

# Clocking Configurations On Voice–Capable IOS–Based Platforms

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## **Introduction**

On platforms that use time–division multiplexing (TDM)–based architectures, there are multiple problems and symptoms that are related to the clocking modes to which Cisco IOS® software defaults.

### **Symptoms**

Symptoms of these problems include:

- One–way audio or no audio in either direction, on plain old telephone service (POTS)–to–VoIP calls or POTS–to–POTS calls.
- Modems that do not train up
- Faxes are incomplete or have missing lines
- Fax connections that fail
- Echo and poor voice quality on VoIP calls
- Static noise heard during phone calls

## **Prerequisites**

### **Requirements**

There are no specific requirements for this document.

### **Components Used**

This document is not restricted to specific software or hardware versions.

## Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

## Background Information

Voice systems that pass digitized Pulse Code Modulation (PCM) speech have always relied on the clocking signal embedded in the received bit stream. This allows connected devices to recover the clock signal from the bit stream, and then use this recovered clock signal to ensure that data on different channels keeps the same timing relationship with other channels. If a common clock source is not used between devices, the binary values in the bit streams can be misinterpreted, because the device samples the signal at the wrong moment. For example, if the local timing of a receiving device uses a slightly shorter time period than the timing of the sending device, a string of eight continuous binary 1s might be interpreted as 9 continuous 1s. If this data is re-sent to further downstream devices that use different timing references, the error can be compounded. When you ensure that each device in the network uses the same clocking signal, the integrity of the traffic across the entire network is ensured.

If timing between devices is not maintained, a condition known as clock slippage (clock slips) can occur. By definition, a clock slip is the repetition or deletion of a bit (or block of bits) in a synchronous data stream, due to a discrepancy in the read and write rates at a buffer. Slips arise because an equipment buffer store, or other mechanisms, cannot accommodate differences between the phases or frequencies of the incoming and outgoing signals. This occurs in cases where the timing of the outgoing signal is not derived from that of the incoming signal.

A T1 or E1 interface sends traffic inside repeating bit patterns that are called frames. Each frame is a fixed number of bits, which allow the device to determine the start and end of a frame. This also means that the receiving device knows exactly when to expect the end of a frame: it simply counts the appropriate number of bits that have come in. Therefore, if the timing between the sending and the receiving device is not the same, the receiving device might sample the bit stream at the wrong moment, which results in the return of an incorrect value.

While Cisco IOS software can easily control the clocking on these platforms, the default clocking mode on a TDM-capable router is effectively free running. This means that the received clock signal from an interface is not connected to the backplane of the router and is not used for internal synchronization between the rest of the router and other interfaces. Therefore, the router uses an internal clock source to pass traffic across the backplane and across other interfaces.

This generally does not present a problem for data applications, because a packet is buffered in internal memory and is then copied to the transmit buffer of the destination interface. Packet reads and writes to memory effectively remove the need for any clock synchronization between ports.

Digital voice ports have a different issue. Unless otherwise configured, Cisco IOS software uses the backplane (or internal) clocking to control data reads and writes to the digital signal processors (DSPs). If a PCM stream comes in on a digital voice port, it uses the external clocking for the received bit stream. However, this bit stream does not necessarily use the same reference as the router backplane, which means that the DSPs might misinterpret the data that comes from the controller. This clocking mismatch seen on the router E1 or T1 controller is referred to as a clock slip. The router uses its internal clock source to send the traffic out of the interface, but the traffic that comes in to the interface uses a completely different clock reference. Eventually, the difference in the timing relationship between the transmit and receive signal becomes so great that the interface controller registers a slip in the received frame.

Later Cisco IOS software platforms, such as the AS5350, AS5400, 7200VXR, 2600, 3700, and 1760, have different implementations of a TDM-based architecture and allow clocking to be propagated across the

backplane of the router and between different interface ports. All of the previously mentioned platforms use different command-line interface (CLI) commands to configure the clocking modes. This depends on the installed hardware. Even though the syntax differs, the commands essentially tell the router to recover the clocking from a digital voice port and to use this signal to drive other router operations.

Because none of these commands are default, you do not initially see them in the router configuration files and, therefore, do not understand their significance.

In most cases, you can check for clock slips on the E1 or T1 interface in order to confirm the problem. Issue the **show controller {e1 | t1}** command for confirmation:

```
Router#show controller e1 0/0

E1 0/0 is up.
  Applique type is Channelized E1 - balanced
  No alarms detected.
  alarm-trigger is not set
  Version info Firmware: 20020812, FPGA: 11
  Framing is CRC4, Line Code is HDB3, Clock Source is Line.
  Data in current interval (97 seconds elapsed):
    0 Line Code Violations, 0 Path Code Violations
    4 Slip Secs, 0 Fr Loss Secs, 0 Line Err Secs, 0 Degraded Mins
    4 Errored Secs, 0 Bursty Err Secs, 0 Severely Err Secs, 0 Unavail Secs
```

This log shows a periodic clock slip on the E1 interface.

## Configuration Steps for Various Platforms

The default clocking behavior needs to be changed through Cisco IOS software configuration commands in order to eliminate the problem. It is *absolutely critical* that you properly set up the clocking commands.

### For AIM-VOICE Cards on the 26xx, 366x, 37xx, and 38xx Platforms

These commands must be added:

- **network-clock-participate wic slot** Where *slot* is the WAN interface card (WIC) slot number in which the E1 or T1 multiflex trunk module (MFT) is installed.

**Note:** If multiple Voice and WAN Interface Cards (VWICs) are installed, then the command must be appropriately repeated.

For the 2600 platform, if a single port E1 or T1 VWIC is physically in WIC slot 1, and no other VWIC modules are installed, then it must be referred to as WIC 0, even though it is still technically on slot 1. The Cisco IOS software configuration also refers to it as controller T1 or E1 0/0.

- **network-clock-participate aim slot** Where *slot* is the slot where the Advanced Integration Module (AIM) is installed.

This only applies to the 2691, 366x, and 37xx platforms that have sockets on their main boards for up to two AIM modules. The slot number is either 0 or 1.

- **network-clock-select priority {E1 | T1} slot** Where *slot* is the card or slot of the interface.

This command needs to be added to configure the clocking priority for the system in order to ensure that the router uses the correct interface as the primary (highest priority) clock source. This same command needs to be repeated with a different priority for each interface in order to establish the clocking hierarchy (in case the primary source goes down):

```
network-clock-select 1 e1 0/0

network-clock-select 2 e1 0/1
```

Issue the **show network-clocks** command in order to verify the clocking configuration:

```
2600#show network-clocks

Network Clock Configuration
-----
Priority      Clock Source      Clock State      Clock Type
  1           E1 0/0            GOOD             E1
  5           Backplane         GOOD             PLL
Current Primary Clock Source
-----
Priority      Clock Source      Clock State      Clock Type
  1           E1 0/0            GOOD             E1
```

## Examples

This is the configuration of a 2600 router with an AIM-VOICE-30 module and the E1 VWIC installed in WIC 0:

```
network-clock-participate wic 0

network-clock-select 1 e1 0/0
```

This is the configuration of a 2691 router with an AIM-VOICE-30 installed in slots 0 and 1, and with a single-port T1 VWIC installed in WIC slot 0 and slot 1:

```
network-clock-participate wic 0

network-clock-participate wic 1

network-clock-participate aim 0

network-clock-participate aim 1

network-clock-select 1 t1 0/0

network-clock-select 2 t1 1/0
```

Refer to the Configuring Network Clock Source and Participation section of AIM-ATM, AIM-VOICE-30, and AIM-ATM-VOICE-30 on the Cisco 2600 Series and Cisco 3660 for more information.

**Note:** When you configure the PRI connected to the PBX, make sure the router is configured with the **clock source internal** and the **isdn protocol-emulate network** commands.

## For 7200VXR, WS-X4604 AGM, and Catalyst 4224

You must add this command on the 7200s:

```
frame-clock-select priority {E1 | T1} card/slot
```

For example, for a PA-VXC-2TE1 card in slot 2:

```
frame-clock-select 1 t1 2/0

frame-clock-select 2 t1 2/1
```

Issue the **show network–clocks** command in order to verify the system clocking.

Refer to step 8 in the Specifying Card Type is Required section of Configuring the T1/E1 Digital Voice Port Adapter for more information on the 7200VXR.

Refer to the TDM Clocking section of Release Notes for Catalyst 4000 Access Gateway Module for Cisco IOS Release 12.1(5)T for more information on Catalyst 4000 voice gateways.

## For AS5350 and AS5400

These gateways have the ability to synchronize the clocking to a particular E1 or T1 interface, to an internal clock, or to an external station (BITS) clock source. The default is internal clocking. The system clocking can be changed with these commands. This depends on the version of Cisco IOS software that you use:

- For Cisco IOS Software Releases 12.2.11T and later:

```
tdm clock priority priority card/slot
```

- For Cisco IOS Software Releases earlier than 12.2.11T:

```
dial-tdm-clock priority priority card-slotcard/slot
```

Issue the **show tdm clock** command in order to verify the system clocking.

Refer to Clock Synchronization for AS5xxx Network Access Servers for more information.

## For 1751V and 1760

These devices use different commands and terminology for their clocking. In the voice mode of operation, the clocking can be exported (the clock is taken externally from the line or interface), or imported (the clock on a port can be taken from the internal oscillator of the router, or another port or interface).

```
tdm clock {T1 | E1} slot/port {voice | data | both} export line
```

*!--- Issue this command on one line:*

```
tdm clock {T1 | E1} slot/port {voice | data | both} import  
          {T1 | E1 | atm | bri | onboard} slot/port {line | internal}
```

This import and export terminology can be confusing, because the term import seems to suggest that the clocking comes directly from the referenced port or interface, and not from the internal oscillator of the router.

Refer to Clock Configuration for Cisco 1751/1760 Routers for more information.

## For MC3810

The MC3810 also uses the **network–clock** commands to synchronize the clocking:

```
network-clock-select {1-4} {T1 | E1 | Serial | System} slot/port
```

Refer to Configuring Synchronized Clocks on the Cisco MC3810 for more information on the possible scenarios.

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