

# **Configuring Frequency Synchronization**

Frequency Synchronization is used to distribute precision frequency around a network. Frequency is synchronized accurately using Synchronized Ethernet (SyncE) in devices connected by Ethernet in a network.

This module describes the concepts around this and details the various configurations involved. For information on SyncE commands, see *System Management Command Reference for Cisco ASR 9000 Series Routers*.

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# **Overview**

Frequency or timing synchronization is the ability to distribute precision frequency around a network. In this context, timing refers to precision frequency, not an accurate time of day. Precision frequency is required in next generation networks for applications such as circuit emulation.

To achieve compliance to ITU specifications for TDM, differential method circuit emulation must be used, which requires a known, common precision frequency reference at each end of the emulated circuit. The incumbent example of frequency synchronization is provided by SDH equipment. This is used in conjunction with an external timing technology to provide synchronization of precision timing across the network.

SDH equipments are widely replaced by Ethernet equipments and synchronized frequency is required over such Ethernet ports. Synchronous Ethernet (SyncE) is used to accurately synchronize frequency in devices connected by Ethernet in a network. SyncE provides level frequency distribution of known common precision frequency references to a physical layer Ethernet network.

To maintain SyncE links, a set of operational messages are required. These messages ensure that a node is always deriving timing information from the most reliable source and then transfers the timing source quality information to clock the SyncE link. In SDH networks, these are known as Synchronization Status Messages (SSMs). SyncE uses Ethernet Synchronization Message Channel (ESMC) to provide transport for SSMs.

#### **Source and Selection Points**

Frequency Synchronization implementation involves Sources and Selection Points.

A Source inputs frequency signals into a system or transmits them out of a system. There are four types of sources:

- Line interfaces. This includes SyncE interfaces and SONET interfaces.
- Clock interfaces. These are external connectors for connecting other timing signals, such as BITS, UTI and GPS.
- PTP clock. If IEEE 1588 version 2 is configured on the router, a PTP clock may be available to frequency synchronization as a source of the time-of-day and frequency.
- Internal oscillator. This is a free-running internal oscillator chip.

Each source has a Quality Level (QL) associated with it which gives the accuracy of the clock. This QL information is transmitted across the network using ESMC or SSMs contained in the SDH frames. This provides information about the best available source the devices in the system can synchronize to. To define a predefined network synchronization flow and prevent timing loops, you can assign priority values to the sources on each router. The combination of QL information and user-assigned priority levels allow each router to choose a source to synchronize its SyncE or SDH interfaces, as described in the ITU standard G.781.

A Selection Point is any point where a choice is made between several frequency signals and possibly one or many of them are selected. Selection points form a graph representing the flow of timing signals between different cards in a router running Cisco IOS XR software. For example, there can be one or many selection points between different Synchronous Ethernet inputs available on a single line card. This information is forwarded to a selection point on the RSP, to choose between the selected source from each card.

The input signals to the selection points can be:

- Received directly from a source.
- Received as the output from another selection point on the same card.
- Received as the output from a selection point on a different card.

The output of a selection point can be used in a number of ways, like:

- To drive the signals sent out of a set of interfaces.
- As input into another selection point on a card.
- As input into a selection point on an another card.

Use **show frequency synchronization selection** command to see a detailed view of the different selection points within the system.



 We recommend you to configure, and enable Frequency Synchronization selection input on two interfaces per line card.

• For link aggregation, you must configure and enable Frequency Synchronization selecction input on a single bundle member.

### SyncE Hardware Support Matrix

This table provides details on the harware that supports SyncE:



**Note** The table also contains support details of upcoming releases. You can read this table in context of the current release and see relevant *Release Notes* for more information on supported features and hardware.

#### Table 1: Feature History Table

Feature Name	Release Information	Feature Description
SyncE Support on 5th Generation 10-Port 400 Gigabit Ethernet Line Cards: • A99-10X400GE-X-SE • A99-10X400GE-X-TR	Release 7.3.2	Frequency Synchronization is used to distribute precision frequency around a network. Frequency is synchronized accurately using Synchronized Ethernet (SyncE) in devices connected by Ethernet in a network. SyncE is now supported on the line cards: • A99-10X400GE-X-SE • A99-10X400GE-X-TR
Hardware Variant	Cisco IOS XR	Cisco IOS XR 64 bit
A9K-8X100GE-L-SE/TR (10GE and 100GE)	5.3.0	6.1.1
A9K-RSP880-SE/TR	5.3.0	6.1.1
A9K-8X100GE-L-SE/TR (40-GE)	6.0.1	6.1.1
A9K-4X100GE-SE/TR A9K-8X100GE-SE/TR	5.3.2 (100G LAN only) 6.0.1	6.1.1
A9K-MOD400-SE/TR A9K-MOD200-SE/TR with MPA 20x10GE and Legacy MPAs	6.0.1	6.2.2
A9K-MOD400-SE/TR A9K-MOD200-SE/TR with MPAs 2x100 and 1x100	6.1.3	6.2.2
A9K-400G-DWDM-TR	5.3.3	
	6.0.1	
A9K-24X10GE-1G-SE/TR	6.2.1	6.3.2
A9K-48X10GE-1G-SE/TR		

Hardware Variant	Cisco IOS XR	Cisco IOS XR 64 bit
A99-RSP-SE/TR (Cisco ASR 9910 Series Routers)	6.1.4	6.3.2
RSP880-LT-SE/TR	6.2.2	6.4.1
A9K-RSP440-TR/SE	4.3.4	
Enhanced Ethernet Linecards		
A99-RP-SE		
A99-RP2-TR/SE	5.3.0	6.3.2
		6.4.1
Cisco ASR 9001 Series Routers	4.3.4	
Cisco ASR 9901 Series Routers	NA	6.4.1
A99-RSP-SE/TR (Cisco ASR 9906 Series Routers)	6.3.1	6.3.2
A9K-RSP5-SE/TR	NA	6.5.15
A99-RP3-SE/TR	NA	6.5.15
A9K-8X100GE-X-TR	NA	6.5.15
A9K-16X100GE-TR	NA	6.5.15
A9K-32X100GE-TR	NA	6.5.15
A99-32X100GE-X-TR	NA	7.1.15
A9K-8HG-FLEX-SE/TR	NA	7.1.15
A9K-20HG-FLEX-SE/TR	NA	7.1.15
ASR-9903	NA	7.1.3
А9903-20НG-РЕС	NA	7.1.3
A99-10X400GE-X-SE/TR	NA	7.3.2
A99-12X100GE	NA	7.4.1
A9K-4X100GE	NA	7.4.1
ASR-9902	NA	7.4.1
A9K-4HG-FLEX-SE/TR	NA	7.4.1
A99-4HG-FLEX-SE/TR	NA	7.4.1

# SyncE Restrictions

This section lists a few restrictions in configuring frequency synchronization. They are:

- On SyncE line interfaces, you can configure multiple interfaces for SyncE input. However, only one interface from each PHY gets selected as best source and programmed as SyncE input (there is no restriction on SyncE output) on the A9K-24X10GE-1G-SE/TR and A9K-48X10GE-1G-SE/TR line cards.
- *clock-interface timing-mode independent* configuration is not supported on Cisco A9K-RSP5-X-TR, A9K-RSP5-X-SE, A99-RP3-X-TR and A99-RP3-X-SE.

# **Clocking Support for nV Cluster**

ASR9K cluster consists of two chassis connected together to provide redundancy and to meet higher bandwidth requirements. RSP440 provides two ICS (Inter-Chassis Synchronization) interfaces on the front plate. Clocking functionality support is added to the ICS interfaces. The ICS interfaces could be used for clocking, in the absence of other methods to synchronize frequency and Time-of-day information between the two cluster racks

## **nV Cluster Limitations**

The limitations for the frequency synchronization support for cluster are:

- This feature is supported only on RSP440.
- The two chassis of the cluster have to be co-located. The length of the cable used for the ICS link should be less than 10 meters. This is needed to ensure the phase delay added due the length of the cable is within limits.
- SSM and QL is not supported on ICS links. SSM messages are not exchanged over the ICS interface. Hence, QL value needs to be configured under ICS clock interface configuration.
- The selection of an input clock source is based on the configuration of priority, QL as well as the clock quality. For SyncE, the ICS interfaces are similar to the SyncE line interfaces as far as input clock selection is concerned.
- All Input clock sources to cluster setup has to be redundant.
- No support for 1588 BC on LAG interfaces with member links across racks.

# Inter-Chassis Synchronization (ICS)

#### **ICS-Frequency Synchronization**

Frequency synchronization is provided using Inter-Chassis Synchronization links (ICS). These are dedicated interfaces on the RSP used to synchronize the time and frequency.

The ICS link between the Primary DSC and Backup DSC carries the clock. There is no transfer of QL information from Primary DSC to Backup DSC. The clock direction is always from Primary DSC to Backup DSC. The Primary DSC transmits the clock and Backup DSC receives the clock.

The ICS clock interface (sync 2 or sync 3) is a clock input on the Backup DSC. The clock selection algorithm for SyncE is independent on each RSP. So, output clock from the rack which has Primary DSC is the outcome of the clock selection on the Primary DSC. The output clock from the rack which has Backup DSC is the outcome of the clock selection on the Backup DSC. If the ICS clock interface configuration is such that it is the selected clock on the Backup DSC, then the output clocks from the Primary rack and Backup rack are synchronised.

### **ICS-Time-of-Day**

The ICS links also carry Time of Day (ToD) information when the ICS clock interfaces are configured for the same. Only the Backup DSC can synchronise with ToD from the Primary DSC and not vice versa. The 1588 clock information transmitted on all 1588 interfaces in the cluster (including interfaces on Backup rack) is of the clock selected at the Primary DSC. Thus, it is important that ICS clock interface on Backup DSC is configured such that it is the clock which is selected for ToD on the Backup DSC.

#### **Recommended ICS Interface Connections**

#### No inter-chassis frequency or time synchronization support:

Figure 1: No inter-chassis frequency support



SyncE is used from the ASR9K cluster to provide precision frequency to mobile cell sites. A BITS clock is connected to each chassis of the cluster, meaning that the frequencies of both chassis are synchronized and the cell sites will all be synchronized, regardless of which chassis they synchronize to. In most deployments redundant BITS connections would be made to each chassis, to prevent against failure of any single BITS link.

#### With inter-chassis synchronization support:

Figure 2: With inter-chassis synchronization support



SyncE is used to synchronize the frequency of an ASR9k cluster to an upstream device. To provide redundancy in the case of one of the external SyncE inputs going down, the frequencies of the different cluster chassis must somehow be synchronized; else cell sites which select links from different chassis to synchronize may be out of sync if one of the SyncE links goes down.

# **Configuring Frequency Synchronization**

# **Enabling Frequency Synchronization on the Router**

This task describes the router-level configuration required to enable frequency synchronization.

	<b>(</b>	
Im	portant	<b>Frequency synchronization</b> configuration is mandatory to enable any type of frequency or time source on the router. This includes SyncE, clock-interfaces, Precision Time Protocol (PTP) or internal oscillator.
	Note	If timing mode system is not configured, the major alarm T4 PLL is in FREERUN mode is raised. This alarm has no functional impact to the system behavior.
SUMMARY STEPS		
	1.	configure
	2	frequency synchronization

- frequency synchronization
- 3. clock-interface timing-mode {independent | system
- 4. quality itu-t option  $\{1 \mid 2 \text{ generation } \{1 \mid 2\}\}$
- **5.** log selection {changes | errors}
- **6.** Use one of these commands:
  - end
  - commit

### **DETAILED STEPS**

#### Procedure

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.
	Example:	
	RP/0/RSP0/CPU0:router# configure	
Step 2	frequency synchronization	Enables frequency synchronization on the router.
	Example:	

	Command or Action	Purpose
	<pre>RP/0/RSP0/CPU0:router(config)# frequency synchronization</pre>	
Step 3	<pre>clock-interface timing-mode {independent   system Example: RP/0/RSP0/CPU0:router(config-freqsync)# clock-interface timing-mode system</pre>	Configures the type of timing sources that can be used to drive the output from a clock interface. If this command is not used, the default quality mode is used. In the default mode, the clock interface output is driven only by input from line interfaces and the internal oscillator; it is never driven by input from another clock interface. In addition, some heuristic tests are run to detect if the signal being sent out of one clock interface can be looped back by some external box and sent back in via the same, or another clock interface.
		<ul> <li>independent—Specifies that the output of clock interfaces is driven only by the line interfaces (SyncE and SONET/SDH), as in the default mode. Loopback detection is disabled.</li> <li>system—Specifies that the output of a clock interface</li> </ul>
		is driven by the system-selected timing source (the source used to drive all SyncE and SONET/SDH interfaces), including clock interfaces. Loopback detection is disabled.
Step 4	quality itu-t option {1   2 generation {1   2}} Example:	(Optional) Specifies the quality level for the router. The default is <b>option 1</b> .
	RP/0/RSP0/CPU0:router(config-freqsync)# quality itu-t	• option 1—Includes PRC, SSU-A, SSU-B, SEC and DNU.
	option 2 generation 1	• option 2 generation 1—Includes PRS, STU, ST2, ST3, SMC, ST4, RES and DUS.
		• option 2 generation 2—Includes PRS, STU, ST2, ST3, TNC, ST3E, SMC, ST4, PROV and DUS.
		Note The quality option configured here must match the quality option specified in the <b>quality receive</b> and <b>quality</b> <b>transmit</b> commands in interface frequency synchronization configuration mode.
Step 5	log selection {changes   errors}	Enables logging to frequency synchronization.
	<pre>Example: RP/0/RSP0/CPU0:router(config-freqsync)# log selection changes</pre>	<ul> <li>changes—Logs every time there is a change to the selected source, in addition to errors.</li> <li>errors—Logs only when there are no available frequency sources, or when the only available frequency source is the internal oscillator.</li> </ul>

	Command or Action	Purpose
Step 6	Use one of these commands:	Saves configuration changes.
	• end • commit	• When you issue the <b>end</b> command, the system prompts you to commit changes:
	Example: RP/0/RSP0/CPU0:router(config-freqsync)# end or RP/0/RSP0/CPU0:router(config-freqsync)# commit	<ul> <li>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</li> <li>Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes.</li> <li>Use the commit command to save the configuration changes to the running configuration file, and remain within the configuration session.</li> </ul>

#### What to do next

Configure frequency synchronization on any interfaces that should participate in frequency synchronization.

# **Configuring Frequency Synchronization on an Interface**

By default, there is no frequency synchronization on line interfaces. Use this task to configure an interface to participate in frequency synchronization.

#### Before you begin

You must enable frequency synchronization globally on the router.

### **SUMMARY STEPS**

- 1. configure
- **2. interface** *type interface-path-id*
- **3**. frequency synchronization
- 4. selection input
- **5. priority** *priority-value*
- 6. wait-to-restore *minutes*
- 7. ssm disable
- 8. time-of-day-priority priority
- 9. quality transmit {exact | highest | lowest} itu-t option *ql-option*
- **10.** quality receive {exact | highest | lowest} itu-t option *ql-option*

- **11.** Use one of these commands:
  - end
  - commit

### **DETAILED STEPS**

#### Procedure

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.
	Example:	
	RP/0/RSP0/CPU0:router# configure	
Step 2	interface type interface-path-id	Enters interface configuration mode.
	Example:	
	<pre>RP/0/RSP0/CPU0:router(config)# interface GigabitEthernet0/1/1/0</pre>	
Step 3	frequency synchronization	Enables frequency synchronization on the interface and
	Example:	enters interface frequency synchronization mode to configure the various options. By default, this causes the
	<pre>RP/0/RSP0/CPU0:router(config-if)# frequency synchronization</pre>	system selected frequency signal to be used for clocking transmission, but does not enable the use of the interface as an input
0. 4		
Step 4	selection input	(Optional) Specifies the interface as a timing source to be passed to the selection algorithm.
	Example:	
	selection input	
Step 5	priority priority-value	(Optional) Configures the priority of the frequency source
	Example:	on a controller or an interface. Values can range from (highest priority) to 254 (lowest priority). The default va
	<pre>RP/0/RSP0/CPU0:router(config-if-freqsync)# priority 100</pre>	is 100.
		This command is used to set the priority for an interface or clock interface. The priority is used in the clock-selection algorithm to choose between two sources that have the same quality level (QL). Lower priority values are preferred.
Step 6	wait-to-restore minutes	(Optional) Configures the wait-to-restore time, in minutes,
	Example:	for frequency synchronization on an interface. This is the amount of time after the interface comes up before it is
	<pre>RP/0/RSP0/CPU0:router(config-if-freqsync)# wait-to-restore 300</pre>	used for synchronization. Values can range from 0 to 12. The default value is 5.

	Command or Action	Purpose
Step 7	ssm disable	(Optional) Disables Synchronization Status Messages (SSMs) on the interface.
	RP/0/RSP0/CPU0:router(config-if-freqsync)# ssm disable	<ul> <li>For SyncE interfaces, this disables sending ESMC packets, and ignores any received ESMC packets.</li> <li>For SONET and clock interfaces, this causes DNUs to be sent, and ignores any received QL value.</li> </ul>
Step 8	<pre>time-of-day-priority priority Example:     RP/0/RSP0/CPU0:router(config-if-freqsync)#     time-of-day-priority 50</pre>	(Optional) Specifies the priority of this time source as the time-of-day (ToD) source. The priority is used as the first criterion when selecting between sources for a time-of-day selection point. Values can range from 1 (highest priority) to 254 (lowest priority); the default value is 100.
Step 9	<pre>quality transmit {exact   highest   lowest} itu-t option ql-option Example: RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality transmit highest itu-t option 1 prc</pre>	<ul> <li>(Optional) Adjusts the QL that is transmitted in SSMs.</li> <li>exact <i>ql</i>—Specifies the exact QL to send, unless DNU would otherwise be sent.</li> <li>highest <i>ql</i>—Specifies an upper limit on the QL to be sent. If the selected source has a higher QL than the QL specified here, this QL is sent instead.</li> <li>lowest <i>ql</i>—Specifies a lower limit on the QL to be sent. If the selected source has a lower QL than the QL specified here, DNU is sent instead.</li> <li>lowest <i>ql</i>—Specified in this command must match the globally-configured quality option in the <b>quality itu-t</b> option command.</li> <li>Note</li> <li>For clock interfaces that do not support SSM, only the lowest QL can be specified. In this case, rather than sending DNIL the output is squelched, and no signal is</li> </ul>
Step 10	<pre>quality receive {exact   highest   lowest} itu-t option ql-option Example: RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive highest itu-t option 1 prc</pre>	<ul> <li>(Optional) Adjusts the QL value that is received in SSMs, before it is used in the selection algorithm.</li> <li>exact <i>ql</i>—Specifies the exact QL regardless of the value received, unless the received value is DNU.</li> <li>highest <i>ql</i>—Specifies an upper limit on the received QL. If the received value is higher than this specified QL, this QL is used instead.</li> <li>lowest <i>ql</i>—Specifies a lower limit on the received QL. If the received value is lower than this specified QL, DNU is used instead.</li> </ul>

	Command or Action	Purpose
		The quality option specified in this command must match the globally-configured quality option in the <b>quality itu-t</b> <b>option</b> command.
		<b>Note</b> For clock interfaces that do not support SSM, only the exact QL can be specified.
Step 11	Use one of these commands:	Saves configuration changes.
	• end • commit	• When you issue the <b>end</b> command, the system prompts you to commit changes:
	Example: RP/0/RSP0/CPU0:router(config-if-freqsync)# end or RP/0/RSP0/CPU0:router(config-if-freqsync)# commit	<ul> <li>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</li> <li>Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes.</li> <li>Use the commit command to save the configuration changes to the running configuration file, and remain within the configuration session.</li> </ul>

# **Configuring Frequency Synchronization on a Clock Interface**

To enable a clock interface to be used as frequency input or output, you must configure the port parameters and frequency synchronization, as described in this task.



**Note** The configuration on clock interfaces must be the same for corresponding clock interfaces across all RSPs to avoid changes in frequency synchronization behavior in the event of an RSP switchover.

### SUMMARY STEPS

- 1. configure
- 2. clock-interface sync port-no location node-id
- **3**. **port-parameters** {**bits-input** *mode* | **bits-output** *mode* | **dti**}
- **4**. ics

- 5. frequency synchronization
- **6**. selection input
- 7. **priority** *priority-value*
- 8. wait-to-restore *minutes*
- 9. ssm disable
- **10.** time-of-day-priority priority
- **11.** quality transmit {exact | highest | lowest} itu-t option *ql-option*
- **12.** quality receive {exact | highest | lowest} itu-t option *ql-option*
- **13.** Use one of these commands:
  - end
  - commit

### **DETAILED STEPS**

### Procedure

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.
	Example:	
	RP/0/RSP0/CPU0:router# configure	
Step 2	clock-interface sync port-no location node-id	Enters clock interface configuration mode to configure the
	Example:	clock interface.
	<pre>RP/0/RSP0/CPU0:router(config)# clock-interface sync 2 location 0/2/0</pre>	
Step 3	<pre>port-parameters {bits-input mode   bits-output mode   dti}</pre>	Specifies the type of external clock source for the clock interface. Options are BITS RX, BITS TX or DTI. The
	Example:	possible <i>mode</i> values for BITS interfaces are <b>2m</b> ,
	RP/0/RSP0/CPU0:router(config-clock-if)# port-parameters dti	6m-output-only, e1 or t1.
Step 4	ics	Enables chassis synchronization.
	Example:	
	<pre>RP/0/RSP0/CPU0:router(config)# ics</pre>	
Step 5	frequency synchronization	Enters clock interface frequency synchronization mode to
	Example:	configure frequency synchronization parameters.
	RP/0/RSP0/CPU0:router(config-clock-if) # frequency	Note The remaining steps in this task are the same as those used
	RP/0/RSP0/CPU0:router(config-clk-freqsync)#	to configure the interface frequency synchronization.
Step 6	selection input	(Optional) Specifies the interface as a timing source to be
	Example:	passed to the selection algorithm.

	Command or Action	Purpose
	<pre>RP/0/RSP0/CPU0:router(config-if-freqsync)# selection input</pre>	
Step 7	<pre>priority priority-value Example:     RP/0/RSP0/CPU0:router(config-if-freqsync)#     priority 100</pre>	<ul> <li>(Optional) Configures the priority of the frequency source on a controller or an interface. Values can range from 1 (highest priority) to 254 (lowest priority). The default value is 100.</li> <li>This command is used to set the priority for an interface or clock interface. The priority is used in the clock-selection algorithm to choose between two sources that have the same quality level (QL). Lower priority values are preferred.</li> </ul>
Step 8	<pre>wait-to-restore minutes Example:     RP/0/RSP0/CPU0:router(config-if-freqsync)#     wait-to-restore 300</pre>	(Optional) Configures the wait-to-restore time, in minutes, for frequency synchronization on an interface. This is the amount of time after the interface comes up before it is used for synchronization. Values can range from 0 to 12. The default value is 5.
Step 9	<pre>ssm disable Example: RP/0/RSP0/CPU0:router(config-if-freqsync)# ssm disable</pre>	<ul> <li>(Optional) Disables Synchronization Status Messages</li> <li>(SSMs) on the interface.</li> <li>For SyncE interfaces, this disables sending ESMC packets, and ignores any received ESMC packets.</li> <li>For SONET and clock interfaces, this causes DNUs to be sent, and ignores any received QL value.</li> </ul>
Step 10	<pre>time-of-day-priority priority Example:     RP/0/RSP0/CPU0:router(config-if-freqsync)#     time-of-day-priority 50</pre>	(Optional) Specifies the priority of this time source as the time-of-day (ToD) source. The priority is used as the first criterion when selecting between sources for a time-of-day selection point. Values can range from 1 (highest priority) to 254 (lowest priority); the default value is 100.
Step 11	<pre>quality transmit {exact   highest   lowest} itu-t option ql-option Example: RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality transmit highest itu-t option 1 prc</pre>	<ul> <li>(Optional) Adjusts the QL that is transmitted in SSMs.</li> <li>exact <i>ql</i>—Specifies the exact QL to send, unless DNU would otherwise be sent.</li> <li>highest <i>ql</i>—Specifies an upper limit on the QL to be sent. If the selected source has a higher QL than the QL specified here, this QL is sent instead.</li> <li>lowest <i>ql</i>—Specifies a lower limit on the QL to be sent. If the selected source has a lower QL than the QL specified here, DNU is sent instead.</li> <li>lowest <i>ql</i>—Specified in this command must match the globally-configured quality option in the <b>quality itu-t</b> option command.</li> <li>Note</li> <li>For clock interfaces that do not support SSM, only the lowest QL can be specified. In this case, rather than</li> </ul>

	Command or Action	Purpose
		sending DNU, the output is squelched, and no signal is sent.
Step 12	quality receive {exact   highest   lowest} itu-t option       ql-option	(Optional) Adjusts the QL value that is received in SSMs, before it is used in the selection algorithm.
	Example: RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive highest itu-t option 1 prc	• exact <i>ql</i> —Specifies the exact QL regardless of the value received, unless the received value is DNU.
		• highest <i>ql</i> —Specifies an upper limit on the received QL. If the received value is higher than this specified QL, this QL is used instead.
		• <b>lowest</b> <i>ql</i> —Specifies a lower limit on the received QL. If the received value is lower than this specified QL, DNU is used instead.
		The quality option specified in this command must match the globally-configured quality option in the <b>quality itu-t</b> <b>option</b> command.
		<b>Note</b> For clock interfaces that do not support SSM, only the exact QL can be specified.
Step 13	Use one of these commands:	Saves configuration changes.
	• end • commit	• When you issue the <b>end</b> command, the system prompts you to commit changes:
	<b>Example:</b>	Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:
	or	• Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration accession and returns the router to
	RP/0/RSP0/CPU0:router(config-if-freqsync)# comm	EXEC mode.
		• Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		• Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the <b>commit</b> command to save the configuration changes to the running configuration file, and remain within the configuration session.

## **Configuring Clock Interface with DTI input**

This procedure describes the steps involved to configure a Clock interface with DTI input.

1. To configure a clock interface, use **clock-interface sync** *value* **location** *node* command in the configuration mode.

RP/0/RSP0/CPU0:router(config)# clock-interface sync 1 location 0/RSP0/CPU0

**2.** To configure port parameters for the given clock interface, use **port-parameters dti** command in the clock-interface configuration mode.

RP/0/RSP0/CPU0:router(config-clock-if) # port-parameters dti

**3.** To enable frequency synchronization, use **frequency synchronization** command in the clock-interface configuration mode.

RP/0/RSP0/CPU0:router(config-clock-if)# frequency synchronization

**4.** To configure selection input for the given clock interface, use **selection input** command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# selection input

**5.** To configure priority for the clock interface, use **priority** *number* command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync) # priority 1

6. To configure wait-to-restore time for the clock interface, use **wait-to-restore** *number* command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# wait-to-restore 0

7. To disable SSM packets for the clock interface, use **ssm disable** command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# ssm disable

8. To configure quality settings for the clock interface, use **quality receive exact itu-t option** *number* **generation** *number* **PRS** command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive exact itu-t option 2
generation 2 PRS

#### Verification

To display the current running configuration of an interface, use **show run clock-interface** command.

RP/0/RSP0/CPU0:router# show run clock-interface sync 1 location 0/RSP0/CPU0

```
clock-interface sync 1 location 0/RSP0/CPU0
port-parameters
dti
```

```
!
frequency synchronization
  selection input
  priority 1
  wait-to-restore 0
   ssm disable
   quality receive exact itu-t option 2 generation 2 PRC
!
!RP/0/RSP0/CPU0:router#
```

## **Configuring GPS Settings for a sync2 interface**

This procedure describes the steps involved to configure GPS settings for a sync2 interface.

1. To configure a clock interface, use **clock-interface sync** *port-number* **location** *interface-location* command in the configuration mode.

RP/0/RSP0/CPU0:router(config)# clock-interface sync 2 location 0/RSP0/CPU0

2. To configure port parameters for the given clock interface, use **port-parameters** command in the clock-interface configuration mode.

RP/0/RSP0/CPU0:router(config-clock-if) # port-parameters

3. To configure GPS input parameters, use gps-input tod-format gprmc pps-input ttl command.

RP/0/RSP0/CPU0:router(config-clk-parms)# gps-input tod-format
gprmc pps-input ttl

4. To return to the clock-interface configuration mode, use **exit** command.

RP/0/RSP0/CPU0:router(config-clk-parms)# exit

**5.** To enable frequency synchronization, use **frequency synchronization** command in the clock-interface configuration mode.

RP/0/RSP0/CPU0:router(config-clock-if)# frequency synchronization

**6.** To configure selection input for the given clock interface, use **selection input** command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# selection input

**7.** To configure priority for the clock interface, use **priority** *number* command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# priority 10

**8.** To configure wait-to-restore time for the clock interface, use **wait-to-restore** *number* command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# wait-to-restore 0

**9.** To disable SSM packets for the clock interface, use **ssm disable** command in the frequency-synchronization clock-configuration mode.

RP/0/RSP0/CPU0:router(config-clk-freqsync)# ssm disable

**10.** To configure quality settings for the clock interface, use **quality receive exact itu-t option** *number* **generation** *number* **PRS** command in the frequency-synchronization clock-configuration mode.

```
RP/0/RSP0/CPU0:router(config-clk-freqsync)# quality receive exact itu-t option 2
generation 2 PRS
```

#### Verification

To verify the configured GPS parameters, use show run clock-interface command.

RP/0/RSP0/CPU0:router# show run clock-interface sync 2 location 0/RSP0/CPU0

```
clock-interface sync 2 location 0/RSP0/CPU0
port-parameters
gps-input tod-format gprmc pps-input ttl
```

## **GPS ToD Support for NMEA**

National Marine Electronics Associations (NMEA) 0183 is a standard protocol used by GPS receivers to transmit data and is responsible for creating a standard uniform interface for digital data exchange between different marine electronic products. NMEA provides protocol strings to send out GPS updates. GPRMC is one such NMEA string that provides exact data and time (Greenwich time), latitude, longitude, heading, and speed. Router receives GPS ToD messages in serial ASCII stream through the RS422 interface in three formats - NTP Type 4, Cisco, and GPRMC. The timing data is extracted from this stream.



Note Cisco ASR 9000 Series Routers can support ToD in NMEA or GPRMC format. Currently, this is supported only on RS422.



**Note** You can refer to the below support information in context of the current release and see relevant *Release Notes* for more information on supported features and hardware.

Supported hardware are:

- A9K-RSP440-SE/TR
- A9K-RSP880-SE/TR
- A99-RP2-SE/TR
- A9K-RSP880-LT-SE/TR
- A99-RSP-SE/TR

# **Configuring ICS**

This task enables inter-chassis synchronization for interfaces.

### **SUMMARY STEPS**

- 1. configure
- **2.** clock-interface sync *port-no* location *node-id*
- 3. port-parameters ics
- 4. frequency synchronization
- 5. selection input
- **6. priority** *priority-value*
- 7. wait-to-restore minutes
- 8. time-of-day-priority priority
- 9. quality receive { exact | highest | lowest} itu-t option option

### **DETAILED STEPS**

### Procedure

	Command or Action	Purpose				
Step 1	configure	Enters global configuration mode.				
	Example:					
	RP/0/RSP0/CPU0:router# configure					
Step 2	clock-interface sync port-no location node-id	Enters clock interface configuration mode to configure the clock interface.				
	Example:					
	<pre>RP/0/RSP0/CPU0:router(config)# clock-interface sync 2 location 1/RSP0/CPU0</pre>					
Step 3	port-parameters ics	Enables inter-chassis synchronization.				
	Example:					
	<pre>RP/0/RSP0/CPU0:router(config-clock-if)# port-parameters ics</pre>					
Step 4	frequency synchronization	Enters clock interface frequency synchronization mode to				
	Example:	configure frequency synchronization parameters.				
	RP/0/RSP0/CPU0:router(config-clock-if)# frequency	Note				
	synchronization RP/0/RSP0/CPU0:router(config-clk-freqsync)#	to configure the interface frequency synchronization.				
Step 5	selection input	(Optional) Specifies the interface as a timing source to be passed to the selection algorithm.				
	Example:					
	<pre>RP/0/RSP0/CPU0:router(config-if-freqsync)# selection input</pre>					

	Command or Action	Purpose
Step 6	<pre>priority priority-value Example:     RP/0/RSP0/CPU0:router(config-if-freqsync)# priority     100</pre>	<ul> <li>(Optional) Configures the priority of the frequency source on a controller or an interface. Values can range from 1 (highest priority) to 254 (lowest priority). The default value is 100.</li> <li>This command is used to set the priority for an interface or clock interface. The priority is used in the clock-selection algorithm to choose between two sources that have the same quality level (QL). Lower priority values are preferred.</li> </ul>
Step 7	<pre>wait-to-restore minutes Example: RP/0/RSP0/CPU0:router(config-if-freqsync)# wait-to-restore 300</pre>	(Optional) Configures the wait-to-restore time, in minutes, for frequency synchronization on an interface. This is the amount of time after the interface comes up before it is used for synchronization. Values can range from 0 to 12. The default value is 5.
Step 8	<pre>time-of-day-priority priority Example: RP/0/RSP0/CPU0:router(config-if-freqsync)# time-of-day-priority 50</pre>	(Optional) Specifies the priority of this time source as the time-of-day (ToD) source. The priority is used as the first criterion when selecting between sources for a time-of-day selection point. Values can range from 1 (highest priority) to 254 (lowest priority); the default value is 100.
Step 9	quality receive { exact   highest   lowest } itu-t optionoptionExample:RP/0/RSP0/CPU0:router (config-clk-freqsync) #quality receive exact itu-t option 1 PRC	

# **Verifying the Frequency Synchronization Configuration**

After performing the frequency synchronization configuration tasks, use this task to check for configuration errors and verify the configuration.

### **SUMMARY STEPS**

- **1**. show frequency synchronization configuration-errors
- 2. show frequency synchronization interfaces brief
- 3. show frequency synchronization interfaces node-id
- 4. show processes fsyncmgr location node-id

#### **DETAILED STEPS**

### Procedure

**Step 1** show frequency synchronization configuration-errors

Example:

RP/0/RSP0/CPU0:router# show frequency synchronization configuration-errors

Displays any errors that are caused by inconsistencies between shared-plane (global) and local-plane (interface) configurations. There are two possible errors that can be displayed:

- Frequency Synchronization is configured on an interface (line interface or clock-interface), but is not configured globally. Refer to Enabling Frequency Synchronization on the Router, on page 7
- The QL option configured on some interface does not match the global QL option. Under an interface (line interface or clock interface), the QL option is specified using the **quality transmit** and **quality receive** commands. The value specified must match the value configured in the global **quality itu-t option** command, or match the default (option 1) if the global **quality itu-t option** command is not configured.

Once all the errors have been resolved, meaning there is no output from the command, continue to the next step.

#### **Step 2** show frequency synchronization interfaces brief

#### Example:

RP/0/RSP0/CPU0:router# show frequency synchronization interfaces brief

Flags:	> - Up d - SSM Disabled	D - 1 x - 1	Down Peer ti	imed	out	S - Assigned for selection i - Init state	
Fl Int	erface	QLrcv	QLuse	Pri	QLsnt	Source	
>Sx Gig Dd Gig	gabitEthernet0/2/0/0 gabitEthernet0/2/0/1	Fail n/a	Fail Fail	100 100	DNU n/a	None None	
RP/0/RSP0/CPU0:router# show frequency synchronization clock-interfaces brief							
Flags:	> - Up d - SSM Disabled	D - I s - (	Down Dutput	sque	elched	S - Assigned for selection L - Looped back	
Node 0/	0/CPU0:						

Fl	Clock Interface	QLrcv	QLuse	Pri	QLsnd	Source
>S	Sync0	PRC	Fail	100	SSU-B	Internal0 [0/0/CPU0]
>	Sync1	SSU-A	Fail	100	SSU-B	Internal0 [0/0/CPU0]
>S	Internal0	n/a	SSU-B	255	n/a	None

Node 0/1/CPU0:

Fl	Clock Interface	QLrcv	QLuse	Pri	QLsnd	Source
=====						
D	Sync0	None	Fail	100	SSU-B	Internal0 [0/1/CPU0]
D	Sync1	None	Fail	100	SSU-B	Internal0 [0/1/CPU0]
>S	Internal0	n/a	SSU-B	255	n/a	None

Verifies the configuration. Note the following points:

- All line interface that have frequency synchronization configured are displayed.
- All clock interfaces and internal oscillators are displayed.
- Sources that have been nominated as inputs (in other words, have **selection input** configured) have 'S' in the Flags column; sources that have not been nominated as inputs do not have 'S' displayed.

```
Note
```

Internal oscillators are always eligible as inputs.

• '>' or 'D' is displayed in the flags field as appropriate.

If any of these items are not true, continue to the next step.

#### **Step 3** show frequency synchronization interfaces node-id

#### Example:

RP/0/RSP0/CPU0:router# show frequency synchronization interfaces GigabitEthernet0/2/0/2

```
Interface GigabitEthernet0/2/0/2 (shutdown)
 Assigned as input for selection
 SSM Enabled
 Input:
   Down
   Last received QL: Failed
   Effective QL: Failed, Priority: 100
 Output:
   Selected source: Sync0 [0/0/CPU0]
   Selected source QL: Opt-I/PRC
   Effective QL: Opt-I/PRC
 Next selection points: LC INGRESS
RP/0/RSP0/CPU0:router# show frequency synchronization clock-interfaces location 0/1/CPU0
Node 0/1/CPU0:
 _____
 Clock interface Sync0 (Down: mode not configured)
   SSM supported and enabled
   Input:
     Down
     Last received QL: Opt-I/PRC
     Effective QL: Failed, Priority: 100
   Output:
     Selected source: Internal0 [0/1/CPU0]
     Selected source QL: Opt-I/SSU-B
     Effective QL: Opt-I/SSU-B
 Next selection points: RP SYSTEM
 Clock interface Sync1 (Down: mode not configured)
   SSM supported and enabled
   Input:
     Down
     Last received QL: Opt-I/PRC
     Effective QL: Failed, Priority: 100
   Output:
     Selected source: Internal0 [0/1/CPU0]
     Selected source QL: Opt-I/SSU-B
     Effective QL:
                        Opt-I/SSU-B
 Next selection points: RP SYSTEM
```

L

```
Clock interface Internal0 (Up)
Assigned as input for selection
Input:
Default QL: Opt-I/SSU-B
Effective QL: Opt-I/SSU-B, Priority: 255
Next selection points: RP_SYSTEM RP_CLOCK_INTF
```

Investigates issues within individual interfaces. If the clock interface is down, a reason is displayed. This may be because there is missing or conflicting platform configuration on the clock interface.

### Step 4 show processes fsyncmgr location node-id

#### Example:

RP/0/RSP0/CPU0:router# show processes fsyncmgr location 0/0/CPU0

```
Job Id: 134
                PID: 30202
      Executable path: /pkg/bin/fsyncmgr
          Instance #: 1
          Version ID: 00.00.0000
            Respawn: ON
       Respawn count: 1
Max. spawns per minute: 12
        Last started: Mon Mar 9 16:30:43 2009
        Process state: Run
       Package state: Normal
    Started on config: cfg/gl/freqsync/g/a/enable
               core: MAINMEM
           Max. core: 0
           Placement: None
         startup path: /pkg/startup/fsyncmgr.startup
              Ready: 0.133s
     Process cpu time: 1730768.741 user, -133848.-361 kernel, 1596920.380 total
_____
                _____
```

Verifies that the fsyncmgr process is running on the appropriate nodes.

# **Class C Timing Support**

To Configure Class C mode, see Class C Timing Mode.