Configuring Clocking and Timing

This chapter explains how to configure timing ports on the Route Switch Processor (RSP) modules of the Cisco ASR 900 Series Router and includes the following sections:

Clocking and Timing Restrictions

The following clocking and timing restrictions apply to the Cisco ASR 900 Series Router:

- You can configure only a single clocking input source within each group of eight ports (0–7 and 8–15) on the T1/E1 interface module using the **network-clock input-source** command.
- Multicast timing is not supported.
- Out-of-band clocking and the **recovered-clock** command are not supported.
- Precision Time Protocol (PTP) is supported only on loopback interfaces.
- Synchronous Ethernet clock sources are not supported with PTP. Conversely, PTP clock sources are not supported with synchronous Ethernet except when configured as hybrid clock. However, you can use hybrid clocking to allow the router to obtain frequency using Synchronous Ethernet, and phase using PTP.
- Time of Day (ToD) and 1 Pulse per Second (1PPS) input is not supported when the router is in boundary clock mode.
- Multiple ToD clock sources are not supported.
- PTP redundancy is supported only on unicast negotiation mode; you can configure up to three master clocks in redundancy mode.
- In order to configure time of day input, you must configure both an input 10 Mhz and an input 1 PPS source.
- PTP over IPv6 is not supported.

- PTP functionality is restricted by license type.

Table 11-1summarizes the PTP functionalities that are available, by license type:

Table 11-1 PTP Functions Supported by Different Licenses

License	PTP Support
Metro Services	Not supported
Metro IP Service	Ordinary Slave Clock
Metro Aggregation Service	Ordinary Slave Clock
Metro IP Service + IEEE 1588-2008 BC/MC	All PTP functionality including boundary and master clock
Metro Aggregation Service + IEEE 1588-2008 BC/MC	All PTP functionality including boundary and master clock

Note If you install the IEEE 1588-2008 BC/MC license, you must reload the router to use the full PTP functionality.

- PTP over Ethernet is not supported in multicast mode; only unicast mode is supported.
- End-to-end Transparent Clock is not supported for PTP over Ethernet.
- G.8265.1 telecom profiles are not supported with PTP over Ethernet.
- The Cisco ASR 900 Series Router do not support a mix of IPv4 and Ethernet clock ports when acting as a transparent clock or boundary clock.

The following restrictions apply when configuring synchronous Ethernet SSM and ESMC:

- To use the **network-clock synchronization ssm option** command, ensure that the router configuration does not include the following:
  - Input clock source
  - Network clock quality level
  - Network clock source quality source (synchronous Ethernet interfaces)
- The **network-clock synchronization ssm option** command must be compatible with the **network-clock eec** command in the configuration.
- To use the **network-clock synchronization ssm option** command, ensure that there is not a network clocking configuration applied to synchronous Ethernet interfaces, BITS interfaces, and timing port interfaces.
- SSM and ESMC are SSO-coexistent, but not SSO-compliant. The router goes into hold-over mode during switchover and restarts clock selection when the switchover is complete.
- It is recommended that you do not configure multiple input sources with the same priority as this impacts the T_{SM} (Switching message delay).
- You can configure a maximum of 4 clock sources on interface modules, with a maximum of 2 per interface module. This limitation applies to both synchronous Ethernet and TDM interfaces.

Clocking and Timing Overview

The Cisco ASR 900 Series Router have the following timing ports:

- 1 PPS Input/Output
- 10 Mhz Input/Output
- ToD
- Building Integrated Timing Supply (BITS)

You can use the timing ports on the Cisco ASR 900 Series Router to perform the following tasks:

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

Note Timing input and output is handled by the active RSP.

Note For timing redundancy, you can use a Y cable to connect a GPS timing source to multiple RSPs. For more information, see the *Cisco ASR 903 Hardware Installation Guide*.

The following sections describe how to configure clocking and timing features on the Cisco ASR 900 Series Router.

- "Understanding PTP" section on page 3
- "Timing Port Specifications" section on page 6
- "Understanding Synchronous Ethernet ESMC and SSM" section on page 6

Understanding PTP

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

PTP is particularly useful for industrial automation systems and process control networks, where motion and precision control of instrumentation and test equipment are important.

Table 11-2 Nodes within a PTP Network

Network Element	Description
Grandmaster	A network device physically attached to the primary time source. All clocks are synchronized to the grandmaster clock.
Ordinary Clock	An ordinary clock is a 1588 clock with a single PTP port that can operate in one of the following modes: • Master mode—Distributes timing information over the network to one or more slave clocks, thus allowing the slave to synchronize its clock to the master. • Slave mode—Synchronizes its clock to a master clock. You can enable the slave mode on up to two interfaces simultaneously in order to connect to two different master clocks.
Boundary Clock	The device participates in selecting the best master clock and can act as the master clock if no better clocks are detected. Boundary clock starts its own PTP session with a number of downstream slaves. The boundary clock mitigates the number of network hops and results in packet delay variations in the packet network between the Grand Master and Slave.
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.

Telecom Profiles

Release 3.8 introduces support for telecom profiles, which allow you to configure a clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. For information about how to configure telecom profiles, see "Configuring Clocking and Timing" section on page 7.

PTP Redundancy

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

- Interact with multiple master ports such as grand master clocks and boundary clock nodes.
- Open PTP sessions.
- 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 The Cisco ASR 900 Series Router supports unicast-based timing as specified in the 1588-2008 standard. Hybrid mode is not supported with PTP 1588 redundancy.

For instructions on how to configure PTP redundancy, see "Configuring PTP Redundancy" section on page 24

Hybrid Clocking

The Cisco ASR 900 Series Router support a hybrid clocking mode that uses clock frequency obtained from the synchronous Ethernet port while using the phase (ToD or 1 PPS) obtained using PTP. The combination of using physical source for frequency and PTP for time and phase improves the performance as opposed to using only PTP.

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

For more information on how to configure hybrid clocking, see "Configuring a Hybrid Clock" section on page 17.

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 ASR 900 Series Router does not currently support peer-to-peer transparent clock mode.

For information on how to configure the Cisco ASR 900 Series Router as a transparent clock, see "Configuring a Transparent Clock" section on page 16.

Time of Day (TOD)

You can use the time of day (ToD) and 1PPS ports on the Cisco ASR 900 Series Router to exchange ToD clocking. In master mode, the router can receive time of day (ToD) clocking from an external GPS unit; the router requires a ToD, 1PPS, and 10MHZ connection to the GPS unit.

In slave mode, the router can recover ToD from a PTP session and repeat the signal on ToD and 1PPS interfaces.

For instructions on how to configure ToD on the Cisco ASR 900 Series Router, see the "Configuring an Ordinary Clock" section on page 8.

Synchronizing the System Clock to Time of Day

You can set the router's system time to synchronize with the time of day retrieved from an external GPS device. For information on how to configure this feature, see "Synchronizing the System Time to a Time-of-Day Source" section on page 28.

Timing Port Specifications

The following sections provide specifications for the timing ports on the Cisco ASR 900 Series Router.

BITS Framing Support

Table 11-3 lists the supported framing modes for a BITS port.

Table 11-3 Framing Modes for a BITS Port on a Cisco ASR 900 Series Router

BITS or SSU Port Support Matrix	Framing Modes Supported	SSM or QL Support	Tx Port	Rx Port
T1	T1 ESF	Yes	Yes	Yes
T1	T1 SF	No	Yes	Yes
E1	E1 CRC4	Yes	Yes	Yes
E1	E1 FAS	No	Yes	Yes
2048 kHz	2048 kHz	No	Yes	Yes

The BITS port behaves similarly to the T1/E1 ports on the T1/E1 interface module; for more information about configuring T1/E1 interfaces, see Chapter 8, "Configuring T1/E1 Interfaces."

Understanding Synchronous Ethernet ESMC and SSM

Synchronous Ethernet incorporates the Synchronization Status Message (SSM) used in Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH) networks. While SONET and SDH transmit the SSM in a fixed location within the frame, Ethernet Synchronization Message Channel (ESMC) transmits the SSM using a protocol: the IEEE 802.3 Organization-Specific Slow Protocol (OSSP) standard.

The ESMC carries a Quality Level (QL) value identifying the clock quality of a given synchronous Ethernet timing source. Clock quality values help a synchronous Ethernet node derive timing from the most reliable source and prevent timing loops.

When configured to use synchronous Ethernet, the Cisco ASR 900 Series Router synchronizes to the best available clock source. If no better clock sources are available, the router remains synchronized to the current clock source.

The router supports two clock selection modes: QL-enabled and QL-disabled. Each mode uses different criteria to select the best available clock source.

For more information about Ethernet ESMC and SSM, see "Configuring Synchronous Ethernet ESMC and SSM" section on page 30.

Note The router can only operate in one clock selection mode at a time.

Note PTP clock sources are not supported with synchronous Ethernet.

Clock Selection Modes

The Cisco ASR 900 Series Router supports two clock selection modes, which are described in the following sections.

QL-Enabled Mode

In QL-enabled mode, the router considers the following parameters when selecting a clock source:

- Clock quality level (QL)
- Clock availability
- Priority

QL-Disabled Mode

In QL-disabled mode, the router considers the following parameters when selecting a clock source:

- Clock availability
- Priority

Note You can use override the default clock selection using the commands described in the "Managing Clock Source Selection" section on page 35.

Managing Clock Selection

You can manage clock selection by changing the priority of the clock sources; you can also influence clock selection by modifying modify the following clock properties:

- Hold-Off Time: If a clock source goes down, the router waits for a specific hold-off time before removing the clock source from the clock selection process. By default, the value of hold-off time is 300 ms.
- Wait to Restore: The amount of time that the router waits before including a newly active synchronous Ethernet clock source in clock selection. The default value is 300 seconds.
- Force Switch: Forces a switch to a clock source regardless of clock availability or quality.
- Manual Switch: Manually selects a clock source, provided the clock source has a equal or higher quality level than the current source.

For more information about how to use these features, see "Managing Clock Source Selection" section on page 35.

Configuring Clocking and Timing

The following sections describe how to configure clocking and timing features on the Cisco ASR 900 Series Router:

Configuring an Ordinary Clock

The following sections describe how to configure the Cisco ASR 900 Series Router as an ordinary clock.

Configuring a Master Ordinary Clock

Follow these steps to configure the Cisco ASR 900 Series Router to act as a master ordinary clock.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number*
4. **priority1** *priorityvalue*
5. **priority2** *priorityvalue*
6. **input [1pps] {R0 | R1}**
7. **tod** {**R0** | **R1**} {**ubx** | **nmea** | **cisco** | **ntp**}
8. **clock-port** *port-name* {**master** | **slave**} [**profile {g8265.1}**]
9. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]

   or

   transport ethernet unicast [**negotiation**]
10. **clock destination** *source-address* | *mac-address* {**bridge-domain** *bridge-domain-id*} | **interface** *interface-name*}
11. **sync interval** *interval*
12. **announce interval** *interval*
13. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.

Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number*
	
	Example:
	`Router(config)# ptp clock ordinary domain 0`
	`Router(config-ptp-clk)#`
		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**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream.
		• **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.

Step 4	**priority1** *priorityvalue* **Example:** `Router(config-ptp-clk)# priority1 priorityvalue`	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:** `Router(config-ptp-clk)# priority2 priorityvalue`	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	**input [1pps] {R0 | R1}** **Example:** `Router(config-ptp-clk)# input 1pps R0`	Enables Precision Time Protocol input 1PPS using a 1PPS input port. Use R0 or R1 to specify the active RSP slot.
Step 7	**tod** {**R0** | **R1**} {**ubx** | **nmea** | **cisco** | **ntp**} **Example:** `Router(config-ptp-clk)# tod R0 ntp`	Configures the time of day message format used by the ToD interface. **Note** The ToD port acts as an input port in case of Master clock and as an output port in case of Slave clock.

	Command	Purpose

Step 8	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
	
	Example:
	`Router(config-ptp-clk)# clock-port Master master`
	`Router(config-ptp-port)#`
		Defines a new clock port and sets the port to PTP master or slave mode; in master mode, the port exchanges timing packets with PTP slave devices.
		
		The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes.
		
		Note Using a telecom profile requires that the clock have a domain number of 4–23.

Step 9	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] or **transport ethernet unicast** [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic; you can use IPv4 or Ethernet transport. 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 10	**clock destination** *source-address* | *mac-address* {**bridge-domain** *bridge-domain-id*} | **interface** *interface-name*} **Example:** `Router(config-ptp-port)# clock-source 8.8.8.1`	Specifies the IP address or MAC address of a clock destination when the router is in PTP master mode.
Step 11	**sync interval** *interval* **Example:** `Router(config-ptp-port)# sync interval -4`	Specifies the interval used to send PTP synchronization messages. The intervals are set using log base 2 values, as follows: • 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.

	Command	Purpose
Step 12	**announce interval** *interval* **Example:** `Router(config-ptp-port)# announce interval 2`	Specifies the interval for PTP announce messages. 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
Step 13	**end** **Example:** `Router(config-ptp-port)# end`	Exit configuration mode.

Configuring a Slave Ordinary Clock

Follow these steps to configure the Cisco ASR 900 Series Router to act as a slave ordinary clock.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**]
4. **output [1pps] {R0 | R1}**
5. **tod** {**R0** | **R1**} {**ubx** | **nmea** | **cisco** | **ntp**}
6. **clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
7. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]

   or

   transport ethernet unicast [**negotiation**]
8. **clock source** *source-address* | *mac-address* {**bridge-domain** *bridge-domain-id*} | **interface** *interface-name*} [*priority*]
9. **announce timeout** *value*
10. **delay-req interval** *interval*
11. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(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**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.
Step 4	**output [1pps] {R0 | R1}** **Example:** `Router(config-ptp-clk)# output 1pps R0`	Enables Precision Time Protocol input 1PPS using a 1PPS input port. Use R0 or R1 to specify the active RSP slot.
Step 5	**tod** {**R0** | **R1**} {**ubx** | **nmea** | **cisco** | **ntp**} **Example:** `Router(config-ptp-clk)# tod R0 ntp`	Configures the time of day message format used by the ToD interface. **Note** The ToD port acts as an input port in case of Master clock and as an output port in case of Slave clock.
Step 6	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.

	Command	Purpose
Step 7	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] or **transport ethernet unicast** [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic; you can use IPv4 or Ethernet transport. 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 source** *source-address* | *mac-address* {**bridge-domain** *bridge-domain-id*} | **interface** *interface-name*} [*priority*] **Example:** `Router(config-ptp-port)# clock-source 8.8.8.1`	Specifies the IP or MAC address of a PTP master clock.
Step 9	**announce timeout** *value* **Example:** `Router(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:** `Router(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	**end** **Example:** `Router(config-ptp-port)# end`	Exit configuration mode.

Configuring a Boundary Clock

Follow these steps to configure the Cisco ASR 900 Series Router to act as a boundary clock.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**]
4. **clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
5. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
6. **clock-source** *source-address* [*priority*]
7. **clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
8. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
9. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	Router(config)# **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(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**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.
Step 4	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 5	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic. 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 6	**clock-source** *source-address* [*priority*] **Example:** `Router(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.

	Command	Purpose
Step 7	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 8	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation`	Specifies the transport mechanism for clocking traffic. 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 9	**end** **Example:** `Router(config-ptp-port)# end`	Exit configuration mode.

Configuring a Transparent Clock

Follow these steps to configure the Cisco ASR 900 Series Router as an end-to-end transparent clock.

Note The Cisco ASR 900 Series Router does not support peer-to-peer transparent clock mode.

Note The transparent clock ignores the domain number.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock e2e-transparent domain** *domain-number*
4. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(config)# ptp clock e2e-transparent domain 4`	Configures the router as an end-to-end transparent clock.
Step 4	**exit** **Example:** `Router(config)# exit`	Exit configuration mode.

Configuring a Hybrid Clock

The following sections describe how to configure the Cisco ASR 900 Series Router to act as a hybrid clock.

- Configuring a Hybrid Boundary Clock, page 11-17
- Configuring a Hybrid Ordinary Clock, page 11-21

Configuring a Hybrid Boundary Clock

Follow these steps to configure a hybrid clocking in boundary clock mode.

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

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary** \| **boundary** \| **e2e-transparent**} **domain** *domain-number* [**hybrid**]
4. **clock-port** *port-name* {**master** \| **slave**} [**profile** {**g8265.1**}]
5. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]

6. **clock-source** *source-address* [*priority*]
7. **clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
8. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
9. **exit**
10. **Use one of the following options:**
- **network-clock input-source** <*priority*> **controller** {**SONET** | **wanphy**}
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**10m** | **2m**]
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**cas** {**120ohms** | **75ohms** | **crc4**}}]
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**crc4** | **fas**] {**120ohms** | **75ohms**} {**linecode {ami** | **hdb3**}}
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**t1** {**d4** | **esf** | **sf**} {**linecode {ami** | **b8zs**}}]
- **network-clock input-source** <*priority*> **interface** <*type/slot/port*>
11. **network-clock synchronization mode ql-enabled**
12. **network-clock hold-off** {**0** | *milliseconds*}
13. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**ptp clock** {**ordinary**	**boundary**	**e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(config)# ptp clock boundary domain 0 hybrid`	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. **Note** Hybrid mode is only supported with slave clock-ports; master mode is not supported. • **boundary**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.

	Command	Purpose
Step 4	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. **Note** Hybrid mode is only supported with slave clock-ports; master mode is not supported. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 5	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic. 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 6	**clock-source** *source-address* [*priority*] **Example:** `Router(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.
Step 7	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 8	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Lo1 negotiation`	Specifies the transport mechanism for clocking traffic. 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 9	**exit**	Exit clock-port configuration.

	Command	Purpose
Step 10	Use one of the following options: • **network-clock input-source** <*priority*> **controller** {**SONET** | **wanphy**} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**10m** | **2m**] • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**cas** {**120ohms** | **75ohms** | **crc4**}}] • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**crc4** | **fas**] {**120ohms** | **75ohms**} {**linecode** {**ami** | **hdb3**}} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**t1** {**d4** | **esf** | **sf**} {**linecode** {**ami** | **b8zs**}}] • **network-clock input-source** <*priority*> **interface** <*type/slot/port*> **Example:** `Router(config)# network-clock input-source 1 external R0 10m`	• (Optional) To nominate SDH or SONET controller as network clock input source. • (Optional) To nominate 10Mhz port as network clock input source. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in t1 mode. • (Optional) To nominate Ethernet interface as network clock input source.
Step 11	**network-clock synchronization mode ql-enabled** **Example:** `Router(config)# network-clock synchronization mode ql-enabled`	Enables automatic selection of a clock source based on quality level (QL). **Note** This command is disabled by default. For more information about this command, see Chapter 11, "Configuring Clocking and Timing."
Step 12	**network-clock hold-off** {**0** | *milliseconds*} **Example:** `Router(config)# network-clock hold-off 0`	(Optional) Configures a global hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action. **Note** You can also specify a hold-off value for an individual interface using the **network-clock hold-off** command in interface mode. For more information about this command, see Chapter 11, "Configuring Clocking and Timing."
Step 13	**end** **Example:** `Router(config)# end`	Exit configuration mode.

Configuring a Hybrid Ordinary Clock

Follow these steps to configure a hybrid clocking in ordinary clock slave mode.

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

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary | boundary | e2e-transparent**} **domain** *domain-number* [**hybrid**]
4. **output [1pps] {R0 | R1}**
5. **tod** {**R0 | R1**} {**ubx | nmea | cisco | ntp**}
6. **clock-port** ***port-name*** **{master | slave}** [**profile** {**g8265.1**}]
7. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
8. **clock-source** *source-address* [*priority*]
9. **exit**
10. **Use one of the following options:**
    - **network-clock input-source** <*priority*> **controller** {**SONET | wanphy**}
    - **network-clock input-source** <*priority*> **external** {**R0 | R1**} [**10m | 2m]**
    - **network-clock input-source** <*priority*> **external** {**R0 | R1**} [**2048k | e1** {**cas** {**120ohms | 75ohms | crc4**}}]
    - **network-clock input-source** <*priority*> **external** {**R0 | R1**} [**2048k | e1** {**crc4 | fas**] {**120ohms | 75ohms**} {**linecode {ami | hdb3**}}
    - **network-clock input-source** <*priority*> **external** {**R0 | R1**} [**t1** {**d4 | esf | sf**} {**linecode {ami | b8zs**}}]
    - **network-clock input-source** <*priority*> **interface** <*type/slot/port*>
11. **network-clock synchronization mode ql-enabled**
12. **network-clock hold-off** {**0** | *milliseconds*}
13. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(config)# ptp clock ordinary domain 0 hybrid`	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. **Note** Hybrid mode is only supported with slave clock-ports; master mode is not supported. • **boundary**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.
Step 4	**output [1pps] {R0 | R1}** **Example:** `Router(config-ptp-clk)# output 1pps R0`	Enables Precision Time Protocol input 1PPS using a 1PPS input port. Use R0 or R1 to specify the active RSP slot.
Step 5	**tod** {**R0** | **R1**} {**ubx** | **nmea** | **cisco** | **ntp**} **Example:** `Router(config-ptp-clk)# tod R0 ntp`	Configures the time of day message format used by the ToD interface. **Note** The ToD port acts as an input port in case of Master clock and as an output port in case of Slave clock.
Step 6	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. **Note** Hybrid mode is only supported with slave clock-ports; master mode is not supported. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.

	Command	Purpose
Step 7	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic. 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-source** *source-address* [*priority*] **Example:** `Router(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.
Step 9	**exit** **Example:** `Router(config-ptp-port)# exit`	Exit clock-port configuration.
Step 10	Use one of the following options: • **network-clock input-source** <*priority*> **controller** {**SONET** | **wanphy**} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**10m** | **2m]** • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**cas** {**120ohms** | **75ohms** | **crc4**}}] • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**crc4** | **fas**] {**120ohms** | **75ohms**} {**linecode** {**ami** | **hdb3**}} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**t1** {**d4** | **esf** | **sf**} {**linecode** {**ami** | **b8zs**}}] • **network-clock input-source** <*priority*> **interface** <*type/slot/port*> `Router(config)# network-clock input-source 1 external R0 10m`	• (Optional) To nominate SDH or SONET controller as network clock input source. • (Optional) To nominate 10Mhz port as network clock input source. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in t1 mode. • (Optional) To nominate Ethernet interface as network clock input source.

	Command	Purpose
Step 11	**network-clock synchronization mode ql-enabled** **Example:** `Router(config-ptp-clk)# network-clock synchronization mode ql-enabled`	Enables automatic selection of a clock source based on quality level (QL). **Note** This command is disabled by default. For more information about this command, see Chapter 11, "Configuring Clocking and Timing."
Step 12	**network-clock hold-off** {**0** | *milliseconds*} **Example:** `Router(config-ptp-clk)# network-clock hold-off 0`	(Optional) Configures a global hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action. **Note** You can also specify a hold-off value for an individual interface using the **network-clock hold-off** command in interface mode. For more information about this command, see Chapter 11, "Configuring Clocking and Timing."
Step 13	**end** **Example:** `Router(config-ptp-clk)# end`	Exit configuration mode.

Configuring PTP Redundancy

The following sections describe how to configure PTP redundancy on the Cisco ASR 900 Series Router:

- Configuring PTP Redundancy in Slave Clock Mode, page 11-24
- Configuring PTP Redundancy in Boundary Clock Mode, page 11-26

Configuring PTP Redundancy in Slave Clock Mode

Follow these steps to configure clocking redundancy in slave clock mode:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock ordinary domain** *domain-number*
4. **clock-port** *port-name* **slave** [**profile** {**g8265.1**}]
5. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
6. **clock-source** *source-address* [*priority*]
7. **clock-source** *source-address* [*priority*]
8. **clock-source** *source-address* [*priority*]
9. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* [**hybrid**] **Example:** `Router(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**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.
Step 4	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 5	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic. 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 6	**clock-source** *source-address* [*priority*] **Example:** `Router(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. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2, the highest priority.
Step 7	**clock-source** *source-address* [*priority*] **Example:** `Router(config-ptp-port)# clock source 133.133.133.134 2`	Specifies the address of an additional PTP master clock; repeat this step for each additional master clock. You can configure up to 3 master clocks.

	Command	Purpose
Step 8	**clock-source** *source-address* [*priority*] **Example:** `Router(config-ptp-port)# clock source 133.133.133.135`	Specifies the address of an additional PTP master clock; repeat this step for each additional master clock. You can configure up to 3 master clocks.
Step 9	**end** **Example:** `Router(config-ptp-port)# end`	Exit configuration mode.

Configuring PTP Redundancy in Boundary Clock Mode

Follow these steps to configure clocking redundancy in boundary clock mode:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number*
4. **clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}]
5. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
6. **clock-source** *source-address* [*priority*]
7. **clock-source** *source-address* [*priority*]
8. **clock-source** *source-address* [*priority*]
9. **clock-port** *port-name* **master** [**profile** {**g8265.1**}]
10. **transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**]
11. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	Router# **configure terminal**	Enter configuration mode.

	Command	Purpose
Step 3	**ptp clock** {**ordinary** | **boundary** | **e2e-transparent**} **domain** *domain-number* **Example:** `Router(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**—Terminates PTP session from Grandmaster and acts as PTP master to slaves downstream. • **e2e-ransparent**—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the acuracy of 1588 clock at slave.
Step 4	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(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. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.
Step 5	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation`	Specifies the transport mechanism for clocking traffic. 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 6	**clock-source** *source-address* [*priority*] **Example:** `Router(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. • 1—Assigns a priority value of 1. • 2—Assigns a priority value of 2, the highest priority.
Step 7	**clock-source** *source-address* [*priority*] **Example:** `Router(config-ptp-port)# clock source 133.133.133.134 2`	Specifies the address of an additional PTP master clock; repeat this step for each additional master clock. You can configure up to 3 master clocks.
Step 8	**clock-source** *source-address* [*priority*] **Example:** `Router(config-ptp-port)# clock source 133.133.133.135`	Specifies the address of an additional PTP master clock; repeat this step for each additional master clock. You can configure up to 3 master clocks.
Step 9	**clock-port** *port-name* {**master** | **slave**} [**profile** {**g8265.1**}] **Example:** `Router(config-ptp-port)# clock-port MASTER master`	Specifies the address of a PTP master clock. The **profile** keyword configures the clock to use the G.8265.1 recommendations for establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes. **Note** Using a telecom profile requires that the clock have a domain number of 4–23.

	Command	Purpose
Step 10	**transport ipv4 unicast interface** *interface-type interface-number* [**negotiation**] **Example:** `Router(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation`	Specifies the transport mechanism for clocking traffic. 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 11	**end** **Example:** `Router(config-ptp-port)# end`	Exit configuration mode.

Synchronizing the System Time to a Time-of-Day Source

The following sections describe how to synchronize the system time to a time of day (ToD) clock source.

- Synchronizing the System Time to a Time-of-Day Source (Master Mode), page 11-28
- Synchronizing the System Time to a Time-of-Day Source (Slave Mode), page 11-29

Synchronizing the System Time to a Time-of-Day Source (Master Mode)

Note System time to a ToD source (Master Mode) can be configured only when PTP master is configured. See Configuring a Master Ordinary Clock, page 11-8. Select any one of the four available ToD format; cisco, nmea, ntp or ubx.10m must be configured as network clock input source.

Follow these steps to configure the system clock to a ToD source in master mode.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **tod-clock input-source** *priority* {**gps** {**R0** | **R1**} | **ptp domain** *domain*}
4. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**tod-clock input-source** *priority* {**gps** {**R0** | **R1**} | **ptp domain** *domain*} **Example:** `Router(config)# TOD-clock 2 gps R0/R1`	In master mode, specify a GPS port connected to a ToD source.
Step 4	**exit** **Example:** `Router(config)# exit`	Exit configuration mode.

Synchronizing the System Time to a Time-of-Day Source (Slave Mode)

Note System time to a ToD source (Slave Mode) can be configured only when PTP slave is configured. See Configuring a Slave Ordinary Clock, page 11-11.

Follow these steps to configure the system clock to a ToD source in slave mode. In slave mode, specify a PTP domain as a ToD input source.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **tod-clock input-source** *priority* {**gps** {**R0** | **R1**} | **ptp domain** *domain*}
4. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enter configuration mode.
Step 3	**tod-clock input-source** *priority* {**gps** {**R0** | **R1**} | **ptp domain** *domain*} **Example:** `Router(config)# TOD-clock 10 ptp domain 0`	In slave mode, specify a PTP domain as a ToD input source.
Step 4	Router(config)# **end**	Exit configuration mode.

Configuring Synchronous Ethernet ESMC and SSM

Synchronous Ethernet is an extension of Ethernet designed to provide the reliability found in traditional SONET/SDH and T1/E1 networks to Ethernet packet networks by incorporating clock synchronization features. The supports the Synchronization Status Message (SSM) and Ethernet Synchronization Message Channel (ESMC) for synchronous Ethernet clock synchronization.

The following sections describe ESMC and SSM support on the Cisco ASR 900 Series Router.

- Configuring Synchronous Ethernet ESMC and SSM, page 11-30
- Managing Clock Source Selection, page 11-35

Configuring Synchronous Ethernet ESMC and SSM

Follow these steps to configure ESMC and SSM on the Cisco ASR 900 Series Router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **network-clock synchronization automatic**
4. **network-clock eec** {**1** | **2**}
5. **network-clock synchronization ssm option** {**1** | **2** {**GEN1** | **GEN2**}}
6. **Use one of the following options:**

- **network-clock input-source** <*priority*> **controller** {**SONET** | **wanphy**}
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**10m** | **2m**]

- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**cas** {**120ohms** | **75ohms** | **crc4**}}]
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**crc4** | **fas**] {**120ohms** | **75ohms**} {**linecode {ami** | **hdb3**}}
- **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**t1** {**d4** | **esf** | **sf**}{**linecode {ami** | **b8zs**}}]
- **network-clock input-source** <*priority*> **interface** <*type/slot/port*>
- **network-clock input-source** <*priority*> **ptp domain** <*domain-number*>

7. **network-clock synchronization mode ql-enabled**
8. **network-clock hold-off** {**0** | *milliseconds*}
9. **network-clock wait-to-restore** *seconds*
10. **network-clock revertive**
11. **esmc process**
12. **network-clock external** *slot/card/port* **hold-off** {**0** | *milliseconds*}
13. **network-clock quality-level** {**tx** | **rx**} *value* {**controller** [**E1**| **BITS**] *slot/card/port* | **external** [**2m** | **10m** | **2048k** | **t1** | **e1**] }
14. **interface** *type number*
15. **synchronous mode**
16. **network-clock source quality-level** *value* {**tx** | **rx**}
17. **esmc mode** [**ql-disabled** | **tx** | **rx**] *value*
18. **network-clock hold-off** {*0* | *milliseconds*}
19. **network-clock wait-to-restore** *seconds*
20. **end**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**network-clock synchronization automatic** **Example:** `Router(config)# network-clock synchronization automatic`	Enables the network clock selection algorithm. This command disables the Cisco-specific network clock process and turns on the G.781-based automatic clock selection process.

	Command	Purpose
Step 4	**network-clock eec** {**1** | **2**} **Example:** `Router(config)# network-clock eec 1`	Specifies the Ethernet Equipment Clock (EEC) type. Valid values are • 1—ITU-T G.8262 option 1 (2048) • 2—ITU-T G.8262 option 2 and Telcordia GR-1244 (1544)
Step 5	**network-clock synchronization ssm option** {**1** | **2** {**GEN1** | **GEN2**}} **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN2`	Configures the G.781 synchronization option used to send synchronization messages. The following guidelines apply for this command: • Option 1 refers to G.781 synchronization option 1, which is designed for Europe. This is the default value. • Option 2 refers to G.781 synchronization option 2, which is designed for the United States. • GEN1 specifies option 2 Generation 1 synchronization. • GEN2 specifies option 2 Generation 2 synchronization.
Step 6	Use one of the following options: • **network-clock input-source** <*priority*> **controller** {**SONET** | **wanphy**} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**10m** | **2m]** • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**cas** {**120ohms** | **75ohms** | **crc4**}}] • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**2048k** | **e1** {**crc4** | **fas**] {**120ohms** | **75ohms**} {**linecode {ami** | **hdb3**}} • **network-clock input-source** <*priority*> **external** {**R0** | **R1**} [**t1** {**d4** | **esf** | **sf**}{**linecode {ami** | **b8zs**}}] • **network-clock input-source** <*priority*> **interface** <*type/slot/port*> • **network-clock input-source** <*priority*> **ptp domain** <*domain-number*> **Example:** `Router(config)# network-clock input-source 1 external R0 10m`	• (Optional) To nominate SDH or SONET controller as network clock input source. • (Optional) To nominate 10Mhz port as network clock input source. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in e1 mode. • (Optional) To nominate BITS port as network clock input source in t1 mode. • (Optional) To nominate Ethernet interface as network clock input source. • (Optional) To nominate PTP as network clock input source.
Step 7	**network-clock synchronization mode ql-enabled** **Example:** `Router(config)# network-clock synchronization mode ql-enabled`	Enables automatic selection of a clock source based on quality level (QL). **Note** This command is disabled by default.

	Command	Purpose
Step 8	**network-clock hold-off** {**0** | *milliseconds*} **Example:** `Router(config)# network-clock hold-off 0`	(Optional) Configures a global hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action. **Note** You can also specify a hold-off value for an individual interface using the **network-clock hold-off** command in interface mode.
Step 9	**network-clock wait-to-restore** *seconds* **Example:** `Router(config)# network-clock wait-to-restore 70`	(Optional) Configures a global wait-to-restore timer for synchronous Ethernet clock sources. The timer specifies how long the router waits before including a restored clock source in the clock selection process. Valid values are 0 to 86400 seconds. The default value is 300 seconds. **Note** You can also specify a wait-to-restore value for an individual interface using the **network-clock wait-to-restore** command in interface mode.
Step 10	**network-clock revertive** **Example:** `Router(config)# network-clock revertive`	(Optional) Sets the router in revertive switching mode when recovering from a failure. To disable revertive mode, use the **no** form of this command.
Step 11	**esmc process** **Example:** `Router(config)# esmc process`	Enables the ESMC process globally.
Step 12	**network-clock external** *slot/card/port* **hold-off** {**0** | *milliseconds*} **Example:** `Router(config)# network-clock external 0/1/0 hold-off 0`	Overrides the hold-off timer value for the external interface.
Step 13	**network-clock quality-level** {**tx** | **rx**} *value* {**controller** [**E1**| **BITS**] *slot/card/port* | **external** [**2m** | **10m** | **2048k** | **t1** | **e1**] } **Example:** `Router(config)# network-clock quality-level rx qL-pRC external R0 e1 cas crc4`	Specifies a quality level for a line or external clock source. The available quality values depend on the G.781 synchronization settings specified by the **network-clock synchronization ssm option** command: • Option 1—Available values are QL-PRC, QL-SSU-A, QL-SSU-B, QL-SEC, and QL-DNU. • Option 2, GEN1—Available values are QL-PRS, QL-STU, QL-ST2, QL-SMC, QL-ST4, and QL-DUS. • Option 2, GEN 2—Available values are QL-PRS, QL-STU, QL-ST2, QL-TNC, QL-ST3, QL-SMC, QL-ST4, and QL-DUS.

	Command	Purpose

Step 14	**interface** *type number*
	
	Example:
	`Router(config)# interface GigabitEthernet 0/0/1`
	`Router(config-if)#`
		Enters interface configuration mode.

Step 15	**synchronous mode** **Example:** `Router(config-if)# synchronous mode`	Configures the Ethernet interface to synchronous mode and automatically enables the ESMC and QL process on the interface.
Step 16	**network-clock source quality-level** *value* {**tx** | **rx**} **Example:** `Router(config-if)# network-clock source quality-level QL-PrC tx`	Applies quality level on sync E interface. The available quality values depend on the G.781 synchronization settings specified by the **network-clock synchronization ssm option** command: • Option 1—Available values are QL-PRC, QL-SSU-A, QL-SSU-B, QL-SEC, and QL-DNU. • Option 2, GEN1—Available values are QL-PRS, QL-STU, QL-ST2, QL-SMC, QL-ST4, and QL-DUS. • Option 2, GEN 2—Available values are QL-PRS, QL-STU, QL-ST2, QL-TNC, QL-ST3, QL-SMC, QL-ST4, and QL-DUS.
Step 17	**esmc mode** [**ql-disabled** | **tx** | **rx**] *value* **Example:** `Router(config-if)# esmc mode rx QL-STU`	Enables the ESMC process at the interface level. The **no** form of the command disables the ESMC process.
Step 18	**network-clock hold-off** {*0* | *milliseconds*} **Example:** `Router(config-if)# network-clock hold-off 0`	(Optional) Configures an interface-specific hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action. You can configure the hold-off time to either 0 or any value between 50 to 10000 ms. The default value is 300 ms.
Step 19	**network-clock wait-to-restore** *seconds* **Example:** `Router(config-if)# network-clock wait-to-restore 70`	(Optional) Configures the wait-to-restore timer for an individual synchronous Ethernet interface.
Step 20	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

You can use the **show network-clocks** command to verify your configuration.

Managing Clock Source Selection

The following sections describe how to manage the selection on the Cisco ASR 900 Series Router:

Specifying a Clock Source

The following sections describe how to specify a synchronous Ethernet clock source during the clock selection process:

Selecting a Specific Clock Source

To select a specific interface as a synchronous Ethernet clock source, use the **network-clock switch manual** command in global configuration mode.

Note The new clock source must be of higher quality than the current clock source; otherwise the router does not select the new clock source.

Command	Purpose
network-clock switch manual external R0 | R1 {{E1 {crc4 | cas |fas}} {T1 {d4 | sf | esf}} } **Example:** `Router# network-clock switch manual external r0 e1 crc4`	Manually selects a synchronization source, provided the source is available and is within the range.
network-clock clear switch {t0 | external *slot/card/port* **[10m | 2m]}** **Example:** `Router# network-clock clear switch t0`	Disable a clock source selection.

Forcing a Clock Source Selection

To force the router to use a specific synchronous Ethernet clock source, use the **network-clock switch force** command in global configuration mode.

Note This command selects the new clock regardless of availability or quality.

Note Forcing a clock source selection overrides a clock selection using the **network-clock switch manual command.**

Command	Purpose
network-clock switch force external R0 | R1 {{**E1** {**crc4 | cas |fas**}} {**T1** {**d4 | sf | esf**}} } **Example:** `Router# network-clock switch force r0 e1 crc4`	Forces the router to use a specific synchronous Ethernet clock source, regardless of clock quality or availability.
network-clock clear switch {**t0 | external** *slot/card/port* [**10m | 2m**]} **Example:** `Router# network-clock clear switch t0`	Disable a clock source selection.

Disabling Clock Source Specification Commands

To disable a **network-clock switch manual** or **network-clock switch force** configuration and revert to the default clock source selection process, use the **network-clock clear switch** command.

Command	Purpose
network-clock clear switch {**t0 | external** *slot/card/port* [**10m | 2m**]} **Example:** `Router# network-clock clear switch t0`	Disable a clock source selection.

Disabling a Clock Source

The following sections describe how to manage the synchronous Ethernet clock sources that are available for clock selection:

- Locking Out a Clock Source, page 11-36
- Restoring a Clock Source, page 11-37

Locking Out a Clock Source

To prevent the router from selecting a specific synchronous Ethernet clock source, use the **network-clock set lockout** command in global configuration mode.

Command	Purpose
network-clock set lockout {**interface** *interface_name slot/card/port* | **external** {**R0** | **R1** [{ **t1** {**sf** | **esf** } **linecode** {**ami** | **b8zs**}} | **e1** [**crc4** | **fas**] **linecode** [**hdb3** | **ami**]} **Example:** `Router# network-clock set lockout interface GigabitEthernet 0/0/0`	Prevents the router from selecting a specific synchronous Ethernet clock source.
network-clock clear lockout {**interface** *interface_name slot/card/port* | **external** {**R0** | **R1** [{ **t1** {**sf** | **esf** } **linecode** {**ami** | **b8zs**}} | **e1** [**crc4** | **fas**] **linecode** [**hdb3** | **ami**] } **Example:** `Router# network-clock clear lockout interface GigabitEthernet 0/0/0`	Disable a lockout configuration on a synchronous Ethernet clock source.

Restoring a Clock Source

To restore a clock in a lockout condition to the pool of available clock sources, use the **network-clock clear lockout** command in global configuration mode.

Command	Purpose
network-clock clear lockout {**interface** *interface_name slot/card/port* | **external** **external** {**R0** | **R1** [{ **t1** {**sf** | **esf** } **linecode** {**ami** | **b8zs**}} | **e1** [**crc4** | **fas**] **linecode** [**hdb3** | **ami**] } **Example:** `Router# network-clock clear lockout interface GigabitEthernet 0/0/0`	Forces the router to use a specific synchronous Ethernet clock source, regardless of clock quality or availability.

Verifying the Configuration

You can use the following commands to verify a clocking configuration:

- **show esmc**—Displays the ESMC configuration.
- **show esmc detail**—Displays the details of the ESMC parameters at the global and interface levels.
- **show network-clock synchronization**—Displays the router clock synchronization state.

- **show network-clock synchronization detail**—Displays the details of network clock synchronization parameters at the global and interface levels.
- **show ptp clock dataset**
- **show ptp port dataset**
- **show ptp clock running**
- **show platform software ptpd statistics**
- **show platform ptp all**
- **show platform ptp tod all**

Troubleshooting

Table 11-4 list the debug commands that are available for troubleshooting the SyncE configuration on the Cisco ASR 900 Series Router:

Caution We recommend that you do not use **debug** commands without TAC supervision.

Table 11-4 SyncE Debug Commands

Debug Command	Purpose
debug platform network-clock	Debugs issues related to the network clock including active-standby selection, alarms, and OOR messages.
debug network-clock	Debugs issues related to network clock selection.
debug esmc error **debug esmc event** **debug esmc packet** [**interface** *interface-name*] **debug esmc packet rx** [**interface** *interface-name*] **debug esmc packet tx** [**interface** *interface-name*]	These commands verify whether the ESMC packets are transmitted and received with proper quality-level values.

Table 11-5 provides the information about troubleshooting your configuration

Table 11-5 Troubleshooting Scenarios

Problem	Solution
Clock selection	• Verify that there are no alarms on the interfaces using the **show network-clock synchronization detail** command. • Ensure that the nonrevertive configurations are in place. • Reproduce the issue and collect the logs using the **debug network-clock errors**, **debug network-clock event**, and **debug network-clock sm** commands. Contact Cisco Technical Support if the issue persists.
Incorrect QL values	• Ensure that there is no framing mismatch with the SSM option. • Reproduce the issue using the **debug network-clock errors** and **debug network-clock event** commands.
Alarms	• Reproduce the issue using the **debug platform network-clock** command enabled in the RSP. Alternatively, enable the **debug network-clock event** and **debug network-clock errors** commands.
Incorrect clock limit set or queue limit disabled mode	• Verify that there are no alarms on the interfaces using the **show network-clock synchronization detail** command. • Use the **show network-clock synchronization** command to confirm if the system is in revertive mode or nonrevertive mode and verify the non-revertive configurations. • Reproduce the current issue and collect the logs using the **debug network-clock errors**, **debug network-clock event**, and **debug network-clock sm** RSP commands.
Incorrect QL values when you use the **show network-clock synchronization detail** command.	• Use the **network clock synchronization SSM** (*option 1* |*option 2*) command to confirm that there is no framing mismatch. Use the **show run interface** command to validate the framing for a specific interface. For the SSM option 1, framing should be SDH or E1, and for SSM option 2, it should be T1. • Reproduce the issue using the **debug network-clock errors** and **debug network-clock event** RSP commands.

Configuration Examples

This section contains sample configurations for clocking features on the Cisco ASR 900 Series Router.

Note This section contains partial router configurations intended to demonstrate a specific feature.

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
announce timeout 7
delay-req interval 100
```

Ordinary Clock —Slave Mode (Ethernet)

```
ptp clock ordinary domain 0
clock-port Slave slave
transport ethernet unicast
clock-source 1234.5678.90ab bridge-domain 2 5
```

Ordinary Clock—Master

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

Ordinary Clock—Master (Ethernet)

```
ptp clock ordinary domain 0
clock-port Master master
transport ethernet unicast
clock destination interface GigabitEthernet0/0/1
```

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—Slave Mode (Ethernet)

```
ptp clock ordinary domain 0
  clock-port Slave slave
    transport ethernet unicast
      clock source 1234.5678.90ab bridge-domain 5 2
```

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 Configuration—Master Mode (Ethernet)

```
ptp clock ordinary domain 0
  clock-port Master master
    transport ethernet unicast
      clock destination 1234.5678.90ab bridge-domain 5
```

Unicast Negotiation—Slave

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

Unicast Negotiation—Slave (Ethernet)

```
ptp clock ordinary domain 0
  clock-port Slave slave
    transport ethernet unicast negotiation
      clock source 1234.5678.90ab bridge-domain 5 5
  clock-port Slave1 slave
    transport ethernet unicast negotiation
      clock source 1234.9876.90ab interface gigabitethernet 0/0/4 2
```

Unicast Negotiation—Master

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

Unicast Negotiation—Master (Ethernet)

```
ptp clock ordinary domain 0
clock-port Master master
transport ethernet unicast negotiation
```

Boundary Clock

```
ptp clock boundary domain 0
 clock-port SLAVE slave
  transport ipv4 unicast interface Loopback 0 negotiation
  clock source 133.133.133.133
 clock-port MASTER master
  transport ipv4 unicast interface Loopback 1 negotiation
```

Transparent Clock

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

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
```

PTP Redundancy—Slave

```
ptp clock ordinary domain 0
```

```
 clock-port SLAVE slave
  transport ipv4 unicast interface Loopback 0 negotiation
  clock source 133.133.133.133 1
   clock source 55.55.55.55 2
   clock source 5.5.5.5
```

PTP Redundancy—Boundary

```
ptp clock boundary domain 0
clock-port SLAVE slave
transport ipv4 unicast interface Loopback 0 negotiation
clock source 133.133.133.133 1
clock source 55.55.55.55 2
clock source 5.5.5.5
clock-port MASTER master
transport ipv4 unicast interface Lo1 negotiation
```

Time of Day Source—Master

```
TOD-clock 10 gps R0/R1
```

Time of Day Source—Slave

```
TOD-clock 10 ptp domain 0
```

Clock Selection Parameters

```
network-clock synchronization automatic
network-clock synchronization mode QL-enabled
network-clock input-source 1 ptp domain 3
```

ToD/1PPS Configuration—Master

```
network-clock input-source 1 external R010m
ptp clock ordinary domain 1
tod R0 ntp
input 1pps R0
clock-port master master
transport ipv4 unicast interface loopback 0
```

ToD/1PPS Configuration—Slave

```
ptp clock ordinary domain 1
tod R0 ntp
output 1pps R0
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 software ptpd stat stream 0
LOCK STATUS : PHASE LOCKED
SYNC Packet Stats
  Time elapsed since last packet: 0.0
  Configured Interval : 0, Acting Interval 0
  Tx packets : 0,  Rx Packets : 169681
  Last Seq Number : 0,  Error Packets : 1272
Delay Req Packet Stats
  Time elapsed since last packet: 0.0
  Configured Interval : 0, Acting Interval : 0
  Tx packets : 84595, Rx Packets : 0
  Last Seq Number : 19059, Error Packets : 0
!output omitted for brevity
Current Data Set
  Offset from master :  0.4230440
  Mean Path Delay :  0.0
  Steps Removed 1
General Stats about this stream
  Packet rate : 0, Packet Delta (ns) : 0
  Clock Stream handle : 0, Index : 0
  Oper State : 6, Sub oper State : 7
  Log mean sync Interval : -5, log mean delay req int : -4


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
```

```
Router#show platform ptp tod all
--------------------------------
ToD/1PPS Info for 0/0
--------------------------------
ToD CONFIGURED        : YES
ToD FORMAT            : NMEA
ToD DELAY             : 0
1PPS MODE             : OUTPUT
OFFSET                : 0
PULSE WIDTH           : 0
ToD CLOCK             : Mon Jan 1  00:00:00 UTC 1900

Router# show ptp clock running domain 0

                     PTP Boundary Clock [Domain 0]
State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
PHASE_ALIGNED  2              32355          159516         Hot standby

PORT SUMMARY

PTP Master
Name               Tx Mode      Role         TransportState        Sessions Port Addr

SLAVE              unicast      slave        Ethernet              1       9.9.9.1
MASTER             unicast      master       Ethernet -            2            -

                            SESSION INFORMATION

SLAVE [Ethernet] [Sessions 1]
 Peer addr          Pkts in    Pkts out   In Errs    Out Errs

 9.9.9.1            159083     31054      0          0

MASTER [Ethernet] [Sessions 2]
 Peer addr                              Pkts in    Pkts out   In Errs    Out Errs
 aabb.ccdd.ee01 [Gig0/2/3]            223        667        0          0
 aabb.ccdd.ee02 [BD 1000]             210        634        0          0
```

Input Synchronous Ethernet Clocking

The following example shows how to configure the router to use the BITS interface and two Gigabit Ethernet interfaces as input synchronous Ethernet timing sources. The configuration enables SSM on the BITS port.

```
!
Interface GigabitEthernet0/0
    synchronous mode
    network-clock wait-to-restore 720
!
Interface GigabitEthernet0/1
    synchronous mode
!

!
network-clock synchronization automatic
network-clock input-source 1 External R0 e1 crc4
network-clock input-source 1 gigabitethernet 0/0
network-clock input-source 2 gigabitethernet 0/1
network-clock synchronization mode QL-enabled
no network-clock revertive
```