

Synchronous Ethernet (SyncE) ESMC and SSM

This module describes Synchronization Status Message (SSM), Ethernet Synchronization Message Channel (ESMC), and generating the Simple Network Management Protocol (SNMP) traps on the SyncE feature.

With Ethernet equipment gradually replacing Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH) equipment in service-provider networks, frequency synchronization is required to provide high-quality clock synchronization over Ethernet ports.

Synchronous Ethernet (SyncE) provides the required synchronization at the physical level. In SyncE, Ethernet links are synchronized by timing their bit clocks from high-quality, stratum-1-traceable clock signals in the same manner as SONET/SDH. Operation messages maintain SyncE links and ensure that a node always derives timing from the most reliable source.

SyncE synchronizes clock frequency over an Ethernet port. In SONET/SDH the communication channel for conveying clock information is SSM, and in SyncE it is the ESMC.

- Finding Feature Information, on page 1
- Prerequisites for Synchronous Ethernet (SyncE) ESMC and SSM, on page 2
- Restrictions for Synchronous Ethernet (SyncE) ESMC and SSM, on page 2
- Information About Synchronous Ethernet (SyncE) ESMC and SSM, on page 2
- How to Configure Synchronous Ethernet (SyncE) ESMC and SSM, on page 3
- Configuration Examples for Synchronous Ethernet (SyncE) ESMC and SSM, on page 8
- Additional References, on page 11
- Feature Information for Synchronous Ethernet (SyncE) ESMC and SSM, on page 12

Finding Feature Information

Your software release may 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. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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

Prerequisites for Synchronous Ethernet (SyncE) ESMC and SSM

You need to first configure the network clock for SyncE configuration. Automatic synchronization of the network clock should be enabled. Ensure that the **network-clock-select** and **network-clock-participate** commands do not exist in the configuration in order to continue with the SyncE configuration.

Restrictions for Synchronous Ethernet (SyncE) ESMC and SSM

- The **network-clock synchronization ssm option** command cannot be used if the following parameters have been configured:
  - Network clock input source using the **network-clock input-source** command.
  - Network clock quality level using the **network-clock quality-level** command.
  - Network clock source quality for any synchronous ethernet interface using the **network-clock source quality** command.

Note After using the **network-clock synchronization ssm option** command, the restricted configurations listed above can be used.

- The **network-clock synchronization ssm option** command must be compatible with the **network-clock eec** command in the configuration.
- The **esmc process** and **synchronous mode** commands can be used only if the SyncE capable interface is installed on the router.

Information About Synchronous Ethernet (SyncE) ESMC and SSM

Synchronous Ethernet (SyncE) ESMC and SSM

Customers using a packet network find it difficult to provide timing to multiple remote network elements (NEs) through an external time division multiplexed (TDM) circuit. The SyncE feature helps to overcome this problem by providing effective timing to the remote NEs through a packet network. SyncE leverages the physical layer of the Ethernet to transmit frequency to the remote sites. SyncE's functionality and accuracy resemble the SONET/SDH network because of its physical layer characteristic. SyncE uses ESMC to allow the best clock source traceability to correctly define the timing source and help prevent a timing loop.

SONET/SDH use 4 bits from the two S bytes in the SONET/SDH overhead frame for message transmission. Ethernet relies on ESMC that is based on an IEEE 802.3 organization-specific slow protocol for message transmission. Each NE along the synchronization path supports SyncE, and SyncE effectively delivers frequency in the path. SyncE does not support relative time (for example, phase alignment) or absolute time (Time of Day).

SyncE provides the Ethernet physical layer network (ETY) level frequency distribution of known common precision frequency references. Clocks for use in SyncE are compatible with the clocks used in the SONET/SDH synchronization network. To achieve network synchronization, synchronization information is transmitted through the network via synchronous network connections with performance of egress clock. In SONET/SDH the communication channel for conveying clock information is Synchronization Status Message (SSM), and in SyncE it the Ethernet Synchronization Message Channel (ESMC).

ESMC carries a Quality Level (QL) identifier that identifies the timing quality of the synchronization trail. QL values in QL-TLV are the same as QL values defined for SONET and SDH SSM. Information provided by SSM QLs during the network transmission helps a node derive timing from the most reliable source and prevents timing loops. ESMC is used with the synchronization selection algorithms. Because Ethernet networks are not required to be synchronous on all links or in all locations, the ESMC channel provides this service. ESMC is composed of the standard Ethernet header for an organization-specific slow protocol; the ITU-T OUI, a specific ITU-T subtype; an ESMC-specific header; a flag field; and a type, length, value (TLV) structure. The use of flags and TLVs improves the management of SyncE links and the associated timing change.

How to Configure Synchronous Ethernet (SyncE) ESMC and SSM

Configuring SyncE

Perform this task to configure SyncE using ESMC and SSM.

SUMMARY STEPS

1. **enable**
2. **network-clock set l ockout** {**external** *slot* / *card* / *port*[**10m**| **2m**| **t1**{**sf** | **esf** | **d4**}] | **interface** *type slot* / *port*}
3. **network-clock clear lockout** {**external** *slot* / *card* / *port* [**10m**| **2m**| **t1** {**sf** | **esf** | **d4**}] | **interface** *type slot* / *port*}
4. **network-clock switch force { external** *slot* / *card* / *port* [**10m** | **2m**] | **t0** | **t1** {**sf** | **esf** | **d4**} **t0 | internal { external** *slot* / *card* / *port*[**10m** | **2m**] **| t0} | interface** *type slot* / *port* **externa**l *slot* / *card* / *port* [**10m** | **2m**] | **t0** }
5. **network-clock switch manual { interface** *type slot* /port *{* **externa**l *slot* / *card* / *port* [**10m** | **2m**] | **t0** } | **external** *slot* / *card* / *port*{**10m** | **2m** | **t0** | **t1** {**sf** | **esf** | **d4**} | **internal { external** *slot* / *card* / *port*[**10m** | **2m**] **| t0}** *}*
6. **network-clock clear switch** {**t0** | **external** *slot* / *card* / *port* [**10m** | **2m**]}
7. **configure terminal**
8. **network-clock synchronization automatic**
9. **network-clock synchronization ssm option** {**1**| **2**{**GEN1**| **GEN2**}}
10. **network-clock input-source** *priority* {**external** *slot* / *card* / *port* [**10m** | **2m** | **t1** {**sf** | **esf** | **d4**}] | **interface** *type slot* / *port*}
11. **network-clock synchronization mode ql-enabled**
12. **network-clock hold-off** {**0**| *milliseconds*}
13. **network-clock wait-to-restore** *seconds*
14. **esmc process**
15. **network-clock external** *slot* / *card* / *port* **hold-off** {**0** | *milliseconds*}

16. **network-clock quality-level** {**tx**| **rx**} *value* {**interface** *type slot* / *port* | **external** *slot* / *card* / *port* [**10m** | **2m** | **t1** {**sf** | **esf** | **d4**}]
17. **network-clock output-source {line** | **system**} *priority interface type slot* / *port* **external** *slot* / *card* / *port*[**10m** | **2m** | **t1**{**sf** | **esf** | **d4**} **]**
18. **interface** *type number*
19. **synchronous mode**
20. **esmc mode** [**ql-disabled**| **tx**| **rx**] *value*
21. **network-clock source quality-level** *value* {**tx** | **rx**}
22. **network-clock hold-off** {**0** | *milliseconds*}
23. **network-clock wait-to-restore** *seconds*
24. **end**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**network-clock set l ockout** {**external** *slot* / *card* / *port*[**10m**	**2m**	**t1**{**sf**	**esf**	**d4**}]	**interface** *type slot* / *port*} **Example:** `Router# network-clock set lockout GigabitEthernet7/1`	Sets the lockout state of input to "on." The input then is no longer considered available by the selection process.
Step 3	**network-clock clear lockout** {**external** *slot* / *card* / *port* [**10m**	**2m**	**t1** {**sf**	**esf**	**d4**}]	**interface** *type slot* / *port*} **Example:** `Router# network-clock clear lockout GigabitEthernet7/1`	Sets the lockout state of input to "off." The input then is considered available by the selection process.
Step 4	**network-clock switch force { external** *slot* / *card* / *port* [**10m**	**2m**]	**t0**	**t1** {**sf**	**esf**	**d4**} **t0	internal { external** *slot* / *card* / *port*[**10m**	**2m**]	**t0}	interface** *type slot* / *port* **externa**l *slot* / *card* / *port* [**10m**	**2m**]	**t0** } **Example:** `Router# network-clock switch force interface GigabitEthernet 7/1 t0`	Overrides the currently selected synchronization source when the synchronization source is enabled and not locked out. If the source selected by the forced switch command is disabled or locked out, the forced switch command is automatically rejected.
Step 5	**network-clock switch manual { interface** *type slot* /port { **externa**l *slot* / *card* / *port* [**10m**	**2m**]	**t0** }		Selects the synchronization source interface when it is enabled and not locked out. Manual switching is used to

	Command or Action	Purpose
	external *slot* / *card* / *port*{**10m** | **2m** | **t0** | **t1** {**sf** | **esf** | **d4**} | **internal { external** *slot* / *card* / *port*[**10m** | **2m**] | **t0}** *}* **Example:** `Router# network-clock switch manual interface GigabitEthernet 7/1 t0`	override the previously assigned synchronization source priorities.
Step 6	**network-clock clear switch** {**t0** | **external** *slot* / *card* / *port* [**10m** | **2m**]} **Example:** `Router# network-clock clear switch t0`	Clears the forced switch and manual switch commands. If the interface is not specified, the force/manual selected interface gets automatically cleared.
Step 7	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 8	**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.
Step 9	**network-clock synchronization ssm option** {**1**| **2**{**GEN1**| **GEN2**}} **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN2`	Configures the router to work in a synchronization network. • Option 1 refers to synchronization networks designed for Europe. This is the default value. • Option 2 refers to synchronization networks designed for United States.
Step 10	**network-clock input-source** *priority* {**external** *slot* / *card* / *port* [**10m** | **2m** | **t1** {**sf** | **esf** | **d4**}] | **interface** *type slot* / *port*} **Example:** `Router(config)# network-clock input-source 1 interface GigabitEthernet 7/1`	Enables selecting an interface that is configured as clock source line, an external timing input interface, a GPS interface, or a packet-based timing recovered clock as the input clock for the system. Interface can be SyncE or channelized SONET.
Step 11	**network-clock synchronization mode ql-enabled** **Example:** `Router(config)# network-clock synchronization mode ql-enabled`	Configures the automatic selection process ql-enabled mode. • QL is disabled by default. • ql-enabled mode can be used only when the synchronization interface is capable to send SSM.

	Command or Action	Purpose
Step 12	**network-clock hold-off** {**0**| *milliseconds*} **Example:** `Router(config)# network-clock hold-off 0`	(Optional) Configures hold-off timer for the interface.
Step 13	**network-clock wait-to-restore** *seconds* **Example:** `Router(config)# network-clock wait-to-restore 70`	(Optional) Configures wait-to-restore timer for the SyncE interface.
Step 14	**esmc process** **Example:** `Router(config)# esmc process`	Enables the ESMC process.
Step 15	**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 16	**network-clock quality-level** {**tx**| **rx**} *value* {**interface** *type slot* / *port* | **external** *slot* / *card* / *port* [**10m** | **2m** | **t1** {**sf** | **esf** | **d4**}] **Example:** `Router(config)# network-clock quality-level rx QL-STU GigabitEthernet 0/0/0`	Forces the QL value for line or external timing input and output.
Step 17	**network-clock output-source {line** | **system**} *priority interface type slot* / *port* **external** *slot* / *card* / *port*[**10m** | **2m** | **t1**{**sf** | **esf** | **d4**} **]** **Example:** `Router(config)# network-clock output-source line 1 GigabitEthernet1/2 external 0/0/1 10m`	Transmits the signal from the external timing input interface to the external timing output interface.
Step 18	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0`	Enters interface configuration mode.
Step 19	**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 20	**esmc mode** [**ql-disabled**| **tx**| **rx**] *value* **Example:** `Router(config-if)# esmc mode rx QL-STU`	(Optional) Enables the ESMC process on the interface.
Step 21	**network-clock source quality-level** *value* {**tx** | **rx**} **Example:** `Router(config-if)# network-clock source quality-level QL-ST4 tx`	(Optional) Provides the forced QL value to the local clock selection process.
Step 22	**network-clock hold-off** {**0** | *milliseconds*} **Example:** `Router(config-if)# network-clock hold-off 0`	(Optional) Configures the hold-off timer for the interface.
Step 23	**network-clock wait-to-restore** *seconds* **Example:** **Example:** `Router(config-if)# network-clock wait-to-restore 70`	(Optional) Configures the wait-to-restore timer for the SyncE interface.
Step 24	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Enabling and Disabling an SNMP Trap in the SyncE Event

A Simple Network Management Protocol (SNMP) trap is defined for an SNMP agent to notify the Network Management Systems (NMS) about any unsolicited information. The SNMP trap notifies NMS when a critical SyncE event occurs on a device. If the SNMP trap is enabled in the SyncE configuration, the SNMP agent code generates a SyncE trap for the SyncE events.

Perform the following tasks to enable and disable the SNMP trap for the SyncE event:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps netsync**
4. **no snmp-server enable traps netsync**
5. **end**
6. **show running-config all | include traps**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server enable traps netsync** **Example:** `Router(config)# snmp-server enable traps netsync`	Enables the SyncE traps.
Step 4	**no snmp-server enable traps netsync** **Example:** `Router(config)# no snmp-server enable traps netsync`	(Optional) Disables the SyncE traps.
Step 5	**end** **Example:** `Router(config)# end`	Exits global configuration mode.
Step 6	**show running-config all | include traps** **Example:** `Router# show running-config all | include trap`	(Optional) Displays the SyncE traps that are enabled on the router.

Configuration Examples for Synchronous Ethernet (SyncE) ESMC and SSM

Example Synchronous Ethernet (SyncE) ESMC and SSM

The following examples shows the SyncE configuration sequence (configuring an interface with two SyncE interfaces and two external interfaces):

```
Interface GigabitEthernet0/0/0
    synchronous mode
    clock source line
    network-clock wait-to-restore 720
!
Interface GigabitEthernet1/0/0
    synchronous mode
    clock source line
!
network-clock synchronization automatic
network-clock input-source 1 external 0/0/0 2m
network-clock input-source 2 external 1/0/0 2m
network-clock output-source line 1 interface GigabitEthernet0/0/0 external 0/0/0 2m
network-clock output-source line 1 interface GigabitEthernet1/0/0 external 1/0/0 2m
```

The following examples shows how to verify whether ESMC is enabled or not:

```
Router# show esmc

Interface: GigabitEthernet0/0/0
Administrative configurations:
  Mode: Synchronous
  ESMC TX: Enable
  ESMC RX : Enable
  QL RX configured : NA
  QL TX configured : NA
Operational status:
  Port status: UP
  QL Receive: QL-SSU-B
  ESMC Information rate : 1 packet/second
  ESMC Expiry: 5 second
```

The following examples shows how to view the network clock synchronization details:

```
Router# show network-clock synchronization detail

Automatic selection process : Enable
Equipment Clock : 2048 (EEC-Option1)
Clock Mode : QL-Enable
ESMC : Disabled
SSM Option : 1
T0 : Internal
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Revertive : No
Force Switch: FALSE
Manual Switch: FALSE
Number of synchronization sources: 1
Secondary src: Ethernet0/0
Slots disabled 0x0
Monitor source(s):  Ethernet0/0
Selected QL: QL-SEC
sm(netsync_ql_dis NETCLK_QL_ENABLE), running yes, state 1A
Last transition recorded: (begin)-> 1A (ql_mode_enable)-> 1A (src_added)-> 1A


Nominated Interfaces

 Interface            SigType     Mode/QL      Prio  QL_IN     ESMC Tx   ESMC Rx
*Internal             NA          NA/Dis       251   QL-SEC    NA        NA
 Et0/0                NA          Sync/En      2     QL-DNU    -         -
```

```
Interface:
-------------------------------------------
Local Interface: Internal
Signal Type: NA
Mode: NA(Ql-enabled)
SSM Tx: Disable
SSM Rx: Disable
Priority: 251
QL Receive: QL-SEC
QL Receive Configured: -
QL Receive Overrided: -
QL Transmit: -
QL Transmit Configured: -
Hold-off: 0
Wait-to-restore: 0
Lock Out: FALSE
Signal Fail: FALSE
Alarms: FALSE
Slot Disabled: FALSE

Local Interface: Et0/0
Signal Type: NA
Mode: Synchronous(Ql-enabled)
ESMC Tx: Enable
ESMC Rx: Enable
Priority: 2
QL Receive: QL-DNU
QL Receive Configured: -
QL Receive Overrided: -
QL Transmit: -
QL Transmit Configured: -
Hold-off: 300
Wait-to-restore: 300
Lock Out: FALSE
Signal Fail: FALSE
Alarms: FALSE
Slot Disabled: FALSE
Dont Use: FALSE
Configured Priority: 2
Force Switch: FALSE
Manual Switch: FALSE
Manual Switch In progress: FALSE
Holdoff_cfg: FALSE
Wtr_cfg: FALSE
Reason for alarm flag: 0
Msw in progress: FALSE
Intf_sig_nv: 0
Hold off Timer: Stopped
Wait to restore Timer: Stopped
Switchover Timer: Stopped
ESMC Tx Timer: Stopped
ESMC Rx Timer: Stopped
Tsm Delay Timer: Stopped
```

Example Enabling and Disabling an SNMP Trap in the SyncE Event

The following example shows how to enable and disable an SNMP trap in the SyncE event:

```
Router > enable
```

```
Router # configure terminal
Router(config)# snmp-server enable traps netsync
Router (config)# no snmp-server enable traps netsync
Router (config)# end
Router# show running-config all| include traps
snmp-server enable traps flowmon
snmp-server enable traps sonet
snmp-server enable traps netsync
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Interface and hardware component configuration commands	*Cisco IOS Interface and Hardware Component Command Reference*

Standards

Standard	Title
ITU-T G.8262	*Timing characteristics of synchronous ethernet equipment slave clock (EEC)*
ITU-T G.8264	*Timing distribution through Packet Networks*
ITU-T G.781	*Synchronization layer functions*

MIBs

MIB	MIBs Link
CISCO-NETSYNC-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
None	--

Technical Assistance

Description	Link
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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Synchronous Ethernet (SyncE) ESMC and SSM

The following table provides release information about the feature or features described in this module. This table 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.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com/. An account on Cisco.com is not required.

Table 1: Feature Information for Synchronous Ethernet (SyncE): ESMC and SSM

Feature Name	Releases	Feature Information
Generating SNMP Trap in SyncE Feature	15.1(2)S Cisco IOS XE Release 3.8S	This feature describes how to set SNMP traps in SyncE to notifies the NMS about any unsolicited information. The following commands were introduced or modified by this feature: **no snmp-server enable traps netsync, show running-config all| include trap, snmp-server enable traps netsync.**
Synchronous Ethernet (SyncE): ESMC and SSM	15.0(1)S Cisco IOS XE Release 3.8S	This feature supports ESMC and the SSM control protocol for SyncE to synchronize clock frequency over an Ethernet port with quality level selection. The following commands were introduced or modified by this feature: **esmc mode ql-disabled**, **esmc process**, **show esmc**, **show interfaces accounting**.