NTP Timing Based on GPS or PTP Clock or Timing card

PTP as a Reference Clock for NTP

You can configure Precision Timing Protocol (PTP) time as the reference clock for Network Time Protocol (NTP) by enabling the feature on the IR8340 router.

PTP time acts as a stratum 0 source, and the Cisco IOS NTP server acts as a stratum 1 device. The server then provides clock information to its NTP clients (strata 2 and 3).

The feature is supported on Cisco Catalyst IR8340 Rugged Series Routers beginning with the Cisco IOS-XE Release 17.9.1. A Network Advantage license is required.

Enabling PTP as a Reference Clock for NTP

The PTP reference clock feature is disabled by default. You enable it by entering a CLI command. Before you begin, configure PTP and ensure that it is in slave mode. See the chapter Configuring Precision Time Protocol (PTP) in this guide for configuration instructions.

To enable PTP as a reference clock for NTP, enter the **ntp refclock ptp** command.

You disable the PTP reference clock feature by entering the **no ntp refclock ptp** command.

Note On IR8340, this feature is supported only with PTP Default, Power, and Dot1as profiles. Telecom profiles (8265.1/8275.1) as source are not supported. You can only enable this feature when **ntp refclock gps** is disabled, as NTP can take only one reference at a time, either GNSS or PTP.

To validate the PTP reference clock configuration on the router, see Validate the PTP Reference Clock, on page 2.

Validate the PTP Reference Clock

After you enable PTP as the reference clock for NTP, you can enter CLI commands to validate the configuration.

Procedure

Step 1 Ccheck that the PTP reference clock configuration is correct and that the feature is running.

Example:

```
#show run | sec ptp|ntp
ntp refclock ptp
ptp clock boundary domain 0  profile power
 clock-port 1
  transport ethernet multicast interface Gi0/1/4
```

Step 2 Check that PTP is in slave mode; that is PTP is in phase aligned state, which means it is locked to a master clock.

Example:

```
#show ptp clock running
                      PTP Boundary Clock [Domain 0]  [Profile: power]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         PHASE_ALIGNED  1              629978         633            Hot standby
                                PORT SUMMARY
                                                                        PTP Master
Name  Tx Mode      Role          Transport    State          Sessions     Port Addr
1     mcast        negotiated    Ethernet     Slave          1            UNKNOWN
```

Step 3 Check that NTP is using PTP as its reference clock.

Example:

```
#show ntp status
Clock is synchronized, stratum 1, reference is .PTP.
nominal freq is 250.0000 Hz, actual freq is 249.9998 Hz, precision is 2**10
ntp uptime is 28233900 (1/100 of seconds), resolution is 4016
reference time is E6161FA8.FFBE7988 (08:26:16.999 UTC Fri Apr 29 2022)
clock offset is 0.9998 msec, root delay is 0.00 msec
root dispersion is 3940.49 msec, peer dispersion is 3938.47 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000000856 s/s
system poll interval is 64, last update was 4 sec ago.
#
```

Troubleshooting PTP as an NTP Reference Clock

Checking PTP-NTP Synchronization

You can check the time on the PTP and NTP cocks to ensure that they are synchronized, as shown in the following example.

```
#show ptp lan clock | inc time
Local clock time: 2022-4-29 8:48:39 UTC
#
#show clock detail
08:48:39.278 UTC Fri Apr 29 2022
Time source is NTP
#
```

Troubleshooting Commands

Table 1: Troubleshooting Commands

Command	Description
ntp logging	Enables syslogs from NTP.
debug ntp all	Provides the complete debugging logs for NTP processes.
debug platform software pd-ptp all	Provides debugging logs on the switch relating to PTP as a reference clock.
show ntp status	Shows detailed NTP status, including whether NTP is using PTP as its reference clock.
show ntp association detail	Shows detailed information about NTP peering.
show ptp clock running	Check that PTP is in slave mode; that is PTP is in phase aligned state, which means it is locked to a master clock.

Viewing Peering Details

The command output shows detailed information about NTP peering. You can use the command to check the amount of time the platform takes to switch to the next available timing source after the initial timing source goes down. In the following example, NTP waits 8x256 seconds to switch over to the next source.

```
#show ntp association detail
127.127.6.1 configured, ipv4, our_master, sane, valid, stratum 0
ref ID .PTP., time E61622E9.00000000 (08:40:09.000 UTC Fri Apr 29 2022)
our mode active, peer mode passive, our poll intvl 256, peer poll intvl 1024
root delay 0.00 msec, root disp 0.00, reach 377, sync dist 4.62
delay 0.00 msec, offset 0.9998 msec, dispersion 2.81, jitter 0.97 msec
precision 2**10, version 4
assoc id 63756, assoc name 127.127.6.1
```

```
assoc in packets 11, assoc out packets 17652, assoc error packets 0
org time E61622E8.FFBE7988 (08:40:08.999 UTC Fri Apr 29 2022)
rec time 00000000.00000000 (00:00:00.000 UTC Mon Jan 1 1900)
xmt time E61622E8.FFBE7988 (08:40:08.999 UTC Fri Apr 29 2022)
filtdelay = 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
filtoffset = 0.99 1.99 0.99 0.99 0.99 0.99 1.99 0.99
filterror = 0.97 2.89 4.81 6.73 8.65 10.57 11.53 12.49
minpoll = 4, maxpoll = 10
```

Using the Timing Card as a Reference Clock for NTP

The IR8340 has the option to update GNSS time to NTP using the **ntp refclock gps** command. If the IR8340 has a timing card inserted, it can provide more accurate time to NTP than the time based on the system oscillator. When GNSS gets unlocked or disabled, the IR8340 is able to use the time from the timing card.

New Command Option

A new command **ntp refclock timing-card** has been added, which adds the timing card local clock as a refclock. This CLI will be present only when timing card is detected in the IR8340.

NTP polls for time from the timing card at stipulated intervals.

Configuration Examples

To configure the device to use the timing card as the reference:

```
router(config)#ntp master
router(config)#ntp refclock timing-card
```

To view the status:

```
router#show ntp status
Clock is synchronized, stratum 4, reference is 127.127.7.1
nominal freq is 250.0000 Hz, actual freq is 249.9997 Hz, precision is 2**10
ntp uptime is 6200 (1/100 of seconds), resolution is 4016
reference time is E8DB7E3A.DC6A8158 (15:36:50.861 IST Thu Oct 19 2023)
clock offset is 1.0000 msec, root delay is 0.00 msec
root dispersion is 3940.44 msec, peer dispersion is 3938.29 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000001064 s/s
system poll interval is 16, last update was 11 sec ago.

router#show ntp associations

address ref clock st when poll reach delay offset disp
~127.127.1.1 .LOCL. 7 14 16 7 0.000 0.000 1938.4
*~127.127.7.1 .TCLO. 3 15 16 3 0.000 1.000 3938.2
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

NTP Timing Based on GPS Clock

The device has the capability to receive time from GNSS, which acts as a Stratum 0 reference clock, and it distributes this time using NTP as a Stratum 1 server.

- When GNSS is locked and stable; the device continues to distribute time from GNSS, even if other Stratum 1 NTP servers are available through NTP peers.

- When GNSS unlocks; the NTP algorithm ensures that it selects an available NTP server that is reachable using NTP peers.

Configuring NTP using GPS Time

You can configure the GPS time as the reference clock for NTP using the command **ntp refclock gps**.

The GPS time acts as a stratum 0 source, and the Cisco IOS NTP server acts as a stratum 1 device, which in turn provides clock information to its NTP clients (stratum 2 and 3).

Procedure

Step 1 Enter global configuration mode:

Example:

```
Router# configure terminal
```

Step 2 Configure the NTP reference clock as GPS:

Example:

```
Router(config)#ntp refclock gps
```

Step 3 To verify the configuration, use the **show** commands in the following example:

Example:

```
Router#
Sep 24 19:58:43.046 GMT: %PKI-6-AUTHORITATIVE_CLOCK: The system clock has been set.
Router#show ntp status
Clock is synchronized, stratum 1, reference is .GPS.
nominal freq is 250.0000 Hz, actual freq is 249.9970 Hz, precision is 2**10
ntp uptime is 94000 (1/100 of seconds), resolution is 4016
reference time is E31778F3.0B851ED8 (19:58:43.045 GMT Thu Sep 24 2020)
clock offset is 11.0000 msec, root delay is 0.00 msec
root dispersion is 3950.55 msec, peer dispersion is 3938.47 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000011995 s/s
system poll interval is 64, last update was 7 sec ago.
Router#
Router#
Router#show ntp associations

address ref clock st when poll reach delay offset disp
*~127.127.5.1 .GPS. 0 38 64 7 0.000 11.000 1938.8
* sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
Router#
Router#show clock
20:00:43.660 GMT Thu Sep 24 2020
Router#
```

Step 4 Use the **debug ntp refclock** command to troubleshoot the configuration:

Example:

```
Router#debug ntp ?
adjust NTP clock adjustments
all NTP all debugging on
```

```
core NTP core messages
events NTP events
packet NTP packet debugging
refclock NTP refclock messages

Router#debug ntp re
Router#debug ntp refclock
*Sep 24 19:58:43.045 GMT: GPS: Poll Requested
*Sep 24 19:58:43.045 GMT: GPS (19:58:43.056 GMT Thu Sep 24 2020)
*Sep 24 19:58:43.045 GMT: Valid time rcvd from GPS: 2020/09/24 19:58:43.056 (frac = 0x0E560440)
*Sep 24 19:58:43.045 GMT: RTS poll timestamp (local clock) was 0xE31778F3.0B851ED8
*Sep 24 19:58:43.045 GMT: GPS timestamp is 0xE31778F3.0E560440
*Sep 24 19:58:43.045 GMT: NTP Core(NOTICE): ntpd PPM
*Sep 24 19:58:43.046 GMT: NTP Core(NOTICE): trans state : 5
*Sep 24 19:58:43.046 GMT: NTP Core(NOTICE): Clock is synchronized.
```