Network Synchronization Support

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. This document explains how to configure network synchronization on the Cisco ASR 1000 Series Aggregation Services Routers.

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. 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 for Network Synchronization Support" section on page 12-24.

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.

Contents

This guide covers the following topics:

Prerequisites for Network Synchronization Support

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 the network elements should be synchronized to a single clock source.
- Use clock sources of the highest quality (in terms of stability and long-term accuracy).
- To ensure resiliency of synchronization, plan for possible failure of the clock sources, network elements, and network trunks.

Network Synchronization Overview

Synchronous Ethernet (SyncE), which is defined by the Telecommunication Standardization Sector (ITU-T) standards, such as G.8261 and G.8262, leverages the PHY layer of the Ethernet to transmit clock information to remote sites.

SyncE provides a cost-effective alternative to the Synchronous Optical Networking (SONET) networks. For SyncE to work, each network element along the synchronization path must support SyncE. To implement SyncE, the bit clock of the Ethernet is aligned to a reliable clock that is traceable to the Primary Reference Clock (PRC).

Features Supported on ASR 1000 Platforms

Platform Support	Features Supported	Features Not Supported
ASR 1001-X	Synchronous Ethernet Feature is supported with Built-in Gigabit and 10-Gigabit Ethernet Ports	NetClk Feature
ASR1002-X	Synchronous Ethernet Feature is supported with Built-in Gigabit Ethernet Ports.	NetClk Feature
ASR1001	—	NetClk and Network Synchronization Feature
ASR 1002, ASR 1004, ASR 1006 and ASR 1013	NetClk is supported on all ASR1000 family routers apart from ASR1001, ASR1002-X, and ASR 1001-X.	—

Note Network-Clocking feature is not supported with SFP-GE-T on any of the ASR1000 platforms.

Cisco ASR 1000 Series Aggregation Services Routers have a dedicated external interface known as BITS interface to recover clocking information from a Synchronization Supply Unit (SSU). They use this clock for SyncE. The BITS interface supports E1 (European SSUs) and T1 (American BITS) framing.

Note The Cisco ASR 1001-X Router does not have an on-board BITS port, hence it does not support those features that use BITS ports.

Table 12-1 lists the framing modes for a BITS port on the Cisco ASR 1002-X Router.

Table 12-1 Framing Modes for a BITS or SSU Port on the Cisco ASR 1002-X Router

BITS or SSU Port Support Matrix	Framing Modes Supported	SSM or QL Support	Tx Port	Rx Port
T1	T1 ESF	Yes	Yes	Yes
T1	T1 SF	Yes	Yes	Yes
T1	T1 D4	Yes	Yes	Yes
E1	E1 CRC4	Yes	Yes	Yes
E1	E1 FAS	Yes	Yes	Yes
E1	E1 CAS	Yes	Yes	Yes
E1	E1 CAS CRC4	Yes	Yes	Yes
2048 kHz	2048 kHz	Yes	Yes	Yes

Table 12-2 lists the framing modes for a BITS port on the other Cisco ASR 1000 Series Aggregation Services Routers.

Table 12-2 Framing Modes for a BITS or SSU Port on the Other Cisco ASR 1000 Series Aggregation Services Routers

BITS or SSU Port Support Matrix	Framing Modes Supported	SSM or QL Support	Tx Port	Rx Port
T1	T1 ESF	No	No	Yes
T1	T1 SF	No	No	Yes
E1	E1 CRC4	No	No	Yes
E1	E1 FAS	No	No	Yes
E1	E1 CAS	No	No	Yes
E1	E1 CAS CRC4	No	No	Yes
2048 kHz	2048 kHz	No	No	Yes

You can configure network synchronization on the Cisco ASR 1000 Series Aggregation Services Routers by using one of the following features:

- Clock Recovery from SyncE

  When this feature is configured, the system clock is recovered from the SyncE clocking source (SyncE-enabled interfaces only). The router uses this clock as the Tx clock for other supported Shared Port Adapters (SPAs).

- Clock Recovery from an External Interface

  When this feature is enabled, the system clock is recovered from a BITS clock source.

- Clock Recovery from a GPS (10M) Source

Note This feature is supported only on the Cisco ASR 1002-X Router.

When this feature is enabled, the system clock is recovered from a GPS (10M) clock source.

- Line to External

Note This feature is not supported on the Cisco ASR 1002-X Router.

When this feature is enabled, the clock received from an Ethernet is forwarded to an external SSU. The SyncE feature provides the clock cleanup functionality. When a router is in the middle of a synchronization chain, the received clock may experience unacceptable wander and jitter. The router recovers the clock from the SyncE interface, converts it to the format required for the BITS interface, and sends it to an SSU through the BITS port. The SSU then performs a cleanup and sends it back to the BITS interface. The cleaned up clock is received from the SSU and is used as the Tx clock for the SyncE ports. In the context of the Cisco ASR 1000 Series Aggregation Services Routers, the interface from which the clock is recovered and the BITS port to the SSU must reside on the same card.

A SyncE-enabled Cisco ASR 1000 Series Router provides the Squelching feature. In this feature, an alarm indication signal (AIS) is sent to the Tx interfaces if the clock source goes down. When the Line to External feature is configured, if the line source goes down at any point of time, an AIS is transmitted through the external interface to the SSU. Squelching can be performed only on external devices, such as SSUs and PRCs.

You can have a maximum of eight clock sources configured on a Cisco ASR 1000 Series Router. On a router that supports the Network Synchronization feature, you can configure selection of the clock source on the basis of the quality of the clock source. With this feature configured, the clock source that offers the best quality is made the default clock source. If the highest level of quality is offered by more than one clock source, the clock source with the highest priority is made the default clock source. You can also manage synchronization by using the following management options:

- 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 milliseconds (ms).
- Wait to Restore: If a SyncE interface comes up, the router waits for a specific period of time before considering the SyncE interface for synchronization source. By default, the value is 300 seconds.
- Force Switch: Forcefully selects a synchronization source irrespective of whether the source is available or within the specified range.
- Manual Switch: Manually select a synchronization source, provided the clock source has a higher quality level than the currently active clock.

Table 12-3 lists the SPAs that support network synchronization.

Table 12-3 SPAs supporting Network Synchronization

SPA Type	SPA Name
ASR 1001-X Built-in SPA	BUILT-IN-2T+6X1GE
ASR1002-X Built-in SPA	6XGE-BUILT-IN

Table 12-3 SPAs supporting Network Synchronization (continued)

SPA Type	SPA Name
Synchronous Ethernet	SPA-2XGE-SYNCE
Ethernet Line Card	ASR1000-2T+20X1GE
Serial and Channelized SPA	SPA-1XCHSTM1/OC3
	SPA-1XCHOC12/DS0
	SPA-8XCHT1/E1-V2 (Supported on the Cisco ASR 1002-X Router and the Cisco ASR1001-X Router, from Cisco IOS XE Release 3.11 onwards)
CEOP	SPA-1CHOC3-CE-ATM
	SPA-24CHT1-CE-ATM
ATM	SPA-1XOC3-ATM-V2
	SPA-3XOC3-ATM-V2
	SPA-1XOC12-ATM-V2
	SPA-2CHT3-CE-ATM
POS	SPA-2XOC3-POS
	SPA-4XOC3-POS
	SPA-4XOC3-POS-V2
	SPA-8XOC3-POS
	SPA-1XOC12-POS
	SPA-2XOC12-POS
	SPA-4XOC12-POS
	SPA-8XOC12-POS
	SPA-1XOC48-POS/RPR
	SPA-2XOC48POS/RPR
	SPA-4XOC48POS/RPR
	SPA-OC192POS-XFP

Note For more information on SPA support matrix see, http://www.cisco.com/en/US/docs/interfaces_modules/shared_port_adapters/configuration/ASR1000/ASRspasw.html

Note Netsync feature on SPA-2XGE-SYNCE is not supported on the Cisco ASR 1001-X Router.

Synchronization Status Message and Ethernet Synchronization Messaging Channel

Network clocking uses the following mechanisms to exchange the quality level of the clock between the network elements:

- Synchronization Status Message, page 12-6
- Ethernet Synchronization Messaging Channel, page 12-6

Synchronization Status Message

Network elements use Synchronization Status Messages (SSM) to inform the neighboring elements about the Quality Level (QL) of the clock. Non-Ethernet interfaces, such as optical interfaces and T1 or E1 SPA frames, use SSM. The key benefits of SSMs are:

- Prevents timing loops.Provides fast recovery when a part of the network fails.
- Ensures that a node gets timing from the most reliable clock source.

Ethernet Synchronization Messaging Channel

In order to maintain a logical communication channel in synchronous network connections, Ethernet relies on a channel called the Ethernet Synchronization Messaging Channel (ESMC), which is based on the IEEE 802.3 Organization-Specific Slow Protocol (OSSP) standards. ESMC relays the SSM code that represents the quality level of the Ethernet Equipment Clock (EEC) in a physical layer.

The ESMC packets are received only for the ports configured as clock sources, and transmitted on all the SyncE interfaces in the system. These packets are then processed by the clock selection algorithm on route processors (RP) and are used to select the best clock. The Tx frame is generated based on the QL value of the selected clock source, and sent to all the enabled SyncE ports.

Clock Selection Algorithm

The clock selection algorithm selects the best available synchronization source from the nominated sources. This algorithm exhibits nonrevertive behavior among the clock sources with the same QL value, and always selects the signal with the best QL value. For clock option 1, the default is revertive, and for clock option 2, the default is nonrevertive.

The clock selection process works in the following modes:

- QL-Enabled Mode, page 12-6
- QL-Disabled Mode, page 12-7

When multiple selection processes are present in a network element, all the processes work in the same mode.

QL-Enabled Mode

In QL-enabled mode, the following parameters contribute to the selection process:

- Quality level
- Signal fail via QL-FAILED

- Priority
- External commands.

If no external commands are active, the algorithm selects the reference (for clock selection) with the highest QL that does not experience a signal fail condition. If multiple inputs have the same highest QL, the input with the highest priority is selected. For multiple inputs having the same highest priority and QL, the existing reference is maintained (if it belongs to the highest priority and QL group). Otherwise, an arbitrary reference from the highest priority and QL group is selected.

QL-Disabled Mode

In QL-disabled mode, the following parameters contribute to the selection process:

- Signal failure
- Priority
- External commands

If no external commands are active, the algorithm selects the reference (for clock selection) with the highest priority that does not experience a signal fail condition. For multiple inputs having the same highest priority, the existing reference is maintained (if it belongs to highest priority group). Otherwise, an arbitrary reference from highest priority group is selected.

Restrictions for Network Synchronization

This section lists the restrictions for configuring network synchronization on a router. See Table 12-3 for a listing of the SPAs that you can use when configuring network synchronization.

- If the network clock algorithm is enabled, use the system clock as the Tx clock (synchronous mode) for the Ethernet interfaces of the corresponding router. You cannot change the synchronous mode on a per-interface basis.
- You can configure up to eight ports as clock sources on a router.
- The SyncE feature coexists with SSO, but is not SSO-compliant. The clock selection algorithm is restarted on a switchover. During switchover, the router goes into holdover mode.
- The SyncE interfaces in the WAN mode cannot be used for QL-enabled clock selection. You must either use them with the system in QL-disabled mode, or disable the ESMC on the interfaces, and use them as QL-disabled interfaces.
- We recommend that you do not configure multiple input sources with the same priority because this impacts the T_{SM} (switching message delay).
- You cannot implement the network clock-based clock selection algorithm and the new algorithm simultaneously. Both these are mutually exclusive.
- The Line to External feature for clock cleanup is supported only if the line interface and the external interface are on the same metronome SPA.

Note The Line to External feature is not supported on the Cisco ASR 1002-X Router.

Configuring Network Synchronization

You can configure network synchronization on the Cisco ASR 1000 Series Aggregation Services Routers by performing one of the following procedures:

- Configuring Clock Recovery from SyncE, page 12-8
- Configuring Clock Recovery from a BITS Port, page 12-9
- Configuring SyncE by Using the Line to External Feature, page 12-14

Configuring Clock Recovery from SyncE

This section describes how to configure clock recovery by using the SyncE method.

SUMMARY STEPS

1. **configure terminal**
2. **network-clock synchronization automatic**
3. **network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}**
4. **interface gigabitethernet** *slot/card/port*
5. **synchronous mode**
6. **exit**
7. **network-clock input-source** *priority* **{interface** *interface-name slot/card/port* **| {external** *slot/card/port***}}**
8. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**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 3	**network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}** **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN1`	Configures the equipment to work in a synchronization network. The *option_id* value 1 refers to a synchronization network design for Europe. This is the default value. The *option_id* value 2 refers to a synchronization network design for the U.S.

	Command	Purpose
Step 4	**interface gigabitethernet** *slot/card/port* **Example:** `Router(config)# interface gigabitethernet 0/2/0`	Specifies the Gigabit Ethernet interface to be configured: *slot/card/port*—Specifies the location of the interface.
Step 5	**synchronous mode** **Example:** `Router(config-if)# synchronous mode`	Sets the mode to synchronous mode.
Step 6	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Step 7	**network-clock input-source priority {interface** *interface-name slot/card/port* **| {external** *slot/card/port***}}**
	
	`Router(config)# network-clock input-source 1 interface gigabitethernet 0/2/0`
	
	`Router(config)# network-clock input-source 1 external R0 2048k`
		Enables clock recovery from SyncE.
		
		The Cisco ASR1006 router supports two RP ports, one active and the other standby.

Step 8	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Examples

The following example shows how to configure clock recovery from SyncE:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN1
Router(config)# interface gigabitethernet 0/2/0
Router(config-if)# synchronous mode
Router(config)# exit
Router(config)# network-clock input-source 1 interface gigabitethernet 0/2/0
Router(config)# exit
```

Configuring Clock Recovery from a BITS Port

This section describes how to configure clock recovery from a BITS port. BITS port can be configured either as an input-source or an output-source.

- Configuring Clock Recovery with a BITS Port as an Input-Source, page 12-10
- Configuring Clock Recovery with a BITS Port as an Output-Source, page 12-11

Configuring Clock Recovery with a BITS Port as an Input-Source

This section describes how to configure clock recovery with a BITS port as an input-source.

SUMMARY STEPS

1. **configure terminal**
2. **network-clock synchronization automatic**
3. **network-clock synchronization ssm option** *option-id generation-id*
4. **network-clock input-source** *priority* **{external** *slot/card/port***}**
5. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enables the privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters the 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.
Step 4	**network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}** **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN1`	Configures the equipment to work in the synchronization network. The *option_id* value 1 refers to synchronization network design for Europe. This is the default value. The *option_id* value 2 refers to the synchronization network design for the U.S.

	Command	Purpose

Step 5	**network-clock input-source priority {external** *slot/card/port***}**
	
	Example:
	`Router(config)# network-clock input-source 1 External 0/3/0 t1 esf`
	
	`Router(config)# network-clock input-source 1 External R0 t1 esf`
	
	Example:For ASR 1002-X Router:
	`Router(config)# network-clock input-source 1 external r0 e1 cas crc4 120 linecode`
		Enables clock recovery from a BITS port.
		
		Note Routers with dual hardware support, such as the Cisco ASR 1006 Router, can have two RP ports, wherein one RP is active and the other is standby. Both the active and standby RP BITS ports can be configured as output sources.

Step 6	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Examples

The following example shows how to configure clock recovery from a BITS port for a Metronome SPA:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN1
Router(config)# network-clock input-source 1 external 0/3/0 t1 esf
Router(config)# exit
```

The following example shows how to configure clock recovery from a BITS port for RP BITS on Cisco ASR 1000 Series Aggregation Services Routers with dual RP:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN
Router(config)# network-clock input-source 1 External R0 t1 esf
Router(config)# exit
```

The following example shows how to configure clock recovery with BITS as the input source on the Cisco ASR 1002-X Series Aggregation Services Routers on the E1 Common Channel Signal mode:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN
Router(config)# network-clock input-source 1 external r0 e1 cas crc4 120 linecode
Router(config)# exit
```

Configuring Clock Recovery with a BITS Port as an Output-Source

This section describes how to configure clock recovery from a BITS port as an output-source.

Note BITS configuration as output sources is supported only on Cisco ASR 1002-X Router.

SUMMARY STEPS

1. **configure terminal**
2. **network-clock synchronization automatic**
3. **network-clock synchronization ssm option** *option-id generation-id*
4. **network-clock output-source** *priority* **{external** *slot/card/port***}**
5. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enables the privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters the 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.
Step 4	**network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}** **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN1`	Configures the equipment to work in synchronization network. The *option_id* value 1 refers to synchronization networks design for Europe. This is the default value. The *option_id* value 2 refers to the synchronization networks design for the U.S.

	Command	Purpose
Step 5	**network-clock output-source priority {external** slot/card/port**}** **Example:** Router(config)# **network-clock output-source system 1 External 0/3/0 t1 esf** Router(config)# **network-clock output-source 1 External R0 t1 esf** **Example:For ASR 1002-X Router:** Router(config)# **network-clock output-source 1 external r0 e1 cas crc4 120 linecode**	Enables clock recovery from a BITS port. **Note** For routers with dual hardware support such as the Cisco ASR 1006 Router can have two RP ports wherein one RP is active and the other is standby. Both the active and standby RP BITS ports can be configured as output sources.
Step 6	**exit** **Example:** Router(config)# **exit**	Exits the global configuration mode.

Examples

The following example shows how to configure clock recovery from a BITS port for a Metronome SPA:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN1
Router(config)# network-clock output-source 1 external 0/3/0 t1 esf
Router(config)# exit
```

The following example shows how to configure clock recovery from a BITS port for RP BITS on Cisco ASR 1000 Series Aggregation Services Routers with dual RP:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN
Router(config)# network-clock output-source 1 external R0 t1 esf
Router(config)# exit
```

The following example shows how to configure clock recovery with BITS as output-source on Cisco ASR 1002-X Series Aggregation Services Routers on a E1 Common Channel Signal Mode:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN
Router(config)# network-clock output-source 1 external r0 e1 cas crc4 120 linecode
Router(config)# exit
```

Configuring SyncE by Using the Line to External Feature

This section describes how to configure network synchronization by using the Line to External feature.

Note The Line to External feature is not supported on the Cisco ASR 1002-X Router.

SUMMARY STEPS

1. **configure terminal**
2. **network-clock synchronization automatic**
3. **network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}**
4. **interface gigabitethernet** *slot/card/port*
5. **synchronous mode**
6. **exit**
7. **network-clock output-source line** *priority* **{interface** *interface-name***} {external** *slot/card/port***}**
8. **exit**

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**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 3	**network-clock synchronization ssm option {**`1 | 2` **{GEN1 | GEN2}}** **Example:** `Router(config)# network-clock synchronization ssm option 2 GEN1`	Configures the equipment to work in a synchronization network. The *option_id* value 1 refers to a synchronization network design for Europe. This is the default value. The *option_id* value 2 refers to a synchronization network design for the U.S.
Step 4	**interface gigabitethernet** *slot/card/port* **Example:** `Router(config)# interface gigabitethernet 0/2/0`	Specifies the Gigabit Ethernet interface to be configured: *slot/card/port*—Specifies the location of the interface.

	Command	Purpose
Step 5	**synchronous mode** **Example:** `Router(config-if)# synchronous mode`	Changes to the synchronous mode.
Step 6	**exit** **Example:** `Router(config)# exit`	Exits the specific configuration mode.
Step 7	**network-clock output-source line** *priority* **{interface** *interface-name***} {external** *slot/card/port***}** **Example:** `Router(config-if-srv)# network-clock output-source line 1 interface gigabitethernet 0/2/0 external 0/3/0`	Configures the line clock to be used on external Tx interfaces. **Note** This command is supported only on the Metronome SPA.
Step 8	**exit** **Example:** `Router(config)# exit`	Exits the global configuration mode.

Examples

The following example shows how to configure a SyncE using the Line to External method:

```
Router# configure terminal
Router(config)# network-clock synchronization automatic
Router(config)# network-clock synchronization ssm option 2 GEN1
Router(config)# interface gigabitethernet 0/2/0
Router(config-if)# synchronous mode
Router(config)# exit
Router(config)# network-clock output-source line 1 interface gigabitethernet 0/2/0
external 0/3/0
Router(config)# exit
```

Managing Synchronization

Manage synchronization on a Cisco ASR 1000 Series Aggregation Service Router using the following management commands:

- **network-clock synchronization mode QL-enabled** command

  Use the **network-clock synchronization mode QL-enabled** command in the global configuration mode to configure the automatic selection process for the QL-enabled mode. This succeeds only if the SyncE interfaces are capable of sending SSMs.

  The following example shows how to configure network clock synchronization (QL-enabled mode) in the global configuration mode:

  ```
  Router(config)# network-clock synchronization mode QL-enabled
  ```

- **esmc process** command

  Use the **esmc process** command in the global configuration mode to enable the ESMC process at system level. The **no** form of this command disables the ESMC process. The **no** form of this command fails if no SyncE-capable interface is installed on the platform.

  The following example shows how to enable the ESMC process in the global configuration mode:

  ```
  Router(config)# esmc process
  ```

- **esmc mode [tx | rx]** command

  Use the **esmc mode [tx | rx]** command in the interface configuration mode to enable the ESMC process at the interface level. The **no** form of the command disables the ESMC process.

  The following example shows how to enable ESMC in the interface configuration mode:

  ```
  Router(config-if)# esmc mode tx
  ```

- **network-clock quality-level** command

  Use the **network-clock source quality-level** command in the interface configuration mode to configure the QL value for ESMC on a *gigabit Ethernet* port. The value is based on global interworking options:

  – If Option 1 is configured, the available values are QL-PRC, QL-SSU-A, QL-SSU-B, QL-SEC, and QL-DNU.

  – If Option 2 is configured with GEN 2, the available values are QL-PRS, QL-STU, QL-ST2, QL-TNC, QL-ST3, QL-SMC, QL-ST4, and QL-DUS.

  – If Option 2 is configured with GEN1, the available values are QL-PRS, QL-STU, QL-ST2, QL-SMC, QL-ST4, and QL-DUS

  The following example shows how to configure the **network-clock source quality-level** in the interface configuration mode:

  ```
  Router(config-if)# network-clock source quality-level QL-PRC rx
  ```

  Use the **network-clock quality-level** command in the global configuration mode to configure the QL value for the SSMs on a BITS port.

  The following example shows how to configure **network-clock quality-level** command in the global configuration mode:

  ```
  Router(config)# network-clock quality-level rx qL-pRC external R0 2048k
  ```

- **network-clock wait-to-restore** command

  Use the **network-clock wait-to-restore** *timer* **global** command to set the wait-to-restore time. You can configure the wait-to-restore time to any value between 0 to 86400 seconds. The default value is 300 seconds. The wait-to-restore timer can be set in the global configuration mode and the interface configuration mode.

  The following example shows how to configure the wait-to-restore timer in the global configuration mode:

```
Router(config)# network-clock wait-to-restore 10 global
```

  The following example shows how to configure the wait-to-restore timer in the interface configuration mode:

```
Router(config)# interface gigabitethernet 0/2/0
Router(config-if)# network-clock wait-to-restore 10
```

- **network-clock hold-off** command

  Use the **network-clock hold-off** *timer* **global** command to configure hold-off time. You can configure the hold-off time to either 0 or any value between 50 to 10000 ms. The default value is 300 ms. The **network-clock hold-off** *timer* can be set in the global configuration mode and the interface configuration mode.

  The following example shows how to configure the hold-off timer:

```
Router(config-if)# network-clock hold-off 50 global
```

- **network-clock switch force** command

  Use the **network-clock switch force** command to forcefully select a synchronization source irrespective of whether the source is available, and within range.

  The following example shows how to configure a force switch:

```
Router# network-clock switch force interface gigabitethernet 0/2/0
```

- **network-clock switch manual** command

  Use the **network-clock switch manual** command to manually select a synchronization source, provided the clock source has a higher quality level than the currently active clock.

  The following example shows how to configure a manual switch:

```
Router# network-clock switch manual interface gigabitethernet 0/2/0
```

- **network-clock clear switch controller-id** command

  Use the **network-clock clear switch controller-id** command to clear the manual, or switch it on by force.

  The following example shows how to clear a switch:

```
Router# network-clock clear switch t0
```

- **network-clock set lockout** command

  Use the **network-clock set lockout** command to lockout a clock source. A clock source flagged as lockout is not selected for SyncE. To clear the lock-out on a source, use the **network-clock clear lockout** command.

  The following example shows how to lock out a clock source:

```
Router# network-clock set lockout interface gigabitethernet 0/2/0
```

The following example shows how to clear the lock out on a clock source:

```
Router# network-clock clear lockout interface gigabitethernet 0/2/0
```

Verifying the Network Synchronization Configuration

Use the following commands to verify the network synchronization configuration:

- Use the **show network-clock synchronization** command to display the output:

```
Router# show network-clock 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 : 1544 (EEC-Option2)
Clock Mode : QL-Enable
ESMC : Enabled
SSM Option : GEN1
T0 : External R0 t1 esf
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : No
Force Switch: FALSE
Manual Switch: FALSE
Number of synchronization sources: 2
sm(netsync NETCLK_QL_ENABLE), running yes, state 1A
Last transition recorded: (src_rem)-> 1A (src_added)-> 1A (src_rem)-> 1A (src_added)->
1A (ql_change)-> 1A (sf_change)-> 1A (force_sw)-> 1C (clear_sw)-> 1A (sf_change)-> 1A
(sf_change)-> 1A


Nominated Interfaces

 Interface            SigType     Mode/QL      Prio  QL_IN  ESMC Tx  ESMC Rx
Internal             NA          NA/Dis       251   QL-ST3    NA        NA
Gi1/2/0              NA          Sync/En      1     QL-FAILED -         -
*External R0          T1 ESF      NA/En        2     QL-STU    NA        NA
```

- Use the **show network-clock synchronization detail** command to display all the details of network clock synchronization parameters at the global and interface level, as shown in the following example:

```
Router# show network-clock synchronization detail

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 : 1544 (EEC-Option2)
Clock Mode : QL-Enable
ESMC : Enabled
SSM Option : GEN1
```

```
T0 : External R0 t1 esf
Hold-off (global) : 300 ms
Wait-to-restore (global) : 300 sec
Tsm Delay : 180 ms
Revertive : No
Force Switch: FALSE
Manual Switch: FALSE
Number of synchronization sources: 2
sm(netsync NETCLK_QL_ENABLE), running yes, state 1A
Last transition recorded: (src_rem)-> 1A (src_added)-> 1A (src_rem)-> 1A (src_added)->
1A (ql_change)-> 1A (sf_change)-> 1A (force_sw)-> 1C (clear_sw)-> 1A (sf_change)-> 1A
(sf_change)-> 1A


Nominated Interfaces

Interface            SigType     Mode/QL      Prio  QL_IN  ESMC Tx  ESMC Rx
Internal             NA          NA/Dis       251   QL-ST3    NA        NA
Gi1/2/0              NA          Sync/En      1     QL-FAILED -         -
*External R0          T1 ESF      NA/En        2     QL-STU    NA        NA

Interface:
-----------------------------------------------
Local Interface: Internal
Signal Type: NA
Mode: NA(Ql-enabled)
SSM Tx: Disable
SSM Rx: Disable
Priority: 251
QL Receive: QL-ST3
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: Gi1/2/0
Signal Type: NA
Mode: Synchronous(Ql-enabled)
ESMC Tx: Disable
ESMC Rx: Enable
Priority: 1
QL Receive: QL-PRS
QL Receive Configured: -
QL Receive Overrided: QL-FAILED
QL Transmit: QL-DUS
QL Transmit Configured: -
Hold-off: 300
Wait-to-restore: 300
Lock Out: FALSE
Signal Fail: FALSE
Alarms: TRUE
Slot Disabled: FALSE

Local Interface: External R0
Signal Type: T1 ESF
Mode: NA(Ql-enabled)
SSM Tx: Disable
SSM Rx: Enable
```

```
Priority: 2
QL Receive: QL-STU
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
```

- Use the **show esmc** command to display the ESMC configuration output:

```
Router# show esmc
Interface: GigabitEthernet0/0/0
  Administative configurations:
    Mode: Synchronous
    ESMC TX: Enable
    ESMC RX: Enable
    QL TX: -
    QL RX: -
    Operational status:
    Port status: UP
    QL Receive: QL-PRC
    QL Transmit: QL-DNU
    QL rx overrided: -
    ESMC Information rate: 1 packet/second
    ESMC Expiry: 5 second
Interface: GigabitEthernet0/0/0
  Administrative configurations:
    Mode: Synchronous
    ESMC TX: Enable
    ESMC RX: Enable
    QL TX: -
    QL RX: -
    Operational status:
    Port status: UP
    QL Receive: QL-DNU
    QL Transmit: QL-DNU
    QL rx overrided: QL-DNU
    ESMC Information rate: 1 packet/second
    ESMC Expiry: 5 second
```

- Use the **show esmc detail** command to display all the details of the ESMC parameters at the global and interface level, as shown in the following example:

```
Router# show esmc detail
Router#show esmc detail
Interface: GigabitEthernet0/0/0
  Administative configurations:
    Mode: Synchronous
    ESMC TX: Enable
    ESMC RX: Enable
    QL TX: -
    QL RX: QL-PRS
  Operational status:
    Port status: UP
    QL Receive: QL-DUS
    QL Transmit: QL-ST3
    QL rx overrided: QL-DUS
```

```
ESMC Information rate: 1 packet/second
ESMC Expiry: 5 second
ESMC Tx Timer: Running
ESMC Rx Timer: Running
ESMC Tx interval count: 1
ESMC INFO pkts in: 0
ESMC INFO pkts out: 256
ESMC EVENT pkts in: 0
ESMC EVENT pkts out: 0
```

Troubleshooting the Network Synchronization Configuration

Note Before you troubleshoot, ensure that all the network synchronization configurations are complete.

Table 12-4 provides information about troubleshooting scenarios that you may encounter while configuring network synchronization.

Table 12-4 Troubleshooting Scenarios

Problem	Solution
Incorrect clock selection	• Verify that there are no alarms on the interfaces. Use the **show network-clock synchronization detail** command to check this. • Ensure that the nonrevertive configurations are in place.
Incorrect QL values	Ensure that there is no framing mismatch with the SSM option.

Table 12-4 Troubleshooting Scenarios (continued)

Problem	Solution

Incorrect clock limit set or queue limit disabled mode	• Verify that there are no alarms on the interfaces. Use the **show network-clock synchronization detail** RP command to confirm.
	• Use the **show network-clock synchronization** command to confirm if the system is in revertive mode or nonrevertive mode and verify the nonrevertive configurations as shown in this example:
	`Router#show network-clock 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 : 1544 (EEC-Option2)`
	`Clock Mode : QL-Enable`
	`ESMC : Enabled`
	`SSM Option : GEN1`
	`T0 : External R0 t1 esf`
	`Hold-off (global) : 300 ms`
	`Wait-to-restore (global) : 300 sec`
	`Tsm Delay : 180 ms`
	`Revertive : No`
	`Force Switch: FALSE`
	`Manual Switch: FALSE`
	`Number of synchronization sources: 2`
	`sm(netsync NETCLK_QL_ENABLE), running yes, state 1A`
	`Last transition recorded: (src_rem)-> 1A (src_added)-> 1A (src_rem)-> 1A (src_added)-> 1A (ql_change)-> 1A (sf_change)-> 1A (force_sw)-> 1C (clear_sw)-> 1A (sf_change)-> 1A (sf_change)-> 1A`

Incorrect QL values observed when you use the **show network-clock synchronization detail** command	Use the **network-clock synchronization SSM** (*option 1* |*option 2*) command to confirm that there is no framing mismatch. Use the **show run interface** command to validate the framing for a specific interface. For SSM *option 1*, framing should be SDH or E1, and for SSM *option 2*, it should be T1.
Mismatched Physical line coding mechanisms between clock source and input source on the router	To ensure that this feature works correctly, both the ends need to be configured with identical physical line coding mechanism and encapsulation values.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*

Standards

Standard	Title
None	—

MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at this 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 Network Synchronization Support

Table 12-5 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.

Note Table 12-5 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 12-5 Feature Information for Network Synchronization Support

Feature Name	Releases	Feature Information
Network Synchronization Support	Cisco IOS XE 3.2S	In Cisco IOS XE Release 3.2S, this feature was introduced on the Cisco ASR 1000 Series Aggregation Service Routers.
Network Synchronization Support	Cisco IOS XE 3.7S	In Cisco IOS XE Release 3.7S, the commands that are used to configure this feature have been extended with the introduction of the Cisco ASR 1002-X Router.
Network Synchronization Support	Cisco IOS XE 3.12S	In Cisco IOS XE Release 3.12S, the commands that are used to configure this feature have been extended to the Cisco ASR 1001-X Router.