

# Multiservice Interchange for Cisco 2600 and 3600 Series Multiservice Platforms



Multiservice Interchange (MIX) adds time-division multiplexing (TDM) connection capabilities to all Cisco 2600 and 3600 platforms. MIX enables the combination of different types of traffic on a single T1 or E1 connection, allowing smooth migration from TDM voice to packet voice on one integrated platform. Customers can also save WAN bandwidth by mixing TDM voice and packet data on the same link using the Drop & Insert function (Integrated Add/Drop Multiplexing).

## Introduction

With IOS software releases 12.1(5)XM1 or 12.2(1)T, Multiservice Interchange (MIX) is available on all Cisco 2600 and 3600 Multiservice platforms with Cisco 3660 platform offers the most extensive features.

## MIX on Cisco 3660

MIX solution on the Cisco 3660 multiservice platform comprises a special combination of hardware and software components. The hardware consists of a multiservice interchange card, also called a MIX module (MIX-3660-64), and one or more of the Voice/WAN interface cards (VWIC), the Fast Ethernet network modules (NM-xFE2W), the High-Density Voice network modules (HDV) and the ATM OC-3 CES network modules (NM-1A-OC3XX-1V). The software is any of the Cisco IOS feature sets starting with Release 12.1(5)XM1 or 12.2(1)T.

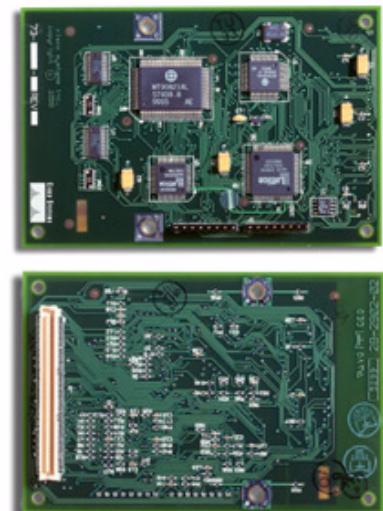
MIX-enabled Cisco 3660 platform provides the ability to integrate voice and data on the same T1/E1 interface without the need for an external time-division multiplexing (TDM) device. The

MIX module (MIX-3660-64) is designed for Cisco 3660 platform only, and it plugs into the TDM slot on the motherboard of a Cisco 3660. Cisco 3660 platform now can support up to 16Mbps of full duplex TDM switching capacity to or from a MIX enabled network module over the multiservice interchange card.

The Cisco 3660 with the installation of a MIX module (MIX-3660-64) provides:

- TDM switching of latency and delay sensitive traffic such as voice and video across the backplane
- Integrated Add/Drop Multiplexing (D&I) capability across different T1/E1 spans
- DSP resource sharing across two different MIX-enabled network modules
- ATM CES applications

**Figure 1** Multiservice Interchange (MIX) Module for Cisco 3660 Series Platform (MIX-3660-64)





D&I (Integrated Add/Drop Multiplexing) on Cisco 3600

While the TDM backplane capability is only available on Cisco 3660 platform, there is an enhancement in IOS 12.1(5)XM1 or 12.2(1)T software release to the Fast Ethernet network module (NM-xFE2W) that is available on all Cisco 3600 platforms. This enhancement is the capability to do Integrated Add/Drop Multiplexing (D&I) across the ports of two Voice/WAN interface cards

(VWIC) resides in the same NM-xFE2W. In the past, D&I had only been allowed between ports on the same VWIC since the introduction of the Voice/WAN Interface cards first supported on IOS release 12.0(5)XK.

MIX functionality available on Cisco 2600 and 3600 platforms are summarized in table 1 below.

**Table 1** MIX Functionality Hardware Support and Min. IOS Release Requirements

Feature	2600	3620/3640	3660	Min. IOS Release
D&I across two VWICs within the same NM <sup>1</sup>	Yes Available on all VWICs and NM-2W	Yes Available on all VWICs and NM-xFE2W	Yes Available on all VWICs and NM-xFE2W	12.1(5)XM1 or 12.2(1)T
D&I across any two VWICs that reside in two different NM's	Not supported	Not supported	Yes Available on VWICs, NM-HDV, NM-xFE2W, and NM-1A-OC3xx-IV <sup>2</sup> ; MIX module required	12.1(5)XM1 or 12.2(1)T
DSP Resource sharing across two NM-HDVs, or across a NM-HDV or a NM-xFE2W	Not supported	Not supported	Yes Available on VWICs, NM-HDV, NM-xFE2W; MIX module required	12.1(5)XM1 or 12.2(1)T
ATM CES <sup>3</sup>	Not supported	Not supported	Yes Available on VWICs, NM-HDV, NM-xFE2W, and NM-1A-OC3xx-IV; MIX module required	12.1(5)XM1 or 12.2(1)T

1. For all Cisco 2600 and 3600, D&I across two T1/E1 within the same VWIC is only supported by the following Voice/Wan Interface Cards: VWIC-2MFT-T1-DI, VWIC-2MFT-E1-DI, and VWIC-2MFT-G703.

2. Only port 1 of a VWIC resident in an ATM OC-3 CES NM can also participate in D&I applications, port 0 cannot.

3. A maximum of 4 E1s' worth of CES traffic can be fed into a single OC-3 card, as follows: 2 E1s from the VWIC inside the OC-3 CES NM and 2 E1s from VWIC in other NMs.



## Key Benefits

- *TDM functionality allows smooth migration to packet voice*—MIX-enabled Cisco 3660 platform provides the ability to integrate TDM voice, packet voice and data on the same T1/E1 interface without the need for an external TDM device. Such a solution encourages customers to put all their network traffic on one integrated platform for ease of management and lower cost of ownership. It is ideal for enterprise customers who are hesitant to cut through all their voice traffic on a packet infrastructure.
- *Allows cost-conscious customers to aggregate bandwidth and save WAN costs*—With the TDM backplane, Cisco 3660 can perform D&I (cross-connection of tdm-groups) across any two VWIC ports reside on either a NM-HDV or a NM-xFE2W. Port 1 of a VWIC resides in an ATM OC3 CES NM can also participate in D&I (Drop and Insert) applications. This functionality allows customers to combine voice and data using Time Division Multiplexing to “channelize” voice and data streams over a common T1/E1 or fractional T1/E1 service for reduced WAN costs.

The enhancement in IOS 12.1(5)XM1 or 12.2(1)T releases enables all Cisco 3600 to do Integrated Add/Drop Multiplexing (D&I) across the ports of two VWICs reside in the same NM-xFE2W.

The D&I feature provides flexible timeslot assignment from port to port on all Cisco 3600 and offers customers investment protection in migration to packet voice.

- *Maximizes system resources through DSP resource sharing across two different network modules*—MIX solution enables a Cisco 3660 to connect T1/E1s carrying voice channels to a NM-xFE2W even though these network modules do not have any DSP resources to process the voice traffic. These voice channels will be mapped to DSP resources on a neighboring NM-HDV.
- *Allows service providers to quickly deliver local or long distance voice for maximum profitability by transporting the traditional PCM-encoded 64-Kbps circuit-based voice over an ATM network*—Enhanced Circuit emulation service (CES) of T1/E1s can now be supported on Cisco 3660 platform through MIX. Voice channels of T1/E1 on NM-xFE2W and NM-HDV network modules can be transported across the

MIX module to ATM OC-3 network modules (NM-1A-OC3XX-1V) over an ATM network. Fully interoperable with today’s existing PSTN infrastructure, PVC-based (permanent virtual circuit) CES allows service providers to quickly deliver local or long distance voice, while SVC (switched virtual circuit) capabilities ensure that these services be optimized for maximum profitability.

## Key Features

The Multiservice Interchange (MIX) solution on Cisco 3660 enables the following key features:

- Connection of TDM streams between two Voice/WAN interface cards (VWICs) on the same Fast Ethernet network module (NM-xFE2W)

Participating VWICs are:

- VWIC-1MFT-T1, VWIC-1MFT-E1
- VWIC-2MFT-T1, VWIC-2MFT-E1
- VWIC-2MFT-T1-DI, VWIC-2MFT-E1-DI
- VWIC-1MFT-G703, VWIC-2MFT-G703

- Connection of TDM streams between separate TDM-enabled network modules

The following network modules (NM) are currently TDM-enabled:

- High-Density Voice  
NM-HDV
- Fast Ethernet Mixed Media (NM-xFE2W)  
NM-1FE2W  
NM-2FE2W  
NM-1FE1R2W  
NM-2W
- ATM OC-3 CES (NM-1A-OC3XX-1V)  
NM-1A-OC3MM-1V  
NM-1A-OC3SMI-1V  
NM-1A-OC3SML-1V

- DSP resource sharing across High-Density Voice network modules (NM-HDV) and Fast Ethernet Mixed Media network modules (NM-xFE2W), so that unused DSPs on a NM-HDV can form a DSP resource pool to support voice traffic on NM-xFE2W across Cisco 3660 backplane
  - NM-HDV provides the DSPs
  - NM-xFE2W or other NM-HDV use the DSPs
  - ds0-groups and voice pri-groups are now supported on a VWIC in a NM-xFE2W



- DSPs to voice channels are statically mapped at configuration time—if not enough DSPs are left on a NM-HDV, the configuration of the ds0/pri-group will not succeed
- Each NM-HDV can be configured to participate in DSP Resource Pool or not
- All NM-HDVs participating in the DSP Resource Pool must be synchronized to the same clock
- All NM-HDVs that participate in the DSP Resource Pool should be configured with the same codec complexity—DSP assignment is not deterministic if the network modules are of mixed complexities
- NM-HDVs need not be a PDVM for the DSP Resource Pool functionality to operate
- EADI (Enhanced Availability D&I) is available for D&I applications across Cisco 3660 backplane. This feature provides for the survival of the TDM cross-connections through a software reload of Cisco 3660.
- Enhanced Circuit emulation of T1/E1s can now be supported on Cisco 3660 through MIX. Voice channels of T1/E1 on NM-xFE2W and NM-HDV network modules can be transported across the MIX module to ATM OC-3 network modules (NM-1A-OC3XX-1V) over an ATM network.
- Clocking options—All network modules (NM) that communicate over the MIX module (MIX-3660-64) must be clocked from the same source. The clocking source can be internal or external. Internally, these network modules must derive clock from MIX module (MIX-3660-64). Externally, clock from the PSTN can propagate across MIX-3660-64 to all network modules via a VWIC that's connected to the PSTN. Finally, all NM's communicate over the MIX module must be in the same clock domain.

The Multiservice Interchange (MIX) solution on the Cisco 2600, 3620 and 3640 enables the following key feature:

- Connection of TDM streams between two Voice/WAN interface cards (VWICs) on the same Fast Ethernet network module (NM-xFE2W, does not apply to the Cisco 2600)

Participating VWICs are:

- VWIC-1MFT-T1, VWIC-1MFT-E1
- VWIC-2MFT-T1, VWIC-2MFT-E1
- VWIC-2MFT-T1-DI, VWIC-2MFT-E1-DI

- VWIC-1MFT-G703, VWIC-2MFT-G703

## Applications

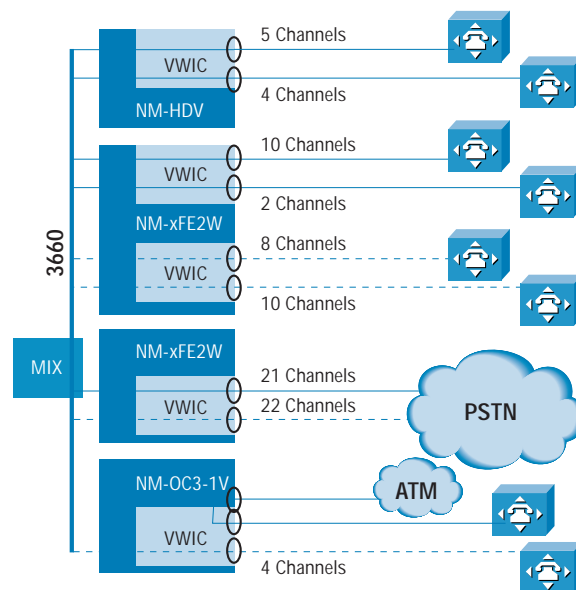
### TDM Voice Switching Solution

In pure D&I applications, Cisco 3660 does not participate in voice processing. It functions purely as a cross-connect for TDM streams from, say, a PBX to the PSTN. For many customers though, this is a viable first step in the integration of voice and data traffic onto a combined infrastructure before taking the leap into VoX technologies.

This type of application can be used to:

- Aggregate voice traffic from multiple PBXs from different branches or building locations, each connecting through a T1/E1 leased line to a Cisco 3660
- Aggregate voice traffic to the PSTN from multiple PBXs in a high-rise building or mall (multi-tenant situation)

Figure 2 TDM Voice Switching Application



In Figure 2 above, a sample application is depicted where voice traffic from seven PBXs, each with less than half the channels on the T1/E1 actively used, is consolidated onto two T1/E1 ports to the PSTN, providing substantial cost savings in the number of PSTN trunks required for this traffic. In the example, the solid lines from the PBXs aggregate onto the solid line to the PSTN, and the dotted lines aggregate onto the dotted line to the PSTN.



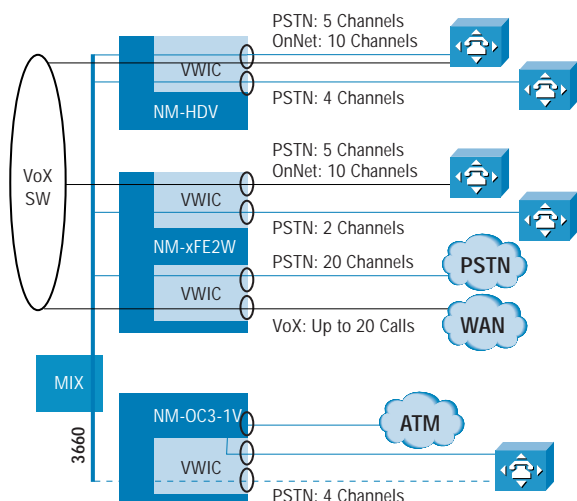
For purposes of illustration some PBX T1/E1s are connected to a NM-HDV while others are connected to NM-xFE2Ws. The DSPs reside on the NM-HDV are not used in this example. Its benefit would be to ease the next migration step when the customer wants to start using VoX for some voice channels. If all the D&I channels are connected to NM-xFE2Ws, the customer will have to buy at least one NM-HDV when he wants to start deploying VoX (and probably more if DSPs on the NM-HDV has to drive voice channels on both the NM-HDV as well as NM-xFE2W). On the other hand, the benefit of the NM-xFE2W is higher density of T1/E1s (4 vs. 2 for the NM-HDV) per NM slot.

The example also shows how the second port on the ATM OC-3 CES card can be used in the D&I application.

VoX for On-net, TDM D&I for Off-Net Solution  
 Another common application for cross-NM D&I is to cross-connect the Off-net voice traffic (PBX to PSTN), while using VoX technology for the On-net traffic (PBX to PBX across the enterprise network).

In Figure 3 below, a sample application is depicted where the PSTN voice traffic from four PBXs are consolidated onto a single T1/E1 port to the PSTN, providing substantial cost savings in the number of PSTN trunks required for this traffic. In addition, several channels from some PBXs are On-net traffic and these are using a VoX application. The cross-connected channels to the PSTN will be configured using tdm-groups, while the channels using VoX will be ds0-groups.

**Figure 3** VoX for On-net, TDM D&I for Off-Net Solution



The voice channels using VoX must have access to DSPs, so there must be at least one NM-HDV in the 3660. The VoX channels connected to the NM-xFE2W will draw its DSPs from the NM-HDV via the DSP Resource Pool sharing feature discussed in this paper.

The MIX Module Architecture (for Cisco 3660 only)

To enhance its flexibility, integration, versatility and efficiency, Cisco 3660 multiservice platform supports one internal TDM slot and two internal Advanced Integration Module (AIM) slots on its motherboard. The MIX module (MIX-3660-64) plugs into the TDM slot and is designed for Cisco 3660 platform only. The AIM slots are used for compression and encryption AIM modules.

The TDM slot connects to both the Cisco 3660's main system bus and a secondary TDM backplane bus running between the WAN interface card (WIC) slots and network module (NM) slots. This flexible architecture enables the MIX module to integrate different types of traffic, whether it is TDM voice, packet voice or data, on a single T1 or E1 connection, enabling customers to manage traffic through their routers efficiently. By supporting the combination of different types of traffic on Cisco 3660 multiservice platform, MIX helps customers migrate smoothly from TDM voice to packet voice on one integrated platform. In addition, MIX can save customers WAN bandwidth by mixing TDM voice and packet data on the same link using Drop and Insert function.

**Table 2** MIX Module Feature and Benefit Summary

Feature	Benefit
<b>Dedicated Hardware for TDM Switching</b>	Offloads switching functions from the platform's CPU to improve overall platform performance and efficiency
<b>High Performance TDM switching Engine</b>	Offers up to 16Mbps of full duplex TDM throughput switching capacity to and from a TDM enabled network module
<b>Uses the one available internal TDM Slot on Cisco 3660 motherboard</b>	External interfaces (WAN Interface Cards and Network Modules) remain free for other applications
<b>Field Upgradable</b>	Easy to be plugged in the TDM slot on a Cisco 3660 motherboard in the field



**Table 2** MIX Module Feature and Benefit Summary (Continued)

Feature	Benefit
Onboard Memory on MIX module for Maintaining TDM Streams	Supports 16Mbps full-duplex TDM streams, no additional memory required
Cisco IOS Commands for Monitoring MIX Activity	Provides detailed statistics and diagnostics for TDM voice, packet voice and data links
Integrate TDM voice and Packet voice traffic on a single T1/E1 connection	Allows smooth migration from TDM voice to packet voice on one integrated Cisco 3660 platform
Drop and Insert (D&I) capability across different T1/E1 span	Saves WAN bandwidth by mixing TDM voice and packet data on the same link
Extended Availability Drop and Insert (EADI) capabilities	Persistent service across software reloads
DSP resource sharing across High-Density Voice network modules (NM-HDV) and Fast Ethernet Mixed Media network modules (NM-xFE2W)	Unused DSP resources on a NM-HDV can support voice traffic on NM-xFE2W across the Cisco 3660 backplane to maximize system resources
ATM CES applications over T1/E1	Allows service providers to quickly deliver local or long distance voice for maximum profitability by transporting the traditional PCM-encoded 64-Kbps circuit-based voice over an ATM network
Works with Cisco IOS Quality of Service Mechanisms	Provides a total solution for bandwidth management and optimization

### Network Management Support

MIX works with the following network management support:

- Simple Network Management Protocol (SNMP) compliant
- Manageable via a MIB browser (no new MIB for MIX)
- CiscoView interface for configuration
- Cisco Voice Manager (CVM) supported

Specifications for the MIX Module (for Cisco 3660 only)

Refer to the Cisco 3660 Data Sheet for additional information on mechanical, environmental, and agency certifications.

**Table 3** Specifications for the MIX Module

Hardware/Platform Requirements	All Cisco 3660 models
Maximum Number of MIX Modules	One supported
Software Requirements	Cisco IOS version 12.1(5)XM1 or 12.2(1)T or later
Dimensions	4.50" x 3.00" (11.43 cm x 7.62 cm)
Weight	1.5 oz (43 gram)
Network Module Support	NM-HDV, NM-1FE2W, NM-2FE2W, NM-1FE1R2W, NM-2W, NM-1A-OC3MM-1V, NM-1A-OC3SMI-1V, and NM-1A-OC3SML-1V
Voice/WAN Interface Card Support	VVIC-1MFT-T1, VVIC-1MFT-E1, VVIC-2MFT-T1, VVIC-2MFT-E1, VVIC-2MFT-T1-DI, VVIC-2MFT-E1-DI, VVIC-1MFT-G703, and VVIC-2MFT-G703
Throughput	Up to 16Mbps of full duplex TDM capacity per Network Module

### Ordering Information

Part Number	Description
MIX-3660-64	MIX card for Cisco 3660 Series Routers



Corporate Headquarters  
Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
www.cisco.com  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 526-4100

European Headquarters  
Cisco Systems Europe  
11, Rue Camille Desmoulins  
92782 Issy-les-Moulineaux  
Cedex 9  
France  
www.cisco.com  
Tel: 33 1 58 04 60 00  
Fax: 33 1 58 04 61 00

Americas Headquarters  
Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
www.cisco.com  
Tel: 408 526-7660  
Fax: 408 527-0883

Asia Pacific Headquarters  
Cisco Systems Australia, Pty., Ltd  
Level 9, 80 Pacific Highway  
P.O. Box 469  
North Sydney  
NSW 2060 Australia  
www.cisco.com  
Tel: +61 2 8448 7100  
Fax: +61 2 9957 4350

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