TDM Circuit DSP Clocking, Slippage and Synchronization Tech Note

TAC   **Document ID: 116050**

Contributed by Baktha Muralidharan, Cisco TAC Engineer.
Apr 12, 2013

Contents

Introduction

This document describes how to troubleshoot problems with network clocking. There are many good documents on clocking issues and remedies, and this document is not intended to repeat information. Instead, the objective is to consolidate the knowledge in those documents and to provide pointers to those documents for details.

When implementing a time−division multiplexing (TDM) (T1/E1) interface, some of the following issues may occur:

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

If the ***show controller t1*** command is used in order to investigate such problems, clock slips may be observed. The solution is not necessarily to make the T1 participate in network clocking; indeed, network clocking might well be the problem.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

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

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If the network is live, make sure that the potential impact of each command is understood before it is implemented.

Conventions

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

Background Information

Assumptions

- Not all network modules (NMs) and voice cards are discussed exhaustively. The presence of onboard digital signal processors (DSPs) and Phase Locked Loop circuitry (PLLs) on a given module determines whether that module can operate in its own clockinPleasein.
- References to T1 apply to E1.
- Data applications (such as the use of T1s/E1s to carry data) are not addressed.
- Platforms without TDM backplane clocks (such as UC5xx and IAD) are not discussed.

Clocking and Clock Slips

Traffic received on a T1 or E1 interface is inside repeating bit patterns called frames; each frame is a fixed number of bits. The receiving device simply counts the number of bits in order to determine the start and end of a frame and thus knows exactly when to expect the end of a frame.

However, 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. This condition is known as a clock slip.

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 when the timing of the outgoing signal is not derived from that of the incoming signal.

In the context of this document, think of the T1 port as the receiving device and the DSP as the sending device.

Clocking on Cisco Routers

TDM–capable Cisco routers use an internal oscillator as a clock source in order to pass traffic across the

backplane and across other interfaces. Cisco routers that are TDM−capable are the integrated services router generation 1 (ISR G1), ISR generation 2 (ISR G2), and the AS5xxx.

While Cisco IOS® software can easily control the clocking, the default clocking mode on these routers is effectively free running. The received clock signal from an interface is not connected to the TDM backplane of the router and is not used for internal synchronization between the rest of the router and other interfaces.

Clocking Domains

Each voice network module card (for example, the NM−HDV2) has its own PLL circuitry and can provide:

- a clocking domain for the ports connected to that NM.
- a clocking domain for packet voice DSP modules (PVDM2s) and DSPs resident on that NM.

In Cisco routers, there is one PLL on the motherboard, called the network−clock. This PLL acts as the internal clock to the TDM backplane on the router and can lock on to one external source of clocking.

Note: The PLL can lock on to only one external source.

Think of NMs as enhanced voice cards. In addition to the voice card electronics, NMs also have PLLs and DSPs. That is, the NM essentially has everything required in order to be a self−contained clocking domain.

When to Synchronize Clocks

Here are several guidelines to help determine if network clocking is required:

- All interfaces that share a common pool of DSP resources (for example, from other NMs) must have synchronized clocks.
- In ISRs, the clock for the DSP resources on the motherboard must be synchronized with the circuit or interface to be used. The DSP resources on the motherboard are clocked from the TDM bus, which is also known as the backplane.
- If the voice gateway's configuration includes connection to a telco with high accuracy clocking and to another TDM device (such as a PBX) on premise, use network clocking to take in the telco clock and regenerate the telco clock as a timing reference to the PBX.

Note: PVDM3s are installed onto the motherboard with the ISR G2 platforms. Therefore, the clocks are synchronized. Compare this to PDM2s, which can also be on NMs.

How to Synchronize Clocks

Clocks are synchronized when you use one clock source for all processing by participating modules and ports. This requires both a participate and a select step:

1. Use the ***network−clock−participate*** command in order to configure the modules with clocks to be synchronized.
2. Configure the clock sources in order of priority to serve as the master or reference clocks. Telco providers generally provide very accurate clocking, so the telco clock source is usually selected as master.
    1. Use the ***clock source line*** command in order to configure the T1 port to connect to the telco.
    2. Use the ***network−clock−select*** command in order to select that T1 as priority 1.

Scenarios

Here are several scenarios that explain when to use network clocking.

Scenarios: Network Clocking is Required

Network clocking is necessary:

- When you use voice cards on the motherboard. Voice cards do not have their own PLLs or DSPs.
- When you use NMs that do not have enough onboard DSPs and that need to use the DSPs on the motherboard.
- When calls that come into the NMs use DSP resources on the motherboard DSPs for transcoding, conferencing, and so forth.

Consider a two−port NM in which the two T1 ports are connected to two different service providers. If the two clock sources are Stratum 1 and are perfectly synchronized, you do not need network clocking. Because this is rare, however, network clocking should be required in this scenario.

Scenarios: Network Clocking is Not Required

Consider the scenario where a voice−enabled gateway has T1s/E1s on NMs with their own DSPs. If there are no DSPs on the motherboard or if the DSPs are not used (that is, no DSP farming is used or configured), each NM operates in its own clocking domain. In this scenario, there is no need for network clocking or for the *network−clock−participate* or *network−clock−configuration* commands.

Scenario: Mixed Configuration

Consider a situation where the T1 ports on two different NMs on a router connect to two different clock sources (such as two different carriers). Here are the different configurations to resolve this situation.

If both modules have onboard DSPs:

- Do not configure network clock participation for either port.

If at least one of the modules has onboard DSPs, but does not need onboard DSPs:

- Configure network clocking for the module that uses only the motherboard DSPs.
- Do not configure network clock participation for the NM that has its own DSPs; this isolates the NM to its own clock domain.

If you want both modules to participate in network clocking:

- Configure one of the modules to take the clock from the service provider.
- Configure the other module to take the clock from an internal source, such as the TDM backplane. This is an example configuration:

```
Miami#show running-config
 !
 !
 Unnecessary output deleted
 !
 network-clock-participate slot 1
 network-clock-participate slot 2
 network-clock-select 1 T1 1/0
```

```
!
!
controller T1 1/0
description PSTN Trunk
framing esf
clock source line
linecode b8zs
ds0-group 1 timeslots 1-24 type e&m-wink-start
!
controller T1 2/0
description Tie Trunk to PBX
framing esf
clock source internal
linecode b8zs
ds0-group 1 timeslots 1-24 type e&m-wink-start
!
end
```

Refer to these documents for details on command syntax. Commands are platform−dependent:

- Clocking Configurations On Voice−Capable IOS−Based Platforms−Provides configuration commands for various platforms.
- Voice System Clocking−Describes clocking, slips, and clock domains.

Note: Use the Command Lookup Tool (registered customers only) in order to obtain more information on the commands used in this section.

Related Information

- ***Technical Support & Documentation − Cisco Systems***