	Position (byte:bit)	Length	Definition
Magic		16	By default, this field displays A6A6. This enables to identify ttag-marker packets on the packet stream.
Version		8	Version number. The default version is 1.
Granularity		16	This field represents the granularity of the 48-bit timestamp size. By default, the value is 04, which is 100 picoseconds or 0.1. nanoseconds.
UTc_offset		8	The utc_offset between the ASIC and the UTC clocks. The default value is 0.
Timestamp_hi		32	The high 16-bit of 48- bit ASIC hardware timestamp. **Note** Add Correction_hi and Correction_lo to Timestamp_hi and Timestamp_lo fields to get the 64-bit ASIC hardware timestamp.
Timestamp_lo		32	The low 32-bit of 48- bit ASIC hardware timestamp. **Note** Add Correction_hi and Correction_lo to Timestamp_hi and Timestamp_lo fields to get the 64-bit ASIC hardware timestamp.
UTC sec		32	The seconds part of UTC timestamp from the CPU clock of the Cisco Nexus 9000 Series switch.
UTC nsec		32	The nanoseconds part of UTC timestamp from the CPU clock of the Cisco Nexus 9000 Series switch.
Reserved		32	Reserved for future use.

Correction_hi		32	The high 32-bit of cumulative PTP correction on the Cisco Nexus 9000 Series switch. **Note** Add Correction_hi and Correction_lo to Timestamp_hi and Timestamp_lo fields to get the 64-bit ASIC hardware timestamp.
Correction_lo		32	The low 32-bit of cumulative PTP correction on the Cisco Nexus 9000 Series switch. **Note** Add Correction_hi and Correction_lo to Timestamp_hi and Timestamp_lo fields to get the 64-bit ASIC hardware timestamp.
Signature		32	The default value is 0xA5A5A5A5. This allows a forward search of marker packet and provide references to the UTC timestamp, so the client software can use that reference UTC to recover the 32-bit hardware timestamp in each packet header.
Pad		8 64	This is align byte to convert the ttag-marker align to 4 byte boundary.

Procedure

Step 1 Enter global configuration mode using the command **configure terminal**

Example:

```
switch# configure terminal
switch(config)#
```

Step 2 Configure the seconds that a switch will take to send a ttag-marker packet to the outgoing ports using the command **ttag-marker-interval***seconds*

Example:

```
switch(config-if)# ttag-marker-interval 90
```

This is a global setting to the switch. By default, it sends a ttag-marker packet every 60 seconds. The range for seconds is from 1 to 25200.

Step 3 Enter the interface configuration mode for the specified interface using the command **interface***type slot/port*

Example:

```
switch(config)# interface ethernet 2/2
switch(config-if)#
```

Step 4 Send the ttag-marker packets to the outgoing port using the command [**no**] **ttag-marker enable**

Example:

```
switch(config-if)# ttag-marker enable
```

Step 5 Remove TTAG from egress packets on the interface using the command **ttag-strip**

Example:

```
switch(config-if)# ttag-strip
```

Verify PTP Configuration

Use one of the following commands to verify the configuration:

Table 3: PTP Show Commands

Command	Purpose
show ptp brief	Displays the PTP status.
show ptp clock	Displays the properties of the local clock, including clock identity.
show ptp clock foreign-masters-record	Displays the state of foreign masters known to the PTP process. For each foreign master, the output displays the clock identity, basic clock properties, and whether the clock is being used as a grandmaster.
show ptp corrections	Displays the last few PTP corrections.
show ptp counters [**all** | **interface ethernet** *slot/port*]	Displays the PTP packet counters for all interfaces or for a specified interface.
show ptp parent	Displays the properties of the PTP parent.
show ptp port interface ethernet *slot/port*	Displays the status of the PTP port on the switch.
show ptp time-property	Displays the PTP clock properties.
show running-config ptp [**all**]	Displays the running configuration for PTP.
clear ptp counters [**all** | **interface ethernet** *slot/port*]	Clears all PTP messages that are received and transmitted on a specific interface or on all interfaces that has PTP enabled.
show ptp detail	Displays the list of all connected peers for each PTP port and indicates whether the role is static or dynamic.

Verify PTP Telecom Profile Configuration

After performing the PTP telecom profile configuration tasks, use this reference to verify the configuration.

show running-config ptp all

The output of this command displays global and interface configurations for PTP telecom profile.

The following is an example of the output of the **show running-config ptp all** command:

```
switch# show running-config ptp all
!Command: show running-config ptp all
!Running configuration last done at: Fri Feb 21 20:09:55 2020
!Time: Fri Feb 21 21:10:19 2020

version 9.3(5) Bios:version 01.00
feature ptp

ptp profile 8275-1
  mode hybrid
ptp source 0.0.0.0
ptp device-type boundary-clock
ptp priority1 128
ptp priority2 10
ptp pdelay-req-interval 0
no ptp notification type parent-change
no ptp notification type gm-change
no ptp notification type high-correction
no ptp notification type port-state-change
ptp correction-range 100000
no ptp correction-range logging
ptp management
ptp mean-path-delay 1000000000
ptp domain 24
ttag-marker-interval 60


interface Ethernet1/1
  ptp
  no ptp profile-override
  ptp destination-mac non-forwardable rx-no-match accept
  ptp transport ethernet
  ptp transmission multicast
  ptp role dynamic
  ptp cost 128
  ptp delay-request minimum interval -4
  ptp announce interval -3
  ptp sync interval -4
  ptp announce timeout 3

interface Ethernet1/6
  ptp
  no ptp profile-override
  ptp destination-mac non-forwardable rx-no-match accept
  ptp transport ethernet
  ptp transmission multicast
  ptp role dynamic
  ptp cost 128
  ptp delay-request minimum interval -4
  ptp announce interval -3
  ptp sync interval -4
  ptp announce timeout 3
```

```
interface Ethernet1/7
  ptp
  no ptp profile-override
  ptp destination-mac non-forwardable rx-no-match accept
  ptp transport ethernet
  ptp transmission multicast
  ptp role dynamic
  ptp cost 128
  ptp delay-request minimum interval -4
  ptp announce interval -3
  ptp sync interval -4
  ptp announce timeout 3

interface Ethernet1/8
  ptp
  no ptp profile-override
  ptp destination-mac non-forwardable rx-no-match accept
  ptp transport ethernet
  ptp transmission multicast
  ptp role dynamic
  ptp cost 128
  ptp delay-request minimum interval -4
  ptp announce interval -3
  ptp sync interval -4
  ptp announce timeout 3
```



Note The output of the **show running-config ptp all** command displays a complete list of all the PTP configured interfaces.

show ptp parent

The output of this command displays the properties of a PTP parent.

The following is an example of the output of the **show ptp parent** command:

```
switch# show ptp parent
PTP PARENT PROPERTIES

Parent Clock:
Parent Clock Identity: 10:b3:d6:ff:fe:bf:a8:63
Parent Port Number: 0
Observed Parent Offset (log variance): N/A
Observed Parent Clock Phase Change Rate: N/A

Grandmaster Clock:
Grandmaster Clock Identity: 10:b3:d6:ff:fe:bf:a8:63
Grandmaster Clock Quality:
        Class: 248
        Accuracy: 254
        Offset (log variance): 65535
        Priority1: 128
        Priority2: 10
```

show ptp corrections

The output of this command displays up to the last 2000 correction details for each PTP slave port.

The following is an example of the output of the **show ptp corrections** command:

```
switch# show ptp corrections
PTP past corrections
--------------------------------------------------------------------------------
Slave Port            SUP Time                  Correction(ns)    MeanPath Delay(ns)
----------  -------------------------------  ------------------  ------------------
Eth1/3      Thu Feb 20 22:51:02 2020 861523           4           260
Eth1/3      Thu Feb 20 22:51:02 2020 735961           4           260
Eth1/3      Thu Feb 20 22:51:02 2020 610170           4           268
Eth1/3      Thu Feb 20 22:51:02 2020 483106           0           280
Eth1/3      Thu Feb 20 22:51:02 2020 355745           0           280
Eth1/3      Thu Feb 20 22:51:02 2020 229924          -4           268
Eth1/3      Thu Feb 20 22:51:02 2020 104819          -4           268
Eth1/3      Thu Feb 20 22:51:01 2020 979604           8           272
```

show ptp clock

The output of this command displays the properties of the local clock, including clock identity.

The following is an example of the output of the **show ptp clock** command:

```
switch# show ptp clock
PTP Device Type : boundary-clock
PTP Device Encapsulation : NA
PTP Source IP Address : 0.0.0.0
Clock Identity : 10:b3:d6:ff:fe:bf:a8:63
Clock Domain: 24
Slave Clock Operation : Unknown
Master Clock Operation : Two-step
Slave-Only Clock Mode : Disabled
Number of PTP ports: 35
Priority1 : 128
Priority2 : 10
Clock Quality:
        Class : 248
        Accuracy : 254
        Offset (log variance) : 65535
Offset From Master : 0
Mean Path Delay : 0
Steps removed : 0
Correction range : 100000
MPD range : 1000000000
Local clock time : Wed Feb 26 17:08:34 2020
Hardware frequency correction : NA
PTP Clock state               : Free-Run
```

show ptp brief

The output of this command displays the PTP clock state for each configured port.

The following is an example of the output of the **show ptp brief** command:

```
switch# show ptp brief
PTP port status
-----------------------------------
Port                  State
--------------------- ------------
Eth1/1                Slave
Eth1/6                Disabled
Eth1/7                Disabled
Eth1/8                Disabled
Eth1/10               Master
Eth1/11               Disabled
Eth1/12               Disabled
Eth1/13               Master
```

```
Eth1/14               Disabled
Eth1/15               Disabled
Eth1/16               Disabled
Eth1/17               Disabled
Eth1/18               Disabled
Eth1/19               Disabled
Eth1/20               Disabled
Eth1/21               Disabled
Eth1/22               Disabled
Eth1/23               Disabled
Eth1/24               Disabled
Eth1/25               Disabled
Eth1/26               Disabled
Eth1/27               Disabled
Eth1/28               Disabled
Eth1/29               Disabled
Eth1/30               Disabled
Eth1/31               Disabled
Eth1/32               Disabled
Eth1/33               Disabled
Eth1/34               Disabled
Eth1/35               Disabled
Eth1/36               Disabled
Eth1/37               Disabled
Eth1/38               Disabled
Eth1/39               Disabled
Eth1/40               Disabled
```

show ptp clock foreign-masters record

The output of this command displays the state of foreign masters known to the PTP process. For each foreign master, the output displays the clock identity, basic clock properties, and whether the clock is being used as a grandmaster..

The following is an example of the output of the **show ptp clock foreign-master-record** command:

```
switch# show ptp port status
P1=Priority1, P2=Priority2, C=Class, A=Accuracy,
OSLV=Offset-Scaled-Log-Variance, SR=Steps-Removed
GM=Is grandmaster

---------   ----------------------  ---  ----  ----  ---  -----  --------
Interface          Clock-ID           P1   P2    C     A    OSLV   SR
---------   ----------------------  ---  ----  ----  ---  -----  --------

Eth1/1    00:00:00:00:00:00:00:01    128  128   6     33   65535  0    GM
```

show ptp detail

The output of this command displays the list of all connected peers for each PTP port and indicates whether the role is static or dynamic.

```
switch(config-if)# show ptp detail
PTP port details:
    Flags:   (S) Static, (D) Dynamic
    Connected Peer details: IP  clock-id

Port             State         Transmission     Transport        Flags
====             =====         ============     =========        =====
Eth1/27/1        Slave         Unicast          IPV4             (S)
Connected Peers:
    10.10.1.36           00:fd:22:ff:fe:8d:1a:a5-0x1901
```

```
Eth1/27/2        Passive       Unicast          IPV4             (D)
Connected Peers:
    10.10.2.36            00:00:00:00:00:00:00:00-0x0

Eth1/27/3        Master        Multicast        IPV4             (D)
Connected Peers:
```

Configuration Examples

This example shows how to configure PTP globally on the device, specify the source IP address for PTP communications, and configure a preference level for the clock:

```
switch# configure terminal
switch(config)# feature ptp
switch(config)# ptp source 10.10.10.1
switch(config)# ptp priority1 1
switch(config)# ptp priority2 1
switch(config)# show ptp brief
PTP port status
-----------------------
Port State
------- --------------
switch(config)# show ptp clock
PTP Device Type: Boundary clock
Clock Identity : 0:22:55:ff:ff:79:a4:c1
Clock Domain: 0
Number of PTP ports: 0
Priority1 : 1
Priority2 : 1
Clock Quality:
  Class : 248
  Accuracy : 254
  Offset (log variance) : 65535
Offset From Master : 0
Mean Path Delay : 0
Steps removed : 0
Local clock time:Mon Dec 22 14:13:24 2014
```

This example shows how to configure PTP on an interface and configure the intervals for the announce, delay-request, and synchronization messages:

```
switch# configure terminal
switch(config)# interface Ethernet 1/1
switch(config-if)# ptp
switch(config-if)# ptp announce interval 3
switch(config-if)# ptp announce timeout 2
switch(config-if)# ptp delay-request minimum interval smpte-2059-2 -3
switch(config-if)# ptp sync interval smpte-2059-2 -3
switch(config-if)# no shutdown
switch(config-if)# show ptp brief
PTP port status
-----------------------
Port State
------- --------------
Eth2/1 Master
switch(config-if)# show ptp port interface ethernet 2/1
PTP Port Dataset: Eth2/1
Port identity: clock identity: 0:22:55:ff:ff:79:a4:c1
```

```
Port identity: port number: 1028
PTP version: 2
Port state: Master
Delay request interval(log mean): 4
Announce receipt time out: 2
Peer mean path delay: 0
Announce interval(log mean): 3
Sync interval(log mean): 1
Delay Mechanism: End to End
Peer delay request interval(log mean): 0
```

This example shows how to configure master/slave role and assign corresponding peer slave/master IP addresses.

```
For Cisco NX-OS Release 9.3(5) and later:
switch# configure terminal
switch(config)# interface ethernet 1/1
switch(config-if)# ptp
switch(config-if)# ptp transmission unicast
switch(config-if)# ptp role master
switch(config-if)# ptp slave 10.1.1.2
switch(config-if)# ptp ucast-source 11.0.0.1
switch(config-if)# ip address 11.0.0.1/24
switch(config-if)# no shutdown

switch# configure terminal
switch(config)# interface ethernet 1/1
switch(config-if)# ptp
switch(config-if)# ptp transmission unicast
switch(config-if)# ptp role slave
switch(config-if)# ptp master 10.1.1.2
switch(config-if)# ptp ucast-source 11.0.0.1
switch(config-if)# ip address 11.0.0.1/24
switch(config-if)# no shutdown

For Cisco NX-OS Release 9.3(4) and earlier:
switch-1(config)# interface ethernet 1/1
switch-1(config-if)# ptp transport ipv4 ucast master
switch-1(config-if-ptp-master)# slave ipv4 1.2.3.1
switch-1(config-if-ptp-master)# slave ipv4 1.2.3.2
switch-1(config-if-ptp-master)# slave ipv4 1.2.3.3
switch-1(config-if-ptp-master)# slave ipv4 1.2.3.4
switch-1(config-if-ptp-master)#

switch-1(config-if)# ptp transport ipv4 ucast slave
switch-1(config-if-ptp-slave)# master ipv4 4.4.4.1
switch-1(config-if-ptp-slave)# master ipv4 4.4.4.2
switch-1(config-if-ptp-slave)# master ipv4 4.4.4.3


switch-1(config-if-ptp-slave)# ptp ucast-source 9.9.9.9


switch-1(config-if)# sh running-config ptp

!Command: show running-config ptp
!Time: Tue Feb  7 17:37:09 2017

version 7.0(3)I4(6)
feature ptp

ptp source 1.1.1.1
```

```
interface Ethernet1/1
  ptp transport ipv4 ucast master
    slave ipv4 1.2.3.1
    slave ipv4 1.2.3.2
    slave ipv4 1.2.3.3
    slave ipv4 1.2.3.4

interface Ethernet1/2
  ptp transport ipv4 ucast slave
    master ipv4 4.4.4.1
    master ipv4 4.4.4.2
    master ipv4 4.4.4.3
  ptp ucast-source 9.9.9.9

switch-1(config-if)#
```

This example shows how to configure PTP in clock operation mode with master or slave ports.

```
PLTFM-A(config)# show ptp clock
PTP Device Type : boundary-clock
PTP Device Encapsulation : layer-3
PTP Source IP Address : 1.1.1.1
Clock Identity : 74:26:ac:ff:fe:fd:de:ff
Clock Domain: 0
Slave Clock Operation : One-step
Master Clock Operation : One-step
Slave-Only Clock Mode : Disabled
Number of PTP ports: 142
Priority1 : 200
Priority2 : 200
Clock Quality:
        Class : 248
        Accuracy : 254
        Offset (log variance) : 65535
Offset From Master : -32
Mean Path Delay : 105
Steps removed : 1
Correction range : 200
MPD range : 100
Local clock time : Wed Jul  3 18:57:23 2019
Hardware frequency correction : NA
```

Additional References

Related Documents

Related Topic	Document Title
1588 IEEE	1588 IEEE standards