



Clocking and Timing

This chapter explains how to configure timing ports on the Cisco ASR 920 Series Router.

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Clocking and Timing Restrictions

The following clocking and timing restrictions apply to the Cisco ASR 920 Series Router:

- Do not configure GNSS in high accuracy operating mode, when Cisco ASR-920-12SZ-A or Cisco ASR-920-12SZ-D router is configured as Precision Time Protocol (PTP) master.
- 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.
- Precision Time Protocol (PTP) is supported only on loopback interfaces, layer 2 interfaces, and BDI interfaces. It is not supported on Layer 3 interfaces.
- Out-of-band clocking and the **recovered-clock** command are not supported.
- 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.
- On Cisco ASR 920 Series Router (ASR-920-12CZ-A, ASR-920-12CZ-D, ASR-920-4SZ-A, and ASR-920-4SZ-D), 1 PPS is only available through ToD port. To provide both ToD and 1 PPS signal on the same port you must use a special Y-cable.



Note The Cisco ASR-920-24SZ-M and ASR-920-24TZ-M do not have a ToD port, BITS port or a 1pps SMB port.

- Cisco ASR 920 Series Router (ASR-920-12CZ-A, ASR-920-12CZ-D, ASR-920-4SZ-A, ASR-920-4SZ-D, ASR-920-24SZ-M, ASR-920-24TZ-M), supports only BITS port and not 10 M input.



Note Fixed Cisco ASR-920-24SZ-IM, ASR-920-24SZ-M, ASR-920-24TZ-M Aggregation Services Routers cannot take any external input and cannot give out any external output.

- 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.
- When PTP is configured on Cisco ASR-920-24SZ-IM Router, changing the configuration mode from LAN to WAN or WAN to LAN is not supported for following IMs:
 - 2x10G
 - 8x1G_1x10G_SFP
 - 8x1G_1x10G_CU
- PTP functionality is restricted by license type.

The table below summarizes the PTP functionalities that are available, by license type:

Table 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.

- 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 920 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.
- We recommended that you do not configure multiple input sources with the same priority as this impacts the TSM (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.
- The **network-clock input-interface ptp domain** command is not supported.
- To shift from non hybrid clock configuration to hybrid clock configuration, you must first unconfigure PTP, unconfigure netsync, reconfigure netsync and configure hybrid PTP.

Clocking and Timing Overview

The Cisco ASR 920 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 920 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 (Cisco ASR-920-24SZ-IM Router)

- Receive input clocking at 10 Mhz, 2.048 Mhz, and 1.544 Mhz (Cisco ASR-920-24SZ-IM Router)

SyncE is supported in both LAN and WAN mode on a 10 Gigabit Ethernet interface.

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 2: Nodes within a PTP Network

Network Element	Description
Grandmaster (GM)	A network device physically attached to the primary time source. All clocks are synchronized to the grandmaster clock.
Ordinary Clock (OC)	An ordinary clock is a 1588 clock with a single PTP port that can operate in one of the following modes: <ul style="list-style-type: none"> • Master mode—Distributes timing information over the network to one or more slave clocks, thus allowing the slave to synchronize its clock to the master. • Slave mode—Synchronizes its clock to a master clock. You can enable the slave mode on up to two interfaces simultaneously in order to connect to two different master clocks.
Boundary Clock (BC)	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 (TC)	A transparent clock is a device or a switch that calculates the time it requires to forward traffic and updates the PTP time correction field to account for the delay, making the device transparent in terms of time calculations.

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](#).

Effective Cisco IOS-XE Release 3.18, the G.8275.1 telecom profile is also supported on the Cisco ASR920 Series Routers (Cisco ASR-920-12CZ-A/D, ASR-920-4SZ-A/D, Cisco ASR 920-10SZ-PD and Cisco ASR-920-24SZ-IM, ASR-920-24SZ-M, ASR-920-24TZ-M). For more information, see [G.8275.1 Telecom Profile](#).

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**

BMCA can also be triggered if clock class of the newly-added master is better. This is true for both, normal PTP as well as PTP with hybrid.

**Note**

The Cisco ASR 920 Series Router supports unicast-based timing as specified in the 1588-2008 standard.

For instructions on how to configure PTP redundancy, see [Configuring PTP Redundancy, on page 31](#).

PTP Redundancy Using Hop-By-Hop Topology Design

Real world deployments for IEEE-1588v2 for mobile backhaul requires the network elements to provide synchronization and phase accuracy over IP or MPLS networks along with redundancy.

In a ring topology, a ring of PTP boundary clock nodes are provisioned such that each boundary clock node provides synchronization to a number of PTP slaves connected to it. Each such ring includes at least two PTP masters with a PRC traceable clock.

However, with this topology the following issues may occur:

- Node asymmetry and delay variation—In a ring topology, each boundary clock uses the same master, and the PTP traffic is forwarded through intermediate boundary clock nodes. As intermediate nodes do not correct the timestamps, variable delay and asymmetry for PTP are introduced based on the other traffic passing through such nodes, thereby leading to incorrect results.
- Clock redundancy—Clock redundancy provides redundant network path when a node goes down. In a ring topology with PTP, for each unicast PTP solution, the roles of each node is configured. The PTP clock path may not be able to reverse without causing timing loops in the ring.

No On-Path Support Topology

The topology (see the figure below) describes a ring with no on-path support. S1 to S5 are the boundary clocks that use the same master clocks. GM1 and GM2 are the grandmaster clocks. In this design, the following issues are observed:

- Timestamps are not corrected by the intermediate nodes.
- Difficult to configure the reverse clocking path for redundancy.
- Formation of timings loops.

Figure 1: Deployment in a Ring - No On-Path Support with IPv4

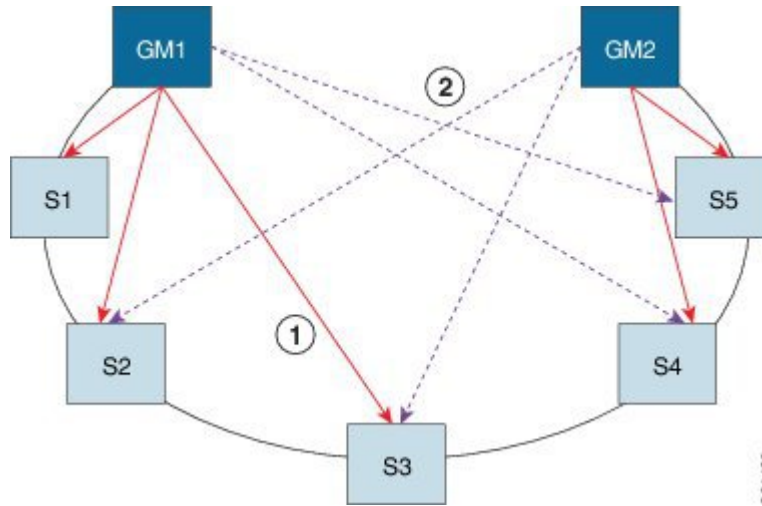


Table 3: PTP Ring Topology—No On-Path Support

Clock Nodes	Behavior in the PTP Ring
GM1	Grandmaster Clock
GM2	Grandmaster Clock
S1	Masters: M1 (1st), M2 (2nd)
S2	Masters: M1 (1st), M2 (2nd)
S3	Masters: M1 (1st), M2 (2nd)
S4	Masters: M2 (1st), M1 (2nd)
S5	Masters: M2 (1st), M1 (2nd)

A solution to the above issue is addressed by using Hop-by-Hop topology configuration.

Hop-By-Hop Topology in a PTP Ring

PTP Ring topology is designed by using Hop-By-Hop configuration of PTP boundary clocks. In this topology, each BC selects its adjacent nodes as PTP masters, instead of using the same GM as the PTP master. These PTP BC masters are traceable to the GM in the network. Timing loop are not formed between adjacent BC nodes. The hot Standby BMCA configuration is used for switching to next the best master during failure.

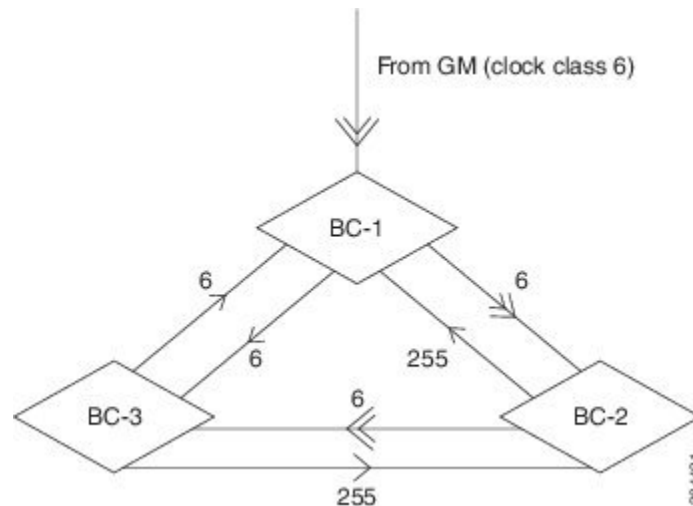
Prerequisites

- PTP boundary clock configuration is required on all clock nodes in the ring, except the master clock nodes (GM), which provide the clock timing to ring. In the above example nodes S1—S5 must be configured as BC.
- The master clock (GM1 and GM2 in the above figure) nodes in the ring can be either a OC master or BC master.

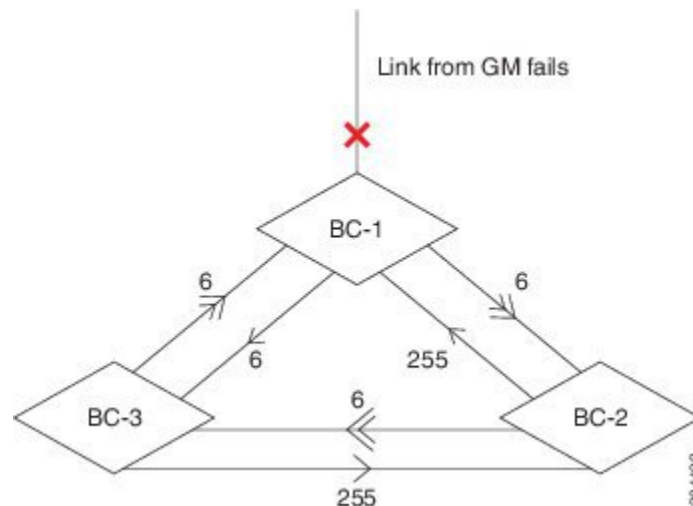
- Instead of each BC using same the GM as a PTP master, each BC selects its adjacent nodes as PTP masters. These PTP BC-masters are traceable to the GM in the network.
- Boundary clock nodes must be configured with the **single-hop** keyword in the PTP configuration to ensure that a PTP node can communicate with it's adjacent nodes only.

Restrictions

- Timing loops should not exist in the topology. For example, if for a node there are two paths to get the same clock back, then the topology is not valid. Consider the following topology and configuration.



The paths with double arrows (>>) are the currently active clock paths and paths with single arrow (>) are redundant clock path. This configuration results in a timing loop if the link between the BC-1 and GM fails.



- In a BC configuration, the same loopback interface should never be used for both master and slave port configuration.
- **Single-hop** keyword is not supported for PTP over MPLS with explicit null configuration. The Single-hop keyword is not supported when PTP packets are sent out with a MPLS tag.

On-Path Support Topology Scenario

Consider the topology as shown in the figure in the section No On-Path Support Topology .

Figure 2: PTP Ring Topology—On-Path Support

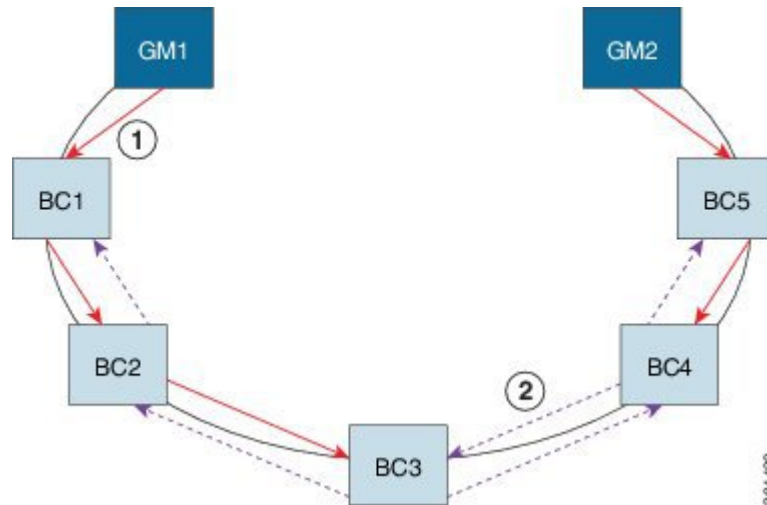


Table 4: PTP Ring Topology—On-Path Support

Clock Node	Behavior in the PTP Ring
GM1	Grandmaster Clock
GM2	Grandmaster Clock
BC1	Masters: M1 (1st), BC2 (2nd) Slaves: BC2
BC2	Masters: BC1(1st), BC3 (2nd) Slaves: BC1, BC3
BC3	Masters: BC2 (1st), BC4 (2nd) Slaves: BC2, BC4
BC4	Masters: BC5 (1st), BC3 (2nd) Slaves: BC3, BC5
BC5	Masters: M2(1st), BC4 (2nd) Slaves: BC4

Now consider there is a failure between BC1 and BC2 (see the figure below). In this case, the BC2 cannot communicate with GM1. Node BC2 receives the clock from BC3, which in turn receives the clock from GM2.

Figure 3: Deployment in a Ring—On-Path Support (Failure)

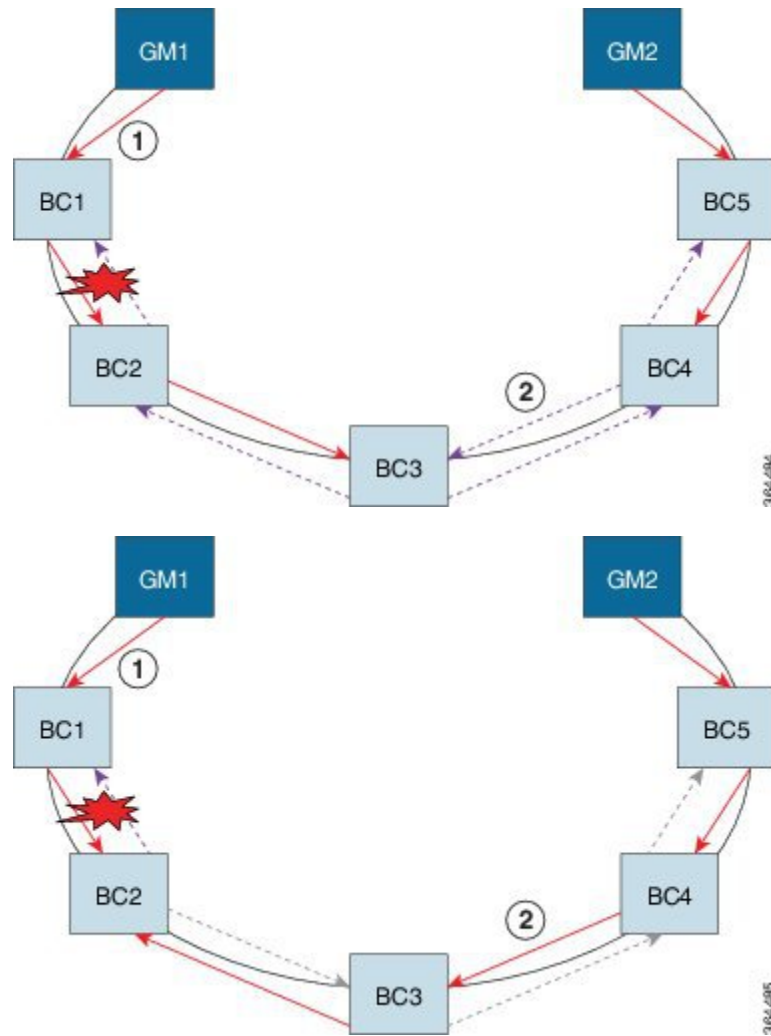


Table 5: PTP Ring Topology—On-Path Support (Failure)

Clock Node	Behavior in the PTP Ring ¹
GM1	Grandmaster Clock
GM2	Grandmaster Clock
BC1	Masters: M1 (1st), BC2 (2nd) Slaves: BC2
BC2	Masters: BC1(1st), BC3 (2nd) Slaves: BC1, BC3
BC3	Masters: BC2 (1st), BC4 (2nd) Slaves: BC2, BC4

Clock Node	Behavior in the PTP Ring ¹
BC4	Masters: BC5 (1st), BC3 (2nd) Slaves: BC3, BC5
BC5	Masters: M2(1st), BC4 (2nd) Slaves: BC4

¹ Red indicates that GM is not traceable and there is no path to the slave.

Configuration Example

PTP Ring boundary clocks must be configured with **single-hop** keyword in PTP configuration. The PTP node can communicate with its adjacent nodes only. This is required for PTP hop-by-hop ring topology.

```
ptp clock boundary domain 0
    clock-port bcslave1 slave
        transport ipv4 unicast interface Lo0 negotiation single-hop
        clock source 1.1.1.1
        clock source 2.2.2.2 1
    clock-port bcmaster1 master
        transport ipv4 unicast interface Lo1 negotiation single-hop
.
.
```



Note

The **single-hop** keyword is not supported for PTP over MPLS with explicit NULL configurations. The **single-hop** keyword is not supported when PTP packets are sent out with a MPLS tag.

For information on configuring PTP redundancy, see [Configuring PTP Redundancy](#).

Best Master Clock Algorithm

Effective Cisco IOS-XE Release 3.15.0S, Best Master Clock Algorithm (BMCA) is supported on the Cisco ASR 920 Series Routers.

BMCA is used to select the master clock on each link, and ultimately, select the grandmaster clock for the entire Precision Time Protocol (PTP) domain. BMCA runs locally on each port of the ordinary and boundary clocks, and selects the best clock.

The best master clock is selected based on the following parameters:

- Priority—User-configurable value ranging from 0 to 255; lower value takes precedence
- Clock Class—Defines the traceability of time or frequency from the grandmaster clock
- Alarm Status—Defines the alarm status of a clock; lower value takes precedence

By changing the user-configurable values, network administrators can influence the way the grandmaster clock is selected.

BMCA provides the mechanism that allows all PTP clocks to dynamically select the best master clock (grandmaster) in an administration-free, fault-tolerant way, especially when the grandmaster clocks changes.

For information on configuring BMCA, see [Configuring Clocking and Timing, on page 14](#).

Hybrid BMCA

In hybrid BMCA implementation, the phase is derived from a PTP source and frequency is derived from a physical lock source. More than one master clock is configured in this model and the best master is selected. If the physical clock does down, then PTP is affected.

Configuration Example: Hybrid BMCA on Ordinary Clock

```
ptp clock ordinary domain 0 hybrid
clock-port SLAVE slave
transport ipv4 unicast interface Lo0 negotiation
clock source 133.133.133.133
clock source 144.144.144.144 1
clock source 155.155.155.155 2

Network-clock input-source 10 interface gigabitEthernet 0/4
```

Configuration Example: Hybrid BMCA on Boundary Clock

```
ptp clock boundary domain 0 hybrid
clock-port SLAVE slave
transport ipv4 unicast interface Lo0 negotiation
clock source 133.133.133.133
clock source 144.144.144.144 1
clock source 155.155.155.155 2
clock-port MASTER master
transport ipv4 unicast interface Lo1 negotiation

Network-clock input-source 10 interface gigabitEthernet 0/4
```

Hybrid Clocking

The Cisco ASR 920 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 Transparent Clock, on page 23](#).

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

For information on how to configure the Cisco ASR 920 Series Router as a transparent clock, see [Configuring a Transparent Clock, on page 23](#).

Time of Day (TOD)

You can use the time of day (ToD) and 1PPS ports on the Cisco ASR 920 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 920 Series Router, see the [Configuring a Master Ordinary Clock, on page 14](#) and [Configuring a Slave Ordinary Clock, on page 19](#).

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, on page 35](#).

Timing Port Specifications

The following sections provide specifications for the timing ports on the Cisco ASR 920 Series Router.

BITS Framing Support

The table below lists the supported framing modes for a BITS port.

Table 6: Framing Modes for a BITS Port on a Cisco ASR 920 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.

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 920 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, on page 37](#).



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 920 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 [Specifying a Clock Source, on page 41](#) and [Disabling a Clock Source, on page 42](#) sections.

Managing Clock Selection

You can manage clock selection by changing the priority of the clock sources; you can also influence clock selection by modifying 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 [Specifying a Clock Source, on page 41](#) and [Disabling a Clock Source, on page 42](#) sections.

Configuring Clocking and Timing

The following sections describe how to configure clocking and timing features on the Cisco ASR 920 Series Router:

Configuring a Master Ordinary Clock

Follow these steps to configure the Cisco ASR 920 Series Router to act as a master ordinary clock.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal</pre>	Enters configuration mode.
Step 3	platform ptp 1pps GPS Example: <pre>Router(config)#platform ptp 1pps GPS</pre>	Enables 1pps SMA port.
Step 4	ptp clock ordinary domain domain-number Example: <pre>Router(config)# ptp clock ordinary domain 0</pre> Example:	Configures the PTP clock. You can create the following clock types: <ul style="list-style-type: none"> • ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode.

	Command or Action	Purpose
	Router(config-ptp-clk)#	
Step 5	priority1 <i>priorityvalue</i> 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 6	priority2 <i>priorityvalue</i> 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 7	utc-offset <i>value</i> leap-second "date time" offset {-1 1} Example: Router(config-ptp-clk)# utc-offset 45 leap-second "01-01-2017 00:00:00" offset 1	(Optional) Starting with Cisco IOS-XE Release 3.18SP, the new utc-offset CLI is used to set the UTC offset value. Valid values are from 0-255. The default value is 36. (Optional) Starting with Cisco IOS-XE Release 3.18.1SP, you can configure the current UTC offset, leap second event date and Offset value (+1 or -1). Leap second configuration will work only when the frequency source is locked and ToD was up before. <ul style="list-style-type: none"> • "date time"— Leap second effective date in dd-mm-yyyy hh:mm:ss format.
Step 8	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 9	tod {R0 R1} {ubx nmea cisco ntp} Example:	Configures the time of day message format used by the ToD interface.

	Command or Action	Purpose
	<pre>Router(config-ptp-clk)# tod R0 ntp</pre>	<p>Note It is mandatory that when electrical ToD is used, the utc-offset command is configured <i>before</i> configuring the tod R0, otherwise there will be a time difference of approximately 37 seconds between the master and slave clocks.</p> <p>Note The ToD port acts as an input port in case of Master clock and as an output port in case of Slave clock.</p>
Step 10	<p>clock-port <i>port-name</i> {master slave} [profile {g8265.1}]</p> <p>Example:</p> <pre>Router(config-ptp-clk)# clock-port Master master</pre> <p>Example:</p> <pre>Router(config-ptp-port)#</pre>	<p>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.</p> <p>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.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 11	<p>Do one of the following:</p> <ul style="list-style-type: none"> • transport ipv4 unicast interface <i>interface-type interface-number</i> [negotiation] • transport ethernet unicast [negotiation] <p>Example:</p> <pre>Router(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation</pre>	<p>Specifies the transport mechanism for clocking traffic; you can use IPv4 or Ethernet transport.</p> <p>The negotiation keyword configures the router to discover a PTP master clock from all available PTP clock sources.</p> <p>Note PTP redundancy is supported only on unicast negotiation mode.</p>
Step 12	<pre>exit</pre>	Exits clock-port configuration.
Step 13	<p>network-clock synchronization automatic</p> <p>Example:</p> <pre>Router(config)# network-clock synchronization automatic</pre>	<p>Enables automatic selection of a clock source.</p> <p>Note This command is mandatory to configure the leap second command.</p> <p>Note This command must be configured before any input source.</p>
Step 14	network-clock synchronization mode ql-enabled	Enables automatic selection of a clock source based on quality level (QL).

	Command or Action	Purpose
	Example: <pre>Router(config)# network-clock synchronization mode ql-enabled</pre>	Note This command is disabled by default.
Step 15	<p>Use one of the following options:</p> <ul style="list-style-type: none"> • 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: <pre>Router(config)# network-clock input-source 1 external R0 10m</pre>	<ul style="list-style-type: none"> • (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 16	<p>clock destination <i>source-address</i> <i>mac-address</i> {bridge-domain <i>bridge-domain-id</i>} interface <i>interface-name</i>}</p> Example: <pre>Router(config-ptp-port)# clock-source 8.8.8.1</pre>	Specifies the IP address or MAC address of a clock destination when the router is in PTP master mode.
Step 17	<p>sync interval <i>interval</i></p> Example: <pre>Router(config-ptp-port)# sync interval -4</pre>	<p>Specifies the interval used to send PTP synchronization messages. The intervals are set using log base 2 values, as follows:</p> <ul style="list-style-type: none"> • 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

	Command or Action	Purpose
		<ul style="list-style-type: none"> • -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 18	announce interval <i>interval</i> Example: <pre>Router(config-ptp-port) # announce interval 2</pre>	<p>Specifies the interval for PTP announce messages. The intervals are set using log base 2 values, as follows:</p> <ul style="list-style-type: none"> • 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 19	end Example: <pre>Router(config-ptp-port) # end</pre>	Exit configuration mode.

Example

The following example shows that the utc-offset is configured before configuring the ToD to avoid a delay of 37 seconds between the master and slave clocks:

```
ptp clock ordinary domain 24

local-priority 1

priority2 128
utc-offset 37
tod R0 cisco
clock-port master-port-1 master profile g8275.1 local-priority 1
transport ethernet multicast interface Gig 0/0/1
```

Configuring a Slave Ordinary Clock

Follow these steps to configure the Cisco ASR 920 Series Router to act as a slave ordinary clock.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal</pre>	Enter configuration mode.
Step 3	ptp clock ordinary domain <i>domain-number</i> [hybrid] Example: <pre>Router(config)# ptp clock ordinary domain 0</pre>	Configures the PTP clock. You can create the following clock types: <ul style="list-style-type: none"> ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode.
Step 4	output [1pps] {R0 R1} [offset <i>offset-value</i>] [pulse-width <i>value</i>] Example: <pre>Router(config-ptp-clk)# output 1pps R0 offset 200 pulse-width 20 usec</pre>	Enables Precision Time Protocol input 1PPS using a 1PPS input port. Use R0 or R1 to specify the active RSP slot. Note Effective Cisco IOS XE Everest 16.6.1, on the Cisco ASR-920-12SZ-IM router, the 1pps pulse bandwidth can be changed from the default value of 500 milliseconds to up to 20 microsecond.
Step 5	tod {R0 R1} {ubx nmea cisco ntp} Example: <pre>Router(config-ptp-clk)# tod R0 ntp</pre>	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 <i>port-name</i> {master slave} [profile {g8265.1}] Example: <pre>Router(config-ptp-clk)# clock-port Slave slave</pre>	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

	Command or Action	Purpose
		<p>master clock, handling SSM, and mapping PTP classes.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 7	<p>Do one of the following:</p> <ul style="list-style-type: none"> • transport ipv4 unicast interface <i>interface-type interface-number</i> [/negotiation] • transport ethernet unicast [negotiation] <p>Example:</p> <pre>Router(config-ptp-port)# transport ipv4 unicast interface loopback 0 negotiation</pre>	<p>Specifies the transport mechanism for clocking traffic; you can use IPv4 or Ethernet transport.</p> <p>The negotiation keyword configures the router to discover a PTP master clock from all available PTP clock sources.</p> <p>Note PTP redundancy is supported only on unicast negotiation mode.</p>
Step 8	<p>clock source <i>source-address</i> <i>mac-address</i> {bridge-domain <i>bridge-domain-id</i>} interface <i>interface-name</i>} [<i>priority</i>]</p> <p>Example:</p> <pre>Router(config-ptp-port)# clock-source 8.8.8.1</pre>	<p>Specifies the IP or MAC address of a PTP master clock.</p>
Step 9	<p>announce timeout <i>value</i></p> <p>Example:</p> <pre>Router(config-ptp-port)# announce timeout 8</pre>	<p>Specifies the number of PTP announcement intervals before the session times out. Valid values are 1–10.</p>
Step 10	<p>delay-req interval <i>interval</i></p> <p>Example:</p> <pre>Router(config-ptp-port)# delay-req interval 1</pre>	<p>Configures the minimum interval allowed between PTP delay-request messages when the port is in the master state.</p> <p>The intervals are set using log base 2 values, as follows:</p> <ul style="list-style-type: none"> • 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

	Command or Action	Purpose
		<ul style="list-style-type: none"> • -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: <code>Router(config-ptp-port)# end</code>	Exit configuration mode.

Configuring a Boundary Clock

Follow these steps to configure the Cisco ASR 920 Series Router to act as a boundary clock.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <code>Router> enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <code>Router# configure terminal</code>	Enter configuration mode.
Step 3	ptp clock ordinary domain <i>domain-number</i> Example: <code>Router(config)# ptp clock ordinary domain 0</code>	Configures the PTP clock. You can create the following clock types: <ul style="list-style-type: none"> • ordinary—A 1588 clock with a single PTP port that can operate in Master or Slave mode.
Step 4	time-properties persist value Example: <code>Router(config-ptp-clk)# time-properties persist 600</code>	(Optional) Starting with Cisco IOS-XE Release 3.18.1SP, you can configure time properties holdover time. Valid values are from 0 to 10000 seconds.

	Command or Action	Purpose
		When a master clock is lost, the time properties holdover timer starts. During this period, the time properties flags (currentUtcOffset, currentUtcOffsetValid, leap61, leap59) persist for the holdover timeout period. Once the holdover timer expires, currentUtcOffsetValid, leap59, and leap61 flags are set to false and the currentUtcOffset remains unchanged. In case leap second midnight occurs when holdover timer is running, utc-offset value is updated based on leap59 or leap61 flags. This value is used as long as there are no PTP packets being received from the selected master. In case the selected master is sending announce packets, the time-properties advertised by master is used.
Step 5	clock-port <i>port-name</i> { master slave } [profile { g8265.1 }] Example: <pre>Router(config-ptp-clk)# clock-port SLAVE slave</pre>	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 6	transport ipv4 unicast interface <i>interface-type interface-number</i> [negotiation] Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation</pre>	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 7	clock-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.133</pre>	Specifies the address of a PTP master clock. You can specify a priority value as follows: <ul style="list-style-type: none"> • 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 or Action	Purpose
Step 8	clock-port <i>port-name</i> { master slave } [profile { g8265.1 }] Example: <pre>Router(config-ptp-port)# clock-port Master master</pre>	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 9	transport ipv4 unicast interface <i>interface-type</i> <i>interface-number</i> [negotiation] Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation</pre>	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 10	end Example: <pre>Router(config-ptp-port)# end</pre>	Exit configuration mode.

Configuring a Transparent Clock

Follow these steps to configure the Cisco ASR 920 Series Router as an end-to-end transparent clock.



Note The Cisco ASR 920 Series Router does not support peer-to-peer transparent clock mode.



Note The transparent clock ignores the domain number.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal</pre>	Enter configuration mode.
Step 3	ptp clock e2e-transparent domain domain-number Example: <pre>Router(config)# ptp clock e2e-transparent domain 0</pre>	Configures the router as an end-to-end transparent clock. <ul style="list-style-type: none"> • e2e-transparent—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the accuracy of 1588 clock at slave.
Step 4	exit Example: <pre>Router(config)# exit</pre>	Exit configuration mode.

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.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal</pre>	Enter configuration mode.

	Command or Action	Purpose
Step 3	<p>ptp clock {ordinary boundary} domain domain-number hybrid</p> <p>Example:</p> <pre>Router(config)# ptp clock ordinary domain 0 hybrid</pre>	<p>Configures the PTP clock. You can create the following clock types:</p> <ul style="list-style-type: none"> • 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.
Step 4	<p>time-properties persist value</p> <p>Example:</p> <pre>Router(config-ptp-clk)# time-properties persist 600</pre>	<p>(Optional) Starting with Cisco IOS-XE Release 3.18.1SP, you can configure time properties holdover time. Valid values are from 0 to 10000 seconds. The default value is 300 seconds.</p> <p>When a master clock is lost, the time properties holdover timer starts. During this period, the time properties flags (currentUtcOffset, currentUtcOffsetValid, leap61, leap59) persist for the holdover timeout period. Once the holdover timer expires, currentUtcOffsetValid, leap59, and leap61 flags are set to false and the currentUtcOffset remains unchanged. In case leap second midnight occurs when holdover timer is running, utc-offset value is updated based on leap59 or leap61 flags. This value is used as long as there are no PTP packets being received from the selected master. In case the selected master is sending announce packets, the time-properties advertised by master is used.</p>
Step 5	<p>utc-offset value leap-second "date time" offset {-1 1}</p> <p>Example:</p> <pre>Router(config-ptp-clk)# utc-offset 45 leap-second "01-01-2017 00:00:00" offset 1</pre>	<p>(Optional) Starting with Cisco IOS-XE Release 3.18SP, the new utc-offset CLI is used to set the UTC offset value.</p> <p>Valid values are from 0-255. The default value is 36.</p> <p>(Optional) Starting with Cisco IOS-XE Release 3.18.1SP, you can configure the current UTC offset, leap second event date and Offset value (+1 or -1). Leap second configuration will work only when the frequency source is locked and ToD was up before.</p> <ul style="list-style-type: none"> • "date time"— Leap second effective date in dd-mm-yyyy hh:mm:ss format.
Step 6	<p>min-clock-class value</p> <p>Example:</p>	<p>Sets the threshold clock-class value. This allows the PTP algorithm to use the time</p>

	Command or Action	Purpose
	<pre>Router(config-ptp-clk)# min-clock-class 157</pre>	<p>stamps from an upstream master clock, only if the clock-class sent by the master clock is less than or equal to the configured threshold clock-class.</p> <p>Valid values are from 0-255.</p> <p>Note Min-clock-class value is supported only for PTP with single master source configuration.</p>
Step 7	<p>clock-port <i>port-name</i> {master slave} [profile {g8265.1}]</p> <p>Example:</p> <pre>Router(config-ptp-clk)# clock-port SLAVE slave</pre>	<p>Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.</p> <p>Note Hybrid mode is only supported with slave clock-ports; master mode is not supported.</p> <p>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.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 8	<p>transport ipv4 unicast interface <i>interface-type interface-number</i> [negotiation] [single-hop]</p> <p>Example:</p> <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation</pre> <p>Example:</p> <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation single-hop</pre>	<p>Specifies the transport mechanism for clocking traffic.</p> <ul style="list-style-type: none"> • negotiation—(Optional) configures the router to discover a PTP master clock from all available PTP clock sources. <p>Note PTP redundancy is supported only on unicast negotiation mode.</p> <p>Note single-hop—(Optional) Must be configured, if Hop-by-Hop PTP ring topology is used. It ensures that the PTP node communicates only with the adjacent nodes.</p>
Step 9	<p>clock-source <i>source-address</i> [<i>priority</i>]</p> <p>Example:</p> <pre>Router(config-ptp-port)# clock source 133.133.133.133</pre>	<p>Specifies the address of a PTP master clock. You can specify a priority value as follows:</p> <ul style="list-style-type: none"> • 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 or Action	Purpose
Step 10	clock-port <i>port-name</i> { master slave } [profile { g8265.1 }] Example: <pre>Router(config-ptp-port)# clock-port MASTER master</pre>	<p>Sets the clock port to PTP master or slave mode; in master mode, the port exchanges timing packets with PTP slave devices.</p> <p>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.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 11	transport ipv4 unicast interface <i>interface-type interface-number</i> [negotiation] [single-hop] Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Lol negotiation</pre> Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Lol negotiation single-hop</pre>	<p>Specifies the transport mechanism for clocking traffic.</p> <ul style="list-style-type: none"> • negotiation—(Optional) configures the router to discover a PTP master clock from all available PTP clock sources. <p>Note PTP redundancy is supported only on unicast negotiation mode.</p> <ul style="list-style-type: none"> • single-hop—(Optional) Must be configured, if Hop-by-Hop PTP ring topology is used. It ensures that the PTP node communicates only with the adjacent nodes.
Step 12	exit	Exits clock-port configuration.
Step 13	network-clock synchronization automatic Example: <pre>Router(config)# network-clock synchronization automatic</pre>	<p>Enables automatic selection of a clock source.</p> <p>Note This command is mandatory to configure the leap second command.</p> <p>Note This command must be configured before any input source.</p>
Step 14	network-clock synchronization mode ql-enabled Example: <pre>Router(config)# network-clock synchronization mode ql-enabled</pre>	<p>Enables automatic selection of a clock source based on quality level (QL).</p> <p>Note This command is disabled by default.</p>
Step 15	<p>Use one of the following options:</p> <ul style="list-style-type: none"> • network-clock input-source <priority> controller {SONET wanphy} • network-clock input-source <priority> external {R0 R1} [10m 2m] 	<ul style="list-style-type: none"> • (Optional) To nominate SDH or SONET controller as network clock input source. • (Optional) To nominate 10Mhz port as network clock input source.

	Command or Action	Purpose
	<ul style="list-style-type: none"> • <code>network-clock input-source <priority> external {R0 R1} [2048k e1 {cas {120ohms 75ohms crc4}}]</code> • <code>network-clock input-source <priority> external {R0 R1} [2048k e1 {crc4 fas} {120ohms 75ohms} {linecode {ami hdb3}}]</code> • <code>network-clock input-source <priority> external {R0 R1} [t1 {d4 esf sf} {linecode {ami b8zs}}]</code> • <code>network-clock input-source <priority> interface <type/slot/port></code> <p>Example:</p> <pre>Router(config)# network-clock input-source 1 external R0 10m</pre>	<ul style="list-style-type: none"> • (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 16	<p><code>network-clock synchronization input-threshold ql value</code></p> <p>Example:</p> <pre>Router(config)# network-clock synchronization input-threshold ql value</pre>	(Optional) Starting with Cisco IOS-XE Release 3.18SP, this new CLI is used to set the threshold QL value for the input frequency source. The input frequency source, which is better than or equal to the configured threshold QL value, will be selected to recover the frequency. Otherwise, internal clock is selected.
Step 17	<p><code>network-clock hold-off {0 milliseconds}</code></p> <p>Example:</p> <pre>Router(config)# network-clock hold-off 0</pre>	<p>(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.</p> <p>Note You can also specify a hold-off value for an individual interface using the network-clock hold-off command in interface mode.</p>
Step 18	<p><code>end</code></p> <p>Example:</p> <pre>Router(config)# end</pre>	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.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal</pre>	Enter configuration mode.
Step 3	ptp clock {ordinary boundary} domain domain-number hybrid Example: <pre>Router(config)# ptp clock ordinary domain 0 hybrid</pre>	Configures the PTP clock. You can create the following clock types: <ul style="list-style-type: none"> • 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.
Step 4	output [1pps] {R0 R1} [offset <i>offset-value</i>] [pulse-width <i>value</i>] Example: <pre>Router(config-ptp-clk)# output 1pps R0 offset 200 pulse-width 20 usec</pre>	Enables Precision Time Protocol input 1PPS using a 1PPS input port. Use R0 or R1 to specify the active RSP slot. Note Effective Cisco IOS XE Everest 16.6.1, on the Cisco ASR-920-12SZ-IM router, the 1pps pulse bandwidth can be changed from the default value of 500 milliseconds to up to 20 microsecond.
Step 5	tod {R0 R1} {ubx nmea cisco ntp} Example: <pre>Router(config-ptp-clk)# tod R0 ntp</pre>	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 <i>port-name</i> {master slave} [profile {g8265.1}] Example: <pre>Router(config-ptp-clk)# clock-port SLAVE slave</pre>	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

	Command or Action	Purpose
		<p>establishing PTP sessions, determining the best master clock, handling SSM, and mapping PTP classes.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 7	<p>transport ipv4 unicast interface <i>interface-type interface-number [negotiation]</i></p> <p>Example:</p> <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation</pre>	<p>Specifies the transport mechanism for clocking traffic.</p> <p>The negotiation keyword configures the router to discover a PTP master clock from all available PTP clock sources.</p> <p>Note PTP redundancy is supported only on unicast negotiation mode.</p>
Step 8	<p>clock-source <i>source-address [priority]</i></p> <p>Example:</p> <pre>Router(config-ptp-port)# clock source 133.133.133.133</pre>	<p>Specifies the address of a PTP master clock. You can specify a priority value as follows:</p> <ul style="list-style-type: none"> • 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	<p>exit</p> <p>Example:</p> <pre>Router(config-ptp-port)# exit</pre>	Exit clock-port configuration.
Step 10	<p>Use one of the following options:</p> <ul style="list-style-type: none"> • 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> <p>Example:</p>	<ul style="list-style-type: none"> • (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 or Action	Purpose
	Router(config)# network-clock input-source 1 external R0 10m	
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.
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.
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 920 Series Router:

Configuring PTP Redundancy in Slave Clock Mode

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

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enter configuration mode.
Step 3	ptp clock {ordinary boundary} domain domain-number [hybrid]	Configures the PTP clock. You can create the following clock types:

	Command or Action	Purpose
	Example: <pre>Router(config)# ptp clock ordinary domain 0</pre>	<ul style="list-style-type: none"> • 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.
Step 4	ptp clock e2e-transparent domain domain-number Example: <pre>Router(config)# ptp clock e2e-transparent domain 0</pre>	Configures the PTP clock. <ul style="list-style-type: none"> • e2e-transparent—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the accuracy of 1588 clock at slave.
Step 5	clock-port port-name {master slave} [profile {g8265.1}] Example: <pre>Router(config-ptp-clk)# clock-port SLAVE slave</pre>	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 6	transport ipv4 unicast interface interface-type interface-number [negotiation] [single-hop] Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation</pre> Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation single-hop</pre>	Specifies the transport mechanism for clocking traffic. <ul style="list-style-type: none"> • negotiation—(Optional) 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. <ul style="list-style-type: none"> • single-hop—(Optional) It ensures that the PTP node communicates only with the adjacent nodes.
Step 7	clock-source source-address [priority] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.133 1</pre>	Specifies the address of a PTP master clock. You can specify a priority value as follows: <ul style="list-style-type: none"> • 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 or Action	Purpose
Step 8	clock-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.134 2</pre>	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-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.135</pre>	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 10	end Example: <pre>Router(config-ptp-port)# end</pre>	Exit configuration mode.

Configuring PTP Redundancy in Boundary Clock Mode

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

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	Router# configure terminal	Enter configuration mode.
Step 3	ptp clock {ordinary boundary} domain <i>domain-number</i> [hybrid] Example: <pre>Router(config)# ptp clock ordinary domain 0</pre>	Configures the PTP clock. You can create the following clock types: <ul style="list-style-type: none"> 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.
Step 4	ptp clock e2e-transparent domain <i>domain-number</i> Example: <pre>Router(config)# ptp clock e2e-transparent domain 0</pre>	Configures the PTP clock. <ul style="list-style-type: none"> e2e-transparent—Updates the PTP time correction field to account for the delay in forwarding the traffic. This helps improve the accuracy of 1588 clock at slave.

	Command or Action	Purpose
Step 5	clock-port <i>port-name</i> { master slave } [profile { g8265.1 }] Example: <pre>Router(config-ptp-clk)# clock-port SLAVE slave</pre>	<p>Sets the clock port to PTP master or slave mode; in slave mode, the port exchanges timing packets with a PTP master clock.</p> <p>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.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 6	transport ipv4 unicast interface <i>interface-type interface-number</i> [negotiation] [single-hop] Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation</pre> Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 0 negotiation single-hop</pre>	<p>Specifies the transport mechanism for clocking traffic.</p> <ul style="list-style-type: none"> • negotiation—(Optional) Configures the router to discover a PTP master clock from all available PTP clock sources. <p>Note PTP redundancy is supported only on unicast negotiation mode.</p> <ul style="list-style-type: none"> • single-hop—(Optional) Must be configured, if Hop-by-Hop PTP ring topology is used. It ensures that the PTP node communicates only with the adjacent nodes.
Step 7	clock-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.133 1</pre>	<p>Specifies the address of a PTP master clock. You can specify a priority value as follows:</p> <ul style="list-style-type: none"> • 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 8	clock-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.134 2</pre>	<p>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.</p>
Step 9	clock-source <i>source-address</i> [<i>priority</i>] Example: <pre>Router(config-ptp-port)# clock source 133.133.133.135</pre>	<p>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.</p>
Step 10	clock-port <i>port-name</i> { master slave } [profile { g8265.1 }] 	<p>Specifies the address of a PTP master clock.</p>

	Command or Action	Purpose
	Example: <pre>Router(config-ptp-port)# clock-port MASTER master</pre>	<p>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.</p> <p>Note Using a telecom profile requires that the clock have a domain number of 4–23.</p>
Step 11	transport ipv4 unicast interface <i>interface-type interface-number [negotiation]/[single-hop]</i> Example: <pre>Router(config-ptp-port)# transport ipv4 unicast interface Loopback 1 negotiation single-hop</pre>	<p>Specifies the transport mechanism for clocking traffic.</p> <ul style="list-style-type: none"> • negotiation—(Optional) Configures the router to discover a PTP master clock from all available PTP clock sources. <p>Note PTP redundancy is supported only on unicast negotiation mode.</p> <ul style="list-style-type: none"> • single-hop—(Optional) Must be configured if Hop-by-Hop PTP ring topology is used. It ensures that the PTP node communicates only with the adjacent nodes
Step 12	end Example: <pre>Router(config-ptp-port)# end</pre>	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)



Note System time to a ToD source (Master Mode) can be configured only when PTP master is configured. See [Configuring a Master Ordinary Clock, on page 14](#). 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.

Procedure

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: Router> enable	<ul style="list-style-type: none"> 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, on page 19](#).

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.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> 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:	In slave mode, specify a PTP domain as a ToD input source.

	Command or Action	Purpose
	Router(config)# TOD-clock 10 ptp domain 0	
Step 4	Router(config)# end	Exit configuration mode.

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.

Configuring Synchronous Ethernet ESMC and SSM

Follow these steps to configure ESMC and SSM on the Cisco ASR 920 Series Router:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none">• 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. Note This command must be configured before any input source.
Step 4	network-clock eec {1 2} Example: Router(config)# network-clock eec 1	Specifies the Ethernet Equipment Clock (EEC) type. Valid values are <ul style="list-style-type: none">• 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:	Configures the G.781 synchronization option used to send synchronization messages. The following guidelines apply for this command:

	Command or Action	Purpose
	<pre>Router(config)# network-clock synchronization ssm option 2 GEN2</pre>	<ul style="list-style-type: none"> • 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	<p>Use one of the following options:</p> <ul style="list-style-type: none"> • 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> <p>Example:</p> <pre>Router(config)# network-clock input-source 1 external R0 10m</pre>	<ul style="list-style-type: none"> • (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	<p>network-clock synchronization mode ql-enabled</p> <p>Example:</p> <pre>Router(config)# network-clock synchronization mode ql-enabled</pre>	<p>Enables automatic selection of a clock source based on quality level (QL).</p> <p>Note This command is disabled by default.</p>
Step 8	<p>network-clock hold-off {0 milliseconds}</p> <p>Example:</p> <pre>Router(config)# network-clock hold-off 0</pre>	<p>(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.</p>

	Command or Action	Purpose
		<p>Note You can also specify a hold-off value for an individual interface using the network-clock hold-off command in interface mode.</p>
Step 9	<p>network-clock wait-to-restore <i>seconds</i></p> <p>Example:</p> <pre>Router(config)# network-clock wait-to-restore 70</pre>	<p>(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.</p> <p>Valid values are 0 to 86400 seconds. The default value is 300 seconds.</p> <p>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.</p>
Step 10	<p>network-clock revertive</p> <p>Example:</p> <pre>Router(config)# network-clock revertive</pre>	<p>(Optional) Sets the router in revertive switching mode when recovering from a failure. To disable revertive mode, use the no form of this command.</p>
Step 11	<p>esmc process</p> <p>Example:</p> <pre>Router(config)# esmc process</pre>	<p>Enables the ESMC process globally.</p>
Step 12	<p>network-clock external <i>slot/card/port</i> hold-off {0 <i>milliseconds</i>}</p> <p>Example:</p> <pre>Router(config)# network-clock external 0/1/0 hold-off 0</pre>	<p>Overrides the hold-off timer value for the external interface.</p>
Step 13	<p>network-clock quality-level {<i>tx</i> <i>rx</i>} <i>value</i> {<i>controller</i> [E1] BITS} <i>slot/card/port</i> external [2m 10m 2048k t1 e1] }</p> <p>Example:</p> <pre>Router(config)# network-clock quality-level rx qL-PRC external R0 e1 cas crc4</pre>	<p>Specifies a quality level for a line or external clock source.</p> <p>The available quality values depend on the G.781 synchronization settings specified by the network-clock synchronization ssm option command:</p> <ul style="list-style-type: none"> • 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.

	Command or Action	Purpose
		<ul style="list-style-type: none"> 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 14	interface <i>type number</i> Example: <pre>Router(config)# interface GigabitEthernet 0/0/1</pre> Example: <pre>Router(config-if)#</pre>	Enters interface configuration mode.
Step 15	synchronous mode Example: <pre>Router(config-if)# synchronous mode</pre>	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 <i>value {tx rx}</i> Example: <pre>Router(config-if)# network-clock source quality-level QL-PrC tx</pre>	<p>Applies quality level on sync E interface.</p> <p>The available quality values depend on the G.781 synchronization settings specified by the network-clock synchronization ssm option command:</p> <ul style="list-style-type: none"> 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] <i>value</i> Example: <pre>Router(config-if)# esmc mode rx QL-STU</pre>	Enables the ESMC process at the interface level. The no form of the command disables the ESMC process.
Step 18	network-clock hold-off { <i>0</i> <i>milliseconds</i> } Example: <pre>Router(config-if)# network-clock hold-off 0</pre>	(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.

	Command or Action	Purpose
		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 <i>seconds</i> Example: <pre>Router(config-if)# network-clock wait-to-restore 70</pre>	(Optional) Configures the wait-to-restore timer for an individual synchronous Ethernet interface.
Step 20	end Example: <pre>Router(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

What to do next

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

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}}} <pre>Router# network-clock switch manual external r0 e1 crc4</pre>	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]} <pre>Router# network-clock clear switch t0</pre>	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}} } 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]} 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]} 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

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
<pre>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]}}</pre> <p>Router# network-clock set lockout interface GigabitEthernet 0/0/0</p>	Prevents the router from selecting a specific synchronous Ethernet clock source.
<pre>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] }</pre> <p>Router# network-clock clear lockout interface GigabitEthernet 0/0/0</p>	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
<pre>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] }</pre> <p>Router# network-clock clear lockout interface GigabitEthernet 0/0/0</p>	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

The below table list the debug commands that are available for troubleshooting the SyncE configuration on the Cisco ASR 920 Series Router:



Caution

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

Table 7: 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 <i>interface-name</i>] debug esmc packet rx [interface <i>interface-name</i>] debug esmc packet tx [interface <i>interface-name</i>]	These commands verify whether the ESMC packets are transmitted and received with proper quality-level values.

The below table provides the information about troubleshooting your configuration

Table 8: Troubleshooting Scenarios

Problem	Solution
Clock selection	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

Problem	Solution
Incorrect clock limit set or queue limit disabled mode	<ul style="list-style-type: none"> • Verify that there are no alarms on the interfaces using the <code>show network-clock synchronization detail</code> command. • Use the <code>show network-clock synchronization</code> 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 <code>debug network-clock errors</code>, <code>debug network-clock event</code>, and <code>debug network-clock sm RSP</code> commands.
Incorrect QL values when you use the <code>show network-clock synchronization detail</code> command.	<ul style="list-style-type: none"> • Use the <code>network clock synchronization SSM</code> (<i>option 1</i> <i>option 2</i>) command to confirm that there is no framing mismatch. Use the <code>show run interface</code> 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 <code>debug network-clock errors</code> and <code>debug network-clock event RSP</code> commands.

Configuration Examples

This section contains sample configurations for clocking features on the Cisco ASR 920 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 5 2
```

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

```
network-clock synchronization automatic
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

```
network-clock synchronization automatic
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 Lol negotiation
```

Hop-By-Hop PTP Redundancy—Slave

```
ptp clock ordinary domain 0
clock-port SLAVE slave
transport ipv4 unicast interface Loopback 0 negotiation single-hop
clock source 133.133.133.133 1
clock source 55.55.55.55 2
clock source 5.5.5.5
```

Hop-By-Hop PTP Redundancy—Boundary

```
ptp clock boundary domain 0
clock-port SLAVE slave
transport ipv4 unicast interface Loopback 0 negotiation single-hop
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 Lol negotiation single-hop
```

Time of Day Source—Master

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

Time of Day Source—Slave

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

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 lpps R0 offset 200 pulse-width 20 usec
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         Transport State      Sessions Port Addr

SLAVE
  9.9.9.1       unicast    slave        Ethernet              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
```

