



Multiservice Interchange (MIX) for Cisco 2600 and 3600 Series Modular Access Routers

Feature History

Release	Modification
12.1(5)XM	The Multiservice Interchange feature was introduced for the Cisco 3600 series.
12.2(4)T	Support was added for TDM cross-connect between two voice/WAN interface cards (VWICs) on the same network module on the Cisco 2600 series. The Multiservice Interchange feature was integrated into Cisco IOS Release 12.2(4)T.

Multiservice interchange (MIX) adds time-division multiplexing (TDM) connection capabilities to Cisco 2600 and 3600 series modular access routers. In addition, extended availability drop and insert (EADI) capabilities have been enhanced to allow TDM MIX connections across slots to stay up through a router reload if they have been saved in the NVRAM.

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Feature Overview

On the Cisco 2600 series, Cisco 3620, and Cisco 3640, MIX features are software only. On the Cisco 3660, MIX requires the installation of a multiservice interchange card, also called a *MIX module* (MIX-3660-64), which provides additional functionality.

MIX features support applications that are sensitive to time delay, such as voice and video. MIX enables the combination of different types of calls on a single T1 or E1 connection, giving customers the flexibility to manage traffic through their routers efficiently, as either traditional TDM connections or in packet-based format.

On Cisco 2600 series platforms, MIX allows connection of TDM streams between two voice/WAN interface cards (VWICs) on the same zero-LAN 2-slot network module (NM-2W).

On all Cisco 3600 series platforms, MIX allows connection of TDM streams between two voice/WAN interface cards (VWICs) on the same Fast Ethernet network module (NM-xFE2W).

On the Cisco 3660, the MIX module also enables the following features:

- Connection of TDM streams between separate MIX-enabled network modules. The following network modules are currently MIX-enabled:
 - High-Density Voice (NM-HDV)
 - Fast Ethernet Mixed Media (NM-xFE2W)
 - ATM OC-3 CES (NM-1AOC3-XX-1V)
- DSP resource sharing across network modules, so that unused DSP resources on one network module (NM-HDV) can be configured to support voice traffic on other network modules (NM-xFE2W or NM-HDV).
- Circuit emulation of T1/E1s on Fast Ethernet Mixed Media cards (NM-xFE2W) and High-Density Voice network modules (NM-HDV) can now be supported by transporting them across MIX to ATM OC-3 network modules (NM-1AOC3-XX-1V).

The MIX feature also enhances extended availability drop and insert (EADI) functionality to ensure that TDM connections across slots survive a software reload if they have been saved in NVRAM. This means that the data or voice connections carried over TDM will survive even if the router goes down and comes back up again. No separate configuration is necessary for EADI, but to ensure that the TDM connections are not interrupted, their **connect** commands must be saved to NVRAM by writing the configuration. Other types of MIX connections, such as CES connections and voice connections that terminate on the router, will not survive a software reboot or reload.

MIX functionality is used to support the following general applications, which are discussed in the next section:

- [Drop and Insert \(D&I\)](#)
- [Circuit Emulation Service \(CES\)](#) (Cisco 3660 only)
- [DSP Resource Pool](#) (Cisco 3660 only)

Drop and Insert

Drop and insert (D&I) is a telephony term that refers to the cross-connecting of TDM circuits. In the context of using Cisco routers for voice traffic, the term refers to the cross-connecting of a TDM stream from one port to another on the router. Drop and insert allows you to take 64Kb DS0 channels from one T1 and digitally cross-connect them to 64Kb DS0 channels on another T1. Individual 64Kb DS0 channels can be transparently passed, uncompressed, between T1/E1 ports without DSP processing because D&I uses circuit switching, which does not require the DSPs that packet switching employs.

On Cisco 2600 series routers, MIX allows connection of TDM streams between two voice/WAN interface cards (VWICs) on the same zero-LAN 2-slot network module (NM-2W). On Cisco 3600 series routers, MIX allows connection of TDM streams between two voice/WAN interface cards (VWICs) on the same Fast Ethernet network module (NM-xFE2W). On Cisco 3660 multiservice platforms equipped with a MIX module, you can also connect ports on different MIX-enabled network modules to each other.

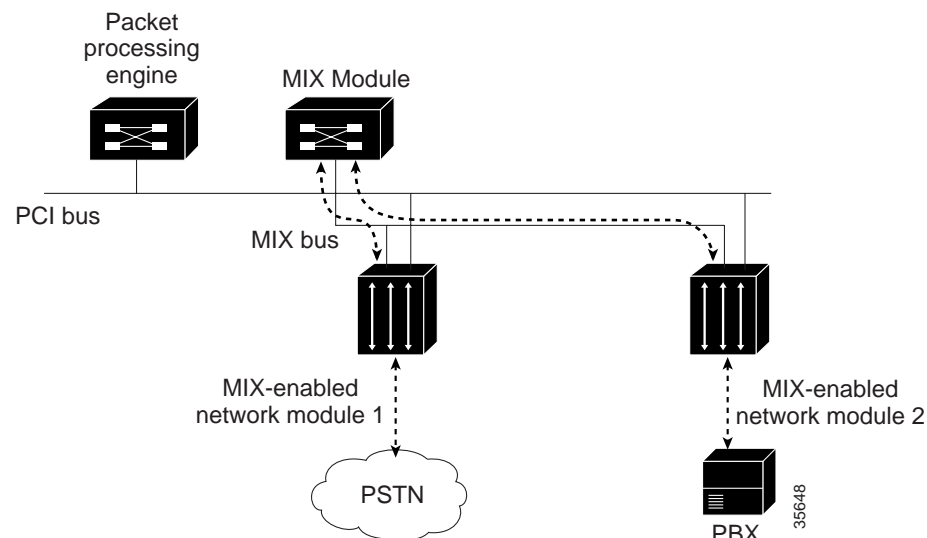
Drop-and-insert connecting is one way to integrate traditional circuit-based PBX technologies with VoIP. Channel traffic is sent between a PBX and central office (CO) switch or other telephony device, allowing the use, for example, of some PBX channels for long-distance service through the public switched telephone network (PSTN), while the router compresses others for interoffice VoIP calls. In addition, drop and insert can cross-connect a telephony switch (from the CO) to a channel bank to provide external analog connectivity.



Note

It is very important that all the slots participating in D&I are synchronized across the MIX module to the same clock, to prevent clock slips that can cause frame loss.

Figure 1 MIX enables drop and insert between two different network modules



Circuit Emulation Service (CES)

The MIX feature on the Cisco 3660 gives you the ability to route cross-connected TDM streams out over CES-enabled network modules to an ATM WAN for toll bypass or other WAN services.

CES, or circuit emulation service, is based on ATM Forum standards that allow communications to take place between AAL1 CES and ATM UNI interfaces; that is, between non-ATM telephony devices (such as classic PBXs) and ATM devices (such as Cisco 3600 series routers). Thus, a Cisco 3660 router equipped with an ATM OC-3 CES network module offers a migration path from classic T1/E1 data communications service to emulated CES T1/E1 unstructured (clear channel) services or structured (N x 64) services in an ATM network. Although standard CES supports ATM AAL1 structured and unstructured CES, the MIX module on the Cisco 3660 supports only structured ATM AAL1.

Clocking and bit integrity are maintained in this application, which is critical for interconnections of existing T1 or E1 interfaces and other kinds of constant bit rate (CBR) equipment. Circuit emulation service includes such features as PBX interconnect, consolidated voice and data traffic, and video conferencing.

In addition to supporting ATM CES on the two T1/E1 ports of its own VWIC, the ATM OC-3 CES network module supports two additional physical T1/E1 ports from another network module (for example, from a Fast Ethernet Mixed Media card). Note that the following limitations apply when an ATM OC-3 CES network module is supporting ATM CES on T1/E1s from other network modules:

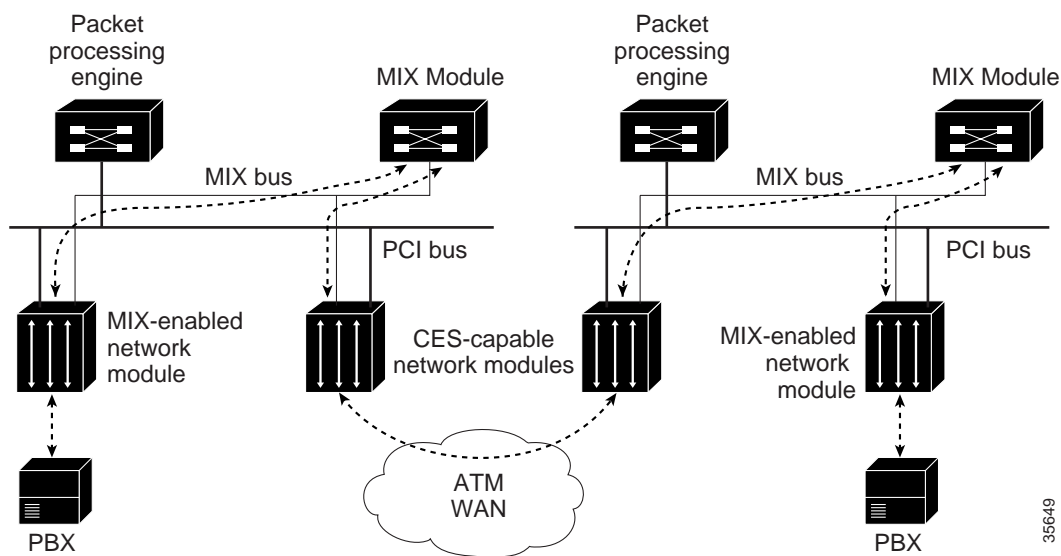
- Only structured CES is supported
- Echo cancellation is not supported



Note

For information about circuit emulation service and ATM OC-3 CES network modules, see the [“Configuring Circuit Emulation Services”](#) section in the [“Configuring ATM”](#) chapter of the *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.2.

Figure 2 MIX enables routing of TDM traffic for circuit emulation service



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DSP Resource Pool

Digital signal processors (DSPs) contain specialized electronics to handle the complex computational processing needed for VoIP, such as compression and coding/decoding. The number of DSP resources required on a router depends on the codec complexity and number of timeslots you are using. Without MIX functionality, the DSP resources on a network module are restricted to serving only the traffic that comes in or goes out over that particular network module. This means that each TDM stream with DSP processing requirements must be routed through a network module with adequate DSP resources to handle those requirements.

In contrast, on a Cisco 3660 equipped with a MIX switching module you can create a pool of DSP resources from selected network modules (NM-HDV) with excess DSP capacity. Then, when you configure DS0 groups or PRI groups, you can assign the DSP resources in this pool to TDM streams from other network modules (NM-xFE2W or NM-HDV) that need the DSP resources but do not have them locally available on their own network modules.

Each network module can be individually configured to participate or to not participate in the DSP resource pool (the default is to participate). If a module participates, its DSP resources are available for assignment to voice traffic on other modules across the MIX bus. If the module does not participate, its DSP resources are reserved only for the traffic from the module's own interfaces.

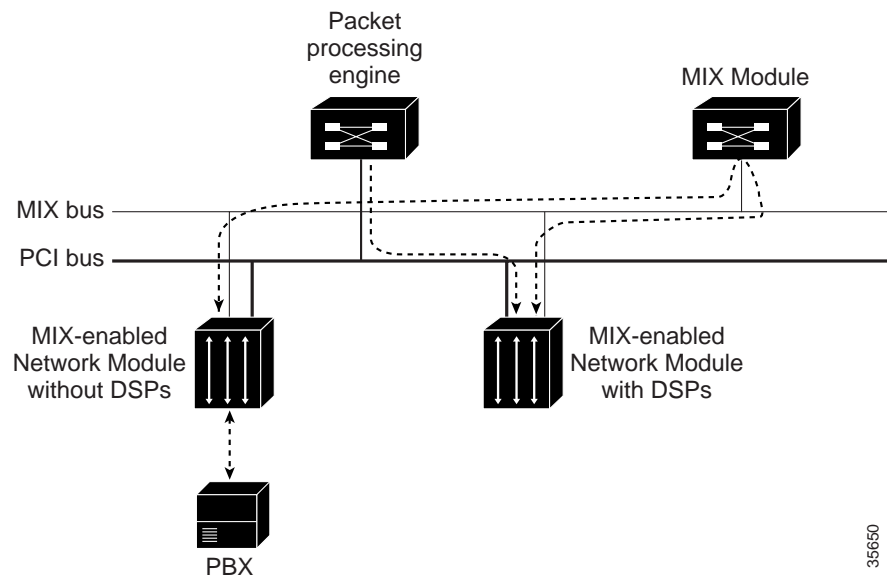
When a DSP resource pool has been enabled, it is possible for T1/E1 interfaces in network modules without DSP resources to pass CAS, CCS, and PRI traffic by using the DSPs in another network module.



Note

DSP resources are allocated to specific TDM streams when the streams are configured with the **ds0-group** or **pri-group** command. This allocation is static and does not change unless the DS0 group or PRI group is reconfigured. Note that DSP resources are not allocated dynamically during call signaling.

Figure 3 MIX allows creation of DSP resource pools to process TDM streams on network modules without DSPs



Benefits

- Drop and insert of TDM streams allows more aggregation of voice and data traffic, resulting in fewer T1s required.
- Drop and insert of TDM streams facilitates the integration of existing TDM traffic with the data network, providing a smooth migration path to VoIP in the future.
- Drop and insert across network modules makes it easier to handle both TDM and packet streams on the Cisco 3660. All voice, video, and data can be routed over the same platform, thus keeping infrastructure costs down and providing more flexibility in your network.
- Circuit emulation services are supported with this feature, so you can route TDM streams out over CES-enabled network modules to an ATM WAN for toll bypass or other WAN services on Cisco 3660 platforms.
- TDM streams from network modules without their own DSP resources can use the DSP resources from other, selected network modules on Cisco 3660 platforms.

Restrictions

- Drop-and-insert TDM connections from an ATM OC-3 CES network module are supported only on the second VWIC port in the network module.
- When an ATM OC-3 CES network module is supporting ATM CES on T1/E1s from other network modules, only structured CES (ATM AAL1) is supported, and echo cancellation is not supported.

Related Features and Technologies

Configuration of MIX-enabled network modules and VWICs is described in these documents:

- ATM OC-3 CES network modules:
“[Configuring Circuit Emulation Services](#)” section in “[Configuring ATM](#)” chapter of the *Cisco IOS Wide-Area Networking Configuration Guide*, Release 12.2.
- Digital T1 and E1 packet voice trunk network modules (High-Density Voice) and T1/E1 multiflex voice/WAN interface cards:
“[Configuring Voice Ports](#)” chapter in the *Cisco IOS Voice, Video, and Fax Configuration Guide*, Release 12.2

Related Documents

- For information about the MIX module and how to install it:
[Installing the Multiservice Interchange Card in Cisco 3660 Routers](#)

The following documents provide information to help you set up a network, configure CAS or PRI, and make TDM connections:

- [Cisco IOS Voice, Video, and Fax Configuration Guide](#), Release 12.2
- [Cisco IOS Voice, Video, and Fax Command Reference](#), Release 12.2
- [Cisco IOS IP Configuration Guide](#), Release 12.2
- [Cisco IOS Interface Configuration Guide](#), Release 12.2
- [Cisco IOS Wide-Area Networking Configuration Guide](#), Release 12.2

The following sites contain hardware installation and configuration guides, as well as regulatory and safety information for the products covered by this feature:

- [Cisco 2600 Series](#)
- [Cisco 3600 Series](#)

Supported Platforms

TDM cross-connect across ports on the same network module:

- Cisco 2600 series
- Cisco 3620
- Cisco 3640
- Cisco 3660

TDM cross-connect across ports on different MIX-enabled network modules, CES connections, and DSP resource pool:

- Cisco 3660

Determining Platform Support Through Feature Navigator

Cisco IOS software is packaged in feature sets that support specific platforms. To get updated information regarding platform support for this feature, access Feature Navigator. Feature Navigator dynamically updates the list of supported platforms as new platform support is added for the feature.

Feature Navigator is a web-based tool that enables you to quickly determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image.

To access Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions at <http://www.cisco.com/register>.

Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Feature Navigator home page at the following URL:

<http://www.cisco.com/go/fn>

Supported Standards, MIBs, and RFCs

Standards

No new or modified standards are supported by this feature.

MIBs

No new or modified MIBs are supported by this feature.

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL:

<http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>

RFCs

No new or modified RFCs are supported by this feature.

Prerequisites

Cisco 2600 series:

- Cisco IOS Release 12.2(4)T or a later release (any image)
- Zero-LAN 2-slot network module (NM-2W) with one or two VWICs in the WAN-card slots (VWICs are the only WAN cards that handle TDM traffic)

Cisco 3620 and Cisco 3640:

- Cisco IOS Release 12.1(5)XM, 12.2(4)T, or a later release (any image)
- Fast Ethernet Mixed Media card (NM-xFE2W) with one or two VWICs in the WAN-card slots (VWICs are the only WAN cards that handle TDM traffic)

Cisco 3660:

- Cisco IOS Release 12.1(5)XM, 12.2(4)T, or a later release (Plus image required for CES connections and DSP resource pool)
- MIX module (MIX-3660-64) installed in the TDM slot on the motherboard
- MIX-enabled network module(s) installed, which can be any of the following:
 - High-Density Voice network module (NM-HDV)
 - Fast Ethernet Mixed Media card (NM-xFE2W) with one or two VWICs in the WAN-card slots (VWICs are the only WAN cards that handle TDM traffic)
 - ATM OC-3 CES network module (NM-1AOC3-XX-1V)

Configuration Tasks

See the following sections for multiservice interchange configuration tasks. Each task in the list includes the supported platform and is identified as optional or required. Note that each of the network modules being connected must first be configured for the type of traffic it will handle. For those instructions, see the documentation for the particular module, listed in the “[Related Features and Technologies](#)” section on page 6.

- [Configuring Network Clock Use](#) (Cisco 3660 with MIX module, required task)
- [Adding DSPs to the DSP Resource Pool](#) (Cisco 3660 with MIX module, optional task)
- [Setting Framer Type for CES](#) (Cisco 3660 with MIX module, optional task)
- [Activating the Connection for Drop and Insert](#) (all platforms, required task)

Configuring Network Clock Use



Note

To ensure accurate and unbroken transmissions through cross-connected network modules, configure the module slots to get their timing from the same network clock, as described in this section.

On a Cisco 3660 with a MIX module, network modules that are cross-connected carry traffic that is sensitive to time delay, such as voice and video. To prevent mismatches and data slips, cross-connected network modules must synchronize their data flows to a single clock source. This is done by configuring both of the module slots to participate in network clocking before making the connection between the two slots.

When you configure network clock use, you select which modules participate and what the source of the network clock will be. Potential clock sources include internal generation from a module’s own phase-lock loop (PLL) chip or external retrieval from PSTN or PBX clocks over trunk lines. If you specify more than one network clock source, you assign each source a different priority level. The highest priority level indicates the clock you most prefer to be the source of timing for the modules you name to participate in network clocking. If the highest-priority clock becomes unavailable, the second highest priority level takes over automatically as the network clock, and so forth for lower priority levels.

The important point is that all network modules that are used for drop and insert across network modules must be configured to use the same clock, which is then called the *network clock*.

To configure network clock use, complete these steps, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# network-clock-participate slot slot	Allows the specified network module to participate in network clocking.
Step 2	Router(config)# network-clock-select priority {t1 e1} slot/port	Establishes the source and priority of the clocking on the MIX module and, in turn, all modules that are participating in network clocking. The source that is given the highest priority is used first; if it becomes unavailable, the source with the second-highest priority is used, and so forth.

Adding DSPs to the DSP Resource Pool



Note

The assignment of DSP resources to TDM streams is a static event that takes place on a first-come, first-serve basis when you configure DS0 groups (T1/E1) or PRI groups (PRI). DSP resources are not allocated dynamically during actual call signaling.

To add a network module's DSP resources to the DSP resource pool on a Cisco 3660 with a MIX module, complete these steps, beginning in global configuration mode:

	Command	Purpose
Step 1	<code>Router(config)# voice-card slot</code>	Enters voice card configuration mode for the specified slot.
Step 2	<code>Router(config-voicecard)# dspfarm</code>	Enters the DSPs on the module specified in the voice-card command into the DSP resource pool.
Step 3	<code>Router(config-voicecard)# exit</code>	Exits voice card configuration mode.

Setting Framer Type for CES

On a Cisco 3660 with a MIX module, if you are making E1 CES connections over ATM OC-3 CES network modules that do *not* contain Cisco T1/E1 multiflex voice/WAN interface cards (VWICs), you must manually set the framer type to E1 before making the TDM connection through the MIX bus. You do not need to use this command in T1 configurations because **t1** is the default for framer type.

To set the framer type, complete these steps, beginning in global configuration mode:

	Command	Purpose
Step 1	<code>Router(config)# ces slot/port</code>	Enters CES configuration mode for the specified slot. Note that port number is always 0, because the configuration applies to the entire slot.
Step 2	<code>Router(config-ces)# framer-type {t1 e1}</code>	Sets framer type to either T1 or E1 for CES connections that use an ATM OC-3 CES network module that does <i>not</i> contain a T1/E1 multiflex voice/WAN interface card (VWIC). The default is t1 .
Step 3	<code>Router(config-ces)# exit</code>	Exits CES configuration mode.

Activating the Connection for Drop and Insert



Note

No additional configuration is required for EADI, but to ensure that TDM connections survive a router reload, save the **connect** commands to NVRAM by writing the configuration.

To activate a drop-and-insert connection, complete the following task, beginning in global configuration mode:

	Command	Purpose
Step 1	Router(config)# connect <i>id</i> { t1 e1 } <i>slot/port-1</i> <i>tdm-group-no-1</i> { t1 e1 } <i>slot/port-2</i> <i>tdm-group-no-2</i>	Activates a connection. See the configuration excerpts following this table for examples of this command and the prompts from connect configuration mode.
Step 2	Router(config-tdm-conn)# exit or Router(config-ces-conn)# exit	Exits connect configuration mode. When the connect configuration mode is exited, the connection is activated.

After you issue the **connect** command, the router changes to TDM connect configuration mode or to CES connect configuration mode, depending on whether you are configuring a TDM or ATM connection, as shown in the following configuration excerpts

```
Router(config)# connect tdm1 t1 2/0 0 t1 2/1 0
Router(config-tdm-conn)#
Router(config-tdm-conn)# exit
Router(config)#
```

```
Router(config)# connect ces1 t1 2/0 1 atm1/0 1/100
Router(config-ces-conn)#
Router(config-ces-conn)# exit
Router(config)#
```

Verifying MIX Connections

To verify MIX settings and connections, use the following commands in privileged EXEC mode:

Command	Purpose
show connections all	Displays detailed information about the connections created by the connect command and dynamically created connections.
show controller { t1 e1 } <i>slot/port</i>	Displays controller information.
show network-clocks	Displays the list of all sources of network clocks according to their priority, and the current chosen clock.

Troubleshooting Tips

The following table lists debug and show commands to help analyze problems with your configuration.

Command	Purpose
<code>show diag [slot-number] [details] [summary]</code>	Displays hardware information for MIX module, in addition to other hardware information. See the example following this table.
<code>debug conn</code>	Displays information from the connection manager, the TDM client, and the DSP client.
<code>debug ces-conn</code>	Displays information from the CES client.

The following example shows output for the **show diag** command:

```
Router# show diag
3660 Chassis type:ENTERPRISE

c3600 Backplane EEPROM:
  Hardware Revision      :1.0
  Part Number            :800-04740-02
  Board Revision         :A0
  Deviation Number       :0-0
  Fab Version            :02
  PCB Serial Number      :HAD03411035
  RMA Test History       :00
  RMA Number             :0-0-0-0
  RMA History            :00
  Chassis Serial Number  :JAB034585UX
  Chassis MAC Address    :0030.9405.1530
  MAC Address block size :112
  Manufacturing Test Data :00 00 00 00 00 00 00 00
  Fab Part Number        :28-2651-02
  Number of Slots        :6
  EEPROM format version 4
  EEPROM contents (hex):
    0x00:04 FF 40 00 C8 41 01 00 C0 46 03 20 00 12 84 02
    0x10:42 41 30 80 00 00 00 00 02 02 C1 8B 48 41 44 30
    0x20:33 34 31 31 30 33 35 03 00 81 00 00 00 00 04 00
    0x30:C2 8B 4A 41 42 30 33 34 35 38 35 55 58 C3 06 00
    0x40:30 94 05 15 30 43 00 70 C4 08 00 00 00 00 00 00
    0x50:00 00 85 1C 0A 5B 02 01 06 FF FF FF FF FF FF FF
    0x60:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
    0x70:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

Backplane MIX Module:
  Hardware Revision      :1.0
  Part Number            :800-03700-01
  Board Revision         :A0
  Deviation Number       :0-0
  Fab Version            :02
  PCB Serial Number      :JAB9801ABCD
  RMA Test History       :00
  RMA Number             :0-0-0-0
  RMA History            :00
  EEPROM format version 4
  EEPROM contents (hex):
    0x00:04 FF 40 01 E1 41 01 00 C0 46 03 20 00 0E 74 01
    0x10:42 41 30 80 00 00 00 00 02 02 C1 8B 4A 41 42 39
    0x20:38 30 31 41 42 43 44 03 00 81 00 00 00 00 04 00
    0x30:FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

Configuration Examples

This section provides the following configuration examples:

- [Network Clock Configuration Examples](#) (Cisco 3660 only)
- [Drop and Insert of Voice or Data Example](#)
- [TDM Connections with CES Example](#) (Cisco 3660 only)
- [DSP Resource Pool Example](#) (Cisco 3660 only)
- [DSP Resource Pool with PRI Support Example](#) (Cisco 3660 only)



Note

Text that is highlighted in these examples is required for the feature illustrated by the example. Other configuration commands in the example are optional or are dependent on your own situation. IP addresses and host names in these examples are fictitious.

Network Clock Configuration Examples

As mentioned, when cross-connecting time-delay-sensitive traffic such as voice and video, you must make sure the data flows are synchronized. This is done by first configuring the cross-connected modules to participate in network clocking, and then specifying the sources and priorities to be used for network clocking. Two examples are shown:

- [Example 1: Internal Source for Network Clocking](#)
- [Example 2: External Source for Network Clocking](#)

Example 1: Internal Source for Network Clocking

This example uses the MIX module internal backplane clock on a Cisco 3660 as a source for network clocking; this is the default if no clock source is explicitly configured. The example configures the modules in slots 2 and 6 to participate in network clocking.

```

!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router3660-1
!
!
→ network-clock-participate slot 2
→ network-clock-participate slot 6
!
ces 1/0
  framer-type t1
!
voice-card 3
  dspfarm
!
voice-card 4
  dspfarm
!
ip subnet-zero
no ip routing

```

To verify the network clock(s) that has been configured and the network clock that is currently being used, enter the **show network-clocks** command.

```
Router3660-1# show network-clocks
Network Clock Configuration
-----
Priority      Clock Source      Clock State      Clock Type
-----
          9          Backplane          Good              PLL

Current Primary Clock Source
-----
Priority      Clock Source      Clock State      Clock Type
-----
          9          Backplane          Good              PLL
```

Example 2: External Source for Network Clocking

This example configures two external clock sources with different priority levels on a Cisco 3660.

```
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Router3660-1
!
network-clock-participate slot 2
network-clock-participate slot 6
→ network-clock-select 3 E1 6/2
→ network-clock-select 5 T1 2/0
!
ces 1/0
  framer-type t1
!
voice-card 3
  dspfarm
!
voice-card 4
  dspfarm
!
ip subnet-zero
no ip routing
```

To verify the network clock(s) that have been configured and the network clock that is currently being used, enter the **show network-clocks** command. This example shows the highest priority clock is in use.

```
Router3660-1# show network-clocks
Network Clock Configuration
-----
Priority      Clock Source      Clock State      Clock Type
-----
          3          E1 6/2          GOOD              E1
          5          T1 2/0          GOOD              T1
          9          Backplane          Good              PLL

Current Primary Clock Source
-----
Priority      Clock Source      Clock State      Clock Type
-----
          3          E1 6/2          GOOD              E1
```

Drop and Insert of Voice or Data Example

This example shows drop and insert of time slots 1-12 of T1 1/0 to time slots 1-12 of T1 2/0. The TDM groups are defined by the command **tdm-group 0 timeslots 1-12 type e&m** under controller t1. The drop and insert connection is made by the command **connect tdm t1 1/0 0 t1 2/0 0**. The time slots can carry either voice or data. When they carry voice, the **tdm-group** definition should include the type of signaling being used.

```

!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname aurora
!
!
!
!
!
!
→ network-clock-participate slot 1
→ network-clock-participate slot 2
→ network-clock-participate slot 3
voice-card 3
 dspfarm
!
!
ip subnet-zero
no ip domain-lookup
ip host igloo 192.168.254.254
!
!
!
controller T1 1/0
 framing esf
 clock source internal
 linecode b8zs
→ tdm-group 0 timeslots 1-12 type e&m
!
controller T1 2/0
 framing esf
 clock source internal
 linecode b8zs
→ tdm-group 0 timeslots 1-12 type e&m
!
controller T1 3/0
!
interface FastEthernet0/0
 ip address 10.7.91.1 255.255.0.0
 no ip mroute-cache
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!

```

```
interface FastEthernet1/0
 ip address 10.0.0.1 255.255.0.0
 duplex auto
 speed auto
!
interface FastEthernet1/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet2/0
 no ip address
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet2/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
ip classless
ip route 192.168.254.254 255.255.255.255 FastEthernet0/0
no ip http server
!
!
!
→ connect tdm1 T1 1/0 0 T1 2/0 0
!
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
```

TDM Connections with CES Example

In this example, a CES connection is being established on a Cisco 3660. A TDM group is defined under controller command, specifying the time slots that need to be carried over ATM PVC, and a CES PVC is specified under the ATM interface. The command **connect ces1 atm3/0 1/100 t1 1/2 0** then establishes the connection.

```

!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname aurora
!
!
!
!
!
→ network-clock-participate slot 1
→ network-clock-participate slot 5
!
ces 5/0
!
ip subnet-zero
no ip domain-lookup
ip host igloo 192.168.254.254
!
!
!
!
!
controller T1 1/0
!
controller T1 1/1
!
controller T1 1/2
  framing esf
  clock source internal
  linecode b8zs
→ tdm-group 0 timeslots 1-24 type e&m
!
!
!
interface FastEthernet0/0
 ip address 10.7.91.1 255.255.0.0
 no ip mroute-cache
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 no ip mroute-cache
 shutdown
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 10.0.0.1 255.255.0.0
 duplex auto
 speed auto
!

```

```

interface FastEthernet1/1
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface FastEthernet2/0
  no ip address
  no ip mroute-cache
  shutdown
  duplex auto
  speed auto
!
interface FastEthernet2/1
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface ATM5/0
  ip address 10.0.1.1 255.255.0.0
  atm clock INTERNAL
  no atm ilmi-keepalive
→ pvc 1/100 ces
!
  ip classless
  ip route 192.168.254.254 255.255.255.255 FastEthernet0/0
  no ip http server
  !
!
→ connect ces1 ATM5/0 1/100 T1 1/2 0
!
!
!
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end

```

DSP Resource Pool Example

In this example, slot 2 is a Fast Ethernet WAN network module and slot 3 is a digital T1/E1 packet voice trunk network module. The DSP on slot 3 is included in the DSP resource pool, making it available to be configured to support traffic from any slot and port on a Cisco 3660.

```

!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname aurora
!
!
!
!
network-clock-participate slot 1
→ network-clock-participate slot 2
→ network-clock-participate slot 3
voice-card 3
→ dspfarm
!
ip subnet-zero
no ip domain-lookup
ip host igloo 192.168.254.254
!
!
!
!
!
controller T1 2/1
    framing esf
    clock source internal
    linecode b8zs
→ ds0-group 0 timeslots 1-24 type fxo-loop-start
!
!
!
interface FastEthernet0/0
    ip address 10.7.91.1 255.255.0.0
    no ip mroute-cache
    duplex auto
    speed auto
!
interface FastEthernet0/1
    no ip address
    no ip mroute-cache
    shutdown
    duplex auto
    speed auto
!
interface FastEthernet1/0
    ip address 10.0.0.1 255.255.0.0
    duplex auto
    speed auto
!
interface FastEthernet1/1
    no ip address
    shutdown
    duplex auto
    speed auto

```

```

!
interface FastEthernet2/0
  no ip address
  no ip mroute-cache
  shutdown
  duplex auto
  speed auto
!
interface FastEthernet2/1
  no ip address
  shutdown
  duplex auto
  speed auto
!
ip classless
ip route 192.168.254.254 255.255.255.255 FastEthernet0/0
no ip http server
!
!
→ voice-port 2/1:0
!
dial-peer voice 1 pots
  destination-pattern 05...
  port 2/1:0
  prefix 05
!
dial-peer voice 3 voip
  destination-pattern 07...
  session target ipv4:10.0.0.2
!
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end

```

DSP Resource Pool with PRI Support Example

In this example from a Cisco 3660, slot 3 contains a Fast Ethernet WAN network module, and slot 1 contains a digital T1/E1 packet voice trunk network module. The DSP on slot 1 is used in a DSP resource pool to provide DSP resources for the traffic in slot 3. This is the ISDN configuration.

```

version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname aurora
!
!
!
!
→ network-clock-participate slot 1
→ network-clock-participate slot 3
voice-card 1
→ dspfarm
!
isdn switch-type primary-5ess
isdn voice-call-failure 0
call rsvp-sync
!
!
!
!
!
controller T1 1/0
!
controller T1 1/1
!
controller T1 3/0
framing esf
linecode b8zs
→ pri-group timeslots 1-24
!
controller T1 3/1
!
controller T1 3/2
!
controller T1 3/3
!
!
!
interface FastEthernet0/0
ip address 10.7.91.1 255.255.0.0
no ip mroute-cache
duplex auto
speed auto
!
interface FastEthernet0/1
mac-address 0000.0000.0001
ip address 10.0.0.100 255.255.255.0
no ip mroute-cache
load-interval 30
no keepalive
speed 100
full-duplex
!
interface FastEthernet3/0

```

```

ip address 192.168.0.1 255.255.255.0
duplex auto
speed auto
!
interface Serial3/0:23
no ip address
ip mroute-cache
no logging event link-status
isdn switch-type primary-5ess
isdn incoming-voice voice
isdn T306 30000
no cdp enable
!
interface FastEthernet3/1
no ip address
shutdown
duplex auto
speed auto
!
ip classless
ip route 192.168.254.254 255.255.255.255 FastEthernet0/0
no ip http server
ip pim ssm
!
!
→ voice-port 3/0:23
!
dial-peer cor custom
!
!
!
dial-peer voice 1000 pots
destination-pattern 01...
direct-inward-dial
port 3/0:23
prefix 01
!
!
dial-peer voice 199 voip
destination-pattern 02...
session target ipv4:192.168.0.2
!
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
end

```

Command Reference

This section documents new or modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 command reference publications.

New Commands

- [debug ces-conn](#)
- [debug conn](#)
- [dspfarm \(voice-card\)](#)
- [framer-type](#)
- [network-clock-participate](#)

Modified Commands

- [network-clock-select](#)

debug ces-conn

To display information from CES clients, use the **debug ces-conn** command in privileged EXEC mode. To disable debug mode, use the **no** form of the command.

debug ces-conn [all | errors | events]

no debug ces-conn

Syntax Description

all	Displays all error and event information
errors	Displays only error information
events	Displays only event information

Command History

Release	Modification
12.1(5)XM	This command is supported on Cisco 3600 series routers.
12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.

Examples

The following example shows debug output for a CES connection.

```
Router# debug ces-conn all
CES all debugging is on
Router#

Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Router(config)# connect conn1 t1 3/0 1 atm1/0 1/100

Router(config-ces-conn)# exit
Router(config)#
*Mar  6 18:32:27:CES_CLIENT:vc QoS parameters are PCR = 590, CDV =
5000, CAS_ENABLED = 1,partial fill = 0, multiplier = 8,cbr rate = 64,
clock recovery = 0,service_type = 3, error method = 0,sdt_size = 196,
billing count = 0
*Mar  6 18:32:27:CES_CLIENT:attempt 1 to activate segment>
```

debug conn

To display information from the connection manager, TDM and DSP clients, use the **debug conn** command in privileged EXEC mode. To disable debug mode, use the **no** form of the command.

debug conn

no debug conn

Syntax Description This command has no arguments or keywords.

Command History	Release	Modification
	12.1(5)XM	This command is supported on Cisco 3600 series routers.
	12.2(4)T	This command is supported on Cisco 2600 series routers and was integrated into Cisco IOS Release 12.2(4)T.

Examples The following example shows connection manager debugging output.

```
Router# debug conn
Connection Manager debugging is on

Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Router(config)# connect conn1 t1 3/0 1 t1 4/0 1

Router(config-tdm-conn)# exit
*Mar 6 18:30:59:%CONN TDM:Segment attached to dsx1
*Mar 6 18:30:59:%CONN TDM:Parsed segment 1
*Mar 6 18:30:59:%CONN TDM:Segment attached to dsx1
*Mar 6 18:30:59:%CONN TDM:Parsed segment 2
*Mar 6 18:30:59:%CONN:Creating new connection
Router(config)#
*Mar 6 18:31:01:%CONN TDM:Interwork Segments
*Mar 6 18:31:01:%CONN TDM:Init Segment @ 61C26980
*Mar 6 18:31:01:%CONN TDM:Init Segment @ 61C26A44
*Mar 6 18:31:01:%CONN TDM:Activating Segment @ 61C26980
*Mar 6 18:31:01:%CONN:Segment alarms for conn conn1 are 2
*Mar 6 18:31:01:%CONN TDM:Activating Segment @ 61C26A44
*Mar 6 18:31:01:%CONN:Segment alarms for conn conn1 are 0
*Mar 6 18:31:01:%CONN TDM:Connecting Segments
*Mar 6 18:31:01:%CONN TDM:MAKING CONNECTION
*Mar 6 18:31:01:%CONN:cm_activate_connection, stat = 5
Router(config)#
```

dspfarm (voice-card)

To add the specified voice card to those participating in the DSP resource pool, use the **dspfarm** command in voice-card configuration mode. To remove the specified card from participation in the DSP resource pool, use the **no** form of this command.

dspfarm

no dspfarm

Syntax Description This command has no arguments or keywords.

Defaults The default behavior is that a card participates in the DSP resource pool.

Command Modes Voice-card configuration

Command History

Release	Modification
12.1(5)XM	This command was introduced for the Cisco 3660.
12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.

Usage Guidelines

This command is used on Cisco 3660 routers with a MIX module installed.

To reach voice-card configuration mode for a particular voice card, enter **voice-card** and the card number while in global configuration mode.

The assignment of DSP resources in the resource pool to particular TDM streams is based on the order in which the streams are configured with the **ds0-group** command (T1/E1) or the **pri-group** command (PRI). It is not a dynamic assignment during call signaling.

Examples

The following example adds the voice card in slot 5 to the group of voice cards participating in the DSP resource pool:

```
Router(config)# voice-card 5
Router(config-voicecard)# dspfarm
```

Related Commands

Command	Description
voice-card	Enters voice-card configuration mode.

framer-type

To set the framer type of supported CES MIX connections to T1 or E1, use the **framer-type** command in CES configuration mode.

This command is needed only with CES-enabled network modules (ATM OC-3 CES network modules) that do *not* contain Cisco T1/E1 multiflex voice/WAN interface cards (VWICs) on the Cisco 3660. Other network modules set their framer type automatically, and therefore do not require use of this command. It is also not necessary to use this command for T1 connections, because **t1** is the default argument.

framer-type {t1 | e1}

Syntax Description	Argument	Description
	t1	The framer type of supported CES connections is T1.
	e1	The framer type of supported CES connections is E1.

Defaults The default behavior is that the framer type is set to T1.

Command Modes CES configuration

Command History	Release	Modification
	12.1(5)XM	This command was introduced for the Cisco 3660.
	12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.

Usage Guidelines This command is used on Cisco 3660 series routers with CES-enabled network modules (ATM OC-3 CES network modules) that do *not* contain Cisco T1/E1 multiflex voice/WAN interface cards (VWICs). To reach CES configuration mode for a particular slot, enter **ces** and the slot number/port number while in global configuration mode. Note that the port value is always 0, as the interface configuration applies to all ports in the slot.

Examples The following example sets the framer type of the CES card in slot 1 to E1:

```
Router(config)# ces 1/0
Router(config-ces)# framer-type e1
```

Related Commands	Command	Description
	ces	Configures CES on a router port and enters controller configuration mode.

network-clock-participate

To enable a network module to receive clock signals from the MIX module on the Cisco 3660, use the **network-clock-participate** command in global configuration mode. To restrict the network module to use only its own clock signals, use the **no** form of this command.

network-clock-participate slot *slot*

no network-clock-participate slot *slot*

Syntax Description

slot	Keyword indicating the value that follows is a slot number.
<i>slot</i>	Slot number of the network module. Values are from 1 to 6 for the Cisco 3660.

Defaults

No network clocking is enabled; interfaces are restricted to using the clocking generated on their own modules.

Command Modes

Global configuration

Command History

Release	Modification
12.1(5)XM	This command was introduced for the Cisco 3660.
12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.

Usage Guidelines

This command is used on Cisco 3660 routers with a MIX module installed.

Examples

To allow the network module in slot 5 to participate in network clocking, the following command was used:

```
Router(config)# network-clock-participate slot 5
```

Related Commands

Command	Description
network-clock-select	Specifies selection priority for the clock sources.

network-clock-select

To name a source to provide timing for the network clock and to specify the selection priority for this clock source, use the **network-clock-select** command in global configuration mode. To cancel the network clock selection, use the **no** form of this command.

Cisco 3660 with MIX module

network-clock-select *priority* { **t1** | **e1** } *slot /port*

no network-clock-select *priority* { **t1** | **e1** } *slot/port*

Cisco MC3810

network-clock-select *priority* { **serial 0** | **system** | *controller* }

no network-clock-select *priority* { **serial 0** | **system** | *controller* }

Syntax	Description
<i>priority</i>	Selection priority for the clock source (1 is highest priority). The clock with highest priority will be selected to drive the system TDM clocks. When the higher priority clock source fails, the next higher priority clock source is selected. Values are: 1 to 8 (Cisco 3660) or 1 to 4 (Cisco MC3810).
t1	(Cisco 3660) Port type is T1.
e1	(Cisco 3660) Port type is E1.
<i>slot/port</i>	(Cisco 3660) Slot number and port number that identify which controller is the clock source. Values are: 1 to 6 (slot number), 0 to 3 (port number).
serial 0	(Cisco MC3810) (Optional) Specifies serial interface 0 as the clock source.
system	(Cisco MC3810) (Optional) Specifies the system clock as the clock source.
<i>controller</i>	(Cisco MC3810) (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).

Defaults

Cisco 3660

The network clock source is the backplane PLL with priority 9.

Cisco MC3810

No network clock source is specified.

Command Modes

Global configuration

Command History

Release	Modification
11.3 MA	This command was introduced for the Cisco MC3810.
12.1(5)XM	This command was supported on the Cisco 3660, and the keywords t1 and e1 were introduced.
12.2(4)T	This command was integrated into Cisco IOS Release 12.2(4)T.

Usage Guidelines**Cisco 3660**

This command is used on Cisco 3660 routers with a MIX card installed to select the controller that provides the clock to the backplane, and in turn to all the network modules that are participating in network clocking.

Cisco MC3810

This command applies to Voice over Frame Relay, Voice over ATM, and Voice over HDLC on the Cisco MC3810.

Examples**Cisco 3660**

This example selects the controller in slot 5/port 1 to provide the clock at priority 3:

```
Router(config)# network-clock-select 3 t1 5/1
```

Cisco MC3810

The following example sets the priority of four network clock sources. When the clock source with the highest priority (controller T1 0) fails, the Cisco MC3810 switches the clock source to the second highest priority (controller T1 1).

```
Router(config)# network-clock-select 1 T1 0
Router(config)# network-clock-select 2 T1 1
Router(config)# network-clock-select 3 serial 0
Router(config)# network-clock-select 4 System
```

Related Commands

Command	Description
network-clock-participate	(Cisco 3660) Configures a network module to participate in network clocking.
network-clock-switch	(Cisco MC3810) Configures the switch delay time to the next priority network clock source when the current network clock source fails.

Glossary

AAL1—ATM adaptation layer 1. One of four AALs recommended by the ITU-T. AAL1 is used for connection-oriented, delay-sensitive services requiring constant bit rates, such as uncompressed video and other isochronous traffic.

ATM—Asynchronous Transfer Mode. A high-bandwidth, low-delay, packet-switching, and multiplexing technique used to transfer voice, video, image, and character-based data in 53-byte cells over various media, including synchronous optical network (SONET), synchronous digital hierarchy (SDH), and digital cross-connect (DCC) systems.

CES—Circuit Emulation Service. ATM emulation of TDM circuits over AAL1.

channel—Term used to describe a group of time slots that are combined to form a point-to-point HDLC data path or a VoIP data path. Also, the smallest subdivision of a circuit or transmission system in which a single type of communication service is provided (for example, a voice or data channel).

channelized E1/T1—An E1 or T1 interface with 31 or 24 time slots respectively. Channels may be assigned one or more time-arbitrary time slots. Multiple channels may be assigned to a single E1 or T1 as long as the time slots allocated do not overlap.

CLI—Command Language Interpreter. Basic Cisco IOS configuration and management interface.

CO—Central office. A telephone operating company facility where local subscriber loops are collected, controlled, and switched to other destinations in the public switched network system. A central office is the site where a local telephone company terminates subscriber lines and houses the switching equipment that interconnects those lines to the local network or a long distance network. CO is frequently used as a synonym for the switching equipment itself.

D&I—Drop and insert. Method of time-switching channels between T1/E1 time slots on different streams. This is also sometimes called *pass-through* or *TDM cross-connect*.

DS0—Digital Signal Level 0. Framing specification used in transmitting digital signals over a single channel at 64-kbps on a T1 facility. Often used to refer to a single 64 Kbps channel, designed for digital voice, which is the building block of a T1 transmission line. Twenty-four DS0 channels make up one T1 line, and thirty-two DS0 channels make up one E1 line.

DS1—Digital Signal Level 1. Framing specification used in transmitting digital signals at 1.544 Mbps on a T1 facility or at 2.108 Mbps on an E1 facility. Often used to refer to a T1 line that contains 24 DS0-formatted channels.

DSP—Digital Signal Processor. Its primary function is to provide stream-to-packet signal processing functionality that includes voice compression, echo cancellation, and tone and voice activity detection.

DSP resource pool—A collection of DSP resources available to a network module on the router.

E1—Wide-area digital transmission scheme. E1 is the European equivalent of a T1 line. The higher E1 clock rate (2.048 MHz) allows for 32 64-kbps time slots, including one time slot (typically time slot 0) for framing and one time slot (typically time slot 16) for D-channel information.

EADI—Extended availability drop and insert. Ability of TDM drop-and-insert connections to remain active through software reboots or reloads.

framer—A hardware device that converts between the raw E1 or T1 bit stream and 8-bit DS0 streams. The framer also extracts and inserts signaling information.

HDLC—High-level Data Link Control. A standard set of protocols for carrying data over a link with error and flow control.

ITU-T—Telecommunication standardization sector of the International Telecommunication Union, the telecommunications agency of the United Nations established to provide worldwide standard communications practices and procedures.

- MIX**—Multiservice Interchange. Feature that allows TDM connections between MIX-enabled ports.
- NM**—Network Module. Modular plug-in device that provides a physical connection to a network medium, either a local-area network or a wide-area network.
- OC3**—Optical Carrier level 3. The optical interface designed with synchronous transport signal (STS-3) rate in SONET (synchronous optical network).
- PCI**—Peripheral component interconnect. Specification that defines the PCI Local bus.
- POTS**—Plain old telephone service.
- PSTN**—Public switched telephone network.
- PVC**—Permanent virtual circuit made between two data terminal equipment (DTE) lines established by configuration.
- T1**—The basic 24-channel, 1.544 Mbps pulse code modulation (PCM) system used in the United States.
- TDM**—Time-division multiplexing. Technique in which information from multiple channels can be allocated bandwidth on a single wire based on preassigned time slots. Bandwidth is allocated to each channel regardless of whether the station has data to transmit.
- TDM bus**—A structure for passing telephony sample data between interfaces. Typically data is channelized to the level of a single telephone call.
- time slot**—Continuously repeating interval of time in which two devices are able to interconnect. In time-division multiplexing (TDM), describes the individual “voice channels” in a T1 or E1 signal. T1 has 24 time slots numbered 1 through 24, all of which are available for voice or data. E1 has 32 time slots numbered 0 through 31, but time slot 0 is dedicated to framing and time slot 16 is dedicated to channel-associated signaling in voice applications. Data-only applications can use time slot 16 if desired.
- VIC**—Voice interconnect card. Provides voice-specific ports, including FXS, FXO, E&M, and BRI.
- VWIC**—A card that can operate as a VIC or as a WIC, providing physical connection to WAN or voice networks.
- VoIP**—Voice over IP. The ability to carry normal telephony-style voice over an IP-based Internet with POTS-like functionality, reliability, and voice quality. VoIP is a blanket term that generally refers to the Cisco standards-based (H.323, etc.) approach to IP voice traffic.
- WIC**—WAN (wide-area network) interconnect card.