CHAPTER 17

Configuring Synchronous Ethernet ESMC and SSM

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 a node always derives timing from the most reliable source.

The SyncE synchronizes clock frequency over an Ethernet port. In SONET/SDH the communication channel for conveying clock information is Synchronization Status Message (SSM), and in SyncE it is the Ethernet Synchronization Message Channel (ESMC).

Note For information about how to configure synchronous Ethernet, see "Configuring Clocking and Timing".

Contents

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 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

- To use the **network-clock synchronization ssm option** command, the following conditions are required:
  - No input source is in the configuration.
  - No network clock quality level is in the configuration.
  - No network clock source quality source is set under any synchronous Ethernet interface.
- 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 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 to 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 do 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

Perform this task to configure SyncE using ESMC and SSM.

	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	**controller BITS** **Example:** `Router(config)# controller BITS`	Enters BITS controller configuration mode.
Step 4	**applique {E1 | T1}** **Example:** `Router(config-controller)# applique e1`	Specifies the BITS controller type.

Step 5	**E1 controller**
	framing {crc4 | no-crc4 | none}
	
	T1 controller
	framing {esf | none | sf}
	
	Example: E1 Controller
	`Router(config-controller)# framing crc4`
	
	Example: T1 Controller
	`Router(config-controller)# framing esf`
		Specify the framing type for the E1 or T1 BITS interface.
		For an E1 interface, ensure that the controller is set to use crc4 framing; CRC4 is the default setting.
		For a T1 interface, configure the controller to use ESF framing; ESF is not the default setting.

Step 6	**ssm** **Example:** `Router(config-controller)# ssm`	Enables SSM on the T1 or E1 BITS interface.
Step 7	**sabit** **Example:** `Router(config-controller)# sabit 4`	(Optional) Specifies the San synchronization status bit used to indicate the clock quality level. Valid values are 4–8. **Note** This command only applies to the E1 controller.

	Command or Action	Purpose

Step 8	**exit**
	
	Example:
	`Router(config-controller)# exit`
	`Router(config)#`
		Exits controller configuration mode and returns to configuration mode.

Step 9	**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 10	**network-clock eec {1 | 2}** **Example:** `Router(config)# network-clock eec 1`	Configures the clocking system hardware with the desired parameters. These are the options: • For option 1, the default value is EEC-Option 1 (2048). • For option 2, the default value is EEC-Option 2 (1544).
Step 11	**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 12	**network-clock input-source** *priority* {**controller BITS** | **E1**} | {**interface** *type slot/card/port*] {**external** [**2m** | **10m**]}} **Example:** `Router(config)# network-clock input-source 1 interface GigabitEthernet 0/1`	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.
Step 13	**network-clock synchronization mode ql-enabled** **Example:** `Router(config)# network-clock synchronization mode ql-enabled`	Configure 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.
Step 14	**network-clock hold-off** {**0** | *milliseconds*} **Example:** `Router(config)# network-clock hold-off 0`	(Optional) Configures hold-off timer for the interface.
Step 15	**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 16	**network-clock-select mode** {**revert** | **nonrevert**} **Example:** `Router(config)# network-clock-select mode revert`	(Optional) Specifies the router switching mode when recovering from a failure.

	Command or Action	Purpose
Step 17	**network-clock-select hold-timeout** {*timeout* | **infinite**} **Example:** `Router(config)# network-clock-select hold-timeout 2000`	(Optional) Specifies how long the router waits before reevaluating the network clock entry.
Step 18	**esmc process** **Example:** `Router(config)# esmc process`	Enables the ESMC process.
Step 19	**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 20	**network-clock quality-level** {**tx** | **rx**} *value* {**interface** *type slot/card/port* | **external** {**2m** | **10m**} | **controller** {**BITS** | **E1**} **Example:** `Router(config)# network-clock quality-level rx QL-STU GigabitEthernet 0/0`	Forces the QL value for line or external timing input and output.
Step 21	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0`	Enters interface configuration mode.
Step 22	**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.
Step 23	**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 24	**network-clock source quality-level** *value* {**tx** | **rx**} **Example:** `Router(config-if)# network-clock source quality-level ql-prc tx`	(Optional) Provides the forced QL value to the local clock selection process.
Step 25	**network-clock hold-off** {*0* | *milliseconds*} **Example:** `Router(config-if)# network-clock hold-off 0`	(Optional) Configures the hold-off timer for the interface.

	Command or Action	Purpose
Step 26	**network-clock wait-to-restore** *seconds* **Example:** `Router(config-if)# network-clock wait-to-restore 70`	(Optional) Configures wait-to-restore timer for the SyncE interface.
Step 27	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

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

Configuration Examples for Synchronous Ethernet (SyncE): ESMC and SSM

Example: Synchronous Ethernet (SyncE): ESMC and SSM

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

```
Interface GigabitEthernet0/0
    synchronous mode
    network-clock wait-to-restore 720
!
Interface GigabitEthernet0/1
    synchronous mode
!
controller BITS
ssm

!
network-clock synchronization automatic
network-clock input-source 1 controller BITS
network-clock input-source 1 gigabitethernet 0/0
network-clock input-source 2 gigabitethernet 0/1
network-clock synchronization mode QL-enabled
network-clock-select hold-timeout infinite
network-clock-select mode nonrevert
```

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

```
Router# show esmc

Interface: GigabitEthernet0/0
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
```

Additional References

Related Documents

Related Topic	Document Title
SyncE 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
None	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	