Configuring Clocking and Timing

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Clock synchronization is important for a variety of applications, including synchronization of radio cell towers. While legacy TDM protocols incorporate timing features, packet-switched networks such as Ethernet do not natively include these features. The Cisco ME 3600X-24CX Series Switch supports legacy TDM technologies while supporting a variety of technologies that distribute clocking information over packet-switched networks.

The following sections describe the clocking and timing features available on the Cisco ME 3600X-24CX Series Switch.

Network Clocking Overview

Clocking is typically distributed from the core network outward to the BTS or Node B at the network edge. The Cisco ME 3600X-24CX Series Switch receives and transmits clocking information using any of the following ports:

- T1/E1
- GigabitEthernet
- BITS/SYNC port
- 1PPS
- 10Mhz
- ToD

The Cisco ME 3600X-24CX Series Switch supports the following clocking types:

- Precision Timing Protocol (PTP)
- Synchronous Ethernet

Precision Timing Protocol (PTP)

The Cisco ME 3600X-24CX Series Switch supports the Precision Time Protocol (PTP) as defined by the IEEE 1588-2008 standard. PTP provides for accurate time synchronization on over packet-switched networks. Nodes within a PTP network can act in one of the following roles:

- Ordinary clock—An ordinary clock is a 1588 clock with a single PTP port that can serve in one of the following roles:
  - Master mode—Distributes timing information over the network to one or more slave clocks, thus allowing the slave to synchronize its clock to the master.
  - Slave mode—Synchronizes its clock to a master clock. You can enable slave clocking on up to two interfaces simultaneously in order to connect to two different master clocks.
- Boundary clock—The device participates in selecting the best master clock and can act as the master clock if no better clocks are detected.
- Transparent clock—A transparent clock is a device or a switch that calculates the time it requires to forward traffic and updates the PTP time correction field to account for the delay, making the device transparent in terms of time calculations.

Note The 1588-2008 standard defines other clocking devices that are not described here.

Note When a shut/no shut is carried on the loopback interface, the PTP port is deleted and recreated. This causes the PTP counters to reset.

Transparent Clocking

A transparent clock is a network device such as a switch that calculates the time it requires to forward traffic and updates the PTP time correction field to account for the delay, making the device transparent in terms of timing calculations. The transparent clock 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 The Cisco ME 3600X-24CX Series Switch does not currently support peer-to-peer transparent clock mode.

For information on how to configure the Cisco ME 3600X-24CX Series Switch as a transparent clock, see Configuring a Transparent Clock, page 8-12.

Clock Synchronization

PTP master devices periodically launch an exchange of messages with slave devices to help each slave clock recompute the offset between its clock and the master clock. Periodic clock synchronization mitigates any drift between the master and slave clocks.

If you use the network clock synchronization SSM option for clock synchronization, ensure to maintain the following values:

- The SSM option value must be 2 for the t1 cards.
- The SSM option value must be 1 for the e1 cards.

Note It is not mandatory to use the network clock synchronization SSM option for clock synchronization.

Synchronous Ethernet

Synchronous Ethernet is a timing technology that allows the Cisco ME 3600X-24CX Series Switch switch to transport frequency information over Ethernet. Because frequency is embedded in Ethernet packets, synchronous Ethernet must be supported by each network element in the synchronization path. Synchronous Ethernet is defined in the ITU-T G.781, G.8261, G.8262, and G.8264, Telcordia GR-253-CORE, and Telcordia GR-1244-CORE standards.

Synchronous Ethernet ESMC and SSM

The Cisco ME 3600X-24CX Series Switch supports Ethernet Synchronization Message Channel (ESMC) and Synchronization Status Message (SSM) to provide clock synchronization on Synchronous Ethernet. For more information about Ethernet ESMC and SSM, see Chapter 8, “Configuring PTP Clocking.”

Note SSM is only supported on BITS interface.

PTP Redundancy

PTP redundancy is an implementation on different clock nodes. This helps the PTP slave clock node achieve the following on the PTP slave nodes:

- Interact with multiple master ports such as grand master clocks and boundary clock nodes. This implementation is known as the hot standby mode.
- Simultaneously open PTP sessions with multiple masters.
- Select the best master from the existing list of masters (referred to as the primary PTP master port or primary clock source).
- Switch to the next best master available in case the primary master fails, or the connectivity to the primary master fails.

Note PTP redundancy is supported only on unicast negotiation mode; you can configure up to three master clocks in redundancy mode.

Note The Cisco ME 3600X 24CX Series Switch supports unicast-based timing as specified in the 1588-2008 standard. Hybrid mode is not supported with PTP 1588 redundancy in releases earlier than Cisco IOS Release 15.4(2)S.

The clock selection considers these attributes of the PTP master port for selecting the clock source (master).

- Clock class—the Master sends this information in the announce message
- PTSF announce fail—if the slave does not receive announce messages from the master
- PTSF sync fail—if the slave does not receive synchronize messages from the master
- PTSF unusable—when either of above, that is—PTSF sync fail or PTSF announce fail, condition is met OR there is a high path delay variation (PDV)
- Local priority of the clock stream—this attribute is user definable through the clock-source command

For information on how to configure PTP Redundancy, see Configuring PTP Redundancy, page 8-15.

Configuring Clocking and Timing

The Cisco ME 3600X-24CX Series Switch switch supports the following network clocking types:

- Precision Time Protocol (PTP)—Clocking and clock recovery based on the IEEE 1588-2008 standard; allows the Cisco ME 3600X-24CX Series Switch switch to receive clocking from another PTP-enabled device or provide clocking to a PTP-enabled device. To configure PTP clocking, see Configuring PTP Clocking.
- Synchronous Ethernet—Allows the network to transport frequency and time information over Ethernet. To configure synchronous Ethernet, see Configuring Synchronous Ethernet.
- Verifying Clock Settings—To verify a clocking configuration, see Verifying Clock-Related Settings.

Configuring PTP Clocking

This section describes how to configure PTP-based clocking on the Cisco ME 3600X-24CX Series Switch.

Note The settings shown in this section are an example only; you must determine the appropriate PTP settings based upon your network clocking design.

Note The configuration sections describing the 1PPS and 10Mhz timing ports only apply to the Cisco ME 3600X-24CX switch.

Note For ME3600-24CX switches, do not assign 192.168.X.X as the IP address on the loopback interface associated with the PTP master or slave clock to avoid internal network route conflicts.

Prerequisites for Configuring PTP Clocking

- To enable PTP v2 Ordinary Slave Clock, one of the following base licenses must be installed on the switch:
  - Metro IP Access
  - Advanced Metro IP Access
- An additional 1588 feature license is required to enable the Ordinary master clock and boundary clock functionality.
- You must reload the switch to activate the license.
- The path from the master clock to the slave clock must be the same (symmetric).
- Use only the archive download-sw command on the Cisco ME 3600X-24CX switch to download a new image from a TFTP server.

Configuring an Ordinary Clock

The following sections describe how to configure the switch as an ordinary clock.

- Configuring a Master Ordinary Clock, page 8-6
- Configuring a Slave Ordinary Clock, page 8-8

Configuring a Master Ordinary Clock

Enter the following commands to configure the switch to act as a master ordinary clock:

	Command	Purpose
Step 1	**enable** **Example:** `Switch> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock ordinary domain 0`	Configures the PTP clock. You can create the following clock types: •Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. •Boundary—Participates in selecting the best master clock and can act as the master clock if no better clocks are detected. **Note** Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.

	Command	Purpose
Step 4	**priority1** *priorityvalue* **Example:** `Switch(config-ptp-clk)# priority1 128`	Sets the preference level for a clock. Slave devices use the priority1 value when selecting a master clock: a lower priority1 value indicates a preferred clock. The priority1 value is considered above all other clock attributes. Valid values are from 0-255. The default value is 128.
Step 5	**priority2** *priorityvalue* **Example:** `Switch(config-ptp-clk)# priority2 128`	Sets a secondary preference level for a clock. Slave devices use the priority2 value when selecting a master clock: a lower priority2 value indicates a preferred clock. The priority2 value is considered only when the router is unable to use priority1 and other clock attributes to select a clock. Valid values are from 0-255. The default value is 128.

Step 6	**clock-port** *port-name* {**master** | **slave**}
	
	Example:
	`Switch(config-ptp-clk)# clock-port Master master`
	`Router(config-ptp-port)#`
		Sets the clock port to PTP master or slave mode; in master mode, the port exchanges timing packets with PTP slave devices.

Step 7	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources. **Note** PTP redundancy is supported only on unicast negotiation mode.
Step 8	**clock-destination** *destination-address* **Example:** `Switch(config-ptp-port)# clock-destination 8.8.8.1`	Specifies the IP address of a clock destination when the router is in PTP master mode. • The *destination-address* parameter is required in master mode. • The *destination-address* parameter is the loopback address of the slave clock. **Note** The **clock-destination** command is not applicable in unicast negotiation mode.
Step 9	**sync interval** *value* **Example:** `Switch(config-ptp-port)# sync interval 1`	Specifies the sync interval.

	Command	Purpose
Step 10	**announce timeout** *value* **Example:** `Switch(config-ptp-port)# announce timeout 8`	Specifies the number of PTP announcement intervals before the session times out. Valid values are 1-10.
Step 11	**exit** **Example:** `Switch(config)# exit`	Exits configuration mode.

Configuring a Slave Ordinary Clock

Follow these steps to configure the switch to act as a slave ordinary clock.

	Command	Purpose
Step 1	Switch# **configure terminal**	Enter configuration mode.
Step 2	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock ordinary domain 0`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • Boundary—Participates in selecting the best master clock and can act as the master clock if no better clocks are detected. **Note** Hybrid mode is supported on the Cisco ME 3600X-24CX switch effective Cisco IOS Release 15.4(2)S.
Step 3	**priority1** *priorityvalue* **Example:** `Switch(config-ptp-clk)# priority1 128`	Sets the preference level for a clock. Slave devices use the priority1 value when selecting a master clock: a lower priority1 value indicates a preferred clock. The priority1 value is considered above all other clock attributes. Valid values are from 0-255. The default value is 128.
Step 4	**priority2** *priorityvalue* **Example:** `Switch(config-ptp-clk)# priority2 128`	Sets a secondary preference level for a clock. Slave devices use the priority2 value when selecting a master clock: a lower priority2 value indicates a preferred clock. The priority2 value is considered only when the router is unable to use priority1 and other clock attributes to select a clock. Valid values are from 0-255. The default value is 128.
Step 5	**clock-port** *port-name* {**master** | **slave**} **Example:** `Switch(config-ptp-clk)# clock-port Slave slave`	Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.

	Command	Purpose
Step 6	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources.
Step 7	**clock-source** *source-address* **Example:** `Switch(config-ptp-port)# clock-source 8.8.8.1`	Specifies the address of a PTP master clock.
Step 8	**sync interval** *value* **Example:** `Switch(config-ptp-port)# sync interval 1`	Specifies the sync interval.
Step 9	**announce timeout** *value* **Example:** `Switch(config-ptp-port)# announce timeout 8`	Specifies the number of PTP announcement intervals before the session times out. Valid values are 1-10.
Step 10	**delay-req interval** *interval* **Example:** `Switch(config-ptp-port)# delay-req interval 1`	Configures the minimum interval allowed between PTP delay-request messages when the port is in the master state. The intervals are set using log base 2 values, as follows: • 3—1 packet every 8 seconds • 2—1 packet every 4 seconds • 1—1 packet every 2 seconds • 0—1 packet every second • -1—1 packet every 1/2 second, or 2 packets per second • -2—1 packet every 1/4 second, or 4 packets per second • -3—1 packet every 1/8 second, or 8 packets per second • -4—1 packet every 1/16 seconds, or 16 packets per second. • -5—1 packet every 1/32 seconds, or 32 packets per second. • -6—1 packet every 1/64 seconds, or 64 packets per second. • -7—1 packet every 1/128 seconds, or 128 packets per second.
Step 11	`Router(config-ptp-port)# end`	Exit configuration mode.

Note To avoid the PTP slave clock stuck on Acquiring state for a very long time, it is recommended to do archive download image on the Cisco ME 3600X-24CX Switch.

Configuring a Boundary Clock

Follow these steps to configure the switch to act as a boundary clock.

	Command	Purpose
Step 1	Switch# **configure terminal**	Enter configuration mode.
Step 2	Router(config)# **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock boundary domain 0`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • Boundary—Participates in selecting the best master clock and can act as the master clock if no better clocks are detected. **Note** Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.
Step 3	**clock-port** *port-name* {**master** | **slave**} **Example:** `Switch(config-ptp-clk)# clock-port SLAVE slave`	Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.
Step 4	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources.
Step 5	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.133`	Specifies the address of a PTP master clock. You can specify a priority value as follows: • No priority value—Assigns a priority value of 0. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2, the highest priority. **Note** This command is optional if PTP is configured in unicast negotiation mode.
Step 6	**clock-port** *port-name* {**master** | **slave**} **Example:** `Switch(config-ptp-port)# clock-port Master master`	Sets the clock port to PTP master or slave mode; in master mode, the port exchanges timing packets with PTP slave devices. **Note** The master clock-port does not establish a clocking session until the slave clock-port is phase aligned.

	Command	Purpose
Step 7	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources.
Step 8	`Switch(config-ptp-port)# end`	Exit configuration mode.

Configuring PTP Input and Output

You can use the 1pps, 10Mhz and BITS timing ports on the Cisco ME 3600X-24CX to do the following:

- Provide or receive 1PPS time of day messages
- Provide output clocking at 10Mhz, 2.048Mhz, and 1.544Mhz
- Receive input clocking at 10Mhz, 2.048Mhz, and 1.544Mhz

Note This section applies only to the Cisco ME 3600X-24CX.

The following section describes how to configure time of day messages, output clocking, and input clocking in master clock mode.

- If you want to configure input clocking using the 10Mhz or BITS timing port, use the following command:
  - Use the **network-clock input-source** command to enable input clocking at 10Mhz, 2.048Mhz, or 1.544Mhz.

    ```
    Switch(config)# network-clock input-source 2 external 1/0/0 10m
    ```

  Input clocking applies when the switch is in master mode.
- To configure output clocking using the 10Mhz or BITS timing port, use the **network-clock output-source** command to specify 10Mhz, 2.048Mhz, or 1.544Mhz output. Use this command when the switch is in slave mode.

  ```
  Switch(config)# network-clock output-source system 2 external 1/0/0 10m
  ```

- To configure the switch to send time of day messages using the 1PPS port, use the **output 1pps** command. Use the **input** or **output** parameters to specify the direction.

  ```
  Switch(config)# ptp clock ordinary domain 0
  Switch(config-ptp-clk)# output 1pps 0/0
  ```

Note Input 1pps is only supported in master mode. Output 1pps configuration is supported in slave or boundary clock mode.

- To configure the time of day message format, use the **tod** command.

  ```
  Switch(config)# ptp clock ordinary domain 0
  Switch(config-ptp-clk)# tod 0/0 ubx
  ```

Configuration Examples

Use commands below for input and output.

network-clock input-source 2 external 1/0/0 10m

```
Switch(config)# network-clock input-source 2 external 1/0/0 ?
  10m    10 MHz signal mode
  2048k  Option 1 2048kHz on BITS/SSU port
  e1     E1 Signal Mode
```

Tod and 1pps configuration.

Master:

```
Switch(config)#ptp clock ordinary domain 0
Switch(config-ptp-clk)#input 1pps 0/0
Switch(config-ptp-clk)#tod 0/0 ?
  cisco  Set TOD format to CISCO
  nmea   Set TOD format to NMEA ZDA
  ntp    Set TOD format to NTP
  ubx    Set TOD format to UBX
```

Slave:

```
Switch(config)#ptp clock ordinary domain 0
Switch(config-ptp-clk)#output 1pps 0/0 ?
  offset       1PPS output offset
  pulse-width  1PPS output pulse width
Switch(config-ptp-clk)#tod 0/0 ?
  cisco  Set TOD format to CISCO
  nmea   Set TOD format to NMEA ZDA
  ntp    Set TOD format to NTP
  ubx    Set TOD format to UBX
```

Note To see further configuration examples for input and output timing, see Clocking Sample Configurations.

Configuring a Transparent Clock

Follow these steps to configure the Cisco ME 3600X-24CX Series Switch as an end-to-end transparent clock.

Note The Cisco ME 3600X-24CX Series Switch does not support peer-to-peer transparent clock mode.

	Command	Purpose
Step 1	Router# **configure terminal**	Enter configuration mode.
Step 2	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**]	Configures the router as an end-to-end transparent clock. **Note** Peer-to-peer transparent clock mode is not supported. **Note** Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.
Step 3	Router(config)# **end**	Exit configuration mode.

Configuring a Hybrid Mode for Clock Recovery

Effective Cisco IOS Release 15.4(2)S, hybrid mode is supported on the Cisco ME 3600-24CX switch. The hybrid mode is supported on the boundary clock and the slave ordinary clocks.

To configure a boundary clock or a slave ordinary clock in hybrid mode, use the following command:

```
ptp clock {ordinary | boundary} domain domain-number hybrid
```

Note This configuration is global for the PTP clock.

Prerequisites

When configuring a hybrid clock, ensure that the frequency and phase sources are traceable to the same master clock.

Restrictions

- Hybrid mode is not supported when PTP ordinary clock is in the master mode.
- Hybrid clock is not supported with ToP as network-clock. It needs a valid physical clock source, for example, Sync-E/BITS/10M/TDM.

Supporting ITU-T G.8265.1—Precision Time Protocol Telecom Profile for Frequency Synchronization

Effective Cisco IOS Release 15.4(3)S, Cisco ME 3600-24CX switch supports configuration of Telecom profile master or slave.

The PTP stack uses the ITU-T G.8265.1 recommendations for PTP unicast session establishment and best master clock algorithm (BMCA).

Prerequisites

- When configuring the Telecom profile, ensure that the master and slave nodes have the same network option configured.
- Negotiation should be enabled for master and slave modes.
- Cisco ME 3600-24CX switch must be enabled using the **network-clock synchronization mode QL-enabled** command for both master and slave modes.

Restrictions

Hybrid mode, boundary clocks, and transparent clocks are not supported by the PTP Telecom profile.

Configuring a PTP Telecom Profile Master

	Command	Purpose
Step 1	**configure terminal**	Enter configuration mode.
Step 2	**ptp clock ordinary domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock ordinary domain 5`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • *domain-number*—Domain number of the ordinary domain. **Note** The telecom profile can be applied only when the *domain-number* is between 4 and 23 (both inclusive).
Step 3	**clock-port** *port-name* **master** [**profile g8265.1**] **Example:** `Switch(config-ptp-clk)# clock-port MASTER master profile g8265.1`	Sets the clock port to PTP telecom profile master.
Step 4	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the switch to discover a PTP master clock from all available PTP clock sources.
Step 5	`Switch(config-ptp-port)# end`	Exits configuration mode.

Configuring a PTP Telecom Profile Slave

	Command	Purpose
Step 1	**configure terminal**	Enter configuration mode.
Step 2	**ptp clock ordinary domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock ordinary domain 5`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • *domain-number*—Domain number of the ordinary domain. **Note** The telecom profile can be applied only when the *domain-number* is between 4 and 23 (both inclusive).

	Command	Purpose
Step 3	**clock-port** *port-name* **slave** [**profile g8265.1**] **Example:** `Switch(config-ptp-clk)# clock-port SLAVE master profile g8265.1`	Sets the clock port to PTP telecom profile master.
Step 4	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the switch to discover a PTP master clock from all available PTP clock sources.
Step 5	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.133`	Specifies the address of a PTP master clock. You can specify a priority value as follows: • No priority value—Assigns a priority value of 0, the highest priority. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2.
Step 6	`Switch(config-ptp-port)# end`	Exits configuration mode.

Configuring PTP Redundancy

The following sections describe how to configure PTP redundancy on the Cisco ME 3600X 24CX Series Switch:

- Configuring PTP Redundancy in Slave Clock Mode, page 8-15
- Configuring PTP Redundancy in Boundary Clock Mode, page 8-17

Configuring PTP Redundancy in Slave Clock Mode

	Command	Purpose
Step 1	**configure terminal**	Enter configuration mode.
Step 2	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock boundary domain 0`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • Boundary—Participates in selecting the best master clock and can act as the master clock if no better clocks are detected. **Note** Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.

	Command	Purpose
Step 3	**clock-port** *port-name* {**master** | **slave**} **Example:** `Switch(config-ptp-clk)# clock-port SLAVE slave`	Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.
Step 4	**transport ipv4** {**unicast** | **multicast** | **multicast-mix**} **interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources. **Note** PTP redundancy is supported only on unicast negotiation mode. **Note** The **multicast** and **multicast-mix** keywords are not currently supported.
Step 5	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.133 1`	Specifies the address of a PTP master clock. You can specify a priority value as follows: • No priority value—Assigns a priority value of 0, the highest priority. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2. **Note** This command is optional if PTP is configured in unicast negotiation mode.
Step 6	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.134 2`	Specifies the address of a PTP master clock.
Step 7	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.135`	Specifies the address of a PTP master clock.
Step 8	`Switch(config-ptp-port)# end`	Exits configuration mode.

Configuring PTP Redundancy in Boundary Clock Mode

	Command	Purpose
Step 1	**configure terminal**	Enter configuration mode.
Step 2	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Switch(config)# ptp clock boundary domain 0`	Configures the PTP clock. You can create the following clock types: • Ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode. • Boundary—Participates in selecting the best master clock and can act as the master clock if no better clocks are detected. **Note** Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.
Step 3	**clock-port** *port-name* {**master** | **slave**} **Example:** `Switch(config-ptp-clk)# clock-port SLAVE slave`	Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.
Step 4	**transport ipv4** {**unicast** | **multicast** | **multicast-mix**} **interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources. **Note** PTP redundancy is supported only on unicast negotiation mode. **Note** The **multicast** and **multicast-mix** keywords are not currently supported.
Step 5	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.133`	Specifies the address of a PTP master clock. You can specify a priority value as follows: • No priority value—Assigns a priority value of 0, the highest priority. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2. **Note** This command is optional if PTP is configured in unicast negotiation mode.
Step 6	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.134 2`	Specifies the address of a PTP master clock.

	Command	Purpose
Step 7	**clock-source** *source-address* [*priority*] **Example:** `Switch(config-ptp-port)# clock source 133.133.133.135`	Specifies the address of a PTP master clock.
Step 8	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Switch(config-ptp-port)# clock-port Master master`	Sets the clock port to PTP master or slave mode; in master mode, the port exchanges timing packets with PTP slave devices. **Note** The master clock-port does not establish a clocking session until the slave clock-port is phase aligned.
Step 9	**transport ipv4** {**unicast** | **multicast** | **multicast-mix**} **interface** *interface-type interface-number* [**negotiation**] **Example:** `Switch(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation`	Sets port transport parameters. The **negotiation** keyword configures the router to discover a PTP master clock from all available PTP clock sources. **Note** PTP redundancy is supported only on unicast negotiation mode. **Note** The **multicast** and **multicast-mix** keywords are not currently supported.
Step 10	`Switch(config-ptp-port)# end`	Exits configuration mode.

Topology and Configuration Example

Consider the following scenario:

Master 1-----Slave-----Master 2

|

Master 3

Configuration on all masters

```
ptp clock ordinary domain 0
clock-port MASTER master
transport ipv4 unicast interface loopback 0 negotiation
```

Configuration on the Slave

```
ptp clock ordinary domain 0
clock-post SLAVE slave
transport ipv4 unicast interface loopback 1 negotiation
clock source master1_IP
clock source master2_IP
clock source master3_IP
```

Configuring Synchronous Ethernet

The following sections describe how to configure synchronous Ethernet timing on the Cisco ME 3600X-24CX Series Switch switch.

Note Hybrid mode is supported on the Cisco ME 3600X 24CX switch effective Cisco IOS Release 15.4(2)S.

Note If you are using a release earlier than Cisco IOS Release 15.4(2)S, hybrid mode is not supported. Therefore, **network-clock input-source** command cannot be configured with Ordinary Slave mode or Boundary Clock mode.

Configuring an External Clock Source

To configure an external clock source using Synchronous Ethernet, use the **network-clock input-source priority external 1/0/0** {{**E1** {**crc4** | **cas** |**fas**}} {**T1** {**d4** | **sf** | **esf**}}} command.

```
Switch(config)# network-clock input-source 1 external 1/0/0
```

Configuring Synchronous Ethernet ESMC and SSM

For instructions on how to configure synchronous Ethernet Synchronization Message Channel (Ascendant Synchronization Status Message (SSM), see Configuring Synchronous Ethernet in *Cisco ME 3800x and ME 3600x Switch Software Configuration Guide*

Verifying Clock-Related Settings

Use the following commands to verify the clock settings:

- **show ptp clock dataset**
- **show ptp port dataset**
- **show ptp clock running**
- **show platform ptp all**

For more information about these commands, see the *Cisco ME 3800X and ME 3600X Switch Command Reference, Release 15.2(4)S*.

Clocking Sample Configurations

The following sections show a sample configurations for clocking features on the switch.

Ordinary Clock—Slave

```
ptp clock ordinary domain 0
clock-port Slave slave
transport ipv4 unicast interface loopback 0 negotiation
clock-source 8.8.8.1
sync interval 1
```

```
announce timeout 7
delay-req interval 3
```

Ordinary Clock—Master

```
ptp clock ordinary domain 0
 clock-port Master master
  transport ipv4 unicast interface loopback 0 negotiation
```

Unicast Configuration—Slave Mode

```
ptp clock ordinary domain 0
clock-port Slave slave
transport ipv4 unicast interface loopback 0
clock-source 8.8.8.1
```

Unicast Configuration—Master Mode

```
ptp clock ordinary domain 0
clock-port Master master
transport ipv4 unicast interface loopback 0
clock-destination 8.8.8.2
sync interval 1
announce interval 2
```

Unicast Negotiation—Slave

```
ptp clock ordinary domain 0
   priority1 2
   priority2 4
   clock-port Slave slave
      transport ipv4 unicast interface Loopback0 negotiation
      clock-source 8.8.8.1
      sync interval 3
      announce timeout 7
      delay-req interval 3
```

Unicast Negotiation—Master

```
ptp clock ordinary domain 0
   priority1 4
   priority2 2
   clock-port Master master
      transport ipv4 unicast interface Loopback0 negotiation
      sync interval 3
      announce timeout 7
```

Hybrid Clock—Boundary

```
ptp clock boundary domain 0 hybrid
 clock-port SLAVE slave
  transport ipv4 unicast interface Loopback0 negotiation
  clock source 133.133.133.133
 clock-port MASTER master
  transport ipv4 unicast interface Loopback1 negotiation
Network-clock input-source 10 interface gigabitEthernet 0/4/0
```

Hybrid Clock—Slave

```
ptp clock ordinary domain 0 hybrid
 clock-port SLAVE slave
  transport ipv4 unicast interface Loopback 0 negotiation
  clock source 133.133.133.133
Network-clock input-source 10 interface gigabitEthernet 0/4/0
```

Boundary Clock

```
ptp clock boundary domain 0
   priority1 2
   priority2 4
   clock-port Slave slave
      transport ipv4 unicast interface Loopback0 negotiation
      clock-source 8.8.8.1
      sync limit 3
      announce timeout 7
      delay-req interval 3
   clock-port Master master
      transport ipv4 interface Loopback1 negotiation
      sync interval 3
      announce interval 7
```

Transparent Clock

```
ptp clock e2e-transparent domain 0
```

PTP Multicast Slave Mode—Hybrid Configuration

```
interface Vlan10
ip address 192.168.52.38 255.255.255.0
ip igmp join-group 224.0.1.129
ptp announce interval 0
ptp sync interval -6
ptp delay-req interval -4
ptp slave multicast hybrid
ptp enable
```

PTP Unicast Slave Mode—Hybrid Configuration

```
interface Vlan2
ip address 192.168.52.38 255.255.255.0
ptp announce interval 3
ptp announce timeout 2
ptp sync interval -6
ptp delay-req interval -4
ptp slave unicast negotiation hybrid
ptp clock-source 192.168.52.10
ptp enable
```

Clock Selection Parameters

```
network-clock synchronization automatic
network-clock synchronization mode QL-enabled
network-clock input-source 1 external 1/0/0 10m
```

ToD/1PPS Configuration—Master

```
network-clock input-source 1 external 1/0/0 10m
ptp clock ordinary domain 0
tod 0/0 ntp
input 1pps 0/0
clock-port master master
transport ipv4 unicast interface loopback 0
```

ToD/1PPS Configuration—Slave

```
ptp clock ordinary domain 0
tod 0/0 ntp
output 1pps 0/0
clock-port SLA slave
transport ipv4 unicast interface loopback 0 negotiation
clock source 33.1.1.
```

Show Commands

```
Router# show ptp clock dataset ?
  current          currentDS dataset
  default          defaultDS dataset
  parent           parentDS dataset
  time-properties  timePropertiesDS dataset

Router# show ptp port dataset ?
 foreign-master  foreignMasterDS dataset
 port            portDS dataset

Router# show ptp clock running domain 0
                      PTP Ordinary Clock [Domain 0]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         ACQUIRING      1              98405          296399         Track one

                               PORT SUMMARY
                                                                                  PTP
Master
Name               Tx Mode      Role         Transport    State        Sessions     Port
Addr
SLAVE             unicast      slave             Lo0         Slave             1
8.8.8.8

                              SESSION INFORMATION
SLAVE [Lo0] [Sessions 1]
 Peer addr          Pkts in    Pkts out   In Errs    Out Errs
 8.8.8.8            296399     98405      0          0
Router#


Router# show platform ptp all
Slave info  : [Loopback0][0x38A4766C]
--------------------------------
clock role          : SLAVE
Slave Port hdl      : 486539266
Tx Mode             : Unicast-Negotiation
Slave IP            : 4.4.4.4
Max Clk Srcs        : 1
Boundary Clock      : FALSE
Lock status         : HOLDOVER
Refcnt              : 1
Configured-Flags    : 0x7F - Clock Port Stream
Config-Ready-Flags  : Port Stream
-----------
PTP Engine Handle   : 0
Master IP           : 8.8.8.8
Local Priority      : 0
Set Master IP       : 8.8.8.8
```

Glossary

hybrid model—A hybrid model is a model where both physical interfaces as well as PTP sessions provide clocking to the system. In this case, there is a list of physical ports and PTP sessions from which the clock can be recovered and used as the system clock.