

Configure Frequency Synchronization

This chapter describes the Cisco IOS XR commands to configure Frequency Synchronization.

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Frequency Synchronization

Frequency synchronization is the ability to distribute precision frequency around the network. Precision frequency is required in the 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.

To maintain frequency synchronization links, a set of operations messages are required. These messages ensure a node is always deriving timing from the most reliable source, and transfers information about the quality of the timing source being used to clock the frequency synchronization link.

Configuring Frequency Synchronization

Enabling Frequency Synchronization on the Router

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

Procedure

Step 1 **configure**

Step 2 **frequency synchronization**

Example:

```
RP/0/(config)# frequency synchronization
```

Enables frequency synchronization on the router.

Step 3 **clock-interface timing-mode system**

Example:

```
RP/0/(config-freqsync)# clock-interface timing-mode system
```

Sets the timing source for clock-interface output.

Step 4 **quality itu-t option** {**1** | **2 generation** {**1** | **2**}}

Example:

```
RP/0/(config-freqsync)# quality itu-t
option 2 generation 1
```

(Optional) Specifies the quality level for the router. The default is **option 1**.

- **option 1**—Includes PRC, SSU-A, SSU-B, SEC and DNU.
- **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 **quality receive** and **quality transmit** commands in interface frequency synchronization configuration mode.

Step 5 **log selection** {**changes** | **errors**}

Example:

```
RP/0/(config-freqsync)# log selection changes
```

Enables logging to frequency synchronization.

- **changes**—Logs every time when there is a change to the selected source, in addition to errors.
- **errors**—Logs only when there are no available frequency sources, or when the only available frequency source is the internal oscillator.

Step 6 Use one of these commands:

- **end**
- **commit**

Example:

```
RP/0/(config-freqsync)# end
```

or

```
RP/0/(config-freqsync)# commit
```

Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

```
Uncommitted changes found, commit them
before exiting(yes/no/cancel)? [cancel]:
```

  - When you enter **yes**, it saves the configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

- When you enter **no**, it exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
- When you enter **cancel**, it leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the **commit** command to save the configuration changes to the running configuration file, and remain within the configuration session.

What to do next

Configure frequency synchronization on any interface 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.

Limitations:

- Maximum two interfaces are monitored for frequency synchronization selection.
- Frequency Synchronization is supported only with the following:

Interface Type	Controller	Mapping Type
Ethernet packet (LAN PHY).	TenGigE, FortyGigE, and HundredGigE	N/A
Ethernet terminated non-channelized OTN.	OTU2e and OTU3	bmp
Ethernet terminated non-channelized OTN.	OTU4	gmp

Before you begin

You must enable frequency synchronization globally on the router.

Procedure

Step 1 **config**

Example:

```
RP/0/# config
```

Enters configuration mode.

Step 2 **interface** *type interface-path-id*

Example:

```
RP/0/(config)# interface tenGigE0/1/0/1
```

Enters interface configuration mode.

Step 3 **frequency synchronization**

Example:

```
RP/0/(config-if)# frequency synchronization
```

Enters interface configuration mode.

Step 4 **selection input**

Example:

```
RP/0/(config-if-freqsync)# selection input
```

(Optional) Specifies the interface as a timing source to be passed to the selection algorithm.

Step 5 **priority** *priority-value*

Example:

```
RP/0/(config-if-freqsync)# priority 100
```

(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.

This command is used to set the priority for an 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*

Example:

```
RP/0/(config-if-freqsync)# wait-to-restore 3
```

(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 7 **ssm disable**

Example:

```
RP/0/(config-if-freqsync)# ssm disable
```

(Optional) Disables Synchronization Status Messages (SSMs) on the interface.

- For frequency synchronization interfaces, this disables sending ESMC packets, and ignores any received ESMC packets.

Step 8 **quality transmit** {**exact** | **highest** | **lowest**} **itu-t option** *ql-option*

Example:

```
RP/0/(config-clk-freqsync)# quality transmit
highest itu-t option 1 prc
```

(Optional) Adjusts the QL that is transmitted in SSMs.

- **exact** *ql*—Specifies the exact QL to send, otherwise DNU will be send.
- **highest** *ql*—Specifies an upper limit on the received QL. The received QL will be used if the received value is higher than this specified QL.

- **lowest** *ql*—Specifies a lower limit on the received QL. DNU will be used if the received value is lower than this specified QL.

The quality option specified in this command must match the globally-configured quality option in the **quality itu-t option** command.

Step 9 **quality receive** {**exact** | **highest** | **lowest**} **itu-t option** *ql-option*

Example:

```
RP/0/(config-clk-freqsync)# quality receive
highest itu-t option 1 prc
```

(Optional) Adjusts the QL value that is received in SSMs, before it is used in the selection algorithm.

- **exact** *ql*—Specifies the exact QL to send, otherwise DNU will be send.
- **highest** *ql*—Specifies an upper limit on the received QL. The received QL will be used if the received value is higher than this specified QL.
- **lowest** *ql*—Specifies a lower limit on the received QL. DNU will be used if the received value is lower than this specified QL.

The quality option specified in this command must match the globally-configured quality option in the **quality itu-t option** command.

Step 10 Use one of these commands:

- **end**
- **commit**

Example:

```
RP/0/(config-if-freqsync)# end
```

or

```
RP/0/(config-if-freqsync)# commit
```

Saves configuration changes.

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 RP's to avoid changes in frequency synchronization behavior in the event of an RP switchover.

Procedure

Step 1 **configure**

Step 2 Perform to configure a clock interface.

Step 3 **ics**

Example:

```
RP/0/(config)# ics
```

Enables chassis synchronization.

Step 4 **frequency synchronization**

Example:

```
RP/0/(config-clock-if)# frequency synchronization
RP/0/(config-clk-freqsync)#
```

Enters clock interface frequency synchronization mode to configure frequency synchronization parameters.

Note
The remaining steps in this task are the same as those used to configure the interface frequency synchronization.

Step 5 **selection input**

Example:

```
RP/0/(config-if-freqsync)# selection input
```

(Optional) Specifies the interface as a timing source to be passed to the selection algorithm.

Step 6 **priority** *priority-value*

Example:

```
RP/0/(config-if-freqsync)# priority 100
```

(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.

This command is used to set the priority for an 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 7 **wait-to-restore** *minutes*

Example:

```
RP/0/(config-if-freqsync)# wait-to-restore 3
```

(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 **ssm disable**

Example:

```
RP/0/(config-if-freqsync)# ssm disable
```

(Optional) Disables Synchronization Status Messages (SSMs) on the interface.

- For frequency synchronization interfaces, this disables sending ESMC packets, and ignores any received ESMC packets.

Step 9 **quality transmit** {**exact** | **highest** | **lowest**} **itu-t option** *ql-option*

Example:

```
RP/0/(config-clk-freqsync)# quality transmit
highest itu-t option 1 prc
```

(Optional) Adjusts the QL that is transmitted in SSMs.

- **exact** *ql*—Specifies the exact QL to send, otherwise DNU will be send.
- **highest** *ql*—Specifies an upper limit on the received QL. The received QL will be used if the received value is higher than this specified QL.
- **lowest** *ql*—Specifies a lower limit on the received QL. DNU will be used if the received value is lower than this specified QL.

The quality option specified in this command must match the globally-configured quality option in the **quality itu-t option** command.

Step 10 **quality receive** {**exact** | **highest** | **lowest**} **itu-t option** *ql-option*

Example:

```
RP/0/(config-clk-freqsync)# quality receive
highest itu-t option 1 prc
```

(Optional) Adjusts the QL value that is received in SSMs, before it is used in the selection algorithm.

- **exact** *ql*—Specifies the exact QL to send, otherwise DNU will be send.
- **highest** *ql*—Specifies an upper limit on the received QL. The received QL will be used if the received value is higher than this specified QL.
- **lowest** *ql*—Specifies a lower limit on the received QL. DNU will be used if the received value is lower than this specified QL.

The quality option specified in this command must match the globally-configured quality option in the **quality itu-t option** command.

Step 11 Use one of these commands:

- **end**
- **commit**

Example:

```
RP/0/(config-if-freqsync)# end
```

or

```
RP/0/(config-if-freqsync)# commit
```

Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

```
Uncommitted changes found, commit them
before exiting(yes/no/cancel)? [cancel]:
```

- When you enter **yes**, it saves the changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
- When you enter **no**, it exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
- When you enter **cancel**, it leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the **commit** command to save the configuration changes to the running configuration file, and remain within the configuration session.

Verifying the Frequency Synchronization Configuration

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

Procedure

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

Example:

```
RP/0/# show frequency synchronization configuration-errors

  RP/0/RP0:ios#sh frequency synchronization configuration-errors
  Tue Aug  2 05:59:14.516 UTC
  Node 0/RP0:

==============
    interface TenGigE0/1/0/2 frequency synchronization
* Frequency synchronization is enabled on this interface, but isn't enabled globally.
RP/0/RP0:ios#
```

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:

- The QL option configured on some interface does not match the global QL option. Under an interface (line 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/# show frequency synchronization interfaces brief

Flags:  > - Up                D - Down              S - Assigned for selection
        d - SSM Disabled      x - Peer timed out    i - Init state
        s - Output squelched
Fl   Interface                QLrcv QLuse Pri QLsnd Output driven by
==== ======================== ===== ===== === ===== ========================
>S   TenGigE0/2/0/7           ST3   ST3   100 PRS   TenGigE0/13/0/7
>S   TenGigE0/2/0/8           ST3   ST3   100 PRS   TenGigE0/13/0/7
>    TenGigE0/13/0/5          PRS   Fail  100 PRS   TenGigE0/13/0/7
>    TenGigE0/13/0/6          PRS   Fail  100 PRS   TenGigE0/13/0/7
>S   TenGigE0/13/0/7          PRS   PRS   100 DUS   TenGigE0/13/0/7
>S   TenGigE0/13/0/8          ST3   ST3   100 PRS   TenGigE0/13/0/7
D    HundredGigE0/13/0/0      Fail  Fail  100 PRS   TenGigE0/13/0/7
```

Verifies the configuration. Note the following points:

- All line interface that have frequency synchronization configured 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/# show frequency synchronization interfaces

Interface FortyGigE0/7/0/2 (unknown)
  Wait-to-restore time 0 minutes
  SSM Enabled
  Input:
    Down - not assigned for selection
    Supports frequency
  Output:
    Selected source: None
    Effective QL: DNU
  Next selection points: LC7_ING_SEL
```

Investigates issues within individual interfaces.

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

Example:

```
RP/0/# 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.

Step 5 **show frequency synchronization clock-interfaces**

Example:

```
RP/0/#show frequency synchronization clock-interfaces

Node 0/RP0:
==============
Clock interface Sync0 (Down: NONE)
    Wait-to-restore time 5 minutes
    SSM supported and enabled
    Input:
      Down - not assigned for selection
      Last received QL: None
      Supports frequency
    Output is disabled
  Next selection points: T0_SEL

  Clock interface Sync1 (Down: NONE)
    Wait-to-restore time 0 minutes
    SSM supported and enabled
    Input is disabled
    Output:
      Selected source: None
      Effective QL: DNU
  Next selection points: None

  Clock interface Sync2 (Down: NONE)
    Wait-to-restore time 5 minutes
    SSM supported and enabled
    Input:
      Down - not assigned for selection
      Last received QL: None
      Supports frequency
    Output is disabled
  Next selection points: T0_SEL

  Clock interface Sync3 (Down: NONE)
    Wait-to-restore time 0 minutes
    SSM supported and enabled
    Input is disabled
    Output:
```

```
      Selected source: None
      Effective QL: DNU
  Next selection points: None

  Clock interface Internal0 (Up)
    Assigned as input for selection
    Input:
      Default QL: None
      Effective QL: Failed, Priority: 255, Time-of-day Priority 255
      Supports frequency
  Next selection points: T0_SEL T4_SEL
```

Step 6 **show frequency synchronization clock-interfaces brief**

Example:

```
RP/0/#show frequency synchronization clock-interfaces brief

Flags:  > - Up                D - Down              S - Assigned for selection
        d - SSM Disabled      s - Output squelched  L - Looped back
Node 0/RP0:
==============
  Fl    Clock Interface     QLrcv  QLuse  Pri QLsnd  Output driven by
  ===== ================== ====== ====== === ====== ========================
  D     Sync0               None   Fail   100 n/a    n/a
  D     Sync1               n/a    n/a    n/a DNU    None
  D     Sync2               None   Fail   100 n/a    n/a
  D     Sync3               n/a    n/a    n/a DNU    None
  DS    Internal0           n/a    Fail   255 n/a    n/a
```

Step 7 **show frequency synchronization clock-interfaces**

Example:

```
RP/0/#show frequency synchronization clock-interfaces

Node 0/RP0:
==============
  Clock interface Sync0 (Unknown state)
    Wait-to-restore time 5 minutes
    SSM supported and enabled
    Input:
      Down - not assigned for selection
      Last received QL: None
      Supports frequency
    Output is disabled
  Next selection points: T0_SEL

  Clock interface Sync1 (Unknown state)
    Wait-to-restore time 5 minutes
    SSM supported and enabled
    Input is disabled
    Output:
      Selected source: None
      Effective QL: DNU
  Next selection points: None

  Clock interface Sync2 (Unknown state)
    Wait-to-restore time 5 minutes
    SSM supported and enabled
    Input:
      Down - not assigned for selection
      Last received QL: None
```

```
    Supports frequency
  Output is disabled
Next selection points: T0_SEL

Clock interface Sync3 (Unknown state)
  Wait-to-restore time 5 minutes
  SSM supported and enabled
  Input is disabled
  Output:
    Selected source: None
    Effective QL: DNU
Next selection points: None

Clock interface Internal0 (Unknown state)
  Assigned as input for selection
  Input:
    Default QL: None
    Effective QL: Failed, Priority: 255, Time-of-day Priority 255
    Supports frequency
Next selection points: T0_SEL T4_SEL
```

Step 8 **show controllers timing controller clock**

Example:

```
RP/0/#show controllers timing controller clock

SYNCEC Clock-Setting:

          Port 0          Port 1          Port 2          Port 3
Config     : No            Yes             No              Yes
BITS Mode  : -             E1              -               E1
Framing    : -             CRC4            -               CRC4
Linecoding : -             AMI             -               AMI
Submode    : -             Sa4             -               Sa4
Shutdown   : No            No              No              No
Direction  : RX            TX              RX              TX
QL Option  : O1            O1              O1              O1
RX_ssm     : -             -               -               -
TX_ssm     : -             SEC             -               SEC
If_state   : ADMIN_DOWN    DOWN            ADMIN_DOWN      DOWN
```