

Synchronization

The terms *IR8340* and *router* are used throughout this document in text and CLI examples to refer to the Cisco Catalyst IR8340 Rugged Series Router, unless otherwise noted.

Synchronization is the process of coordinating or aligning two or more events, signals, systems, or processes to work together in time, frequency, or phase. It ensures consistency, precision, and smooth interaction.

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Synchronization

Frequency and time distribution are key capabilities of the Cisco Catalyst IR8340 Rugged Series Routers. These routers support:

- WAN ports (Gigabit Ethernet ports (0/0/0 and 0/0/1)) distribute both frequency and phase information,
- LAN ports (Gigabit Ethernet 0/1/0 to Gigabit Ethernet 0/1/11) distribute phase information,
- GPS source synchronization, and
- phase distribution through an external Inter-Range Instrumentation Group - Time Code Format B (IRIG-B) interface and an external The time of Day (ToD) RS485 interface.

Frequency synchronization

Router can recover the reference clock frequency from GNSS, SyncE, PTP Telecom Profile (G.8265.1/G.8275.1), or local oscillator input sources:

When a reference clock is selected, it is propagated to downstream network elements via SyncE or Precision Time Protocol (PTP) telecom profile (G.8265.1 or G.8275.1).

Time or phase synchronization

Accurate Time of Day (TOD) synchronization between network devices is critical for ensuring precise calculation of network delays.

The time or phase synchronization can be achieved using GNSS, PTP, IRIG-B, or handset input sources:

Time module and license

Starting from Cisco IOS-XE Release 17.9.1, the Cisco Catalyst IR8340 Rugged Series Routers support a pluggable time module (Cisco PID: IRM-TIMING-MOD), which includes:

- ToD and one pulse-per-second (1 PPS) output provide or receive ToD messages or one PPS messages,
- IRIG-B interfaces (analog and digital input and output), and
- Global Navigation Satellite System (GNSS) receiver

Note The Network-Advantage license is required on the Cisco Catalyst IR8340 Rugged Series Routers to enable all timing features, including GNSS, IRIG-B, and PTP profiles such as G.8265.1, G.8275.1, 1588v2, Power, and 802.1AS profiles. Use the **license boot level network-advantage** command to activate the Network-Advantage license.

Time module status

You can monitor the status of the time module.

Procedure

Use the **show inventory** command to display the status of the time module.

Example:

```
Router# show inventory
                    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    INFO: Please use "show license UDI" to get serial number for licensing.
                    ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    NAME: "Chassis", DESCR: "Cisco IR8340-K9 Chassis Type"
                    PID: IR8340-K9         , VID: V00  , SN: FDO2523J1BL
                    NAME: "Power Supply Module 0", DESCR: "150W AC Power Supply Module for Cisco
IR8340-K9"
                    PID: PWR-RGD-AC-DC-H   , VID: V01  , SN: DTH251705BY
                    NAME: "module 0", DESCR: "Cisco IR8340 Built-In NIM controller"
                    PID: IR8340-K9         , VID: V00  , SN: FDO252207UG

                        NAME: "Timing", DESCR: "Timing Module"
                            PID: IRM-TIMING-MOD    , VID: V00  , SN: FDO253409KG

                    NAME: "NIM subslot 0/0", DESCR: "Front Panel 2 ports Gigabitethernet Module"
                    PID: IR8340K9-2x1GC    , VID: V01  , SN:
```

Inter-Range Instrumentation Group codes evolution and applications

Inter-Range Instrumentation Group (IRIG) is a standardized format for precise time synchronization. It provides:

- Accurate time data, including date, hours, minutes, and seconds.
- A one Pulse Per Second (1 PPS) signal for stable timing and frequency reference.
- Enhancement of frequency accuracy through phase-locking and stable oscillators.
- Availability in both analog (modulated) and digital (binary) formats.
- Applications in telecommunications, power grids, GPS, and industrial automation.
- Accurate global time distribution when combined with GNSS.

IRIG-B time protocol for synchronization

The IRIG standard was first published in 1960, with the latest version, IRIG standard 200-04 (IRIG Serial Time Code Formats), updated in September 2004.

IRIG time codes are a result of the U.S. military's initiative in the late 1950s to standardize timing codes. This effort resolved compatibility issues and enabled the seamless exchange of synchronized test data across test ranges.

Six IRIG code variations were developed (A, B, D, E, G, H) of which IRIG time code B (IRIG-B) became widely accepted for time distribution in the power, industrial automation, and control industries.

Industrial applications and functionality of IRIG-B

IRIG-B is widely used in industries such as electric utilities to synchronize system devices like power breakers, relays, and meters. It transmits a 100-bit time frame each second, containing time-of-year and year information in a BCD format, with an optional field for seconds-of-day in SBS. Although IRIG-B is a reliable and predictable framework for distributing timing signals, it traditionally relies on an accurate timing source, such as GPS, for precision.

IRIG-B with GNSS timecode

The IRIG protocol supports format-B (IRIG-B), as defined in the IRIG standard 200-04. In addition to the GNSS interface, it can handle both receive (INPUT) and transmit (OUTPUT) of 4 analog (AM) and 4 digital (TTL) time code formats, as shown in the table.

IRIG-B modes		Format ID	IRIG signal
Analog (AM)	AM02	AM-B122	Amplitude Modulated, 1 kHz, 1 millisecond resolution, BCD_{TOY}
	AM03	AM-B123	Amplitude Modulated, 1 kHz, 1 millisecond resolution, BCD_{TOY}, SBS
	AM06	AM-B126	Amplitude Modulated, 1 kHz, 1 millisecond resolution, BCD_{TOY}, BCD_{YEAR}
	AM07	AM-B127	Amplitude Modulated, 1 kHz, 1 millisecond resolution, BCD_{TOY}, BCD_{YEAR}, SBS

IRIG-B modes		Format ID	IRIG signal
Digital (TTL)	TTL02	TTL-B002	Unmodulated, DCLS, pulse-width-coded, BCD_{TOY}
	TTL03	TTL-B003	Unmodulated, DCLS, pulse-width-coded, BCD_{TOY}, SBS
	TTL06	TTL-B006	Unmodulated, DCLS, pulse-width-coded, BCD_{TOY}, BCD_{YEAR}
	TTL07	TTL-B007	Unmodulated, DCLS, pulse-width-code, BCD_{TOY}, BCD_{YEAR}, SBS

Note

- BCD: Contains day of year, hours, minutes, and seconds.
- BCD_Year: Includes BCD and year 00–99, which does not include the century in its coding.
- SBS: Represents Straight Binary Seconds. Its value ranges from 0 to 86339.

Physical interfaces

The router includes two physical interfaces, analog (AM) and digital (TTL), both capable of handling INPUT and OUTPUT signals. The support for IRIG-B signaling enables the router to function as a central timing device in various scenarios:

- INPUT: The router receives IRIG-B timing signals (AM or TTL) from an external IRIG-B time source when required. In this case, IRIG-B can serve as the clock source for PTP, with the router configured as a Grand Master Clock (GMC) for time distribution.
- OUTPUT: The router uses other precise timing sources, such as GNSS or GPS, PTP, or NTP, as its clock source. It can then transmit IRIG-B timing signals to devices that depend on IRIG-B at the location.

This table illustrates how time sources are mapped to corresponding time distribution protocols, showing how one source can serve as the reference for another.

Time Source	Time Distribution
IRIG-B IN	PTP
GNSS, PTP, and NTP	IRIG-B OUT

Configure IRIG-B

You can configure IRIG mode (AM or TTL) and direction (IN or OUT) on the interface.

Procedure

Step 1 Use the **config terminal** command to enter global configuration mode.

Example:

```
Router# configure terminal
```

Step 2 Use the **irig mode** *mode_type* **dir** *direction* command to configure IRIG mode.

Example:

```
Router(config)# irig mode TTL2 dir IN
```

The possible options to configure IRIG mode are: TTL2, TTL3, TTL6, TTL7, AM2, AM3, AM6, and AM7

- TTL2 = IRIG-B002, TTL3 = IRIG-B003, TTL6 = IRIG-B006, TTL7 = IRIG-B007
- AM2 = IRIG-B122, AM3 = IRIG-B123, AM6 = IRIG-B126, AM7 = IRIG-B127

The possible values for direction are: IN and OUT

Use the **no** form of the command to disable the IRIG feature on the interface.

Note
To switch input from digital to analog or vice versa, you must remove the input configuration on one port before reconfiguring the input on another port.

Step 3 (optional) Use the **show irig** command to display IRIG-B mode and direction configurations on the IR8340.

Example:

This example shows output for the OUT direction.

Example:

```
Router# show irig
IRIG-B Digital mode disabled
IRIG-B Analog mode AM02 dir OUT
IRIG-B Clk Id 1 Source PTP  time: Year: 2021 Day: 343 Hour 8 Min 33 Sec 35.
                            ns 1639038815645806587 [0x16BF091E6BA52FFB]
IRIG-B Virtual Clock State: INACTIVE
*** IRIG-B input is disabled ***
```

Example:

This example shows output for the IN direction.

```
Router# show irig
IRIG-B Digital mode disabled
IRIG-B Analog mode AM02 dir IN
IRIG-B Clk Id 5 Source IRIG-B  time: Year: 2021 Day: 343 Hour 8 Min 36 Sec 25.
IRIG-B Virtual Clock State: ACTIVE
*** IRIG-B AM input mode ***
B122: Day 343 Hour 8 Min 36 Sec 24
NOTE: Input time shown is the last received frame time
```