



# Network Synchronization Support

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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.

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## Finding Feature Information

Your software release might not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. 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, on page 25](#).

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).

The following EPAs and line cards support Synchronous Ethernet:

**Table 1: Synchronous Ethernet Support for EPA and Line cards**

EPA	Line cards
EPA-10X10GE	ASR1000-6TE
EPA-18X1GE	ASR1000-2T+20X1GE
EPA-40X2GE	
EPA-100X1GE	
Built-in EPAs on ASR1001-HX, ASR1002-HX	



**Note** The 2-Port Gigabit Synchronous Ethernet SPA (SPA-2X1GE-SYNCE) is not supported on ASR 1002-x chassis.

## 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

Platform Support	Features Supported	Features Not Supported
ASR1002-X	Synchronous Ethernet Feature is supported with Built-in Gigabit Ethernet Ports.	NetClk Feature
ASR1001	—	NetClk and Network Synchronization Feature



**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.

The below table lists the framing modes for a BITS port on the Cisco ASR 1002-X Router.

**Table 2: 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

The below table lists the framing modes for a BITS port on the other Cisco ASR 1000 Series Aggregation Services Routers.

**Table 3: 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

<b>BITS or SSU Port Support Matrix</b>	<b>Framing Modes Supported</b>	<b>SSM or QL Support</b>	<b>Tx Port</b>	<b>Rx Port</b>
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




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

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

- Line to External




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

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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.

- System to External: The system clock is used as the Tx clock for an external interface. By default, the system clock is not transmitted through the external interface.
- 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. System to External: If the router loses all the clock sources, an AIS is sent through the external interface to the SSU.

Snquelching 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.

The following table lists the SPAs that support network synchronization.

**Table 4: 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
Synchronous Ethernet	SPA-2XGE-SYNCE
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 Type	SPA Name
	SPA-8XOC3-POS
	SPA-1XOC12-POS
	SPA-1XOC12-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](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

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:

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.

**product="name=">Hybrid Mode**

## Restrictions for Network Synchronization

This section lists the restrictions for configuring network synchronization on a router.

- 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 TSM (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

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 or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b>  Router# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 2</b>	<b>network-clock synchronization automatic</b> <b>Example:</b>	Enables the network clock selection algorithm. This command disables the Cisco-specific network clock process,



	Command or Action	Purpose
	<pre>Router(config)# network-clock synchronization automatic</pre>	and turns on the G.781-based automatic clock selection process.
<b>Step 3</b>	<p><b>network-clock synchronization ssm option {1   2 {GEN1   GEN2}}</b></p> <p><b>Example:</b></p> <pre>Router(config)# network-clock synchronization ssm option 2 GEN1</pre>	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.
<b>Step 4</b>	<p><b>interface gigabitethernet slot/card/port</b></p> <p><b>Example:</b></p> <pre>Router(config)# interface gigabitethernet 0/2/0</pre>	Specifies the Gigabit Ethernet interface to be configured: slot/card/port—Specifies the location of the interface.
<b>Step 5</b>	<p><b>synchronous mode</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# synchronous mode</pre>	Sets the mode to synchronous mode.
<b>Step 6</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	Exits the global configuration mode.
<b>Step 7</b>	<p><b>network-clock input-source priority {interface interface-name slot/card/port   {external slot/card/port}}</b></p> <p><b>Example:</b></p> <p><b>Example:</b></p> <pre>Router(config)# network-clock input-source 1 interface gigabitethernet 0/2/0</pre> <p><b>Example:</b></p> <pre>Router(config)# network-clock input-source 1 external R0 2048k</pre>	Enables clock recovery from SyncE. The Cisco ASR1006 router supports two RP ports, one active and the other standby.

	Command or Action	Purpose
<b>Step 8</b>	<b>exit</b> <b>Example:</b> Router(config)# <b>exit</b>	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

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

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **network-clock synchronization automatic**
4. **network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}**
5. **network-clock input-source priority {external slot/card/port}**
6. **exit**

#### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router# <b>enable</b>	Enables the privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b>	Enters the global configuration mode.

	Command or Action	Purpose
	Router# <b>configure terminal</b>	
<b>Step 3</b>	<b>network-clock synchronization automatic</b> <b>Example:</b> Router(config)# <b>network-clock synchronization automatic</b>	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.
<b>Step 4</b>	<b>network-clock synchronization ssm option {1   2 {GEN1   GEN2}}</b> <b>Example:</b> Router(config)# <b>network-clock synchronization ssm option 2 GEN1</b>	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.
<b>Step 5</b>	<b>network-clock input-source priority {external slot/card/port}</b> <b>Example:</b> Router(config)# <b>network-clock input-source 1 External 0/3/0 t1 esf</b> <b>Example:</b> Router(config)# <b>network-clock input-source 1 External R0 t1 esf</b> <b>Example:</b> Router(config)# <b>network-clock input-source 1 external r0 e1 cas crc4 120 linecode</b>	Enables clock recovery from a BITS port. <b>Note</b> 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.
<b>Step 6</b>	<b>exit</b> <b>Example:</b> Router(config)# <b>exit</b>	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 a SyncE Using the System-to-External Method

This section describes how to configure SyncE using System-to-External method.

### SUMMARY STEPS

1. enable
2. configure terminal
3. network-clock synchronization automatic
4. network-clock synchronization ssm option {option\_id {GEN1 | GEN2}}
5. *network-clock output-source system priority {external slot/card/port [2m | 10m]}*
6. exit

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router# enable	Enables the privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# configure terminal	Enters the global configuration mode.
<b>Step 3</b>	network-clock synchronization automatic <b>Example:</b> 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
<b>Step 4</b>	<p>network-clock synchronization ssm option {option_id {GEN1   GEN2}}</p> <p><b>Example:</b></p> <p><b>Example:</b></p> <p><b>Example:</b></p> <pre>Router(config)# network-clock synchronization ssm option 2 GEN1</pre>	Configures the equipment to work in a synchronization network. The option_id value 1 refers to a synchronization networks design for Europe. This is the default value. The option_id value 2 refers to a synchronization networks design for the U.S.
<b>Step 5</b>	<p>network-clock output-source system priority {external slot/card/port [2m   10m]}</p> <p><b>Example:</b></p> <p><b>Example:</b></p> <p><b>Example:</b></p> <pre>Router(config)# network-clock output-source system 1 external 4/0/0 t1 sf</pre>	Configures the system clock to be used on external Tx interfaces.
<b>Step 6</b>	<p>exit</p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	Exits the global configuration mode.

## Examples

The following example shows how to configure SyncE using System-to-External method:

```
Router>enable
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 5/3/0 t1 sf
Router(config)# exit
```

The following example shows how to configure clock cleanup using an SSU:

```
Router(config)# network-clock output-source line 1 interface GigabitEthernet1/0/0 External
1/0/0 t1 sf
Router(config)# network-clock input-source 1 External 5/3/0 t1 sf
```

## 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. **enable**
2. **configure terminal**
3. **network-clock synchronization automatic**
4. **network-clock synchronization ssm option {1 | 2 {GEN1 | GEN2}}**
5. **network-clock output-source priority {external slot/card/port}**
6. **exit**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router# <b>enable</b>	Enables the privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 3</b>	<b>network-clock synchronization automatic</b> <b>Example:</b> Router(config)# <b>network-clock synchronization automatic</b>	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.
<b>Step 4</b>	<b>network-clock synchronization ssm option {1   2 {GEN1   GEN2}}</b> <b>Example:</b> Router(config)# <b>network-clock synchronization ssm option 2 GEN1</b>	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.
<b>Step 5</b>	<b>network-clock output-source priority {external slot/card/port}</b> <b>Example:</b> Router(config)# <b>network-clock output-source system 1 External 0/3/0 t1 esf</b> <b>Example:</b>	Enables clock recovery from a BITS port. <b>Note</b> 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.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config)# network-clock output-source 1 External R0 t1 esf</pre> <p><b>Example:</b></p> <pre>Router(config)# network-clock output-source 1 external r0 e1 cas crc4 120 linecode</pre>	
<b>Step 6</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	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
```

## Configuring a SyncE Using the System-to-External Method

This section describes how to configure SyncE using System-to-External method.

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 or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 2</b>	<b>network-clock synchronization automatic</b> <b>Example:</b> Router(config)# <b>network-clock synchronization automatic</b>	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.
<b>Step 3</b>	<b>network-clock synchronization ssm option {1   2 {GEN1   GEN2}}</b> <b>Example:</b> Router(config)# <b>network-clock synchronization ssm option 2 GEN1</b> <b>Example:</b>	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.
<b>Step 4</b>	<b>interface gigabitethernet <i>slot/card/port</i></b> <b>Example:</b> Router(config)# <b>interface gigabitethernet 0/2/0</b>	Specifies the Gigabit Ethernet interface to be configured: <i>slot/card/port</i> —Specifies the location of the interface.
<b>Step 5</b>	<b>synchronous mode</b> <b>Example:</b>	Changes to the synchronous mode.



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

```
Router(config)# network-clock source 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
Gil/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
Gil/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
  Administrative 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 overridden: -
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 overridden: 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
Administrative 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 overridden: 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.

The following table provides information about troubleshooting scenarios that you may encounter while configuring network synchronization.

Table 5: Troubleshooting Scenarios

Problem	Solution
Incorrect clock selection	<ul style="list-style-type: none"> <li>• Verify that there are no alarms on the interfaces. Use the show network-clock synchronization detail command to check this.</li> <li>• Ensure that the nonrevertive configurations are in place.</li> </ul>
Incorrect QL values	Ensure that there is no framing mismatch with the SSM option.
Incorrect clock limit set or queue limit disabled mode	<ul style="list-style-type: none"> <li>• Verify that there are no alarms on the interfaces. Use the show network-clock synchronization detail RP command to confirm.</li> <li>• Use the <b>show network-clock synchronization</b> command to confirm if the system is in revertive mode or nonrevertive mode and verify the nonrevertive configurations as shown in this example:</li> </ul> <pre>Router#show network-clock synchronization Symbols: En - Enable, Dis - Disable, Adis - Admin Disable NA - Not Applicable * - Synchronization source selected # - Synchronization source force selected &amp; - 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)-&gt; 1A (src_added)-&gt; 1A (src_rem)-&gt; 1A (src_added)-&gt; 1A (ql_change)-&gt; 1A (sf_change)-&gt; 1A (force_sw)-&gt; 1C (clear_sw)-&gt; 1A (sf_change)-&gt; 1A (sf_change)-&gt; 1A</pre>

Problem	Solution
Incorrect QL values observed when you use the <b>show network-clock synchronization detail</b> command	Use the <b>network-clock synchronization SSM</b> ( <i>option 1</i>   <i>option 2</i> ) command to confirm that there is no framing mismatch. Use the <b>show run interface</b> command to validate the framing for a specific interface. For SSM <i>option 1</i> , framing should be SDH or E1, and for SSM <i>option 2</i> , 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	<i>Cisco IOS Master Commands List, All Releases</i>

### 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:  <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### 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.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Network Synchronization Support

The following table 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** The following 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.

**Table 6: 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.

