



Configuring Synchronous Ethernet ESMC and SSM

Synchronous Ethernet is an extension of Ethernet designed to provide the reliability found in traditional SONET/SDH and T1/E1 networks to Ethernet packet networks by incorporating clock synchronization features that support the Synchronization Status Message (SSM) and Ethernet Synchronization Message Channel (ESMC) for synchronous Ethernet clock synchronization.

The following sections describe ESMC and SSM support on the Cisco ASR 903 Series Router.

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Understanding Synchronous Ethernet ESMC and SSM

Ethernet Synchronization Message Channel (ESMC) incorporates the Synchronization Status Message (SSM) used in Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH) networks. While SONET and SDH transmit the SSM in a fixed location within the frame, ESMC transmits the SSM using a protocol: the IEEE 802.3 Organization-Specific Slow Protocol (OSSP) standard.

The ESMC carries a Quality Level (QL) value identifying the clock quality of a given synchronous Ethernet timing source. Clock quality values help a synchronous Ethernet node derive timing from the most reliable source and prevent timing loops.

When configured to use synchronous Ethernet, the Cisco ASR 903 Series Router synchronizes to the best available clock source. If no better clock sources are available, the router remains synchronized to the current clock source.

The router supports two clock selection modes: QL-enabled and QL-disabled. Each mode uses different criteria to select the best available clock source.



Note The router can only operate in one clock selection mode at a time.



Note Conversely, PTP clock sources are not supported with synchronous Ethernet. However, you can use hybrid clocking to allow the router to obtain frequency using Synchronous Ethernet and phase using PTP.

Clock Selection Modes

The Cisco ASR 903 Series Router supports two clock selection modes, which are described in the following sections.

QL-Enabled Mode

In QL-enabled mode, the router considers the following parameters when selecting a clock source:

- Clock quality level (QL)
- Clock availability
- Priority

QL-Disabled Mode

In QL-disabled mode, the router considers the following parameters when selecting a clock source:

- Clock availability
- Priority



Note You can use override the default clock selection using the commands described in the [Managing Clock Source Selection](#), on page 7.

Managing Clock Selection

You can manage clock selection by changing the priority of the clock sources; you can also influence clock selection by modifying modify the following clock properties:

- **Hold-Off Time:** If a clock source goes down, the router waits for a specific hold-off time before removing the clock source from the clock selection process. By default, the value of hold-off time is 300 ms.
- **Wait to Restore:** The amount of time that the router waits before including a newly active synchronous Ethernet clock source in clock selection. The default value is 300 seconds.

- Force Switch: Forces a switch to a clock source regardless of clock availability or quality.
- Manual Switch: Manually selects a clock source, provided the clock source has an equal or higher quality level than the current source.

For more information about how to use these features, see [Managing Clock Source Selection](#), on page 7.

Restrictions and Usage Guidelines

The following restrictions apply when configuring synchronous Ethernet SSM and ESMC:

- To use the **network-clock synchronization ssm option** command, ensure that the router configuration does not include the following:
 - Input clock source
 - Network clock quality level
 - Network clock source quality source (synchronous Ethernet interfaces)
- The **network-clock synchronization ssm option** command must be compatible with the **network-clock eec** command in the configuration.
- To use the **network-clock synchronization ssm option** command, ensure that there is not a network clocking configuration applied to synchronous Ethernet interfaces, BITS interfaces, and timing port interfaces.
- SSM and ESMC are SSO-coexistent, but not SSO-compliant. The router goes into hold-over mode during switchover and restarts clock selection when the switchover is complete.
- It is recommended that you do not configure multiple input sources with the same priority as this impacts the TSM (Switching message delay).
- You can configure a maximum of 4 clock sources on interface modules, with a maximum of 2 per interface module. This limitation applies to both synchronous Ethernet and TDM interfaces.
- Copper SFP is *not* supported for SyncE Rx and Tx on the uplink interfaces. SyncE Rx and Tx is supported on the uplink interfaces only for fiber SFP only.

Configuring Synchronous Ethernet ESMC and SSM

Follow these steps to configure ESMC and SSM on the Cisco ASR 903 Series Router.

SUMMARY STEPS

1. enable
2. configure terminal
3. network-clock synchronization automatic
4. network-clock eec {1 | 2}
5. network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}
6. network-clock input-source *priority* {**interface** *interface_name slot/card/port* | **ptp domain** *domain_num* | {**external** {R0 | R1 [{ t1 {sf | esf} linecode {ami | b8zs} line-build-out *length* } | e1 [crc4 | fas] [125ohm | 75ohm] linecode [hdb3 | ami] } | 10m] }}
7. network-clock synchronization mode ql-enabled
8. network-clock hold-off {0 | *milliseconds*}
9. network-clock wait-to-restore *seconds*
10. network-clock revertive
11. esmc process
12. network-clock external *slot/card/port* hold-off {0 | *milliseconds*}
13. network-clock quality-level {tx | rx} *value* {**interface** *interface-name slot/card/port* | **controller** [E1 | BITS] *slot/card/port* | external [2m | 10m] }
14. interface *type number*
15. synchronous mode
16. esmc mode [ql-disabled | tx | rx] *value*
17. network-clock hold-off {0 | *milliseconds*}
18. network-clock wait-to-restore *seconds*
19. end

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	network-clock synchronization automatic Example: Router(config)# network-clock synchronization automatic	Enables the network clock selection algorithm. This command disables the Cisco-specific network clock process and turns on the G.781-based automatic clock selection process.

	Command or Action	Purpose
Step 4	<p>network-clock eec {1 2}</p> <p>Example:</p> <pre>Router(config)# network-clock eec 1</pre>	<p>Specifies the Ethernet Equipment Clock (EEC) type. Valid values are</p> <ul style="list-style-type: none"> • 1—ITU-T G.8262 option 1 (2048) • 2—ITU-T G.8262 option 2 and Telcordia GR-1244 (1544)
Step 5	<p>network-clock synchronization ssm option {1 2} {GEN1 GEN2}</p> <p>Example:</p> <pre>Router(config)# network-clock synchronization ssm option 2 GEN2</pre>	<p>Configures the G.781 synchronization option used to send synchronization messages. The following guidelines apply for this command:</p> <ul style="list-style-type: none"> • Option 1 refers to G.781 synchronization option 1, which is designed for Europe. This is the default value. • Option 2 refers to G.781 synchronization option 2, which is designed for the United States. • GEN1 specifies option 2 Generation 1 synchronization. • GEN2 specifies option 2 Generation 2 synchronization.
Step 6	<p>network-clock input-source <i>priority</i> {interface <i>interface_name slot/card/port</i> ptp domain <i>domain_num</i> {external {R0 R1 [{ t1 {sf esf } linecode {ami b8zs} line-build-out length } e1 [crc4 fas] [125ohm 75ohm] linecode [hdb3 ami] } 10m } }</p> <p>Example:</p> <pre>Router(config)# network-clock input-source 1 interface GigabitEthernet 0/0/1</pre>	<p>Enables you to select an interface as an input clock for the router. You can select the BITS, Gigabit Ethernet 0/0, Gigabit Ethernet 0/1 interfaces, or GPS interfaces, or an external interface.</p>
Step 7	<p>network-clock synchronization mode ql-enabled</p> <p>Example:</p> <pre>Router(config)# network-clock synchronization mode ql-enabled</pre>	<p>Enables automatic selection of a clock source based on quality level (QL).</p> <p>Note This command is disabled by default.</p>
Step 8	<p>network-clock hold-off {0 <i>milliseconds</i>}</p> <p>Example:</p> <pre>Router(config)# network-clock hold-off 0</pre>	<p>(Optional) Configures a global hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action.</p> <p>Note You can also specify a hold-off value for an individual interface using the network-clock hold-off command in interface mode.</p>
Step 9	<p>network-clock wait-to-restore <i>seconds</i></p> <p>Example:</p> <pre>Router(config)# network-clock wait-to-restore 70</pre>	<p>(Optional) Configures a global wait-to-restore timer for synchronous Ethernet clock sources. The timer specifies how long the router waits before including a restored clock source in the clock selection process.</p> <p>Valid values are 0 to 86400 seconds. The default value is 300 seconds.</p>

	Command or Action	Purpose
		Note You can also specify a wait-to-restore value for an individual interface using the network-clock wait-to-restore command in interface mode.
Step 10	network-clock revertive Example: Router(config)# network-clock revertive	(Optional) Sets the router in revertive switching mode when recovering from a failure. To disable revertive mode, use the no form of this command.
Step 11	esmc process Example: Router(config)# esmc process	Enables the ESMC process globally.
Step 12	network-clock external slot/card/port hold-off {0 milliseconds} Example: Router(config)# network-clock external 0/1/0 hold-off 0	Overrides the hold-off timer value for the external interface.
Step 13	network-clock quality-level {tx rx} value {interface interface-name slot/card/port controller [E1 BITS] slot/card/port external [2m 10m]} Example: Router(config)# network-clock quality-level rx qL-prc external R0 e1 cas crc4	Specifies a quality level for a line or external clock source. The available quality values depend on the G.781 synchronization settings specified by the network-clock synchronization ssm option command: <ul style="list-style-type: none"> • Option 1—Available values are QL-PRC, QL-SSU-A, QL-SSU-B, QL-SEC, and QL-DNU. • Option 2, GEN1—Available values are QL-PRS, QL-STU, QL-ST2, QL-SMC, QL-ST4, and QL-DUS. • Option 2, GEN 2—Available values are QL-PRS, QL-STU, QL-ST2, QL-TNC, QL-ST3, QL-SMC, QL-ST4, and QL-DUS.
Step 14	interface type number Example: Router(config)# interface GigabitEthernet 0/0/1 Example: Router(config-if)#	Enters interface configuration mode.
Step 15	synchronous mode Example: Router(config-if)# synchronous mode	Configures the Ethernet interface to synchronous mode and automatically enables the ESMC and QL process on the interface.

	Command or Action	Purpose
Step 16	esmc mode [<i>ql-disabled</i> <i>tx</i> <i>rx</i>] <i>value</i> Example: <pre>Router(config-if)# esmc mode rx QL-STU</pre>	Enables the ESMC process at the interface level. The no form of the command disables the ESMC process.
Step 17	network-clock hold-off { <i>0</i> <i>milliseconds</i> } Example: <pre>Router(config-if)# network-clock hold-off 0</pre>	(Optional) Configures an interface-specific hold-off timer specifying the amount of time that the router waits when a synchronous Ethernet clock source fails before taking action. You can configure the hold-off time to either 0 or any value between 50 to 10000 ms. The default value is 300 ms.
Step 18	network-clock wait-to-restore <i>seconds</i> Example: <pre>Router(config-if)# network-clock wait-to-restore 70</pre>	(Optional) Configures the wait-to-restore timer for an individual synchronous Ethernet interface.
Step 19	end Example: <pre>Router(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

What to Do Next

You can use the **show network-clocks** command to verify your configuration.

Managing Clock Source Selection

The following sections describe how to manage the selection on the Cisco ASR 903 Series Router:

Specifying a Clock Source

The following sections describe how to specify a synchronous Ethernet clock source during the clock selection process:

Selecting a Specific Clock Source

To select a specific interface as a synchronous Ethernet clock source, use the **network-clock switch manual** command in global configuration mode.

**Note**

The new clock source must be of higher quality than the current clock source; otherwise the router does not select the new clock source.

Command	Purpose
network-clock switch manual external R0 R1 {{E1 {crc4 cas fas}} {T1 {d4 sf esf}} } Router# network-clock switch manual external r0 e1 crc4	Manually selects a synchronization source, provided the source is available and is within the range.
network-clock clear switch {t0 external <i>slot/card/port</i> [10m 2m} Router# network-clock clear switch t0	Disable a clock source selection.

Forcing a Clock Source Selection

To force the router to use a specific synchronous Ethernet clock source, use the **network-clock switch force** command in global configuration mode.

**Note**

This command selects the new clock regardless of availability or quality.

**Note**

Forcing a clock source selection overrides a clock selection using the **network-clock switch manual command**.

Command	Purpose
network-clock switch force external R0 R1 {{E1 {crc4 cas fas}} {T1 {d4 sf esf}} } Router# network-clock switch force r0 e1 crc4	Forces the router to use a specific synchronous Ethernet clock source, regardless of clock quality or availability.
network-clock clear switch {t0 external <i>slot/card/port</i> [10m 2m} Router# network-clock clear switch t0	Disable a clock source selection.

Disabling Clock Source Specification Commands

To disable a **network-clock switch manual** or **network-clock switch force** configuration and revert to the default clock source selection process, use the **network-clock clear switch** command.

Command	Purpose
network-clock clear switch {t0 external slot/card/port [10m 2m]} Router# network-clock clear switch t0	Disable a clock source selection.

Disabling a Clock Source

The following sections describe how to manage the synchronous Ethernet clock sources that are available for clock selection:

Locking Out a Clock Source

To prevent the router from selecting a specific synchronous Ethernet clock source, use the network-clock set lockout command in global configuration mode.

Command	Purpose
network-clock set lockout {interface interface_name slot/card/port external {R0 R1 [{ t1 {sf esf } linecode {ami b8zs} } e1 [crc4 fas] linecode [hdb3 ami] } } Router# network-clock set lockout interface GigabitEthernet 0/0/0	Prevents the router from selecting a specific synchronous Ethernet clock source.
network-clock clear lockout {interface interface_name slot/card/port external {R0 R1 [{ t1 {sf esf } linecode {ami b8zs} } e1 [crc4 fas] linecode [hdb3 ami] } } Router# network-clock clear lockout interface GigabitEthernet 0/0/0	Disable a lockout configuration on a synchronous Ethernet clock source.

Restoring a Clock Source

To restore a clock in a lockout condition to the pool of available clock sources, use the **network-clock clear lockout** command in global configuration mode.

Command	Purpose
<pre>network-clock clear lockout {interface interface_name slot/card/port external external {R0 R1 [{ t1 {sf esf } linecode {ami b8zs}} e1 [crc4 fas] linecode [hdb3 ami] }</pre> <pre>Router# network-clock clear lockout interface GigabitEthernet 0/0/0</pre>	Forces the router to use a specific synchronous Ethernet clock source, regardless of clock quality or availability.

Verifying the Configuration

You can use the following commands to verify your configuration:

- **show esmc**—Displays the ESMC configuration.
- **show esmc detail**—Displays the details of the ESMC parameters at the global and interface levels.
- **show network-clock synchronization**—Displays the router clock synchronization state.
- **show network-clock synchronization detail**—Displays the details of network clock synchronization parameters at the global and interface levels.

Troubleshooting

[Table 1: SyncE Debug Commands](#), on page 10 list the debug commands that are available for troubleshooting the SyncE configuration on the Cisco ASR 903 Series Router:



Caution

We recommend that you do not use **debug** commands without TAC supervision.

Table 1: SyncE Debug Commands

Debug Command	Purpose
debug platform network-clock	Debugs issues related to the network clock including active-standby selection, alarms, and OOR messages.
debug network-clock	Debugs issues related to network clock selection.

Debug Command	Purpose
debug esmc error debug esmc event debug esmc packet [interface <i>interface-name</i>] debug esmc packet rx [interface <i>interface-name</i>] debug esmc packet tx [interface <i>interface-name</i>]	These commands verify whether the ESMC packets are transmitted and received with proper quality-level values.

Table 2: Troubleshooting Scenarios , on page 11 provides the information about troubleshooting your configuration

Table 2: Troubleshooting Scenarios

Problem	Solution
Clock selection	<ul style="list-style-type: none"> • Verify that there are no alarms on the interfaces using the show network-clock synchronization detail command. • Ensure that the nonrevertive configurations are in place. • Reproduce the issue and collect the logs using the debug network-clock errors, debug network-clock event, and debug network-clock sm commands. Contact Cisco Technical Support if the issue persists.
Incorrect QL values	<ul style="list-style-type: none"> • Ensure that there is no framing mismatch with the SSM option. • Reproduce the issue using the debug network-clock errors and debug network-clock event commands.
Alarms	<ul style="list-style-type: none"> • Reproduce the issue using the debug platform network-clock command enabled in the RSP. Alternatively, enable the debug network-clock event and debug network-clock errors commands.

Problem	Solution
<p>Incorrect clock limit set or queue limit disabled mode</p>	<ul style="list-style-type: none"> • Verify that there are no alarms on the interfaces using the <code>show network-clock synchronization detail</code> command. • Use the show network-clock synchronization command to confirm if the system is in revertive mode or nonrevertive mode and verify the non-revertive configurations. • Reproduce the current issue and collect the logs using the <code>debug network-clock errors</code>, <code>debug network-clock event</code>, and <code>debug network-clock sm RSP</code> commands.
<p>Incorrect QL values when you use the <code>show network-clock synchronization detail</code> command.</p>	<ul style="list-style-type: none"> • Use the network clock synchronization SSM (<i>option 1</i> <i>option 2</i>) command to confirm that there is no framing mismatch. Use the show run interface command to validate the framing for a specific interface. For the SSM option 1, framing should be SDH or E1, and for SSM option 2, it should be T1. • Reproduce the issue using the <code>debug network-clock errors</code> and <code>debug network-clock event RSP</code> commands.

Configuration Examples

Example: Input Synchronous Ethernet Clocking

The following example shows how to configure the router to use the BITS interface and two Gigabit Ethernet interfaces as input synchronous Ethernet timing sources. The configuration enables SSM on the BITS port.

```

!
Interface GigabitEthernet0/0
  synchronous mode
  network-clock wait-to-restore 720
!
Interface GigabitEthernet0/1
  synchronous mode
!
!
network-clock synchronization automatic
network-clock input-source 1 External R0 e1 crc4
network-clock input-source 1 gigabitethernet 0/0
network-clock input-source 2 gigabitethernet 0/1
network-clock synchronization mode QL-enabled
no network-clock revertive

```

SSM Support on Cisco ASR 900 Series 4-Port OC3/STM1 or 1-Port OC12/STM4 Interface Module

SSM is carried over OC-3 and OC-12 optical links. Effective Cisco IOS-XE release 3.18 SP, the SSM is transported in the S1 byte when it is carried over an optical line for SONET and SDH. The SSM messages enable SONET and SDH devices to select the highest quality timing reference automatically and avoid the timing loops.

SSM is supported on Cisco ASR 900 Series 4-Port OC3/STM1 or 1-Port OC12/STM4 Module. It has four ports and the default rate is OC-3. OC-3 rate is supported on all the four ports and OC-12 rate is supported on first port only.

S1 Byte

The SSM is transported in the S1 byte when it is carried over an optical line for SONET and SDH. S1 byte resides in Multiplex Section Overhead (MSOH) in SDH frame. The last four bits (5 to 8) carries SSM information.

Supported Quality Levels

The quality levels supported for SDH framing mode are:

- QL-PRC
- QL-SSU-A
- QL-SSU-B
- QL-SEC (SDH equipment clock)
- QL-DNU

The quality levels supported for SONET framing mode are:

- GEN1—PRS, STU, ST2, ST3, SMC, ST4, and DUS
- GEN2—PRS, STU, ST2, TNC, ST3E, ST3, SMC, ST4, and DUS

Configuring SSM on Cisco ASR 900 Series 4-Port OC3/STM1 or 1-Port OC12/STM4 IM

```
enable
configure terminal
network-clock synchronization automatic
network-clock eec 1
network-clock synchronization ssm option 2 GEN2
controller SONET 0/0/0
framing sdh
network-clock input-source 10 controller SONET 0/5/1
network-clock synchronization mode ql-enabled
network-clock hold-off 0
```

```

network-clock wait-to-restore 70
network-clock revertive
network-clock quality-level tx ql-prC controller SONET 0/0/0
network-clock quality-level rx ql-ssu-a controller SONET 0/5/1
network-clock hold-off 0
network-clock wait-to-restore 70
end

```

Configuring Clock Source

```

enable
configure terminal
controller sonet 0/5/0
clock source line
end

```

Verification of SSM Configuration

Use the **show network-clocks synchronization** command to verify the SSM configuration on Cisco ASR 900 Series 4-Port OC3/STM1 or 1-Port OC12/STM4 IM:

```

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-Enable
ESMC : Enabled
SSM Option : 1
T0 : TenGigabitEthernet0/3/0
Hold-off (global) : 300 ms
Wait-to-restore (global) : 0 sec
Tsm Delay : 180 ms
Revertive : Yes

```

Nominated Interfaces

Interface	SigType	Mode/QL	Prio	QL_IN	ESMC Tx	ESMC Rx
Internal	NA	NA/Dis	251	QL-SEC	NA	NA
*SONET 0/5/1	NA	NA/En	10	QL-PRC	NA	NA

Router#