Network Synchronization for the Cisco 4000 Series Integrated Services Routers

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To maintain the quality of the services offered by the network and to operate efficiently, devices must operate at the same clock rates. This document explains how to configure network synchronization between two devices—the router and a network interface module (NIM), such as the Cisco Fourth-Generation T1/E1 Voice and WAN Network Interface Module.

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Finding Feature Information

Your software release might not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.
Information About Network Synchronization

• Network Efficiency, page 2
• Synchronization between the NIM and the Router, page 2

Network Efficiency

Most of the services that are provided over networks must be fully synchronized with one another in order to operate efficiently. If the network devices that constitute a network do not operate at the same clock rates, there is an overall decrease in the performance of the network and a consequent degradation in the quality of the services offered by the network.

Synchronization between the NIM and the Router

Network synchronization is supported for Cisco Fourth-Generation T1/E1 Voice and WAN Network Interface Modules (NIMs) on the Cisco 4000 Series ISR, by using the network-clock synchronization automatic global configuration command. By default, this command is disabled and user must configure it on Cisco 4000 Series ISR. This command is made ineffective for a particular NIM if you use the no network-clock participation slot/subslot command. See Example 3: Disabling and Enabling a Module from Participating in the Backplane Clock, page 6. This causes the NIM to have its own separate clock domain.
Prerequisites for Network Synchronization

The following goals must be taken into account while designing the synchronization plan for a network:

- Synchronize the greatest number of network elements to the smallest number of independent clock sources. Ideally, all network elements should be synchronized to a single clock source.
- Use high-quality clock sources for stability and long-term accuracy.
- To ensure the resiliency of synchronization, plan for possible failure of clock sources, network elements, and network trunks.

Restrictions for Network Synchronization

This section lists the restrictions for configuring network synchronization on a router. Network synchronization can be configured only for a Cisco Fourth-Generation T1/E1 Voice and WAN Network Interface Module.

- You can configure two ports per NIM as clock sources on a router.
- We recommend that you do not configure multiple input sources with the same priority because this impacts the $T_{SM}$ (switching message delay).
- The quality of a clock source is not considered by the router. Synchronization Status Messages (SSMs), which inform neighboring network elements about the quality level of a clock, are not supported by the router. The router uses a clock source based on the source’s availability and priority.

How to Configure Network Synchronization

- Configuring Clock Recovery with a Primary Clock Source
- Configuring the Deselection of a Primary Clock Source
- Configuring Participation of a Module in the Backplane Clock
- Configuring Network Clocking with Revertive Mode
- Configuring the Wait-to-Restore Timer
- Configuring the Hold-Off Timer
- Configuring Lockout of a Clock Source
- Configuring Network Clocking with Force Switching

Configuring Clock Recovery with a Primary Clock Source

This section describes how to configure clock recovery with a primary or secondary clock source.

SUMMARY STEPS

1. configure terminal
2. network-clock synchronization automatic
3. controller [t1|e1] slot/bay/port
4. clock source line primary
5. network-clock input-source priority controller [t1|e1] slot/bay/port
6. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 2 network-clock synchronization automatic</td>
<td>Enables the network clock selection algorithm. (Note that network clock synchronization is disabled by default.) Disables the Cisco-specific network clock process, and turns on the G.781-based automatic clock selection process.</td>
</tr>
<tr>
<td>Example: Router(config)# network-clock synchronization automatic</td>
<td></td>
</tr>
<tr>
<td>Step 3 controller [t1</td>
<td>e1] slot/bay/port</td>
</tr>
<tr>
<td>Example: Router(config)# controller t1 0/2/0</td>
<td></td>
</tr>
<tr>
<td>Step 4 clock source line [primary</td>
<td>secondary]</td>
</tr>
<tr>
<td>Example: Router(config)# clock source line primary</td>
<td></td>
</tr>
<tr>
<td>Step 5 network-clock input-source priority controller [t1</td>
<td>e1] slot/bay/port</td>
</tr>
<tr>
<td>Example: Router(config)# network-clock input-source priority controller t1 0/2/0</td>
<td>Note: The network-clock input-source priority command, which selects the configured controller clock as the backplane clock source, is only available if the module is participated to the backplane.</td>
</tr>
<tr>
<td>Step 6 exit</td>
<td>Exits the global configuration mode.</td>
</tr>
<tr>
<td>Example: Router(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Configuring the Deselection of a Primary Clock Source

This section describes how to deselect a clock source. This ensures that the clock source does not reappear after the router is rebooted.
SUMMARY STEPS

1. configure terminal
2. no network-clock input-source priority controller [t1 | e1] slot/bay/port

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Router# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

Step 2: no network-clock input-source priority controller [t1|e1] slot/bay/port | Deselects the clock source. |
| Example: Router(config)# no network-clock input-source 1 controller t1 0/2/0 | |

Example: Deselection of a Clock Source

In this example, the 0/2/0 T1 controller, which has been deselected, does not appear in the list of clock sources shown by the show network-clocks synchronization command.

Router# show network-clocks synchronization

Symbols: En - Enable, Dis - Disable, Adis - Admin Disable
         NA - Not Applicable
         * - Synchronization source selected
         # - Synchronization source force selected
         & - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EBC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : Internal
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : No
Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Configuring Participation of a Module in the Backplane Clock

By default, a NIM (module) participates in the backplane clock. In the first two examples below, the `show platform hardware subslot slot/subslot module device networkclock` command verifies that a module participates in the backplane clock.

If you do not want clock synchronization with the backplane clock for a NIM, you can use the `no network-clock synchronization participate slot/subslot` command shown in Example 3: Disabling and Enabling a Module from Participating in the Backplane Clock, page 6.

Example 1: Verifying that a Module Participates in the Backplane Clock

In this example, the `show platform hardware subslot slot/subslot module device networkclock` command shows:

“ntwk_clk_selected No”—none of the ports of the NIM 0/2 are configured as an input-source. To assign a controller to be an input clock source, see the command `network-clock input-source priority controller [t1|e1] slot/bay/port` in the “Configuring Clock Recovery with a Primary Clock Source” section on page 3.

“ntwk_clk_participate Yes”—the NIM 0/2 participates in the router’s backplane clock. This is the default for a NIM attached to the router.

Router# show platform hardware subslot 0/2 module device networkclock

primary clock 255, secondary clock 0, ntwk_clk_selected No, ntwk_clk_participate Yes, current clock = 0
PLL status= 1, and cntl = 7

Example 2: Verifying that a Module Participates in the Backplane Clock and is Selected as a Source

In this example, the `network-clock input-source priority controller [t1 | e1] slot/bay/port` command configures NIM 0/2/0 as an input clock source.

The `show platform hardware subslot slot/subslot module device networkclock` command shows:

“ntwk_clk_selected Yes”—a port on the NIM 0/2 T1 controller is selected as an input clock source.

“ntwk_clk_participate Yes”—the NIM 0/2 T1 controller participates in the router’s backplane clock.

Router# configure terminal
Router(config)# network-clock input-source priority controller 150 controller T1 0/2/0
Router(config)# end
Router# show platform hardware subslot 0/2 module device networkclock

primary clock 255, secondary clock 0, ntwk_clk_selected Yes, ntwk_clk_participate Yes, current clock = 0
PLL status= 1, and cntl = 17

Example 3: Disabling and Enabling a Module from Participating in the Backplane Clock

In the following example, NIM 0/2 is disabled from participating in the backplane clock, using the `no network-clock synchronization participate slot/subslot` command. This is displayed by the `show platform hardware subslot slot/subslot module device networkclock` command. ntwk_clk_participate = “No” indicates that module participation is disabled.
Router# configure terminal
Router(config)# no network-clock synchronization participate 0/2
Router(config)# end
Router# show platform hardware subslot 0/2 module device networkclock
primary clock 255, secondary clock 0, ntwk_clk_selected No, ntwk_clk_participate No,
current clock = 0
PLL status= 2, and cntl = 6
Then NIM 0/2 is made to participate in the backplane clock, by using the network-clock synchronization participate 0/2 command. This is verified by the show platform hardware subslot slot/subslot module device networkclock command. ntwk_clk_participate = “Yes” indicates that the module participation is enabled.

Router# configure terminal
Router(config)# network-clock synchronization participate 0/2
Router(config)# end
Router# show platform hardware subslot 0/2 module device networkclock
primary clock 255, secondary clock 0, ntwk_clk_selected No, ntwk_clk_participate Yes, current clock = 0
PLL status= 2, and cntl = 6

Configuring Network Clocking with Revertive Mode

Revertive mode can be set for a clock source or reference. For example, if an original source is set to be in revertive mode and there is a failure in the original source, the clock switches to using an alternate source. After the original clock source recovers from a failure, the clock source reverts back to this original source, independent of the condition of the alternate source.

The default value for network clock synchronization is non-revertive mode. In non-revertive mode, if a failure occurs for the original clock source, a switch to an alternate clock source occurs. This alternate clock source continues to be used, even after the original source recovers from the failure that caused the switch.

SUMMARY STEPS

1. network-clock revertive
2. show network-clocks synchronization

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 network-clock revertive</td>
<td>Configures revertive mode for the network clock.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# network-clock revertive</td>
<td></td>
</tr>
<tr>
<td>Step 2 show network-clocks synchronization</td>
<td>Verifies that the network clock is now in revertive mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# show network-clocks synchronization</td>
<td></td>
</tr>
</tbody>
</table>
Example: Configuring Network Clocking with Revertive Mode

The following example starts by setting two clock sources:

- T1 0/3/0—secondary clock source (lower priority than T1 0/2/0)
- T1 0/2/0—primary clock source (higher priority than T1 0/3/0)

Revertive mode is set for network clocking using the network-clock revertive command for the primary clock source.

Because T1 0/2/0 has a higher priority than T1 0/3/0, T1 0/2/0 is selected as the clock source. The first show network-clocks synchronization command in the example shows the T1 0/2/0 clock source selected and in revertive mode.

This example supposes that the primary clock source goes down after the first show network-clocks synchronization command. In this situation, T1 0/3/0 is selected as the clock source. The state of QL-IN is shown as “QL-FAILED” in the second show network-clocks synchronization command below.

Later, as a result of setting revertive mode, when clock source T1 0/2/0 comes back up again, the selected clock reverts to T1 0/2/0. This is shown by the third show-network-clocks synchronization command in the example. (If revertive mode had not been set, when T1 0/2/0 came back up, the clock source would stay as T1 0/3/0 and not revert to T1 0/2/0.)

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock revertive
Router(config)# controller t1 0/2/0
Router(config-controller)# clock source line primary
Router(config)# network-clock input-source 1 controller t1 0/2/0
Router(config)# controller t1 0/3/0
Router(config-controller)# clock source line secondary
Router(config)# network-clock input-source 50 controller t1 0/3/0
Router# show network-clocks synchronization
```

Symbols:
- En - Enable, Dis - Disable, Adis - Admin Disable
- NA - Not Applicable
- * - Synchronization source selected
- # - Synchronization source force selected
- & - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (ERC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/2/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : Yes

Nominated Interfaces

```
<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>1</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/3/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
```

(At this point, the primary clock source T1 0/2/0 becomes unavailable; for example, due to a signal failure.)
Network Synchronization for the Cisco 4000 Series Integrated Services Routers

How to Configure Network Synchronization

Automatic selection process: Enable
Equipment Clock: 2048 (EEC-Option1)
Clock Mode: QL-Disable
ESMC: Disabled
SSM Option: 1
T0: T1 0/2/0
Hold-off (global): 300 ms
Wait-to-restore (global): 300 sec
Tsm Delay: 180 ms
Revertive: Yes

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>1</td>
<td>QL-FAILED</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/3/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

(At this point, the primary clock source T1 0/2/0 becomes available again.)

Router# show network-clocks synchronization

Symbols: En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process: Enable
Equipment Clock: 2048 (EEC-Option1)
Clock Mode: QL-Disable
ESMC: Disabled
SSM Option: 1
T0: T1 0/2/0
Hold-off (global): 300 ms
Wait-to-restore (global): 300 sec
Tsm Delay: 180 ms
Revertive: Yes

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>1</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/3/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Configuring the Wait-to-Restore Timer

Use the network-clock wait-to-restore timer global command to specify how long the router waits before including a primary clock source in the clock selection process; for example, after a signal failure has affected the primary clock source.

SUMMARY STEPS

1. network-clock wait-to-restore timer global
2. show network-clocks synchronization
DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>network-clock wait-to-restore timer global</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Router# network-clock wait-to-restore 500 global</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>show network-clocks synchronization</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Router# show network-clocks synchronization</td>
</tr>
</tbody>
</table>

Example: Configuring the Wait-to-Restore Timer

The first part of this example is the same as shown in the “Configuring Network Clocking with Revertive Mode” section on page 7. The example starts after two clock sources have been set: T1 0/2/0 and T1 0/3/0. T1 0/2/0 is the primary clock source—it has a higher priority than the T1 0/3/0 clock source. Revertive mode is set for network clocking using the `network-clock revertive` command.

If a signal failure occurs, the system goes to hold-over (selects the “Internal” clock source) and waits for the period determined by the ‘wait-to-restore’ timer value, before switching back to the first clock source.

The `show network-clocks synchronization` command shows the timer to be 300 seconds. Next, the wait-to-restore timeout is changed using the `network-clock wait-to-restore` command. In this example, the wait-to-restore time is set to 500 seconds. You can configure the wait-to-restore time to any value between 0 to 86400 seconds. The default value is 300 seconds.

Entering the `show network-clocks synchronization` command now shows the wait-to-restore value of 500 seconds.

```
Router(config)# network-clock revertive
Router# show network-clocks synchronization
```

Symbols:     En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/2/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : No
Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>2</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/3/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>2</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Configuring the Hold-Off Timer

Use the `network-clock hold-off timer` command to specify the length of time that the router waits when a primary clock source fails before removing the primary clock source from the clock selection process.

**SUMMARY STEPS**

1. `network-clock hold-off timer global`
2. `show network-clocks synchronization`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>network-clock hold-off timer global</code></td>
<td>Changes the hold-off timeout period. The <code>timer</code> default value is 300 ms.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router# network-clock hold-off 500 global</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>show network-clocks synchronization</code></td>
<td>Verifies the hold-off timeout period has been set to the correct value.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router# show network-clocks synchronization</code></td>
<td></td>
</tr>
</tbody>
</table>
Example: Configuring the Hold-off Timer

The `show network-clocks synchronization` command shows the hold-off time to be 300 milliseconds (the default value). The hold-off timeout is changed using the command `network-clock hold-off 500` global command. Entering the `show network-clocks synchronization` command shows that the hold-off value is now 500 milliseconds.

```
Router# show network-clocks synchronization

Symbols:     En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/2/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 500 sec
Tsm Delay : 180 ms
Revertive : No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/1/1</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-FAILED</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
```

```
Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#

Router(config)# network-clock hold-off 500 global

Router(config)# end

Router# show network-clocks synchronization

Feb 18 15:03:30.597 IST: %SYS-5-CONFIG_I: Configured from console by console

Symbols:     En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/2/0
Hold-off (global) : 500 ms
Wait-to-restore (global) : 500 sec
```

Configuring Lockout of a Clock Source

The `network-clock set lockout controller` command may be useful during testing and debugging.

**Note** To clear the lockout on a source, use the `network-clock clear lockout` command.
SUMMARY STEPS

1. `network-clock set lockout controller [t1|e1] slot/bay/port`
2. `show network-clocks synchronization`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Sets a lockout on a controller clock source.</td>
</tr>
<tr>
<td>`network-clock set lockout controller [t1</td>
<td>e1] slot/bay/port`</td>
</tr>
<tr>
<td><code>Router# network-clock set lockout controller t1 0/2/0</code></td>
<td>Displays whether the clock has been set to revertive mode.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>show network-clocks synchronization</code></td>
<td>Example:</td>
</tr>
<tr>
<td><code>Router# show network-clocks synchronization</code></td>
<td></td>
</tr>
</tbody>
</table>

**Example: Configuring Lockout of a Clock Source**

The following example starts with a configuration in which several clock sources have different priority levels.

To start with, T1 0/1/1 is the primary clock source as shown by the first `show network-clocks synchronization` command. T1 0/2/0 is then locked out using the `network-clock clear lockout controller` command. A `show network-clocks synchronization` command shows the primary clock source is now T1 0/1/1. In the example, T1 0/1/1 goes down at this point.

T1 0/2/0 is not selected as the primary clock source—Internal is selected instead, as shown by another `show network-clocks synchronization` command. The initial primary clock source is then cleared using the `network-clock clear lockout controller` command. Another `show network-clocks synchronization` command shows that the primary clock source is now T1 0/2/0 (T1 0/1/1 is still down).

Symbols:  
- En - Enable, Dis - Disable, Adis - Admin Disable  
- NA - Not Applicable  
- * - Synchronization source selected  
- # - Synchronization source force selected  
- & - Synchronization source manually switched  

Automatic selection process: Enable  
Equipment Clock: 2048 (EBC-Option1)  
Clock Mode: QL-Disable  
ESMC: Disabled  
SSM Option: 1  
T0: T1 0/1/1  
Hold-off (global): 300 ms  
Wait-to-restore (global): 0 sec  
Tsm Delay: 180 ms  
Revertive: No  
Nominated Interfaces  
<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
</table>
How to Configure Network Synchronization

Internal                         NA                         NA/Dis            251  QL-SEC  NA      NA
*T1 0/1/1                        NA                         NA/Dis            50   QL-SEC  NA      NA
T1 0/2/0                         NA                         NA/Dis            150  QL-SEC  NA      NA

Router# network-clock set lockout controller T1 0/2/0

Router# show network-clocks synchronization

Symbols:                        En - Enable, Dis - Disable, Adis - Admin Disable
                                NA - Not Applicable
                                * - Synchronization source selected
                                # - Synchronization source force selected
                                & - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/1/1
Hold-off (global) : 300 ms
Wait-to-restore (global) : 0 sec
Tsm Delay : 180 ms
Revertive : No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
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</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
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<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
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<tr>
<td>*T1 0/1/1</td>
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<td>NA/Dis</td>
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<td>50</td>
<td>QL-SEC</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td></td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
</tr>
</tbody>
</table>

Router# network-clock clear lockout controller T1 0/2/0

Router# show network-clocks synchronization

Symbols:                        En - Enable, Dis - Disable, Adis - Admin Disable
                                NA - Not Applicable
                                * - Synchronization source selected
                                # - Synchronization source force selected
                                & - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : Internal
Hold-off (global) : 300 ms
Wait-to-restore (global) : 0 sec
Tsm Delay : 180 ms
Revertive : No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td></td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/1/1</td>
<td>NA</td>
<td>NA/Dis</td>
<td></td>
<td>50</td>
<td>QL-FAILED</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td></td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
</tr>
</tbody>
</table>

Router# network-clock clear lockout controller T1 0/2/0

Router# show network-clocks synchronization

Symbols:                        En - Enable, Dis - Disable, Adis - Admin Disable
                                NA - Not Applicable
                                * - Synchronization source selected
                                # - Synchronization source force selected
                                & - Synchronization source manually switched

Automatic selection process : Enable
Network Synchronization for the Cisco 4000 Series Integrated Services Routers

How to Configure Network Synchronization

Equipment Clock : 2048 (EBC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T0 : T1 0/2/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 0 sec
Tsm Delay : 180 ms
Revertive : No
Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/1/1</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-FAILED</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Configuring Network Clocking with Force Switching

Instead of configuring using the set lockout controller command, you can force the network clock source to change to another clock source using the network-clock switch force controller command, irrespective of whether the source is available, and within range.

For example, this command is useful when you want to remove the module of the first controller for maintenance purposes. Use the network-clock switch force command to forcefully select another clock source.

Another command that performs the same function as network-clock switch force controller is the network-clock switch manual controller command. This command manually selects a synchronization source. The following example shows how to configure force switching:

Router# network-clock switch force controller t1 0/3/0 t0

You can later use the network-clock clear switch controller-id command to clear the effect of either a network-clock switch force controller command or network-clock switch manual controller command.

SUMMARY STEPS

1. network-clock force controller [t1|e1] slot/bay/port
2. show network-clocks synchronization

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>network-clock switch force controller [t1</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# network-clock switch force controller t1 0/3/0 t0</td>
</tr>
<tr>
<td>Step 2</td>
<td>show network-clocks synchronization</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# show network-clocks synchronization</td>
</tr>
</tbody>
</table>

Example: Configuring Network Clocking with Force Switching

The following example starts with a configuration in which several clock sources have different priority levels.

The command network-clock switch force controller [ t1 | e1 ] slot/bay/port t0 switches the network clock source to a second priority clock source. You can verify that the primary clock source is now 0/3/0 T1 controller using the show network-clocks synchronization command. The switch is then cleared using the network-clock clear switch t0 command.
Router# network-clock switch force controller t1 0/2/0
Router# show network-clocks synchronization

Symbols: En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process: Enable
Equipment Clock: 2048 (EEC-Option1)
Clock Mode: QL-Disable
ESMC: Disabled
SSM Option: 1
T0: T1 0/1/1
Hold-off (global): 300 ms
Wait-to-restore (global): 0 sec
Tsm Delay: 180 ms
Revertive: No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/1/1</td>
<td>NA</td>
<td>NA/Dis</td>
<td>50</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Router# network-clock switch force controller T1 0/2/0 t0
Router# show network-clocks synchronization

Symbols: En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Automatic selection process: Enable
Equipment Clock: 2048 (EEC-Option1)
Clock Mode: QL-Disable
ESMC: Disabled
SSM Option: 1
T0: T1 0/2/0
Hold-off (global): 300 ms
Wait-to-restore (global): 0 sec
Tsm Delay: 180 ms
Revertive: No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
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<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>#T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>150</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Router# network-clock clear switch t0

Configuration Examples for Network Synchronization

- **Example 1:** Configuring Clock Recovery with a Primary Clock Source (Single Clock Source), page 18
- **Example 2:** Configuring Clock Recovery with a Primary Clock Source (Two Clock Sources), page 18
- **Example 3:** Switchover from Primary Clock Source due to Loss of Signal, page 19
- **Example 4:** Switching of Input Source Clock, page 19
Example 1: Configuring Clock Recovery with a Primary Clock Source (Single Clock Source)

The following example shows how to configure clock recovery for controller T1 on the 0/2/0 slot/bay/port as the primary clock source.

In this example, the 0/2/0 T1 controller has a higher priority (value = 1) than the internal clock. T1 0/2/0 is the primary clock source as indicated by the asterisk “*” in the interfaces listed below (“*T1 0/2/0”).

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# no network-clock synchronization participate 0/2
Router(config)# controller t1 0/2/0
Router(config-controller)# clock source line primary
Router(config-controller)# end
Router#
```

```
Symbols:     En - Enable, Dis - Disable, Adis - Admin Disable
             NA - Not Applicable
             * - Synchronization source selected
             # - Synchronization source force selected
             & - Synchronization source manually switched

Automatic selection process : Enable
Equipment Clock : 2048 (SEC-Option1)
Clock Mode : QL-Disable
ESMC : Disabled
SSM Option : 1
T1 : 0/2/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : No

Nominated Interfaces

<table>
<thead>
<tr>
<th>Interface</th>
<th>SigType</th>
<th>Mode/QL</th>
<th>Prio</th>
<th>QL_IN</th>
<th>ESMC Tx</th>
<th>ESMC Rx</th>
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</thead>
<tbody>
<tr>
<td>Internal</td>
<td>NA</td>
<td>NA/Dis</td>
<td>251</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>*T1 0/2/0</td>
<td>NA</td>
<td>NA/Dis</td>
<td>1</td>
<td>QL-SEC</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
```

Example 2: Configuring Clock Recovery with a Primary Clock Source (Two Clock Sources)

The following example shows how to configure clock recovery for controller T1 on the 0/2/0 slot/bay/port as the primary clock source.

In this example, the 0/2/0 T1 controller is shown to have a high priority (value = 1) which is higher than the priority of the 0/3/0 T1 controller (value = 2); therefore the 0/2/0 T1 controller is the primary clock source.

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# controller t1 0/2/0
Router(config)# clock source line primary
Router(config)# network-clock input-source 1 controller t1 0/2/0
Router(config)# exit
Router#
```

```
Symbols:     En - Enable, Dis - Disable, Adis - Admin Disable
             NA - Not Applicable
             * - Synchronization source selected
             # - Synchronization source force selected
```
Example 3: Switchover from Primary Clock Source due to Loss of Signal

The following example shows how a primary clock source is affected by a signal failure which causes the primary clock source to change or switch to a different source.

Router# config terminal
Router(config)# network-clock input-source
1 controller t1 0/2/0
Perform a signal failure of the primary clock source, by shutting down the remote end or causing an “Out of Resource” condition of the primary clock source, by disconnecting a cable.

After the above signal failure or “Out of Resource,” verify the feature using the following `show network-clocks synchronization` command. Note that the output shows the primary clock source, T1 0/2/0, as having a QL_IN value of QL-FAILED and therefore the primary clock source has switched to the “Internal” clock (shown by an asterisk “*”).

Router# show network-clocks synchronization
Symbols: En - Enable, Dis - Disable, Adis - Admin Disable
NA - Not Applicable
* - Synchronization source selected
# - Synchronization source force selected
& - Synchronization source manually switched

Example 4: Switching of Input Source Clock

This example shows a primary clock source being affected by a signal failure, which then causes a different clock source to be selected.

Router# config terminal
Perform a signal failure of the primary clock source, by shutting the remote end or causing an “Out of Resource” condition of the primary clock source, by disconnecting a cable.

After the above signal failure or “Out of Resource”, verify the feature using the following `show network-clocks synchronization` command. Note that the output shows the primary clock source T1 0/3/0. The controller T1 0/2/0 has a QL_IN value of QL-FAILED and therefore the primary clock source has switched to the controller T1 0/3/0 clock (shown by an asterisk “*”).

```
Router# show network-clocks synchronization
```

### Configuration Examples for Network Synchronization

#### Configuring Clocking for Non-Facility Associated Signaling Voice

This example shows how to configure clocking for the Non-Facility Associated Signaling (NFAS) voice on Cisco 4000 Series ISRs:

```
controller T1 0/1/0
  framing esf
  clock source line primary
  linecode b8zs
  cablelength long 0db
  pri-group timeslots 1-24 nfas_d primary nfas_int 0 nfas_group 0
!
controller T1 0/1/1
  framing esf
  clock source line secondary
  linecode b8zs
  cablelength long 0db
  pri-group timeslots 1-24 nfas_d backup nfas_int 1 nfas_group 0
!
controller T1 0/1/2
  framing esf
  clock source network
  linecode b8zs
  cablelength long 0db
  pri-group timeslots 1-24 nfas_d none nfas_int 2 nfas_group 0
!
controller T1 0/1/3
  framing esf
  clock source network
```

---

**Network Synchronization for the Cisco 4000 Series Integrated Services Routers**

OL-31796-01
linecode b8zs
 cablelength long 0db
 pri-group timeslots 1-24 nfas_d none nfas_int 3 nfas_group 0

Additional References

- Related Documents, page 21
- Standards, page 21
- MIBs, page 21
- RFCs, page 21
- Technical Assistance, page 22

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
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<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
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Standards

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MIBs

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<th>MIBs Link</th>
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<tbody>
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<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at this URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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RFCs

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## Technical Assistance

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<th>Description</th>
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<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>
Feature Information for Network Synchronization

Table 1 lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Another similar feature (Network Synchronization Support) is used by the Cisco ASR 1000 Series. See “Synchronous Ethernet Support” in the Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide.

Note

Table 1 lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Synchronization</td>
<td>Cisco IOS XE</td>
<td>This feature was implemented on the Cisco ISR 4400 Series.</td>
</tr>
<tr>
<td></td>
<td>Release 3.12S</td>
<td></td>
</tr>
</tbody>
</table>

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Feature Information for Network Synchronization