



## IEEE 1588v2 PTP Support

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IEEE 1588v2 Precision Time Protocol (PTP) is a packet-based two-way message exchange protocol for synchronizing clocks between nodes in a network, thereby enabling an accurate time distribution over a network. This document explains how to configure IEEE 1588v2 PTP on the Cisco ASR 1002-X Routers.

- [Restrictions for IEEE 1588v2 PTP, on page 1](#)
- [Information About IEEE 1588v2 PTP, on page 1](#)
- [Configuring IEEE 1588v2 PTP, on page 9](#)
- [Additional References, on page 20](#)
- [Feature Information for IEEE 1588v2 PTP Support, on page 20](#)

### Restrictions for IEEE 1588v2 PTP

These are the restrictions for configuring IEEE 1588v2 PTP:

- Supports IPv4 unicast mode, but not multicast mode.
- Does not support Dot1q, Q-in-Q, and port-channel interfaces.
- PTP master supports only a maximum of 32 PTP slaves.
- PTP boundary clock is supported only in unicast negotiation mode.
- IPv6 and Multiprotocol Label Switching (MPLS) encapsulation are not supported for PTP packet transfer over Cisco ASR 1002-X Routers.
- The time-of-day recovered from a 1588v2 session does not synchronize with the system clock.
- GPS interfaces can be used only for clock recovery. You cannot transmit the system clock on the GPS interface.

### Information About IEEE 1588v2 PTP

IEEE 1588v2 PTP is a packet-based two-way message exchange protocol for synchronizing a local clock with a primary reference clock or a grand master clock in hierarchical master-slave architecture. This synchronization is achieved through packets that are transmitted and received in a session between a master clock and a slave clock. IEEE 1588v2 PTP supports system-wide synchronization accuracy in the sub-microsecond range with little use of network and local clock-computing resources.

The following sections describe the terminologies used for better understanding of the IEEE 1588v2 PTP.

## PTP Clocks

PTP employs a hierarchy of clock types to ensure that precise timing and synchronization is maintained between the source and the numerous PTP clients that are distributed throughout the network. A logical grouping of PTP clocks that synchronize with each other using the PTP protocol, but are not necessarily synchronized to the PTP clocks in another domain, is called a PTP domain.

The three PTP clock types are Ordinary clock, Boundary clock, and Transparent clock.

- **Ordinary clock**—This clock type has a single PTP port in a domain, and maintains the timescale used in the domain. It may serve as a source of time, that is, be a master, or may synchronize to another clock by being a slave. It provides time to an application or to an end device.
- **Boundary clock**—This clock type has multiple PTP ports in a domain, and maintains the timescale used in the domain. It may serve as a source of time, that is, be a master, or may synchronize to another clock by being a slave. A boundary clock that is a slave has a single slave port, and transfers timing from that port to the master ports.
- **Transparent clock**—This clock type is a device that measures the time taken for a PTP event message to pass through the device, and provides this information to the clocks receiving this PTP event message.

{start cross reference} Table 13-1 {end cross reference} shows the 1588v2 PTP support matrix on a Cisco ASR1000 platform.

*Table 1: 1588v2 PTP Support Matrix on a Cisco ASR1000 platform*

Platform/PTP Clock mode	Ordinary Clock	Boundary Clock	Transparent Clock	Hybrid Clock
ASR1002X	Yes	Yes	No	No

## Components of a PTP-enabled Network

The three key components of a PTP-enabled data network are grand master, PTP client, and PTP-enabled router acting as a Boundary clock.

- **Grand Master**—An IEEE1588v2 PTP network needs a grand master to provide a precise time source. The most economical way of obtaining the precise time source for the grand master is through a Global Positioning System (GPS) because it provides +/- 100 nanosecond (ns) accuracy. First, the PTP grand master's built-in GPS receiver converts the GPS timing information to PTP time information, which is typically Coordinated Universal Time (UTC), and then delivers the UTC time to all the PTP clients.
- **PTP client**—A PTP client has to be installed on servers, network-monitoring and performance-analysis devices, or other devices that want to use the precise timing information provided by PTP, and it's mostly an ordinary clock. The two kinds of PTP clients are pure software PTP clients and hardware-assistant PTP clients.
- **PTP boundary clock**—Any router that is between a PTP master and PTP slave can act as a PTP boundary clock router. It has two interfaces, one facing the PTP master and another facing the PTP slave. The boundary clock router acts as a *slave* on the interface facing the *PTP master router*, and acts as a *master* on the interface facing the *PTP slave router*. The PTP boundary clock router is deployed to minimize timing delay in cases where the distance between PTP master router and the PTP slave router is more.



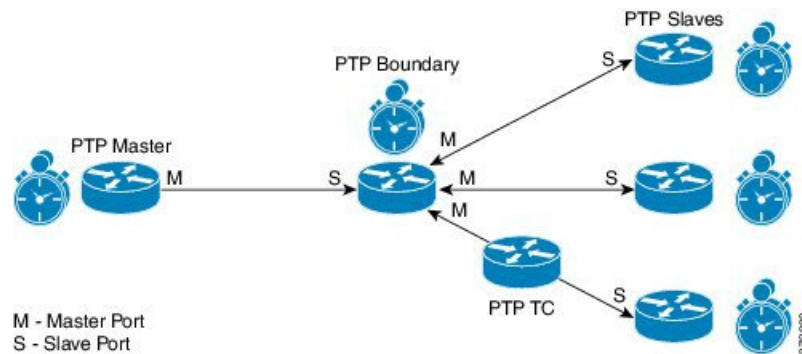

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**Note** Intermediary nodes between PTP master and slave should be a PTP-enabled or transparent clock node.

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The following figure shows the functions of a PTP Enabled device.

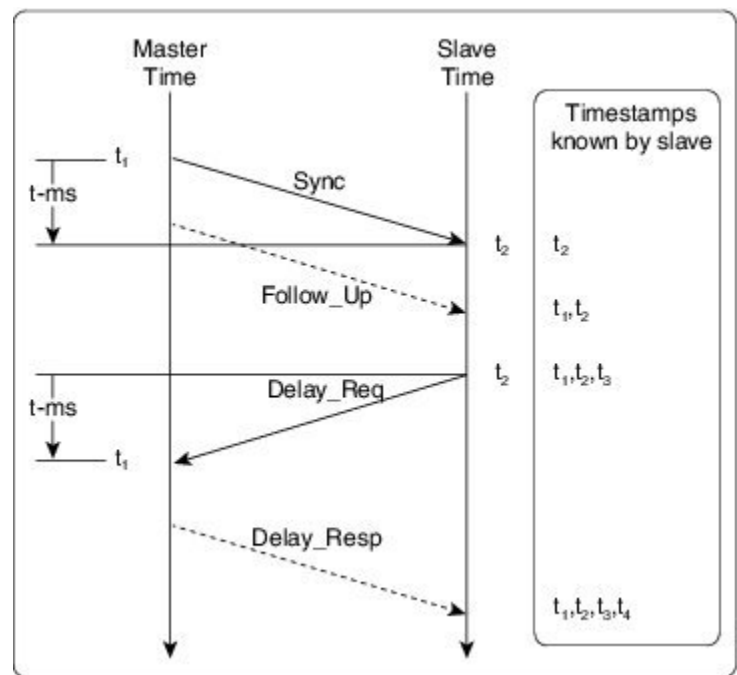
**Figure 1: 372860.eps Functions of a PTP-Enabled Device**



## Clock-Synchronization Process

Clock synchronization is achieved through a series of messages exchanged between the master clock and the slave clock as shown in the figure.

**Figure 2: Clock-Synchronization Process**



After the master-slave clock hierarchy is established, the clock synchronization process starts. The message exchange occurs in this sequence:

1. The master clock sends a Sync message. The time at which the Sync message leaves the master is time-stamped as  $t_{1}$ .
2. The slave clock receives the Sync message and is time-stamped as  $t_{2}$ .
3. The slave sends the Delay\_Req message, which is time-stamped as  $t_{3}$  when it leaves the slave, and as  $t_{4}$  when the master receives it.

4. The master responds with a Delay\_Resp message that contains the time stamp  $t_{4\{end\ subscript\}}$ .

The clock offset is the difference between the master clock and the slave clock, and is calculated as follows:

$$\text{Offset} = t_{2\{end\ subscript\}} - t_{1\{end\ subscript\}} - \text{meanPathDelay}$$

IEEE1588 assumes that the path delay between the master clock and the slave clock is symmetrical, and hence, the mean path delay is calculated as follows:

$$\text{meanPathDelay} = ((t_{2\{end\ subscript\}} - t_{1\{end\ subscript\}}) + (t_{4\{end\ subscript\}} - t_{3\{end\ subscript\}}))/2$$

## PTP Messages

All PTP communication is performed through message exchange. The two sets of messages defined by IEEE1588v2 are General messages and Event messages.

- **General messages**—These messages do not require accurate time stamps, and are classified as Announce, Follow\_Up, Delay\_Resp, Pdelay\_Resp\_Follow\_Up, Management, and Signaling.
- **Event messages**—These messages require accurate time stamping, and are classified as Sync, Delay\_Req, Pdelay\_Req, and Pdelay\_Resp.

## PTP Clocking Modes

The following are the PTP clocking modes supported on a Cisco ASR 1002-X Router:

- **Unicast Mode**—In unicast mode, the master sends the Sync or Delay\_Resp messages to the slave on the unicast IP address of the slave, and the slave in turn sends the Delay\_Req message to the master on the unicast IP address of the master.
- **Unicast Negotiation Mode**—In unicast negotiation mode, the master does not know of any slave until the slave sends a negotiation message to the master. The unicast negotiation mode is good for scalability purpose because one master can have multiple slaves.

## PTP Accuracy

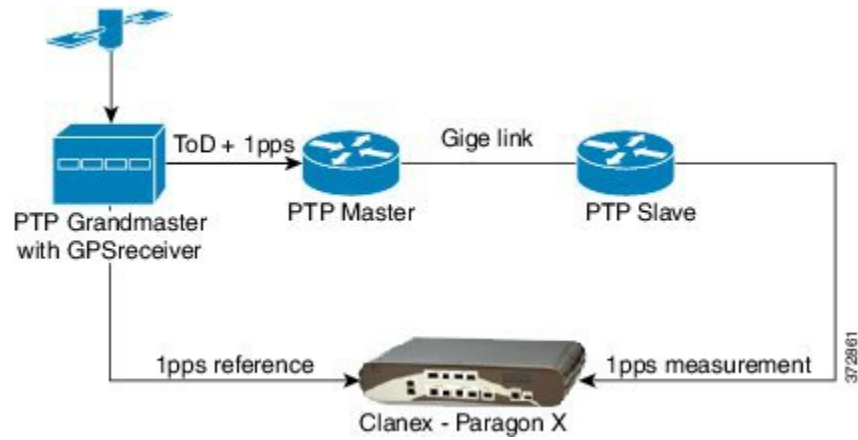
Accuracy is an important aspect of PTP implementation on an Ethernet port. For a packet network, Packet Delay Variation (PDV) is one of the key factors that impacts the accuracy of a PTP clock. The Cisco ASR 1002-X Router can handle the PDV of the network with its advanced hardware and software capabilities, such as hardware stamping and special high-priority queue for PTP packets. It can provide around 300 ns accuracy in a scalable deployment scenario.

The two methods used on the same topology to cross-check and verify the results are:

- One-pulse-per-second (1PPS) to verify the PTP slave.
- Maximum Time Interval Error (MTIE) and Time Deviation (TDEV) to verify the PDV.

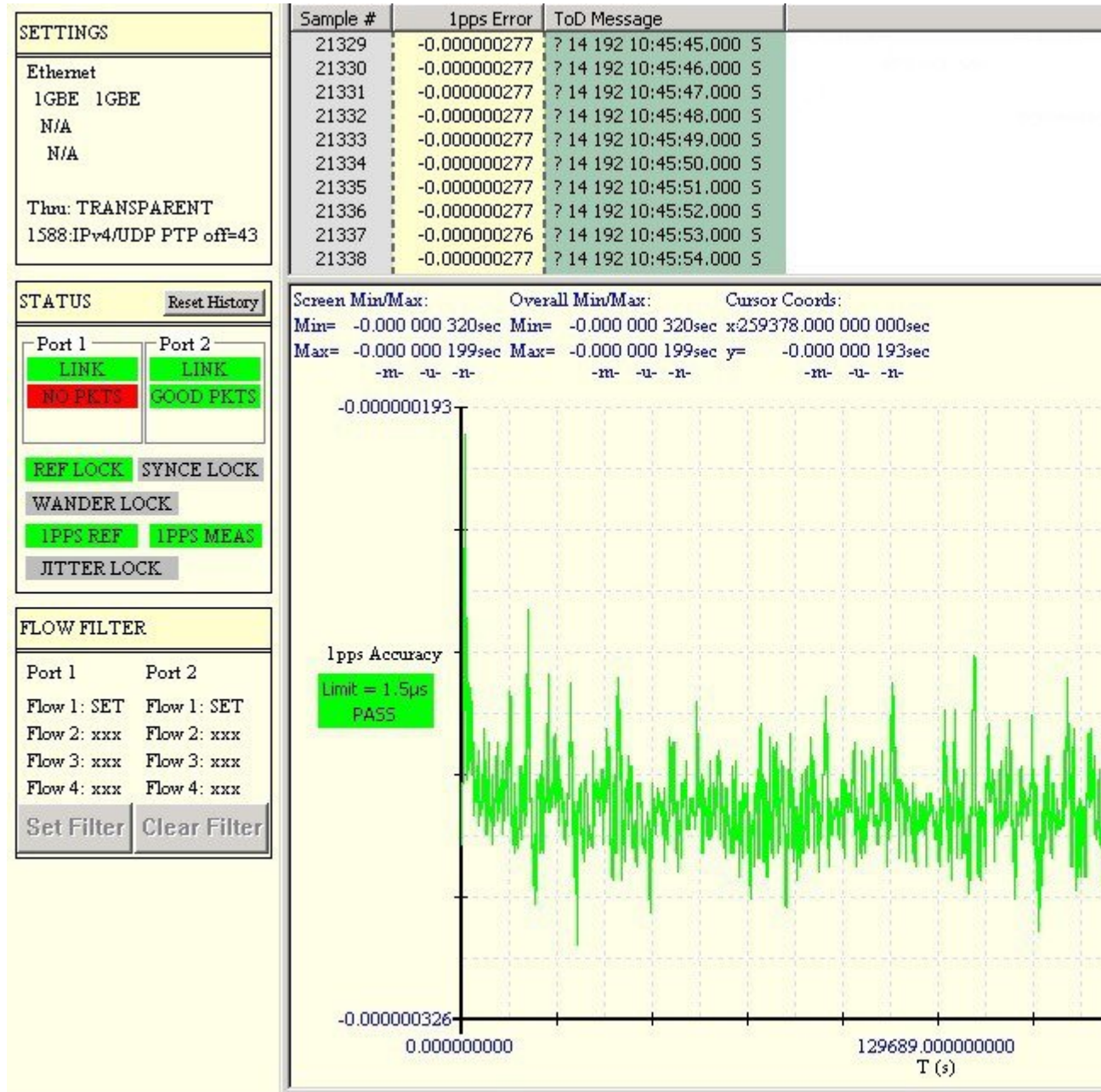
The verification topology includes a grand master with a GPS receiver, a Cisco ASR 1002-X Router, PTP hardware slave clocks with 1PPS output, and a test equipment for the measurement.

**Figure 3: 1PPS Accuracy Measurement**



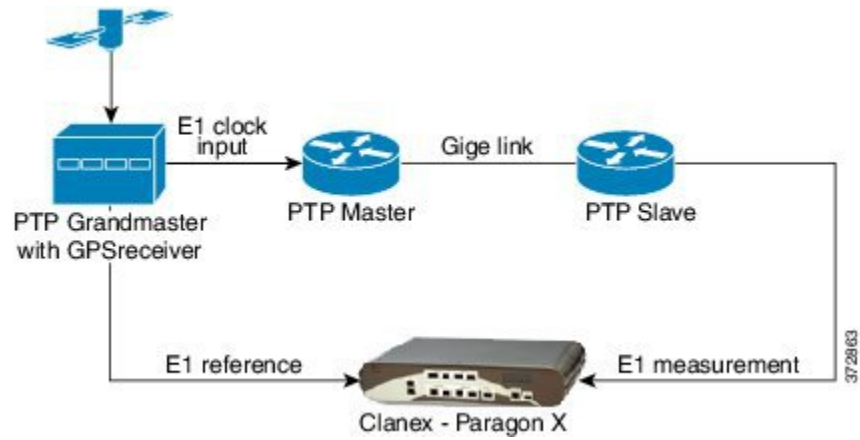
The following figure shows the PPS accuracy, with time of day measured using the test equipment as per the topology shown in the following figure. The average PPS accuracy value found is 250 ns.

Figure 4: Graph Showing PPS Accuracy



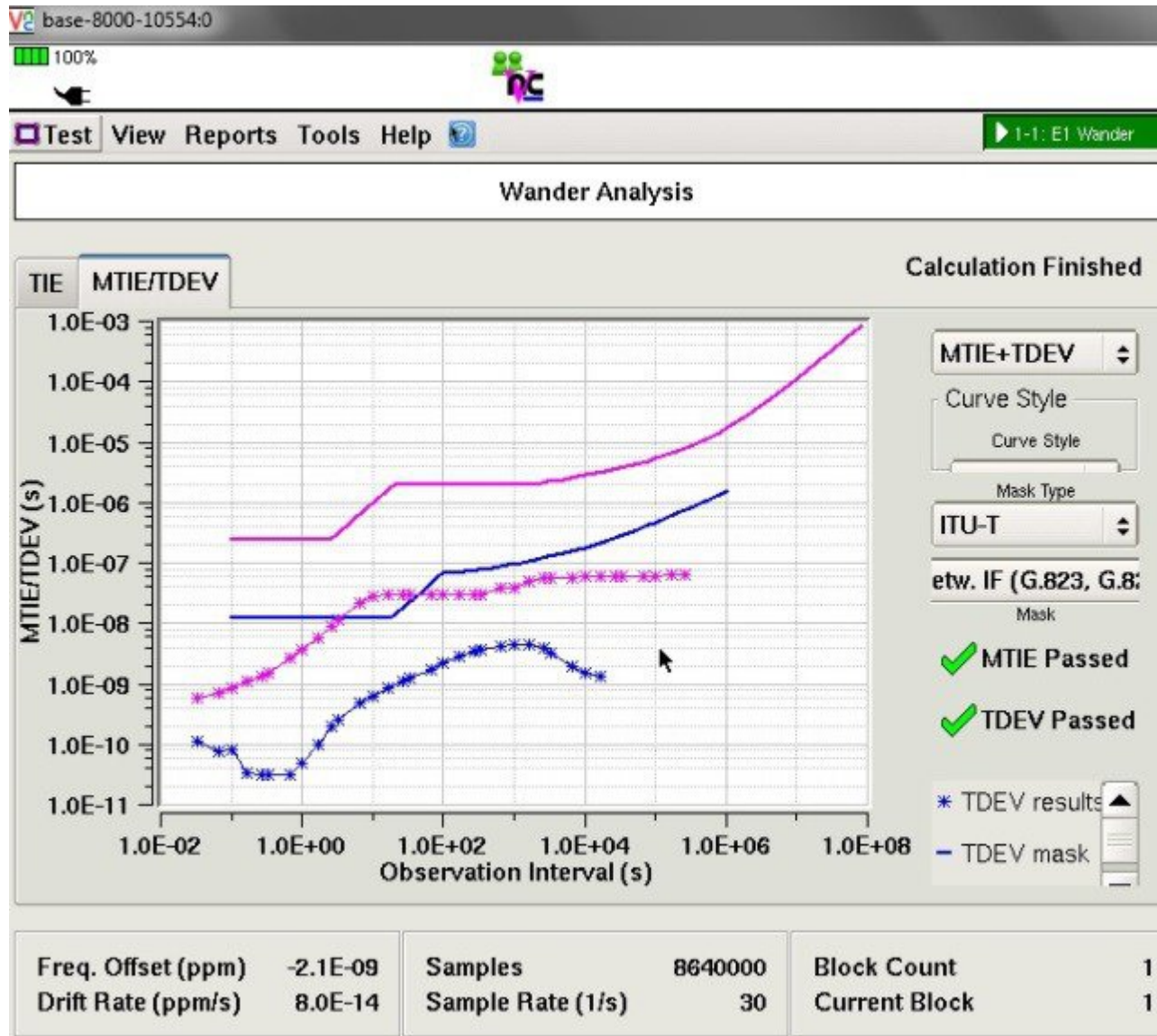
{start cross reference}Figure 13-5{end cross reference} shows a topology that includes a grand master with a GPS receiver, a Cisco ASR 1002-X Router, PTP hardware slave clocks, and a test equipment for the MTIE and TDEV measurement.

Figure 5: MTIE and TDEV measurement



{start cross reference}Figure 13-6{end cross reference} shows a graph with the MTIE and TDEV measurements to verify the PDV.

Figure 6: Graph to show MTIE and TDEV Measurement



## IEEE 1588v2 PTP Support

IEEE 1588v2 PTP supports these features on a Cisco ASR1002-X Router:

- Two-step Ordinary clock and Boundary clock.
- Hardware-assistant PTP implementation to provide sub-300 ns accuracy.
- PTP operation on all physical onboard Gigabit Ethernet interfaces.
- Supports built-in Gigabit Ethernet links in two-step clock mode.



# Configuring IEEE 1588v2 PTP

You can configure IEEE 1588v2 PTP features on the Cisco ASR 1002-X Router by performing the following procedures:

## Configuring Input or Output Network Clocking

We recommend that you configure a stable input clock source from a GPS device before configuring PTP master. The GPS device acts as a PTP grand master, and the BITS or 10-MHz port of a Cisco ASR 1002-X Router can be used to input or output the network clock. Perform these tasks to configure network clocking on a Cisco ASR 1002-X Router:

## Configuring an Ordinary Clock

You can configure a Cisco ASR 1002-X Router in Ordinary clock mode as either master or slave.

*Figure 7: Ordinary Clock Scenario with a GPS Device as Grand Master*



Perform these tasks to configure an ordinary clock as either master or slave:

## Configuring an Ordinary Clock as PTP Master

This section describes how to configure an ordinary clock as PTP master.

### SUMMARY STEPS

1. **configure terminal**
2. **ptp clock ordinary domain *domain\_number***
3. **clock-port *name* master**
4. **transport ipv4 unicast interface {GigabitEthernet | Loopback} *interface-number* [negotiation]**
5. **clock destination *ip-address***
6. **sync interval *interval***
7. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>ptp clock ordinary domain</b> <i>domain_number</i> <b>Example:</b>  Router(config)# <b>ptp clock ordinary domain 0</b>	Creates a PTP clock and specifies the clock mode.
<b>Step 3</b>	<b>clock-port</b> <i>name</i> <b>master</b> <b>Example:</b>  Router(config-ptp-clk)# <b>clock-port MASTER master</b>	Specifies the clocking mode of a PTP port and enters the clock port configuration mode.
<b>Step 4</b>	<b>transport ipv4 unicast interface</b> {GigabitEthernet   Loopback} <i>interface-number</i> [ <b>negotiation</b> ] <b>Example:</b>  Router(config-ptp-port)# <b>transport ipv4 unicast interface Loopback11 negotiation</b>	Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets.  The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchange negotiation messages before establishing a relationship. <b>Note</b> Only Loopback interface type is supported.
<b>Step 5</b>	<b>clock destination</b> <i>ip-address</i> <b>Example:</b>  Router(config-ptp-port)# <b>clock destination 20.20.20.20</b>	Specifies the IP address of a PTP clock destination.  If the clock port is set to master mode with unicast negotiation, you need not use this command because the device uses negotiation to determine the IP address of PTP slave devices.
<b>Step 6</b>	<b>sync interval</b> <i>interval</i> <b>Example:</b>  Router(config-ptp-port)# <b>sync interval -4</b>	(Optional) Specifies the interval used to send PTP synchronization messages.  The default value is -5.
<b>Step 7</b>	<b>end</b> <b>Example:</b>  <b>Example:</b>  Router(config-ptp-port)# <b>end</b>	Exits global configuration mode.

## Examples

The following example shows how to configure an ordinary clock as PTP master:

```
Router# configure terminal
Router(config)# ptp clock ordinary domain 0
Router(config-ptp-clk)# clock-port MASTER master
Router(config-ptp-port)# transport ipv4 unicast interface
Loopback11
negotiation
Router(config-ptp-port)# clock destination
20.20.20.20
```

```
Router(config-ptp-port)# Sync interval
-4
Router(config-ptp-port)# end
```

## Configuring an Ordinary Clock as PTP Slave

This section describes how to configure Ordinary Clock as PTP slave.

### SUMMARY STEPS

1. **configure terminal**
2. **ptp clock ordinary domain domain\_number**
3. **clock-port name slave**
4. **transport ipv4 unicast interface {GigabitEthernet | Loopback} interface-number [negotiation]**
5. **clock source ip-address**
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>ptp clock ordinary domain domain_number</b> <b>Example:</b> Router(config)# <b>ptp clock ordinary domain 0</b>	Creates a PTP clock and specifies the clock mode.
<b>Step 3</b>	<b>clock-port name slave</b> <b>Example:</b> Router(config-ptp-clk)# <b>clock-port SLAVE slave</b>	Specifies the clocking mode of a PTP port and enters the clock port configuration mode.
<b>Step 4</b>	<b>transport ipv4 unicast interface {GigabitEthernet   Loopback} interface-number [negotiation]</b> <b>Example:</b> Router(config-ptp-port)# <b>transport ipv4 unicast interface Loopback22 negotiation</b>	Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets.  The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchanges negotiation messages before establishing a relationship. <b>Note</b> Only Loopback interface type is supported.
<b>Step 5</b>	<b>clock source ip-address</b> <b>Example:</b> Router(config-ptp-port)# <b>clock source 10.10.10.10</b>	Specifies the source IP address of a PTP master clock. <b>Note</b> You can specify only 1 master clock IP address. Priority-based clock source selection is not supported.

	Command or Action	Purpose
Step 6	<b>end</b> <b>Example:</b> Router(config-ptp-port) # <b>end</b>	Exits global configuration mode.

## Examples

The following example shows how to configure an ordinary clock as PTP slave:

```
Router# configure terminal
Router(config)# ptp clock ordinary domain 0
Router(config-ptp-clk)# clock-port SLAVE master
Router(config-ptp-port)# transport ipv4 unicast interface
Loopback22
negotiation
Router(config-ptp-port)# clock source
10.10.10.10
Router(config-ptp-port)# end
```

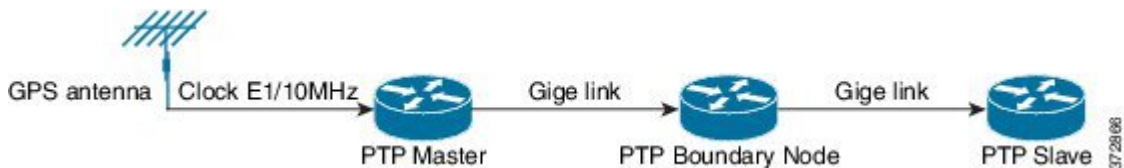
## Configuring a Boundary Clock

You can configure the PTP master and PTP slave in a boundary clock topology as shown in the figure in the same way that you configure a master and slave in ordinary clock mode. This section describes how to configure a Cisco ASR 1002-X Router in boundary clock mode.



**Note** Currently, boundary clock supports only unicast negotiation mode.

*Figure 8: PTP Boundary Clock Scenario*



## SUMMARY STEPS

1. **configure terminal**
2. **ptp clock boundary domain** domain\_number
3. **clock-port** name slave
4. **transport ipv4 unicast interface** {GigabitEthernet | Loopback} interface-number [negotiation]
5. **clock source** ip-address
6. **exit**
7. **clock-port** name master
8. **transport ipv4 unicast interface** {GigabitEthernet | Loopback} interface-number [negotiation]
9. **end**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 2</b>	ptp clock boundary domain domain_number <b>Example:</b> Router(config)# ptp clock boundary domain 0	Creates a PTP clock and specifies the clock mode.
<b>Step 3</b>	clock-port name slave <b>Example:</b> Router(config-ptp-clk)# clock-port SLAVE slave	Specifies the clocking mode of a PTP port and enters the clock port configuration mode.
<b>Step 4</b>	<b>transport ipv4 unicast interface {GigabitEthernet   Loopback} interface-number [negotiation]</b> <b>Example:</b> Router(config-ptp-port)# <b>transport ipv4 unicast interface Loopback11 negotiation</b>	Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets.  The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchange negotiation messages before establishing a relationship. <b>Note</b> Only Loopback interface type is supported.
<b>Step 5</b>	<b>clock source ip-address</b> <b>Example:</b> Router(config-ptp-port)# <b>clock source 10.10.10.10</b>	Specifies the source IP address of a PTP master clock. <b>Note</b> You can specify only one master clock IP address. Priority-based clock source selection is not supported.
<b>Step 6</b>	<b>exit</b> <b>Example:</b> Router(config-ptp-port)# <b>exit</b>	Exits clock port configuration mode.
<b>Step 7</b>	clock-port name master <b>Example:</b> Router(config-ptp-clk)# clock-port MASTER master	Specifies the clocking mode of a PTP port and enters clock port configuration mode.
<b>Step 8</b>	<b>transport ipv4 unicast interface {GigabitEthernet   Loopback} interface-number [negotiation]</b> <b>Example:</b> Router(config-ptp-port)# <b>transport ipv4 unicast interface Loopback10 negotiation</b>	Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets.  The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchange negotiation messages before establishing a relationship. <b>Note</b> Only Loopback interface type is supported.

	Command or Action	Purpose
Step 9	<b>end</b> <b>Example:</b>  <b>Example:</b>  Router(config-ptp-port) # <b>end</b>	Exits global configuration mode.

## Examples

The following example shows how to configure a boundary clock:

```
Router# configure terminal
Router(config)# ptp clock ordinary domain 0
Router(config-ptp-clk)# clock-port SLAVE slave
Router(config-ptp-port) # transport ipv4 unicast interface
Loopback11
negotiation
Router(config-ptp-port) # clock source
10.10.10.10
Router(config-ptp-port) # exit
Router(config-ptp-clk)# clock-port MASTER master
Router(config-ptp-port) # transport ipv4 unicast interface
Loopback10
negotiation
Router(config-ptp-port) # end
```

## Configuring Time of Day

A Cisco ASR 1002-X Router can exchange time of day and 1PPS input with an external device, such as a GPS receiver, using the time of day and 1PPS input and output interfaces on the router.

Perform these tasks to configure Time of Day (ToD) messages on the Cisco ASR 1002-X Router:

### Configuring Input Time-of-Day Messages

This section describes how to configure input time-of-day messages.



#### Note

You can configure time-of-day input only in a PTP master clock port.

#### SUMMARY STEPS

1. **configure terminal**
2. ptp clock ordinary domain domain\_number
3. **tod {R0 | R1} {cisco | ntp}**
4. **input [1pps] { R0 | R1 }**
5. clock-port *name* master
6. **transport ipv4 unicast interface {GigabitEthernet | Loopback} interface-number [negotiation]**

7. `clock destination ip-address`
8. `end`

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><code>configure terminal</code></p> <p><b>Example:</b></p> <pre>Router# <b>configure terminal</b></pre>	Enters global configuration mode.
<b>Step 2</b>	<p><code>ptp clock ordinary domain domain_number</code></p> <p><b>Example:</b></p> <pre>Router(config)# <b>ptp clock ordinary domain 0</b></pre>	Creates a PTP clock and specifies the clock mode.
<b>Step 3</b>	<p><code>tod {R0   R1} {cisco   ntp}</code></p> <p><b>Example:</b></p> <p><b>Example:</b></p> <pre>Router(config-ptp-clk)# <b>tod R0 ntp</b></pre>	<p>Configures the time-of-day message format used by the 1PPS or BITS interface.</p> <p><b>Note</b> Currently, only R0 1PPS port is supported; R1 is not valid. Also, only ntp mode is supported, not cisco mode.</p>
<b>Step 4</b>	<p><code>input [1pps] { R0   R1 }</code></p> <p><b>Example:</b></p> <pre>Router(config-ptp-clk)# <b>input 1pps R0</b></pre>	<p>Enables PTP input clocking using a 1.544-Mhz, 2.048-Mhz, or 10-Mhz timing interface, or phase using the 1PPS or RS-422 interface.</p> <p><b>Note</b> Currently, only R0 1PPS port is supported; R1 is not valid.</p>
<b>Step 5</b>	<p><code>clock-port name master</code></p> <p><b>Example:</b></p> <pre>Router(config-ptp-clk)# <b>clock-port MASTER master</b></pre>	Specifies the clocking mode of a PTP port and enters the clock port configuration mode.
<b>Step 6</b>	<p><code>transport ipv4 unicast interface {GigabitEthernet   Loopback} interface-number [negotiation]</code></p> <p><b>Example:</b></p> <pre>Router(config-ptp-port)# <b>transport ipv4 unicast interface Loopback11 negotiation</b></pre>	<p>Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets.</p> <p>The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchange negotiation messages before establishing a relationship.</p> <p><b>Note</b> Only Loopback interface type is supported.</p>
<b>Step 7</b>	<p><code>clock destination ip-address</code></p> <p><b>Example:</b></p> <pre>Router(config-ptp-port)# <b>clock destination 20.20.20.20</b></pre>	<p>Specifies the IP address of a PTP clock destination.</p> <p>If the clock port is set to master mode with unicast negotiation, you need not use this command because the device uses negotiation to determine the IP address of PTP slave devices.</p>

	Command or Action	Purpose
<b>Step 8</b>	<b>end</b> <b>Example:</b> Router(config-ptp-port) # <b>end</b>	Exits global configuration mode.

### What to do next

#### Examples

The following example shows how to configure input time-of-day messages:

```
Router# configure terminal
Router(config)# ptp clock ordinary domain 0
Router(config-ptp-clk)# tod R0 ntp
Router(config-ptp-clk)# input
lpps R0
Router(config-ptp-clk)# clock-port MASTER master
Router(config-ptp-port)# transport ipv4 unicast interface
Loopback11
negotiation
Router(config-ptp-port)# clock destination
20.20.20.20

Router(config-ptp-port)# end
```

## Configuring Output Time-of-Day Messages

This section describes how to configure output time-of-day messages.



**Note** You can configure ToD output only on PTP slave clock ports.

### SUMMARY STEPS

1. **configure terminal**
2. ptp clock ordinary domain domain\_number
3. **tod {R0 | R1} {cisco | ntp}**
4. **output [1pps] { R0 | R1 }**
5. clock-port name slave
6. **transport ipv4 unicast interface {GigabitEthernet | Loopback} interface-number [negotiation]**
7. **clock source ip-address**
8. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b>	Enters global configuration mode.



	Command or Action	Purpose
	Router# <b>configure terminal</b>	
<b>Step 2</b>	ptp clock ordinary domain domain_number <b>Example:</b> Router(config)# ptp clock ordinary domain 0	Creates a PTP clock and specifies the clock mode.
<b>Step 3</b>	tod {R0   R1} {cisco   ntp} <b>Example:</b> <b>Example:</b> Router(config-ptp-clk) # <b>tod R0 ntp</b>	Configures the time-of-day message format used by the 1PPS or BITS interface. <b>Note</b> Currently, only R0 1PPS port is supported; R1 is not valid. Also, only ntp mode is supported, not cisco mode.
<b>Step 4</b>	output [1pps] { R0   R1 } <b>Example:</b> Router(config-ptp-clk) # <b>output R0 ntp</b>	Enables output of time-of-day messages using a 1PPS interface. <b>Note</b> Currently, only R0 1PPS port is supported; R1 is not valid.
<b>Step 5</b>	clock-port name slave <b>Example:</b> Router(config-ptp-clk) # clock-port SLAVE slave	Specifies the clocking mode of a PTP port and enters the clock port configuration mode.
<b>Step 6</b>	transport ipv4 unicast interface {GigabitEthernet   Loopback} interface-number [negotiation] <b>Example:</b> Router(config-ptp-port) # <b>transport ipv4 unicast interface Loopback11 negotiation</b>	Specifies the IP version, transmission mode, and interface that a PTP clock port uses to exchange timing packets. The <b>negotiation</b> keyword specifies the unicast negotiation mode where the slave and master clock exchange negotiation messages before establishing a relationship. <b>Note</b> Only Loopback interface type is supported.
<b>Step 7</b>	clock source ip-address <b>Example:</b> Router(config-ptp-port) # <b>clock source 10.10.10.10</b>	Specifies the source IP address of a PTP master clock. <b>Note</b> You can specify only 1 master clock IP address. Priority-based clock source selection is not supported.
<b>Step 8</b>	end <b>Example:</b> <b>Example:</b> Router(config-ptp-port) # <b>end</b>	Exits global configuration mode.

## What to do next

### Examples

The following example shows how to configure output time-of-day messages:

```

Router# configure terminal
Router(config)# ptp clock ordinary domain 0
Router(config-ptp-clk)# tod R0 ntp
Router(config-ptp-clk)# output
lpps R0
Router(config-ptp-clk)# clock-port MASTER master
Router(config-ptp-port)# transport ipv4 unicast interface
Loopback11
negotiation
Router(config-ptp-port)# clock source
10.10.10.10
Router(config-ptp-port)# end

```

## Configuration Examples for IEEE 1588v2 PTP on a Cisco ASR1002-X Router

This example shows how to configure IEEE 1588v2 PTP on a Cisco ASR1002-X Router:

### Unicast Negotiation Mode

#### Master Clock

```

ptp clock ordinary domain 1
tod R0 ntp
input lpps R0
clock-port MASTER master
transport ipv4 unicast interface loopback 0 negotiation

```

#### Slave clock

```

ptp clock ordinary domain 1
tod R0 ntp
output lpps R0
clock-port SLAVE slave
transport ipv4 unicast interface loopback 0 negotiation
clock source 10.1.1.1

```

#### Boundary clock

```

ptp clock boundary domain 1
clock-port SLAVE slave
transport ipv4 unicast interface loopback 0 negotiation
clock source 10.1.1.1
clock-port MASTER master
transport ipv4 unicast interface loopback 1 negotiation

```

### Unicast Mode

#### Master Clock

```

ptp clock ordinary domain 1
tod R0 ntp
input lpps R0
clock-port MASTER master
transport ipv4 unicast interface loopback 0
clock destination 20.1.1.1

```

#### Slave clock

```

ptp clock ordinary domain 1
tod R0 ntp

```

```

output lpps R0
clock-port SLAVE slave
transport ipv4 unicast interface loopback 0
clock source 10.1.1.1

```

## Verifying the IEEE 1588v2 PTP Configuration

Use the following commands to verify the IEEE 1588v2 PTP configuration:

- Use the **show ptp clock running domain 0** command to display the output:

```
Router# show ptp clock running domain 0
```

On the **MASTER**:

```

                PTP Ordinary Clock [Domain 0]
      State      Ports      Pkts sent      Pkts rcvd      Redundancy Mode
  FREQ_LOCKED   1                31522149       10401171       Hot standby

```

PORT SUMMARY

```

Name Tx Mode      Role      Transport      State      Sessions      PTP Master
MASTER unicast   master    Lo1            Master     1             -

```

SESSION INFORMATION

```

MASTER [Lo1] [Sessions 1]
Peer addr      Pkts in      Pkts out      In Errs      Out Errs
11.11.11.11    10401171     31522149     0             0

```

On the **SLAVE**:

```

                PTP Ordinary Clock [Domain 0]
      State      Ports      Pkts sent      Pkts rcvd      Redundancy Mode
  PHASE_ALIGNED 1                4532802       13357682       Track one

```

PORT SUMMARY

```

Name Tx Mode      Role      Transport      State      Sessions      PTP Master
SLAVE unicast   slave     Lo20           Slave     1             10.10.10.10

```

SESSION INFORMATION

```

SLAVE [Lo20] [Sessions 1]
Peer addr      Pkts in      Pkts out      In Errs      Out Errs
10.10.10.10    13357682     4532802     0             0

```

- Use the **show platform software ptp tod** command to check the time-of-day information:

```

PTPd ToD information:
Time: 06/24/14 02:06:29

```

- Use the **show platform ptp tod all** command to check the time-of-day state:

```
Router# show platform ptp tod all
```

On the **MASTER**

```
-----
ToD/1PPS Info for : R0
-----
```

```

RJ45 JACK TYPE      : RS422
ToD CONFIGURED      : YES
ToD FORMAT           : NTPv4
ToD DELAY            : 0
1PPS MODE           : INPUT
1PPS STATE           : UP
ToD STATE            : UP

```

On the **SLAVE**:

```
-----
ToD/1PPS Info for : R0
-----
```

```

RJ45 JACK TYPE      : RS422
ToD CONFIGURED     : YES
ToD FORMAT         : NTPv4
ToD DELAY          : 0
1PPS MODE         : OUTPUT
OFFSET            : 0
PULSE WIDTH       : 0
-----

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<i>Cisco IOS Master Commands List, All Releases</i>

### MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at this URL:  {start hypertext}http://www.cisco.com/go/mibs{end hypertext}

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	{start hypertext}http://www.cisco.com/cisco/web/support/index.html{end hypertext}

## Feature Information for IEEE 1588v2 PTP Support

{start cross reference} Table 13-2 {end cross reference} lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature

set, or platform. To access Cisco Feature Navigator, go to {start hypertext} <http://www.cisco.com/go/cfn> {end hypertext}. An account on Cisco.com is not required.



**Note** {start cross reference} Table 13-2 {end cross reference} lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 2: Feature Information for Network Synchronization Support**

Feature Name	Releases	Feature Information
IEEE 1588v2 PTP Support	Cisco IOS XE 3.13S	In Cisco IOS XE Release 3.13S, this feature was introduced on the Cisco ASR 1002-X Routers.

