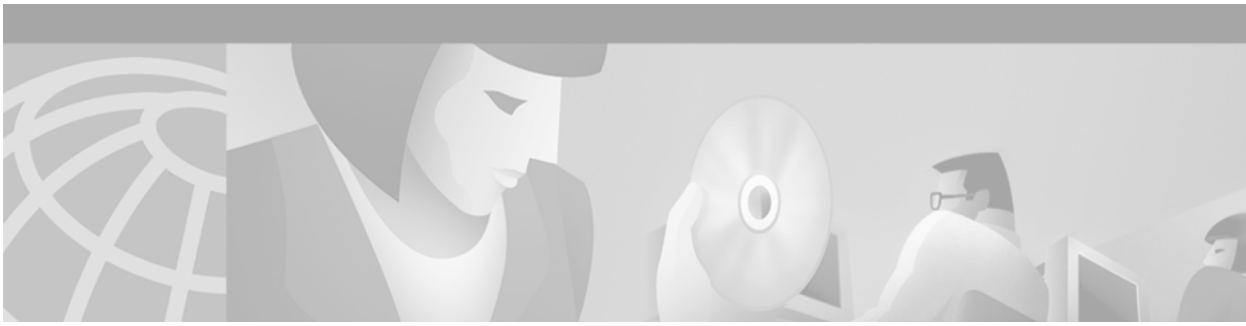


Configuring Synchronized Clocking

This appendix describes how to configure synchronized clocking. It contains the following sections:

For more information about configuring synchronized clocking, refer to the "Configuring Video Applications" chapter of the *Cisco IOS Voice, Video, and Fax Configuration Guide* and to the *Cisco IOS Wide-Area Networking Configuration Guide*.

For a description of the commands used to configure synchronized clocking, refer to the *Cisco IOS Voice, Video, and Fax Command Reference* and to the *Cisco IOS Wide-Area Networking Command Reference*.

To identify the hardware platform or software image information mentioned in this appendix, use the Feature Navigator on Cisco.com to search for information about the feature or refer to the software release notes for a specific release. For more information, see the "Identifying Supported Platforms" section in the "Using Cisco IOS Software" chapter.

Synchronized Clocking Overview

The Cisco MC3810 multiservice concentrator supports voice and video streams in addition to traditional data streams. Because voice and video streams are real-time streams and originate from synchronous devices, it is important to configure the synchronous clocking to prevent data corruption and data loss.

Due to the real-time nature of voice and video, more configuration and planning is required for voice traffic than is required for traditional data traffic. Because voice and video streams are real-time and continuous, the information is normally generated by the source device and received by the destination device at a synchronized fixed rate. If the source and destination clocking are not synchronized, meaning that the devices generate information at different rates, there will be a loss of information as one side overruns and the other side underruns.

As a result, for voice and video configurations, a single master clock source must be configured to make the network synchronous. The master clock must be used as the clock source for all devices on the network, even when the voice traffic is compressed.

Clocking mismatches can be caused by a variety of configuration problems. The following situations can cause problems:

- Multiple network clock sources that are not synchronized.

  In back-to-back voice systems where the two devices are using different clock sources that are not synchronized, data loss can occur when one device overruns and the other device underruns the voice stream.

  In situations where there is a minor clock mismatch, the Cisco MC3810 may be able to process the mismatch in its internal voice coders in the same way that the voice coders handle minor network delay and jitter. The voice waveform will be degraded but often not noticeably.

  However, when the Cisco MC3810 is using circuit emulation services (CES) to send video traffic, similar clock compensation is not possible because the CES must be in synchronous mode. As a result, when video traffic is sent over a nonsynchronized network, data corruption may occur. This situation will cause video devices connected to the MC3810 to lose frame synchronization and enter a frame-search mode, causing noticeable data loss. Because of these requirements, the network clocks must be synchronized when processing video traffic on the Cisco MC3810.

- Layer 1 conflicts

  Layer 1 conflicts can take place when a Cisco MC3810 with two multiflex trunk modules (MFTs) is placed at the border of two separately clocked T1 or E1 networks and is forced to resolve the clock difference between the networks. As a result, DS1 clock and frame slips can occur, which can result in lengthy reframe times and can cause an attached DS1 device to declare the line down.

Configuring the Cisco MC3810 to a Synchronous Clocked Network

To ensure a synchronized system, you must configure a master clock somewhere within the network and distribute and recover the clock throughout the network. This will allow end devices at opposite ends of the network to reference a common clock source. If you cannot configure a synchronized system, then you can configure multiple clock sources on your network as long as they are accurate enough that the clocking on both clock sources will match.

You can statically configure the Cisco MC3810 to receive or generate clocking using one of the following scenarios:

- Obtain the synchronous clock from a network device attached to controller T1 or E1 0 and distribute the clocking to the other controller and to the universal input/output (UIO) serial ports.
- Obtain the synchronous clock from a network device attached to Controller T1 or E1 1 and distribute the clocking to the other controller and to the UIO serial ports.
- Obtain the synchronous clock from a network device directly attached to serial port 0 (in data terminal equipment [DTE] mode only) and distribute the clocking to the other serial ports and to both controllers.
- Generate the clock internally on the Cisco MC3810 and distribute the clocking to all interfaces.
- When in T1 or E1 mode, all MFTs can provide either line or internal clocking. When one controller is configured to line clocking (obtaining the clocking from the network), the other controller must be configured to internal clocking (obtaining the clocking internally from the other controller).

Note Configuring a clock source from the digital voice module (DVM) is supported if the installed DVM is either hardware version 4.50 or later and the system control board (SCB) is version 6.05 or later. To verify the hardware version of the SCB, enter the **show version** command and check the entry for the Cisco MC3810 processor revision. To verify the hardware version of the DVM, enter the **show controller T1/E1** command and check the HWVersion entry.

For more information on how to configure clocking for these scenarios, see the "Synchronized Clocking Configuration Task List" section later in this appendix.

In addition, you can define a hierarchy of potential clock sources so that when the primary clock source goes down, the Cisco MC3810 can automatically switch to a backup clock source. For more information, see the "Configuring a Hierarchy of Clock Sources for Backup Purposes" section later in this appendix.

Synchronized Clocking Configuration Task List

Because of the different ways that public switched telephone networks (PSTNs) and data networks provide clocking, there may be incompatibilities when the Cisco MC3810 is used to integrate voice and data networks. As a result, the Cisco MC3810 must synchronize the disparate clocking, and you must be careful in how you configure your clock sources. The clocking can be derived from one of the following sources:

- The PBX
- The video CODEC (for video applications)
- The ATM or Frame Relay WAN carrier
- The Cisco MC3810 internal clock

Depending on the configuration, you must determine how to configure the appropriate interface on the Cisco MC3810 for the clocking configuration. Each interface provides different clocking support, and depending on the interface used, the commands required to configure the clocking are different. You must also determine whether the Cisco MC3810 interface will be the data circuit-terminating equipment (DCE) or the DTE in the configuration.

The following sections provide configuration tasks:

Configuring the Cisco MC3810 to Obtain Clocking from the Network

This section, which describes several scenarios for statically configuring clocking on the Cisco MC3810, includes the following procedures:

- Configuring the Cisco MC3810 to Recover Clocking from a Network Device Attached to Serial 0, page 801

Note The procedures in this section statically configure the clock source for the interfaces. If the clock source fails, these procedures do not configure a backup clock source. For information on configuring a hierarchy of backup clock sources, see the "Configuring a Hierarchy of Clock Sources for Backup Purposes" section later in this appendix.

Configuring the Cisco MC3810 to Recover Clocking from a Network Device Attached to a T1/E1 Controller

When the Cisco MC3810 recovers clocking from a network device attached to a T1 or E1 controller, the clock recovery circuit on the controller will place a recovered 2 MHz clock on the common circuit toward the network clock phased lock loop (PLL). Once the network-clock PLL circuit receives the valid 2 MHz clock from the controller, the network clock PLL synchronizes to the recovered clock and redistributes the clock to the rest of the system. The other T1/E1 controller and the serial ports on the Cisco MC3810 then derive their clocking from the network clock PLL.

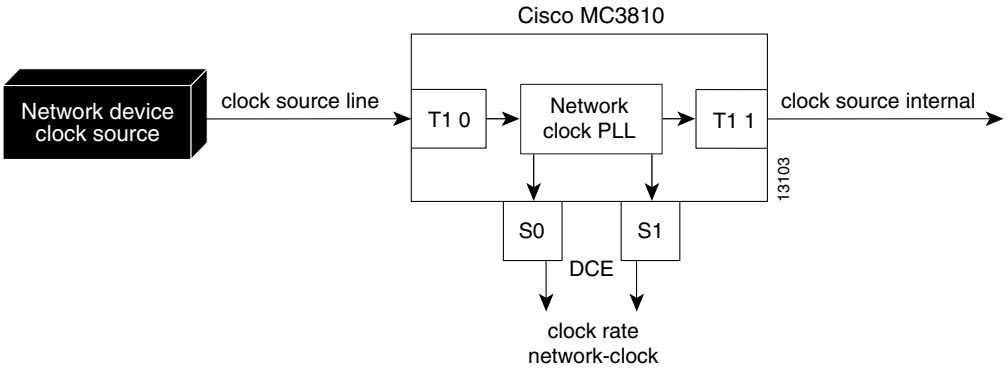
When you configure a T1/E1 controller to recover clocking from a network device, configure the **clock-source** controller configuration command to the **line** setting.

Note Do not configure both T1/E1 controllers to the **line** setting. Doing so will cause both controllers to attempt to drive the network clock PLL at the same time. If you configure both T1/E1 controllers to **line**, there will be clocking conflicts. You will not receive an error message if you incorrectly configure the clocking in this way. Configure one controller for line timing and the other controller for internal or loop timing.

The one exception to this rule is if you configure backup clocks to dynamically activate if the primary clock fails. For more information, see the "Configuring a Hierarchy of Clock Sources for Backup Purposes" section later in this appendix.

Figure 125 is an example in which the Cisco MC3810 obtains its clock source from a network device attached to controller T1/E1 0 (the MFT).

Figure 125 Obtaining the Clock Source from a Network Device Attached to Controller T1/E1 0



To make sure the network is synchronized, configure the attached network device that obtains its clocking from the Cisco MC3810 (from the T1/E1 controller clock source set to **internal**) to derive its clock from the T1/E1 signal sent by the Cisco MC3810. If the T1/E1 signal received from the attached network device is not synchronous with the Cisco MC3810 network clock, frame and clock slips will occur at the T1/E1 controller, causing loss of data.

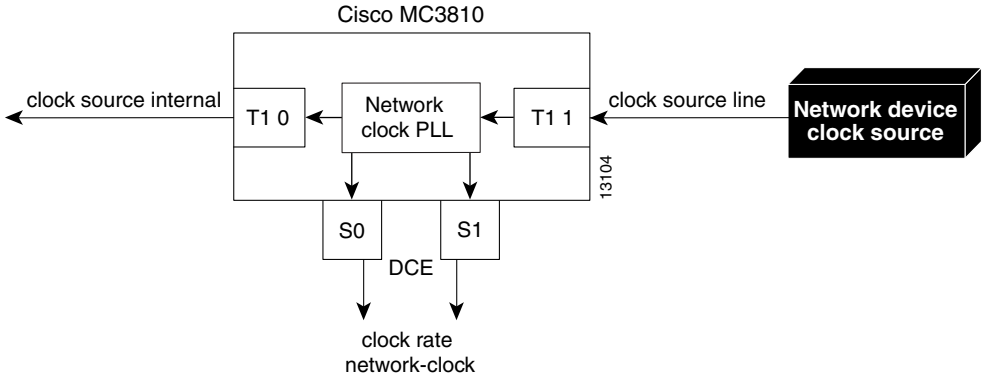
To configure the Cisco MC3810 to obtain its clock source from a network device attached to controller T1/E1 0, use the following commands beginning in global configuration mode.

	Command	Purpose
Step 1	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for controller T1/E1 0. The *number* argument specifies the network processor module number. The range is 0 through 2.
Step 2	`Router(config-controller)# clock source {line | internal | loop-timed}`	Specifies the clock source of a DS1 link on the Cisco MC3810. (Use the **line** keyword.) Keyword definitions are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed. • **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as data circuit-terminating equipment (DCE) clock sources. This situation assumes that the PBX also takes the clocking from the central office, thereby synchronizing the clocks on the DVM and the MFT.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 4	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for controller T1/E1 1 (see Step 1).
Step 5	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 1 to obtain its clocking from the internal network clock PLL. (Use the **internal** keyword.) For a full explanation of the keywords, see Step 2.

	Command	Purpose
Step 6	`Router(config-controller)# network-clock base-rate {56k | 64k}`	Configures the network clock base rate for universal I/O serial ports 0 and 1. The keywords are as follows: • **56k**—Sets the network clock base rate to 56 kilobits per second (kbps). • **64k**—Sets the network clock base rate to 64 kbps.
Step 7	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	`Router(config)# interface serial number:timeslot`	Enters interface configuration mode for serial 0. The arguments are as follows: • *number*—Specifies the channelized E1 or T1 controller number (0 in the Figure 116 example). • *timeslot*—For ISDN, specifies the D channel time slot, which is :23 channel for channelized T1 and the :15 for channelized E1. PRI time slots are in the range of from 0 to 23 for channelized T1 and in the range of from 0 to 30 for channelized E1. For channel-associated signaling or robbed-bit signaling, specifies the channel group number. The colon (:) is required. On a dual port card, it is possible to run channelized on one port and primary rate on the other port.
Step 9	`Router(config-if)# clock rate network-clock rate`	Configures the network clock speed for serial ports 0 or 1 in DCE mode. The *rate* argument specifies the network clock speed in bits per second. The range is from 56 kbps to 2048 kbps. The value entered should be a multiple of the value set for the **network-clock base-rate** command (see Step 6). (Repeat Steps 8 and 9 for serial port 1.)
Step 10	`Router(config-if)# exit`	Exits interface configuration mode.
Step 11	`Router# show network-clocks`	Displays the network clock configuration.

Figure 126 shows an example in which the Cisco MC3810 obtains its clock source from a network device attached to controller T1/E1 1 (the DVM).

Figure 126 Obtaining the Clock Source from a Network Device Attached to Controller T1/E1 1



To configure the Cisco MC3810 to obtain its clock source from a network device attached to controller T1/E1 1, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for controller T1/E1 1. The *number* argument specifies the network processor module number. The range is 0 through 2.
Step 2	`Router(config-controller)# clock source {line | internal | loop-timed}`	Specifies the clock source of a DS1 link on the Cisco MC3810. (Use the **line** keyword.) Keyword definitions are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed. • **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as data circuit-terminating equipment (DCE) clock sources. This situation assumes that the PBX also takes the clocking from the central office, thereby synchronizing the clocks on the DVM and the MFT.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 4	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 0 to configure the clock source for the MFT.

	Command	Purpose
Step 5	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 1 to obtain its clocking from the internal network clock phased lock loop (PLL). (Use the **internal** keyword.) For an explanation of the keywords, see Step 2.
Step 6	`Router(config-controller)# network-clock base-rate {56k | 64k}`	Configures the network clock base rate for serial ports 0 and 1. The keywords are as follows: • **56k**—Sets the network clock base rate to 56 kilobits per second (kbps). • **64k**—Sets the network clock base rate to 64 kbps.
Step 7	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	`Router(config)# interface serial number:timeslot`	Enters interface configuration mode and specifies the serial 0 interface. The arguments are as follows: • *number*—Specifies the channelized E1 or T1 controller number (0 in the Figure 117 example). • *timeslot*—For ISDN, the D channel time slot, which is :23 channel for channelized T1 and the :15 for channelized E1. PRI time slots are in the range of from 0 to 23 for channelized T1 and in the range of from 0 to 30 for channelized E1.For channel-associated signaling or robbed-bit signaling, the channel group number. The colon (:) is required. On a dual port card, it is possible to run channelized on one port and primary rate on the other port.
Step 9	`Router(config-if)# clock rate network-clock rate`	Configures the network clock speed for serial ports 0 or 1 in DCE mode. The *rate* argument specifies the network clock speed in bits per second. The range is from 56 kbps to 2048 kbps. The value entered should be a multiple of the value set for the **network-clock base-rate** command (see Step 6). (Repeat Steps 8 and 9 for serial port 1.)
Step 10	`Router(config-if)# exit`	Exits interface configuration mode.
Step 11	`Router# show network-clocks`	Displays the network clock configuration.

Configuring a T1/E1 Controller to Loop-Time the Clocking Back to the Network Clock Source

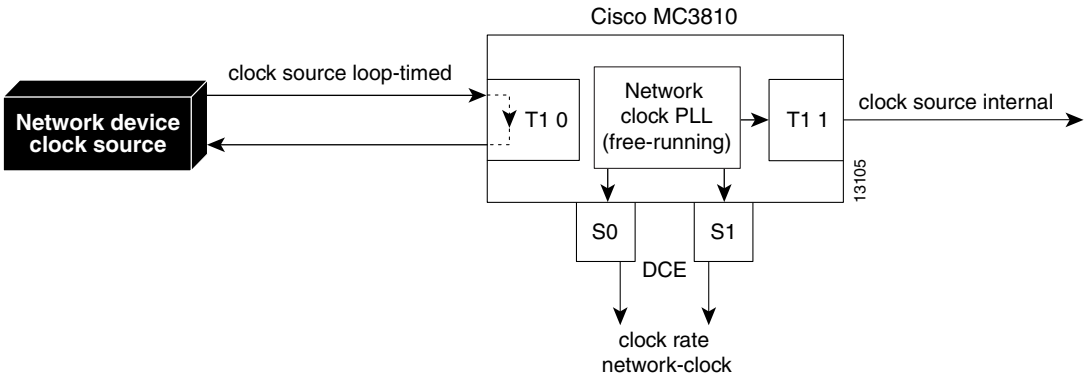
When you configure a T1/E1 controller to loop-time the clocking back to a network device, you configure the **clock-source** controller command to the **loop-timed** setting. The **clock-source** command on the other T1/E1 controller should in most cases be set to the **internal** setting.

When a controller's clock source is set to loop-timed, the internal network clock PLL is placed into free-running mode.

Note Use caution when configuring the controller clock source to loop-timed. This setting should only be used in certain cases, such as when there are two master clocks but you can only obtain clocking from one master clock at a time. Using the functionality to configure a hierarchy of clock sources, you can configure a controller set to loop-timed clock source to become the Cisco MC3810 clock source if the primary clock source fails. For more information about configuring a hierarchy of clock sources, see the "Configuring a Hierarchy of Clock Sources for Backup Purposes" section later in this appendix.

Figure 127 shows an example of a configuration in which the input clock source on the MFT is loop-timed back to the clock source device.

Figure 127 Loop-Timed Clock Source on a T1/E1 Controller



To configure the Cisco MC3810 to use loop-timed clock mode on controller T1/E1 0, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for controller T1/E1 0. The *number* argument specifies the network processor module number. The range is 0 through 2.
Step 2	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 0 to take the clock from the receive line and send it back to the source. (Use the **loop-timed** keyword.) The keywords are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed.

	Command	Purpose
		• **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as data circuit-terminating equipment (DCE) clock sources. This situation assumes that the PBX also takes the clocking from the central office thereby synchronizing the clocks on the DVM and the MFT.
Step 3	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 4	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 1.
Step 5	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 1 to obtain its clocking from the internal network clock phased lock loop (PLL). For an explanation of the keywords, see Step 2. **Note** To configure controller T1 1 for loop-timed mode, follow the same configuration procedure, but change the controller that will be configured for loop-timed mode.
Step 6	`Router(config-controller)# network-clock base-rate {56k | 64k}`	Configures the network clock base rate for universal I/O serial ports 0 and 1. The keywords are as follows: • **56k**—Sets the network clock base rate to 56 kilobits per second (kbps). • **64k**—Sets the network clock base rate to 64 kbps.
Step 7	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 8	`Router(config)# interface serial number`	Enters interface configuration mode for serial 0.
Step 9	`Router(config-if)# clock rate network-clock rate`	Configures the network clock speed for serial port 0 for DCE mode. The *rate* argument specifies the network clock speed in bits per second. The range is from 56 kbps to 2048 kbps. The value entered should be a multiple of the value set for the **network-clock base-rate** command (see Step 6). Repeat Steps 8 and 9 for serial port 1.
Step 10	`Router(config-if)# exit`	Exits interface configuration mode.
Step 11	`Router# show network-clocks`	Displays the network clock configuration.

Configuring the Cisco MC3810 to Recover Clocking from a Network Device Attached to Serial 0

If serial interface 0 is configured as DTE, it can accept clocking from the attached DCE and use the clocking to drive the network-clock PLL on the Cisco MC3810. The clocking is then distributed to the T1/E1 controllers and to serial interface 1.

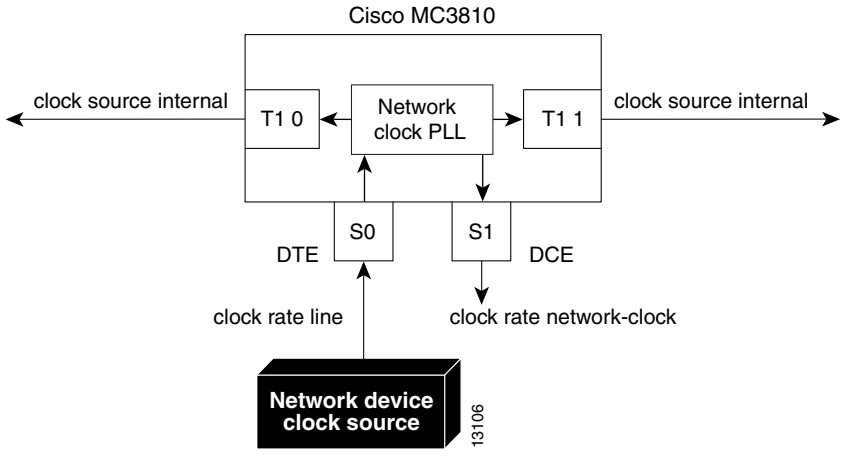
Because the input to the network clock PLL must be 2 MHz, a clock multiplier circuit is used to multiply the incoming clock on serial 0 to 2 MHz in 8 Hz increments. This multiplier is configured using the **clock-rate line** serial interface command. This command is valid only when serial 0 is configured as the DTE device.

Note To recover clocking over serial interfaces, the Cisco MC3810 can recover clocking only from a device attached to serial 0 in DTE mode. It cannot recover clocking from a device attached to serial 1 or to serial 0 in DCE mode.

Note When Q.SIG, ISDN, or the BRI voice module (BVM) is enabled, Serial 1 is normally configured for DCE. If Serial 1 is configured as DTE, you need to make sure that the clock driving serial 1 comes from the same source as the clock driving the system. When Q.SIG, ISDN, or the BVM is enabled, the CPU takes the serial 1 data in time-slot mode that is driven by the system clock. If this clock is different from the clock driving the data into Serial 1, there will be cyclic redundancy check (CRC) errors and the line will not come up.

Figure 128 shows an example of the Cisco MC3810 obtaining clocking from a network device attached to Serial 0.

Figure 128 Clock Source from a Network Device Attached to Serial 0



To configure the Cisco MC3810 to use a network device attached to serial port 0 as the clock source, use the following commands,beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# network-clock base-rate {56k | 64k}`	Configures the network clock base rate for universal I/O serial ports 0 and 1. The keywords are as follows: • **56k**—Sets the network clock base rate to 56 kilobits per second (kbps). • **64k**—Sets the network clock base rate to 64 kbps.
Step 2	`Router(config)# network-clock-select priority [serial 0 | system | bvm |controller]`	Configures the network clock PLL to use the multiplied 2 Hz. clock from serial 0. (Set the priority and use the **serial 0** keyword.) The keywords and arguments are as follows: • *priority*—Specifies the priority of the clock source.Valid entries are from 1 to 4. You can configure up to four clock sources. The higher the number of the clock source, the higher the priority. For example, clock source 1 has higher priority than clock source 2. When the higher priority clock source fails, after the delay specified using the network-clock-switch command, the next higher priority clock source is selected. • **serial 0**—(Optional) Specifies serial interface 0 as the clock source. • **system**—(Optional) Specifies the system clock as the clock source. • **bvm**—(Optional) Specifies clocking priority for the BRI voice module. • *controller*—(Optional) Specifies which controller is the clock source. You can specify either the trunk controller (T1/E1 0) or the digital voice module (T1/E1/ 1).
Step 3	`Router(config)# interface serial number`	Enters interface configuration mode for serial 0.
Step 4	`Router(config-if)# clock rate line rate`	Configures the network clock line rate on serial 0 acting in data terminal equipment (DTE) mode. The rate value is the rate of the incoming clock, and this value must be a multiple of 8 kHz.
Step 5	`Router(config-if)# exit`	Exits interface configuration mode.
Step 6	`Router(config)# interface serial number`	Enters interface configuration mode for serial 1.

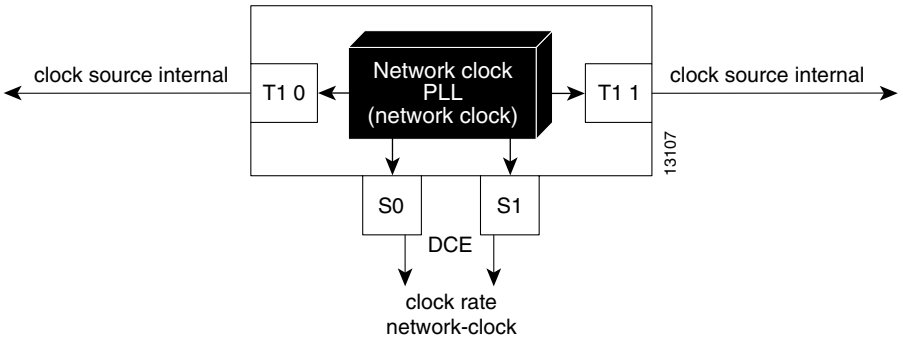
	Command	Purpose
Step 7	`Router(config-if)# clock rate network-clock rate`	Configures the network clock line rate for serial 1 acting in data circuit-terminating equipment (DCE) mode. The rate must be a multiple of the value set with the **network-clock base-rate** command and must match the value set in Step 1.
Step 8	`Router(config-if)# exit`	Exits interface configuration mode.
Step 9	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 0.
Step 10	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 0 to obtain its clocking from the internal network clock PLL. (Use the **internal** keyword.) The keywords are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed. • **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as DCE clock sources. This situation assumes that the PBX also takes the clocking from the central office, thereby synchronizing the clocks on the DVM and the MFT.
Step 11	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 12	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 1.
Step 13	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 1 to obtain its clocking from the internal network clock PLL. (Use the **internal** keyword.) For a full explanation of the keywords, see Step 10 in this configuration task table.
Step 14	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 15	`Router# show network-clocks`	Displays the network clock configuration.

Configuring the Cisco MC3810 to Use the Internal Clock Source

When you configure the Cisco MC3810 to use the internal clock source, the clock source for both T1/E1 controllers is set to **internal** and the master clocking is generated from the Cisco MC3810 2 MHz network clock PLL. The internal clock source is accurate to a Stratum 4 level (plus or minus 0.01 percent).

Figure 129 shows an example of the Cisco MC3810 using its internal clock source and transmitting it outward onto the associated networks.

Figure 129 Using the Cisco MC3810 Internal Clock Source



To configure the Cisco MC3810 to use its internal 2 MHz clock as the clock source, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# network-clock base-rate {56k | 64k}`	Sets the network clock base rate for the serial ports. The default is 56 kilobits per second.
Step 2	`Router(config)# interface serial number`	Enters interface configuration mode for serial 0.
Step 3	`Router(config-if)# clock rate network-clock rate`	Configures the network clock line rate on serial 0 acting in data circuit-terminating (DCE) mode. The rate must be a multiple of the value set with the **network-clock base-rate** command and must match the value set in Step 1.
Step 4	`Router(config-if)# exit`	Exits interface configuration mode.
Step 5	`Router(config)# interface serial 1`	Enters interface configuration mode for serial 1.
Step 6	`Router(config-if)# clock rate network-clock rate`	Configures the network clock line rate on serial 1 acting in DCE mode. The rate must be a multiple of the value set with the **network-clock base-rate** command and must match the value set in Step 1.
Step 7	`Router(config-if)# exit`	Exits interface configuration mode.
Step 8	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 0.

	Command	Purpose
Step 9	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 0 to obtain its clocking from the internal network clock PLL. (Use the **internal** keyword.) The keywords are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed. • **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as DCE clock sources. This situation assumes that the PBX also takes the clocking from the central office, thereby synchronizing the clocks on the DVM and the MFT.
Step 10	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 11	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1 1.
Step 12	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 1 to obtain its clocking from the internal network clock PLL. (Use the **internal** keyword.) For a full explanation of the keywords, see Step 9.
Step 13	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 14	`Router# show network-clocks`	Displays the network clock configuration.

Note When using the internal Cisco MC3810 clock source as the master clock, make sure to configure any other network devices directly attached to the Cisco MC3810 T1/E1 controllers and serial ports to obtain their clocking from the Cisco MC3810.

Configuring a Hierarchy of Clock Sources for Backup Purposes

The previous configurations apply when a static network clock source is desired with a single clock source. In some conditions, you may want to define a hierarchy of clock sources so that if the primary clock source fails, the system can be configured to use a secondary source rather than to switch to the internal clock (as in the previous configuration sections).

Using the **network-clock-select** command, you can configure a dynamic hierarchy of clock sources that are used if the primary clock source fails. Each clock source is assigned a priority. A higher priority number of a clock source places that source higher in the clocking hierarchy. The highest clock source priority is used as the default.

When a clock source fails, the Cisco MC3810 switches to the clock source in the hierarchy with the next highest priority. For example, if the clock source with priority 1 (the highest priority) fails, the Cisco MC3810 switches to the clock source with priority 2. Then, if the clock source with priority 2 fails, the Cisco MC3810 switches to the clock source with priority 3 (assuming that the clock source with priority 1 has not become active in the meantime.)

If the module providing the clock experiences a failure (for example, if the T1/E1 controller experiences loss of signal or loss of frame), the clock source will be switched.

Note If you shut down a controller that is the current clock source, the shutdown will not cause the clock source to be switched.

To configure a hierarchy of clock sources for backup purposes, use the following commands beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# network-clock-select` *priority* [**serial 0** | **system** | **bvm** | *controller*]	Specifies the highest priority clock source that will provide timing to the system backplane pulse code modulation (PCM) bus. The keywords and arguments are as follows: • *priority*—Specifies the priority of the clock source.Valid entries are from 1 to 4. You can configure up to four clock sources. The higher the number of the clock source, the higher the priority. For example, clock source 1 has higher priority than clock source 2. When the higher priority clock source fails, after the delay specified using the **network-clock-switch** command, the next higher priority clock source is selected. • **serial 0**—(Optional) Specifies serial interface 0 as the clock source. • **system**—(Optional) Specifies the system clock as the clock source. • **bvm**—(Optional) Specifies clocking priority for the BRI voice module. • *controller*—(Optional) Specifies which controller is the clock source. You can specify either the trunk controller (T1/E1 0) or the digital voice module (T1/E1/ 1).

	Command	Purpose
Step 2	`Router(config)# network-clock-switch [switch-delay | never] [restore-delay | never]`	Configure the amount of time the network clock will wait before switching to a different clock and the amount of time the current network clock will wait before recovering. The keywords and arguments are as follows: • *switch-delay*—(Optional) Sets the duration the system waits before switching to the clock source with the next highest priority (as configured with the **network-clock-select** command). • **never**—(Optional) Indicates no delay time before the current network clock source recovers. • *restore-delay*—(Optional) Sets the duration before the current network clock source recovers. • **never**—(Optional) Indicates no delay time before the next priority network clock source is used when the current network clock source fails.
Step 3	`Router(config)# controller {T1 | E1} number`	Enters controller configuration mode for T1/E1. If one of the controllers will be used as a clock source in the hierarchy, enter controller configuration mode for the T1/E1 controller.
Step 4	`Router(config-controller)# clock source {line | internal | loop-timed}`	Configures controller T1/E1 0 to obtain the Cisco MC3810 clock source from an attached network device. (Use the **line** keyword.) Keyword definitions are as follows: • **line**—Specifies that the DS1 link uses the recovered clock. The line value is the default clock source used when the multiflex trunk module (MFT) is installed. • **internal**—Specifies that the DS1 link uses the internal clock. The internal value is the default clock source used when the digital voice module (DVM) is installed. • **loop-timed**—Specifies that the T1/E1 controller will take the clock from the Rx (line) and use it for Tx. This setting decouples the controller clock from the system-wide clock set with the **network-clock-select** command. The loop-timed clock enables the DVM to connect to a PBX and to connect the MFT to a central office when both the PBX and the central office function as data circuit-terminating equipment (DCE) clock sources. This situation assumes that the PBX also takes the clocking from the central office, thereby synchronizing the clocks on the DVM and the MFT.

	Command	Purpose
		If the other controller will be used as a potential clock source in the hierarchy, repeat Steps 3 and 4 in this configuration task table. **Note** To prevent clock source conflicts, make sure to configure both controllers to **clock source line** *after* configuring the **network-clock-select** commands. For more information about how clock source conflicts are resolved using this feature, see the section following this procedure.
Step 5	`Router(config-controller)# exit`	Exits controller configuration mode.
Step 6	`Router(config)# interface serial` *number*	Enters interface configuration mode. If serial interface 0 will be used as a potential clock source in the hierarchy, enter interface configuration mode for serial 0.
Step 7	`Router(config-if)# clock rate line` *rate*	Configures the network clock line rate on serial 0 acting in data terminal equipment (DTE) mode. The rate must be a multiple of the value set with the **network-clock base-rate** command.
Step 8	`Router(config)# exit`	Exits interface configuration mode.
Step 9	`Router# show network-clocks`	Displays the network clock configuration.

When you configure a hierarchy of clock sources, each potential clock source must be preconfigured to a mode that enables the Cisco MC3810 to derive the clock from that source. For example, if a controller will be a potential clock source, the controller clock source must be configured to **line**. If the controller clock source is configured to **internal**, the controller cannot be configured as a potential backup clock source using the **network-clock-select** command.

In the normal configuration, configuring both controllers to clock source line causes clocking conflicts. However, when configuring a hierarchy of clock sources, because only one controller is used as the primary clock source at one time, the conflict is prevented.

The following rules apply to configuring the clock source hierarchy:

- If a controller is a potential clock source in the hierarchy, the controller clock source must be configured to **line**.
- If a controller is a potential clock source in the hierarchy but is not currently being used as the clock source, the clock source setting for that controller is automatically switched to **loop-timed**. This is a temporary state set by the software to prevent a clocking conflict. If the controller becomes the clock source because another clock source fails, the clock source setting for the controller switches to **line**.

  In this situation, even though the setting for the controller clock is switched to loop-timed, the actual configuration remains **line**. This is the difference between the preconfigured state and the temporary "set state" of the controller.
- If either controller is the active clock source, the network clock PLL switch is thrown in the direction of the active clock. The system clock is recovered from the controller with the active clock source.

- If serial interface 0 is the active clock source, the clock source settings for both controllers are automatically set to **loop-timed** and the network clock PLL switch is thrown in the direction of the serial port. The system clock is driven by a clock recovered from the DTE serial 0 interface, which has been multiplied from (n x 8000) Hz to 2 MHz.
- If the internal system clock is the active clock source, the clock source settings for both controllers are automatically set to **loop-timed,** and the network clock PLL switch is thrown in the direction of the controllers. Because both controllers are in the **loop-timed** state, neither clock provides a recovered clock to drive the PLL, resulting in a free-running, or internally timed, system clock.

The following is a configuration example showing a hierarchy of clock sources:

```
network-clock-select 1 t1 0
network-clock-select 2 t1 1
network-clock-select 3 serial0
network-clock-select 4 system
network-clock-switch 10 10

controller t1 0
 clock source line

controller t1 1
 clock source line

interface serial0
 clock rate line 64000
```

In this configuration, controller T1 0 is the primary clock source, and the clock source is configured to **line**. Controller T1 1 is a backup clock source and although the clock source is configured to **line**, the system temporarily sets the clock source to the **loop-timed** state.

If the controller T1 0 clock source fails, the system switches to use controller T1 1 as the clock source. The clock source **loop-timed** “set state” on controller T1 1 is switched to the preconfigured **line** state.