IRIG-B

IRIG Time Code B

In many industrial environments, the Inter-Range Instrumentation Group (IRIG) time code B (IRIG-B) enables you to timing information to devices that may not support Precision Time Protocol (PTP) or Network Time Protocol (NTP) on Ethernet interfaces. IRIG-B is one of several standard formats for transferring timing information.

Cisco IE9320 GE Fiber switches (IE-9320-22S2C4X-A and IE-9320-22S2C4X-E) have integrated IRIG-B interfaces to provide an external timing source. The switches support the IRIG timing feature beginning with IOS XE Release 17.12.1.

IRIG time codes stem from the U.S. military's need to standardize the timing codes of test ranges towards the end of the 1950s. This standardization resulted in a common set of time codes that eliminated incompatibility challenges and allowed for the exchange of synchronized test data across ranges. Six IRIG codes variations were developed: A, B, D, E, G, H. IRIG time code B (IRIG-B) became widely accepted for time distribution with power, industrial automation, and control industries.

The following list displays facts about IRIG time codes and IRIG-B:

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

- IRIG sends a complete time frame once per second, and each frame is composed of 100 bits.

- IRIG contains time-of-year and year information in binary coded decimal (BCD) format, and (optionally) seconds-of-day in straight-binary seconds (SBS) format.

- Although IRIG is considered to be a reliable and predictable timing source distribution framework (dedicated timing signals), it traditionally relies on a precise timing source, such as GPS.

- The IRIG-B time protocol is widely used by electric utilities and other verticals to establish and maintain time synchronization between system devices, such as power breakers, relays, and meters.

IRIG-B and IE9300 Hardware

IE9320 GE Fiber (IE-9320-22S2C4X-E and IE-9320-22S2C4X-A) switches have IRIG-B timecode input and output capability.

There are two mini-BNC connectors on the front panel: one for digital time code, and a second for analog time code, each of which can be configured separately as input or output. The following illustration shows the two IRIG-B connectors on the front of the switch.

Figure 1: IRIG Timecode Connectors
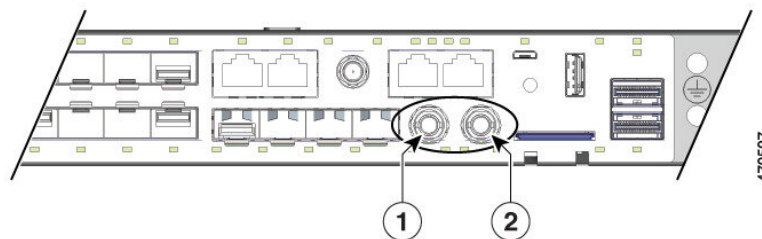
| 1 | IRIG-B digital timecode connector (mini-BNC connector) | 2 | IRIG-B analog timecode connector (mini-BNC connector) |

Note You must buy or build cables for IRIG-B connectivity following the IRIG-B standard and switch's specifics. These cables are *not* provided with the platform.

The following table shows the behavior of IRIG timecode LEDS, which are just below the connectors.

LED	Color	System Status
Analog In	Off	Analog timecode input is not configured.
	Solid Green	Analog timecode input is present and operating properly.
	Alternating Green and Amber	Analog timecode signal is present with errors.
	Blinking Amber	Analog timecode input configured, no signal present.
Analog Out	Off	Analog timecode output is not configured.
	Solid Green	Analog timecode output is configured and sending a signal.

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Digital In	Off	Digital timecode input is not configured.
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Digital Out	Off	Digital timecode output is not configured.
	Solid Green	Digital timecode output is configured and sending a signal.

IRIG-B Software Requirements

IOS XE software supports IRIG-B INPUT and OUTPUT capabilities. The following table shows the minimum IOS XE versions required to support either IRIG-B signaling direction. Review Release Notes for Cisco Catalyst IE9300 Rugged Series Switches and follow Cisco's recommendations before upgrading IOS XE versions on your switch.

IRIG-B Direction	Minimum IOS XE Support
Output	Cisco IOS XE.17.12.1
Input	

IRIG-B Direction and Time Sources

Cisco IE9320 GE Fiber switches have two physical interfaces: one for analog (AM) and one for digital (TTL), with input or output signal capabilities for each interface.

IRIG-B input or output signaling support allows the IE9320 GE Fiber switch to serve as a central timing device in multiple use cases:

- **Input:** The switch receives IRIG-B timing signaling (AM or TTL) from an IRIG-B time source only if available or so required. In this case, IRIG-B can be used as the switch clock source for PTP only. The switch is configured as the Grand Master Clock (GMC) for time distribution.

- **Output:** The switch utilizes other precise timing sources—such as GNSS (GPS), PTP, or NTP—as a clock source. The IRIG-B interfaces can be used to transmit timing signal to IRIG-B dependent devices in location.

The following table shows the mapping of the time source to the time distribution protocol:

Time Source	Time Distribution
PTP	IRIG-B in
GNSS (GPS), PTP, NTP	IRIG-B out

IRIG-B: IE9300 Support

The IRIG protocol for IE9320 GE Fiber switches is implemented for IRIG-B format according to the IRIG standard 200-04. The implementation includes capability to receive (Input) or transmit (Output) 4x Analog (AM) and 4x Digital (TTL) time code formats, as shown in the following table.

IE9320 IRIG-B Modes	Format ID		IRIG Signal
Analog (AM)	AM02	AM-B122	Amplitude Modulated, 1kHz / 1ms resolution, BCD_{TOY}
	AM03	AM-B123	Amplitude Modulated, 1kHz / 1ms resolution, BCD_{TOY}, SBS
	AM06	AM-B126	Amplitude Modulated, 1kHz / 1ms resolution, BCD_{TOY}, BCD_{YEAR}
	AM07	AM-B127	Amplitude Modulated, 1kHz / 1ms resolution, BCD_{TOY}, BCD_{YEAR}, SBS
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

Configuration Scenario

This configuration scenario shows two Cisco IE9320 GE Fiber switches (IE-9320-22S2C4X-A and IE-9320-22S2C4X-E) configured to use IRIG-B signaling in different ways.

Information about the scenario:

- Time source GNSS (GPS), IRIG-B TTL07 OUT for time distribution—IE93200 (v23-ie9320-2)

- Time source IRIG-B TTL07 IN, PTP for time distribution—IE93200 (v23-ie93200-4)

✎

Note   See the sections "Global Navigation Satellite System" and "Precision Time Protocol" in the *Precision Time Protocol Configuration Guide, Cisco Catalyst IE9300 Rugged Series Switches*.

Configure IRIG-B

You use a single single CLI command statement to configure IRIG-B. The statement sets the IRIG-B mode and signal direction (`in` or `out`) for each interface. You can have two IRIG-B configuration statements.

Before you begin

Configure IRIG by completing the following command at the configuration prompt:

```
irig mode mode dirsignal/direction
```

Example:

```
v23-ie93200-4(config)#irig mode ?
 AM02 AM-B122 format
 AM03 AM-B123 format
 AM06 AM-B126 format
 AM07 AM-B127 format
 TTL02 TTL-B002 format
 TTL03 TTL-B003 format
 TTL06 TTL-B006 format
 TTL07 TTL-B007 format

v23-ie5000-4(config)#irig mode TTL07 dir ?
 in input direction
 out output direction
```

Configure a GNSS Time Source, IRIG-B Out

The IE9320 GE Fiber switch (v23-ie9320-2) is configured to use its GNSS (GP)S interface and,consequently, GPS as its time source. That is, IRIG-B sources its time from GPS. The IRIG-B digital interface is configured to provide timing signal Out to the other IE9320 GE Fiber switch (v23-ie9320-4).

Before you begin

Step 1   Enable GNSS, using the **gnss** command, as shown in the following example.

Example:

```
v23-ie9320-2(config)#gnss
```

Step 2   Configure the mode and direction, as shown in the following example.

Example:

```
v23-ie9320-2(config)#irig mode TTL07 dir out
```

Step 3   Verify the IRIG-B output and that GNSS is the IRIG-B time source, as shown in the following example.

Example:

```
v23-ie9320-2#show irig
IRIG-B Digital mode TTL07 dir out <<<--- Confirms IRIG-B mode and direction as configured (OUT)
IRIG-B Analog mode disabled

IRIG-B Clk Id 3 Source GNSS time: Year: 2021 Day: 98 Hour 15 Min 7 Sec 20 <<-- GNSS Clock source
                            ns 1617894440419015968 (0x1673EA6BED413D20)

IRIG-B Virtual Clock State: INACTIVE <<<--- IRIG-B clock inactive, not an internal time source

*** IRIG-B input is disabled ***
```

Configure a PTP Time Source, IRIG-B In

The IE9320 GE Fiber switch (v23-ie9320-4) is configured to receive IRIG-B TTL07 (In) timing signal from the other IE9320 GE Fiber switch (v23-ie93200-2) and use it as its time source. This in turn will be used as the timing source for PTP for time network distribution. No other timing sources or protocols are configured.

Before you begin

Step 1   At the configuration prompt, configure the switch for PTP as the Grand Master Clock boundary clock (GMC-BC), as shown in the following example.

Example:

```
v23-ie9320-4#ptp clock boundary domain 0 profile default
v23-ie9320-4(config-ptp-clk)#gmc-default
```

Step 2   Configure the mode and direction, as shown in the following example.

Example:

```
v23-ie9320-4(config)#irig mode TTL07 dir in
```

Step 3   Verify IRIG-B Input as the time source and that PTP sources time from IRIG-B, as shown in the following example.

Example:

```
v23-ie9320-4#show irig
IRIG-B Digital mode TTL07 dir in <<<--- Confirms IRIG-B mode and direction as configured (IN)
IRIG-B Analog mode disabled

IRIG-B Clk Id 2 Source IRIG-B time: Year: 2021 Day: 98 Hour 15 Min 7 Sec 20 <<-- IRIG-B source
                            ns 1617894440918157031 (0x1673EA6C0B0186E7)

IRIG-B Virtual Clock State: ACTIVE <<<--- IRIG-B clock active, time source possible for PTP

*** IRIG-B TTL input mode ***
B007 : Year 21 Day 98 Hour 15 Min 7 Sec 19 SBS 0xD4A7(54439) <<-- TTL-B007 signal received

NOTE: Input time shown is the last received frame time
```

Step 4   Verify that PTP recognizes IRIG-B as its clock source, as shown in the following example.

Example:

```
v23-ie93200-4#sh ptp time-property
PTP CLOCK TIME PROPERTY
  Current UTC offset valid: FALSE
  Current UTC offset: 0
  Leap 59: FALSE
  Leap 61: FALSE
  Time Traceable: FALSE
  Frequency Traceable: FALSE
  PTP Timescale: FALSE
  Time Source: Other <<--- This denotes IRIG-B
```

Note In the preceding example, `Time Source: Other` is used to identify IRIG-B because there is no IRIG classification in PTP messaging. If NTP were configured as the source, then it would show `Time Source: NTP`.

Additional Resources

Consult the following resources for more information about Cisco Catalyst IE9300 Rugged Series Switchess:

- *Cisco Catalyst IE9300 Rugged Series Data Sheet*

- *Precision Time Protocol Configuration Guide, Cisco Catalyst IE9300 Rugged Series Switches*

- Cisco's IOT community on cisco.com

Feature History for IRIG-B

The following table provides release and related information for the features that are documented in this guide. The features are available in all the releases after the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Dublin 17.12.x	Inter-Range Instrumentation Group time code B (IRIG-B)	Cisco IE9320 GE Fiber switches have integrated IRIG-B interfaces to provide an external timing source. These interfaces help make the switches a robust industrial platform with strong precision timing capabilities.