Product Overview

This chapter provides an overview of the Cisco 6015 system. This chapter contains the following sections:

1.1 Introduction to the Cisco 6015 System

The Cisco 6015 system is part of the Cisco digital subscriber line (DSL) product family that provides end-to-end service by carrying data between a subscriber's home or office and a network, which can be managed by one of the following:

- Competitive local exchange carrier (CLEC)
- Incumbent local exchange carrier (ILEC)
- International post, telephone, and telegraph (PTT)

The Cisco 6015 system is also designed for use in multitenant/multiple dwelling units (MTU/MDUs) and can be deployed in either a commercial or an outside-plant environment, such as at a digital loop carrier (DLC) remote site.

Note Before you install a Cisco 6015 system in an outside-plant environment, verify that the remote terminal enclosure meets the following compliance requirements: GR-487, UL 50 Type 4X, EN60529 IP 55, and NEMA 4X.

Figure 1-1 details a high-level network architecture diagram of a Cisco 6015 installed in an outside-plant environment.

Figure 1-1   Network Architecture for a Cisco 6015 in an Outside-Plant Environment
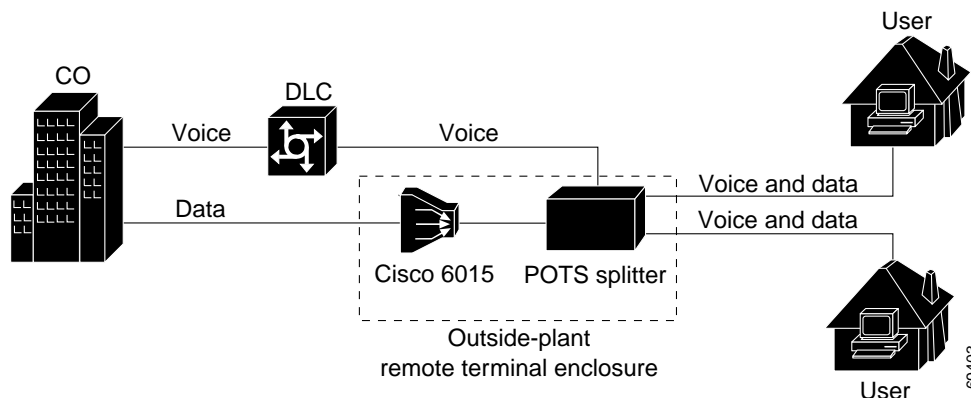
The Cisco 6015 system sends and receives subscriber data (often Internet service) over existing copper telephone lines and concentrates all traffic onto a single high-speed trunk for transport to the Internet or a corporate intranet. Asymmetric digital subscriber line (ADSL) or single-pair high-speed digital subscriber line, also known as symmetric high bit rate digital subscriber loop (SHDSL), customer premises equipment (CPE) devices, which are connected to PCs or routers at the subscriber site, modulate data so that it can travel over telephone lines to the Cisco 6015 system.

Note For detailed information on the various components in the Cisco DSL product family (including central office [CO] and CPE devices), see the "Related Documentation" section on page xix.

The Cisco 6015 system includes the following hardware and software components:

- Cisco 6015 chassis—Deployed with a standard network interface-version 2 (NI-2). The following components will be installed in the chassis:

  - Quad-port flexi ATU-C line cards (4xflexis), octal-port DMT ATU-C line cards (8xDMTs—both commercial and outside-plant versions), octal-port DMT ATU-C over ISDN line cards (8xDMT over ISDN), octal-port single-pair high-speed digital subscriber line, also known as symmetric high bit rate digital subscriber loop (G.SHDSL) line cards (8xG.SHDSLs)

Note The 4xflexi, 8xG.SHDSL, commercial environment 8xDMT, and the 8xDMT over ISDN can be used only in a commercial environment. They cannot be used in an outside-plant environment. For line card intermixing information, see the "Cisco 6015 Cards and Modules" section on page 1-11.

  - DS3+T1/E1 inverse multiplexing over ATM (IMA) NI-2 card, the industrial temperature (ITEMP) DS3+T1/E1 IMA NI-2 card, or the OC-3c/OC-3c NI-2 card

Note The OC-3c/OC-3c NI-2 card can only be used in a commercial environment. The ITEMP DS3+T1/E1 IMA NI-2 card is the only NI-2 card designed for use in an outside-plant environment.

- – Fan module

- – DS3+T1 Input/Output (I/O) module or E1 I/O module

- – DSL interface module

- – DC power entry module (PEM)

- AC/DC converter (optional if you need to convert AC power to usable DC power)

> **Note** The AC/DC converter can be used only in a commercial environment. It cannot be used in an outside-plant environment.

- Plain old telephone service (POTS) splitter (optional). The POTS splitter is a passive device that supports simultaneous voice (basic telephone service) and data services and is available from Cisco Ecosystem partners

> **Note** Third-party POTS splitters can be installed in a Cisco 6015 with a POTS splitter configuration. Please verify the compatibility with your Cisco representative.
>
> For POTS splitter information, refer to the vendor documentation.
>
> A system configuration using 8xDMTs or 8xDMT over ISDNs requires a POTS splitter that expands the system capacity to 48 subscriber ports. Depending on the POTS splitter selected for your configuration, the installation of an additional POTS splitter may be necessary.

- Management software—Provisions and manages the Cisco 6015 system.

  - – Cisco IOS—A command-line interface (CLI) that is available for network element provisioning.

  - – Cisco DSL Manager (CDM)—A graphical user interface (GUI) designed to configure and manage the 6xxx series of Cisco IOS software-based DSL access multiplexers (DSLAMs). CDM provides the following areas of network management—fault, configuration, performance, and security. CDM runs with the Cisco Element Manager Framework (EMF); both are installed on Sun workstations.

    Cisco EMF is based on an object model in which network elements or modules represent the managed entity. Each object is defined by a class and specific attributes. An object can represent a network element or a more abstract entity such as a link relationship, a network, or a container such as a site, shelf, or region.

> **Note** See the "Hardware Specifications" section on page A-1 for minimum software and network management release requirements per Cisco 6015 chassis component.

1.1.1 Features

The Cisco 6015 system includes the following features:

- Small footprint that terminates up to 48 subscribers per chassis

- Front-access, six-slot multiport line-card architecture

- North American and world-wide safety and compliance

- – Network Equipment Building System (NEBS)

- – American National Standards Institute (ANSI)

- – European Telecommunication Standards Institute (ETSI)

- – ATM carrier-class network element standards

- • Supports up to 24 ADSL ports with 4xflexis

- • Supports up to 48 ADSL ports with 8xDMTs or 8xDMT over ISDNs, or up to 48 SHDSL ports with 8xG.SHDSLs

- • Carrierless amplitude and phase modulation (CAP) rate-adaptive DSL (RADSL), ANSI T1.413 Discrete Multitone (DMT), trellis coded pulse amplitude modulation (TC-PAM), and G.lite modem support

- • Network transmission connections

  - – DS3

  - – T1/E1 IMA

  - – OC-3c

- • Manageable through IOS or CDM

- • Subtending—Up to 13 Cisco 6015 chassis can be linked together (subtended) so that they are served by a single network trunk port, which supports up to 624 subscribers (using octal-port *x*TU-C line cards)

> **Note** The Cisco 6015 can also serve as the subtending host chassis to, or a subtended node chassis from, the Cisco 6100, Cisco 6130, Cisco 6160, and Cisco 6260.

- • Supports the entire range of virtual channel identifier (VCI)/virtual path identifier (VPI) connections, and none of the connections are limited by memory.

- • Building integrated timing supply (BITS) clock input

- • Facility alarm input

- • Nonblocking ATM switching architecture

- • Up to three ATM classes of service simultaneously per queue

- • Commercial or outside plant deployment

- • Optional AC power supply, for use only in a commercial environment

1.1.2 Configurations

This guide details the installation steps for the following configurations:

- • Cisco 6015 with a POTS Splitter Configuration

- • Cisco 6015 Without a POTS Splitter Configuration

- • Subtended Network Configuration

- • IMA Configuration

1.1.2.1 Cisco 6015 with a POTS Splitter Configuration

The Cisco 6015 with a POTS splitter configuration supports up to 48 subscribers through directly connected modems using ADSL technology. To increase subscribership, you can add additional chassis to your system.

This configuration includes the following hardware components:

- Cisco 6015 chassis
  - 4xflexis (configure as CAP, DMT, or G.lite)—Use only in a commercial environment
  - 8xDMTs—Two versions: one for a commercial environment and one for an outside-plant environment
  - 8xDMT over ISDNs—Use only in a commercial environment
- AC/DC converter—Optional if you use AC power; use only in a commercial environment
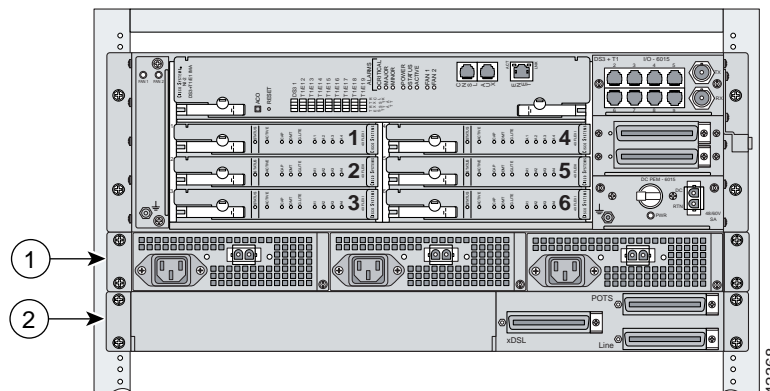- Third-party vendor POTS splitter
  - POTS cards

Note A system configuration using 8xDMTs or 8xDMT over ISDNs requires a POTS splitter that expands the system capacity to 48 subscriber ports. Depending on the POTS splitter selected for your configuration, the installation of an additional POTS splitter may be necessary.

The 8xDMT over ISDN is designed for use in a configuration with a POTS splitter only.

Figure 1-2 shows the components that can be used in a Cisco 6015 with a POTS splitter configuration.

Figure 1-2   Cisco 6015 with a POTS Splitter Configuration in North America

| 1 | AC/DC Converter | 2 | Third-party POTS splitter |

Note In North America, the DS3+T1 I/O module will be installed in the chassis. In world-wide environments, the E1 I/O module will be installed in the chassis.

1.1.2.2 Cisco 6015 Without a POTS Splitter Configuration

The Cisco 6015 without a POTS splitter configuration supports up to 48 subscribers through directly connected modems using ADSL or SHDSL technology. To increase subscribership, you can add additional chassis to your system.

This configuration includes the following hardware components:

- Cisco 6015 chassis

    - 4xflexis (configure as CAP, DMT, or G.lite)—Use only in a commercial environment

    - 8xDMTs—Two versions: one for a commercial environment and one for an outside-plant environment

    - 8xG.SHDSLs—Use only in a commercial environment

- AC/DC converter—Optional if you use AC power; use only in a commercial environment

In this configuration, the Cisco 6015 connects directly to the main distribution frame (MDF) in a commercial environment or the enclosure protection block in an outside-plant environment.

Figure 1-3 shows the components that can be used in a Cisco 6015 without a POTS splitter configuration.

Figure 1-3   Cisco 6015 Without a POTS Splitter Configuration
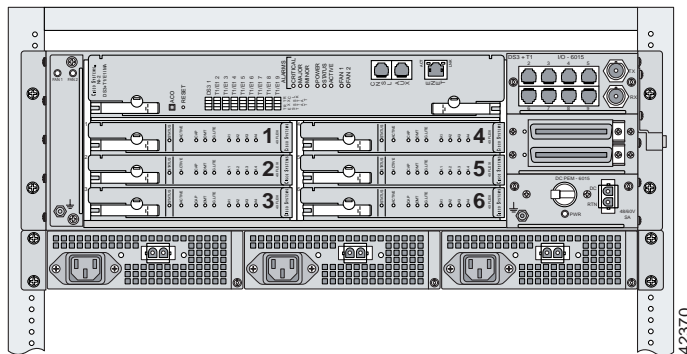
> **Note**   In North America, the DS3+T1 I/O module will be installed in the chassis. In world-wide environments, the E1 I/O module will be installed in the chassis.

1.1.2.3 Subtended Network Configuration

A subtended network configuration

- Services and aggregates the data from one or more Cisco 6015 chassis into a subtending host chassis to take advantage of the data network interface on the subtending host chassis.

> **Note**   The Cisco 6015 can also serve as the subtending host chassis to, or a subtended node chassis from, the Cisco 6100, Cisco 6130, Cisco 6160, and Cisco 6260.

- Provides additional benefits by reducing the number of ATM edge-switch ports that are required to terminate the chassis.
- Supports both a Cisco 6015 with a POTS splitter and a Cisco 6015 without a POTS splitter configuration.

The term *subtending* refers to the host chassis, and *subtended* refers to the downstream chassis in a subtended network.

The following subtended network configurations are supported:

- DS3 trunk with up to eight individual T1/E1 subtended interfaces or up to four IMA groups, or a combination of the two
- Daisy chain configuration for OC-3c subtended Cisco 6015 chassis.
- Eight T1 IMA trunked and subtended interfaces
    - T1 IMA group or T1 User-Network Interface (UNI) as the trunk
    - Up to seven individual T1 interfaces or up to four IMA groups, or a combination of the two

Note   The use of a T1 or IMA group trunk disables the DS3 interface.

- Eight E1 IMA trunked and subtended interfaces
    - E1 IMA group or E1 UNI as the trunk
    - Up to seven individual E1 interfaces or up to four IMA groups, or a combination of the two

The following sections detail the different types of subtending network connections.

1.1.2.3.1 Subtended Network Configuration with the DS3+T1/E1 IMA NI-2 Card and the ITEMP DS3+T1/E1 IMA NI-2 Card

In a subtended network configuration using a DS3+T1/E1 IMA NI-2 card or an ITEMP DS3+T1/E1 IMA NI-2 card, you can subtend up to 12 Cisco 6015 chassis through a daisy-chain configuration of IMA links, or a star configuration of IMA links. The subtending chassis connect through one subtending host chassis with a DS3 connection to the ATM backbone.

You can also make the host chassis ATM trunk connection through a T1 or IMA group, but that disables the DS3 interface. See the "IMA Configuration" section on page 1-8 for more information on using IMA group or individual links.

Note   The Cisco 6015 can also serve as the subtending host chassis to, or as a subtended node chassis from, the Cisco 6100, Cisco 6130, Cisco 6160, or Cisco 6260.

Figure 1-4 shows an example of a subtended network with a star topology. Subtended Network—Star Topology. The subtending host chassis in the middle of the star topology connects directly to the ATM switch. With a DS3 trunk, you can have up to eight subtended node chassis connected to the subtending host chassis.

Figure 1-4   Star Topology for Cisco 6015 Subtended Network


✎
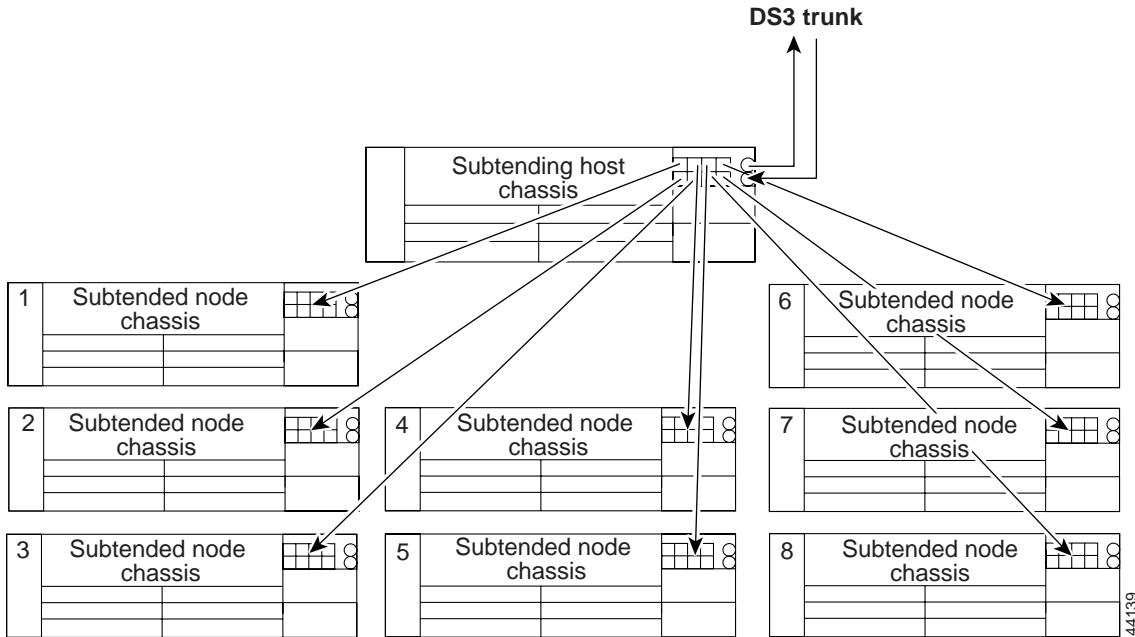
Note   Consult with your network architect or Cisco customer service representative for examples of other subtending topology configurations using the DS3+T1/E1 IMA NI-2 card and the ITEMP DS3+T1/E1 IMA NI-2 card.

1.1.2.3.2 IMA Configuration

The DS3+T1/E1 IMA NI-2 card uses IMA technology to aggregate multiple low-speed links into one larger virtual trunk or IMA group. An inverse multiplexer appears to your ATM switch router as one logical pipe. IMA provides you with modular bandwidth to access the ATM network between T1 or E1 and DS3 or E3 rates. The Cisco 6015 allows you to combine up to a maximum of eight T1 or E1 lines to form an IMA group.

IMA breaks up the ATM cell stream, distributes the cells over the multiple physical links of an IMA group, then recombines the cells into a single stream at the other end of the connection. The ATM cells are distributed in a round-robin fashion over the physical links of the IMA group, recombined at the receiving IMA group, and passed in their original form to the ATM layer (see Figure 1-5). Using the multiple links of an IMA group increases the logical link bandwidth to approximately the sum of the individual link rates. The physical links should be nominally the same length to avoid excessive intra-group delay. Cisco recommends that all of the links in an IMA group be bundled together between the source and the destination.

Figure 1-5   Inverse Multiplexing and Recombining of ATM Cells Through IMA Groups
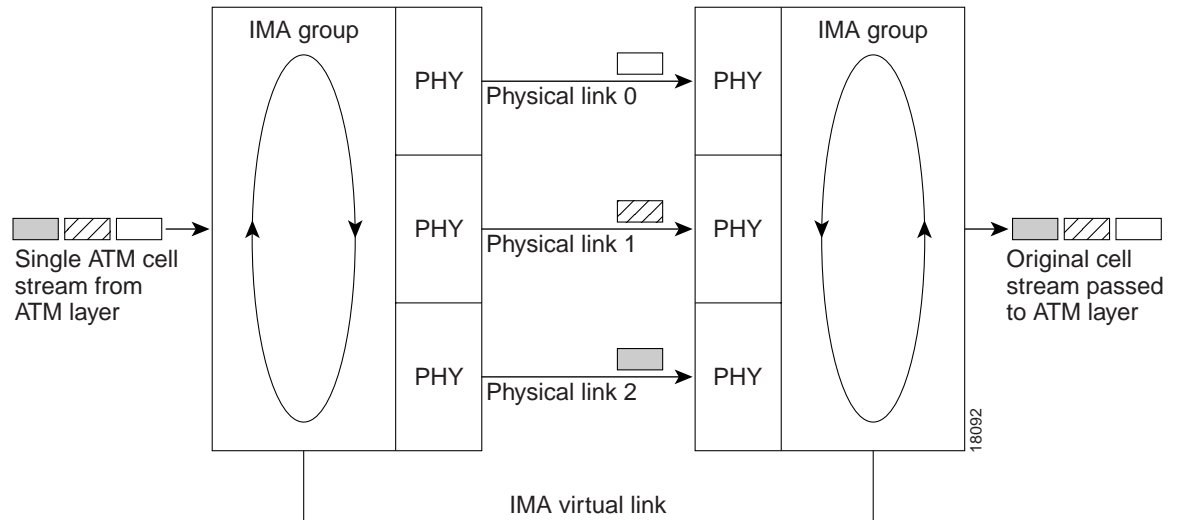
The T1 and E1 IMA I/O modules have eight ports. You can use the eight ports on the T1 and E1 IMA I/O modules as independent ATM links or in the IMA mode. The following bullets are examples of possible IMA groups, independent ATM links, and mixed modes. Examples of IMA groups assume two links per group.

- Four IMA groups with any combination of eight links
- Three IMA groups and up to two independent ATM links
- Two IMA groups and up to four independent ATM links
- One IMA group and up to six independent ATM links
- No IMA group and up to eight independent ATM links

The T1 (1.544 Mbps) and E1 (2.048 Mbps) IMA port adapters provide trunk or subtend connectivity and are used for intercampus or wide-area links. The T1 and E1 IMA port adapters support unshielded twisted-pair (UTP) connectors. The order of assignment of links to an IMA group is not restricted.

The IMA group interfaces use a modified naming convention from the other interfaces in the system. These interfaces are named with the convention *atm<slot>/ima<group>*, where *<slot>* is the slot number for the DS3+T1/E1 IMA NI-2 card and *<group>* is the IMA group number from 0 to 3. Table 1-1 lists the interface naming conventions.

Table 1-1   Interface Naming Conventions

| Interface	Name
DS3 link	atm0/1
T1/E1 link 0	atm0/2
T1/E1 link 1	atm0/3
T1/E1 link 2	atm0/4
T1/E1 link 3	atm0/5
T1/E1 link 4	atm0/6
T1/E1 link 5	atm0/7
T1/E1 link 6	atm0/8

Table 1-1   Interface Naming Conventions (continued)

Interface	Name
T1/E1 link 7	atm0/9
IMA group 0	atm0/ima0
IMA group 1	atm0/ima1
IMA group 2	atm0/ima2
IMA group 3	atm0/ima3

1.1.2.3.3 Subtended Network Configuration with OC-3c/OC-3c NI-2 Cards

In a subtended network configuration using OC-3c/OC-3c NI-2 cards (SMF or MMF), you can subtend up to 12 OC-3c configured chassis in a daisy chain, all connecting through one subtending host chassis to the ATM backbone (see Figure 1-6).

Note   The Cisco 6015 can also serve as the subtending host chassis to, or as a subtended node chassis from, the Cisco 6100, Cisco 6130, Cisco 6160, or Cisco 6260.

Figure 1-6   Daisy Chain Topology for OC-3c Interfaces
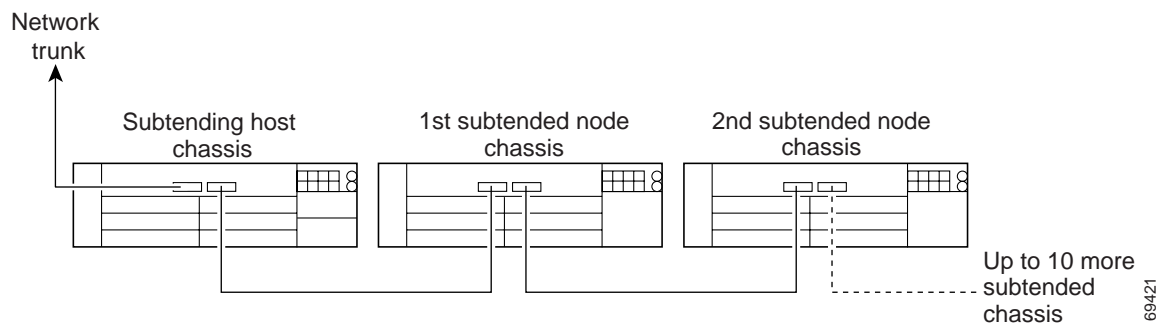
1.2 Cisco 6015 Chassis Overview

The Cisco 6015 chassis uses a front-access, six-slot multiport line-card architecture capable of supporting up to 48 *x*DSL ports that are connected either directly or through a POTS splitter.

Note   For hardware specifications for the Cisco 6015, see the "Cisco 6015 System Specifications" section on page A-2.

The chassis supports the following hardware components:

- Up to six 4xflexi, 8xDMT, 8xG.SHDSL, or 8xDMT over ISDNs
- DS3+T1/E1 IMA NI-2 card, ITEMP DS3+T1/E1 IMA NI-2 card, or OC-3c/OC-3c NI-2 card
- DS3+T1 or E1 I/O module
- DSL interface module
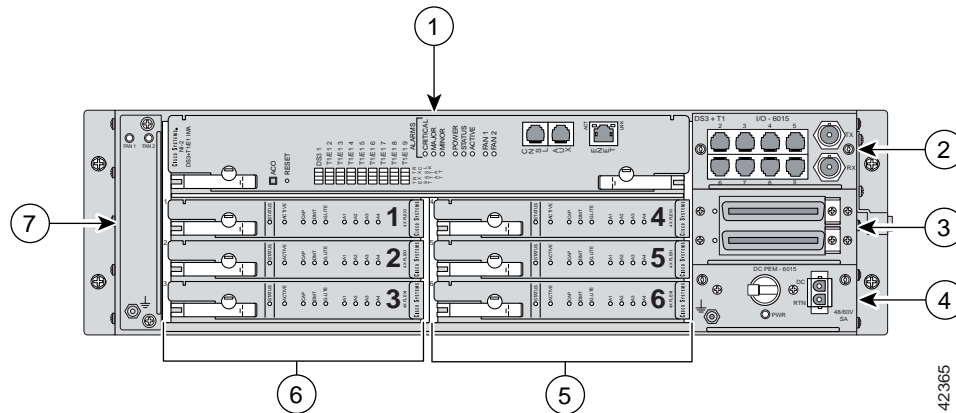
- DC PEM

- Fan module

Note   You can purchase blank faceplates for empty Cisco 6015 module slots.

The 8xDMT over ISDN can be used only in a Cisco 6015 system with a POTS splitter configuration.

Figure 1-7 identifies the Cisco 6015 card and module slots. Each line card slot on a chassis is numbered along the left edge of the card slot (slots 1 through 6). In the guide illustrations, the slot numbers are shown on the cards for easy reference and readability. These slots are referred to in subsequent sections of this chapter and elsewhere in this guide.

Figure 1-7   Cisco 6015 Card and Module Slots

1	NI-2 card	5	Line card slots 4 to 6
2	I/O module	6	Line card slots 1 to 3
3	DSL interface module	7	Fan module
4	DC PEM		

The following sections detail these Cisco 6015 hardware components:

- Cisco 6015 Cards and Modules, page 1-11
- Rear Interface Header, page 1-36
- AC/DC Converter, page 1-37

1.2.1 Cisco 6015 Cards and Modules

This section contains the following information about Cisco 6015 cards and modules:

- 4xflexi Overview, page 1-12
- 8xDMT Overview, page 1-14
- 8xDMT Over ISDN Overview, page 1-17

The Cisco 6015 chassis supports line card intermixing. However, mixing cards with different types of encoding (ADSL or SHDSL) on the same side of the chassis could result in decreased performance of the loop due to overlapping frequency spectrums. To minimize potential performance degradation in the binder, install ADSL and SHDSL line cards in separate halves of the chassis. For example, if you install 4xflexis on the left side of the chassis (slots 1 to 3), install 8xSHDSLs on the right side of the chassis (slots 4 to 6).

1.2.1.1 4xflexi Overview

The 4xflexi

- Supports CAP, DMT, or G.lite line encoding.
- Supports four ADSL modem connections.
- Converts ADSL modulation from the line into digital data streams to and from the NI-2 card.
- Negotiates the line rate with the CPE when it trains and bases the rate on line quality and distance.

Note   The 4xflexi cannot be used in an outside-plant environment.

For line card intermixing information, see the "Cisco 6015 Cards and Modules" section on page 1-11.

If provisioned, the 4xflexi rate adapts to the maximum bit rate negotiable on the line. The maximum bit rate settings are provisioned in the management software.

**Note**   For hardware specifications for the 4xflexi, see the "4xflexi Specifications" section on page A-3.

The Cisco 6015 chassis can include up to six 4xflexis for a total of 24 ADSL modem connections.

The edge connector key, located on the rear of the 4xflexi, connects the 4xflexi to the backplane of the chassis. You can install only the edge connector key with seven notches in the Cisco 6015.

Figure 1-8 shows a close-up of the 4xflexi faceplate.

Figure 1-8   4xflexi Faceplate
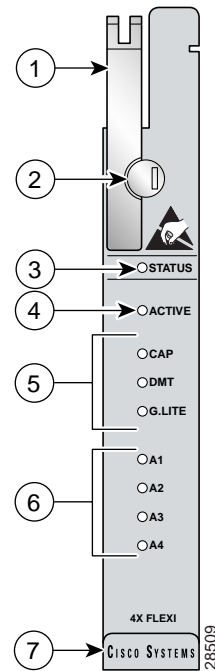
1	Ejector lever	5	Line card mode LED
2	Locking tab	6	Modem port status LEDs
3	STATUS LED	7	Extraction tab
4	ACTIVE LED		

Table 1-2 describes the 4xflexi LED indicator functions.

Table 1-2   4xflexi LED Functions

LED	State	Function
STATUS	Green slow blinking	The self-test is in progress.
	Green fast blinking	The image download is in progress.
	Green solid	The status is OK.
	Red	The self-test or line card has failed.
	Off	The ATU-C line card has a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
CAP	Green solid	The line card is in CAP mode.
	Off	The line card is not in CAP mode.

Table 1-2   4xflexi LED Functions (continued)

LED	State	Function
DMT	Green solid	The line card is in DMT mode.
	Off	The line card is not in DMT mode.
G.LITE	Green solid	The line card is in G.lite mode.
	Off	The line card is not in G.lite mode.
A1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.
A2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
A3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
A4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.

1.2.1.2 8xDMT Overview

The 8xDMT can be installed in the following environments:

- Commercial—Use 8xDMT product number ATUC-8-DMT-1
- Outside plant—Use 8xDMT product number ATUC-8-DMT-1-H

The 8xDMT

- Supports eight ADSL modem connections.
- Converts ADSL modulation from the line into digital data streams to and from the NI-2 card.
- Negotiates the line rate with the CPE when it trains and bases the rate on line quality and distance.

If provisioned, the 8xDMT rate adapts to the maximum bit rate negotiable on the line. The maximum bit rate settings are provisioned in the management software.

> **Note** For hardware specifications for the 8xDMT, see the "8xDMT Specifications" section on page A-4.
>
> For line card intermixing information, see the "Cisco 6015 Cards and Modules" section on page 1-11.

The Cisco 6015 chassis can include up to six 8xDMTs for a total of 48 ADSL modem connections.

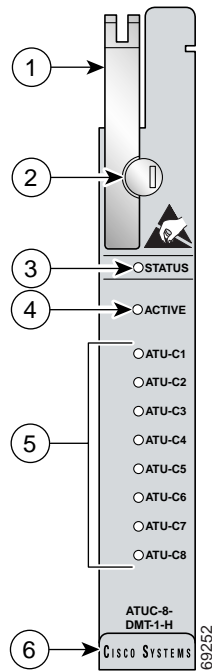Figure 1-9 shows a close-up of the 8xDMT commercial environment faceplate.

Figure 1-9   Commercial Environment 8xDMT Faceplate
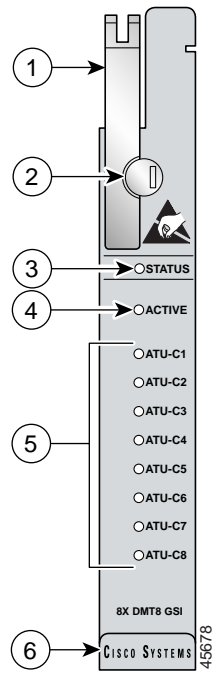
1	Ejector lever	4	ACTIVE LED
2	Locking tab	5	Modem port status LEDs
3	STATUS LED	6	Extraction tab

Figure 1-10 shows a close-up of the 8xDMT outside-plant environment faceplate.

Figure 1-10   Outside-Plant Environment 8xDMT Faceplate

1	Ejector lever	4	ACTIVE LED
2	Locking tab	5	Modem port status LEDs
3	STATUS LED	6	Extraction tab

Table 1-3 describes LED functions on both the commercial and the outside-plant versions of the 8xDMT.

Table 1-3   8xDMT LED Functions

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The ATU-C line card has had a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
ATU-C 1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 1 is idle.

Table 1-3   8xDMT LED Functions (continued)

LED	State	Function
ATU-C 2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
ATU-C 3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
ATU-C 4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
ATU-C 5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
ATU-C 6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
ATU-C 7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
ATU-C 8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.1.3 8xDMT Over ISDN Overview

The 8xDMT over ISDN

- Supports eight ADSL modem connections.

- Converts ADSL modulation from the line into digital data streams to and from the NI-2 card.

- Negotiates the line rate with the CPE when it trains and bases the rate on line quality and distance.

- The 8xDMT over ISDN can be used only in a Cisco 6015 system with a POTS splitter configuration.

Note   The 8xDMT over ISDN cannot be used in an outside plant environment.

For hardware specifications for the 8xDMT over ISDN, see the "8xDMT Over ISDN Specifications" section on page A-5.

Figure 1-11 shows a close-up of the 8xDMT over faceplate.

Figure 1-11   8xDMT Over ISDN Faceplate
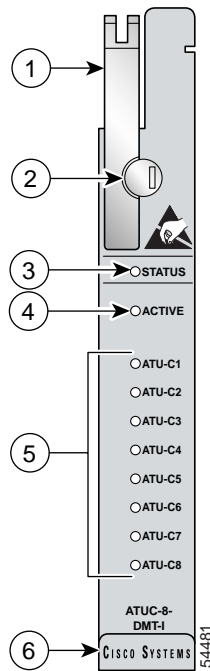
1	Ejector lever	4	ACTIVE LED
2	Locking tab	5	Modem port status LEDs
3	STATUS LED	6	Extraction tab

Table 1-4 describes the 8xDMT over ISDN LED indicator functions.

Table 1-4   8xDMT Over ISDN LED Functions

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The ATU-C line card has had a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.
ATU-C 1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.

Table 1-4   8xDMT Over ISDN LED Functions (continued)

LED	State	Function
ATU-C 2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
ATU-C 3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
ATU-C 4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
ATU-C 5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
ATU-C 6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
ATU-C 7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
ATU-C 8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.1.4 8xG.SHDSL Overview

The 8xG.SHDSL

- Is designed for use in a Cisco 6015 without a POTS splitter configuration.
- Supports eight G.SHDSL modem connections.
- Supports trellis coded pulse amplitude modulation (TC-PAM) line encoding.
- Converts G.SHDSL modulation from the line into digital data streams to and from the NI-2 card.
- Supports fixed and adaptive rate modes.

Note The 8xG.SHDSL cannot be used in an outside-plant environment.

For line card intermixing information, see the "Cisco 6015 Cards and Modules" section on page 1-11. For hardware specifications for the 8xG.SHDSL, see the "8xG.SHDSL Specifications" section on page A-6.

The Cisco 6015 chassis can include up to six 8xG.SHDSLs for a total of 48 SHDSL modem connections.

Note   The 8xG.SHDSL line card supports multiple line rates ranging from 72 kbps to 2312 kbps in fixed mode. In rate adaptive mode, the 8xG.SHDSL line card supports rates ranging from 2312 kbps to 200 kbps in 64 kbps decrements. In rate adaptive mode, line rate is negotiated and then locked when the line trains.

Figure 1-12 shows a close-up of the 8xG.SHDSL faceplate.

Figure 1-12   8xG.SHDSL Faceplate
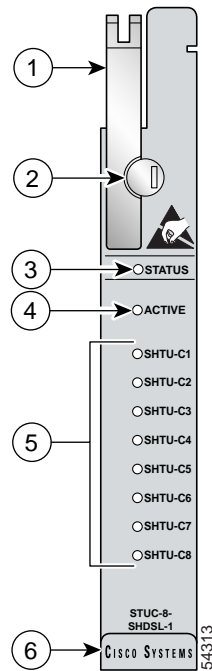
1	Ejector lever	4	ACTIVE LED
2	Locking tab	5	Modem port status LEDs
3	STATUS LED	6	Extraction tab

Table 1-5 describes the 8xG.SHDSL LED indicator functions.

Table 1-5   8xG.SHDSL LED Functions

LED	State	Function
STATUS	Green slow blinking	No errors, but no connection established.
	Green fast blinking	The image download is in progress.
	Green solid	NI-2 communication established.
	Red	The self-test or line card has failed.
	Off	The line card has had a power failure.
ACTIVE	Green solid	The line card is activated.
	Off	The line card is not in service.

Table 1-5   8xG.SHDSL LED Functions (continued)

LED	State	Function
SHTU-C1	Green solid	Modem 1 is trained.
	Green blinking	Training is in progress for modem 1.
	Off	Modem 1 is idle.
SHTU-C2	Green solid	Modem 2 is trained.
	Green blinking	Training is in progress for modem 2.
	Off	Modem 2 is idle.
SHTU-C3	Green solid	Modem 3 is trained.
	Green blinking	Training is in progress for modem 3.
	Off	Modem 3 is idle.
SHTU-C4	Green solid	Modem 4 is trained.
	Green blinking	Training is in progress for modem 4.
	Off	Modem 4 is idle.
SHTU-C5	Green solid	Modem 5 is trained.
	Green blinking	Training is in progress for modem 5.
	Off	Modem 5 is idle.
SHTU-C6	Green solid	Modem 6 is trained.
	Green blinking	Training is in progress for modem 6.
	Off	Modem 6 is idle.
SHTU-C7	Green solid	Modem 7 is trained.
	Green blinking	Training is in progress for modem 7.
	Off	Modem 7 is idle.
SHTU-C8	Green solid	Modem 8 is trained.
	Green blinking	Training is in progress for modem 8.
	Off	Modem 8 is idle.

1.2.1.5 DS3+T1/E1 IMA NI-2 Card Overview

The DS3+T1/E1 IMA NI-2 card can be installed in the following environments:

- Commercial—Use the DS3+T1/E1 IMA NI-2 card (part number NI-2-DS3-T1E1)

- Outside plant—Use the ITEMP DS3+T1/E1 IMA NI-2 card (part number NI-2-DS3-T1E1-H)

The DS3+T1/E1 IMA NI-2 card provides a high-speed connection for aggregated data traffic from the *x*TU-C line cards. The NI-2 card performs central processor, host, and system controller functions. The NI-2 card runs and is controlled by Cisco IOS software.

The DS3+T1/E1 IMA NI-2 card performs the following system tasks:

- Contains the ATM switch fabric

- Controls timing through an internal clock or BITS interface, or from an ATM interface (DS3, T1, or E1)

> **Note** The BITS interface is connected through a header that is located on the back of the chassis.

- Provides CO facility alarm input
- Provides operating status visual indications
- Performs subtending and other control functions

The ITEMP DS3+T1/E1 IMA NI-2 card motherboard and IOS daughter card are populated with industrial temperature components so that the NI-2 card can operate in an outside-plant environment.

The NI-2 card operation mode (DS3/T1 or E1) is determined by the type of I/O module, DS3+T1 or E1, installed in the Cisco 6015 chassis. For more information on the I/O modules, see the "I/O Module Overview" section on page 1-29.

> **Note** For hardware specifications for the DS3+T1/E1 IMA NI-2 card, see the "DS3+T1/E1 IMA and ITEMP DS3+T1/E1 IMA NI-2 Cards Specifications" section on page A-7.
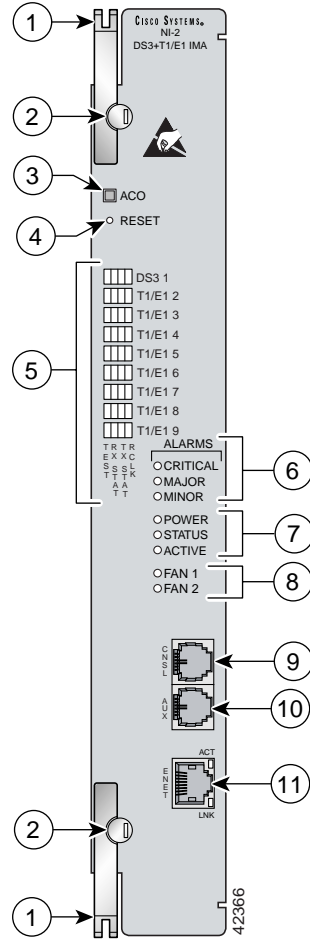
Figure 1-13 shows a close-up of the DS3+T1/E1 IMA NI-2 card faceplate.

✎
Note   The only cosmetic difference between the DS3+T1/E1 IMA NI-2 card and the ITEMP DS3+T1/E1 IMA NI-2 card is the word "ITEMP" silkscreened on the card faceplate.

Figure 1-13   DS3+T1/E1 IMA NI-2 Card Faceplate

1	Ejector lever	**7**	Card status LED group
2	Locking tab	**8**	Fan alarm LED group
3	ACO[1] button	**9**	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.

4	Maintenance RESET port	10	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
5	Interface status LED groups: DS3 1, T1/E1 2, T1/E1 3, T1/E1 4, T1/E1 5, T1/E1 6, T1/E1 7, T1/E1 8, and T1/E1 9. These groups show the status of the trunk and subtend connections on the I/O module or I/O card	11	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.
6	System alarm LED group		

1. ACO = alarm cutoff

Table 1-6 describes the LED group indicators and their functions.

Table 1-6   DS3+T1/E1 IMA NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** in Figure 1-13)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX[1] STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX[2] STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK[3]	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**6** in Figure 1-13)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**7** in Figure 1-13)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	When lit, this LED indicates that the NI-2 card is operating as the active network interface in the chassis.

Table 1-6   DS3+T1/E1 IMA NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
Fan alarm (**8** in Figure 1-13)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	Red	The fan module or fan tray is not operational and is in alarm mode. **Note** Because there is only one fan module in the Cisco 6015, this LED is not operational.
ENET interface LED (**11** in Figure 1-13)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1. RX = receive

2. TX = transmit

3. RCLK = receive clock

1.2.1.6 OC-3c/OC-3c NI-2 Card Overview

The OC-3c/OC-3c NI-2 card

- Connects to the *x*TU-C line cards through point-to-point serial data buses on the backplane

- Performs central processor, host, and system controller functions

- Contains the ATM switch fabric

- Supports the aggregation of up to 12 subtended node chassis configured for OC-3c operation in a daisy chain configuration.

- Provides an OC-3c subtend interface through optical connectors located on the NI-2 card faceplate.

- Controls timing and redundancy

Note   The BITS interface is connected through a header located on the back of the Cisco 6015 chassis.

The OC-3c/OC-3c NI-2 card can only be used in a commercial environment.

- Provides CO facility alarm relay contact interfaces and an ACO button

- Provides operating status visual and audible indications

- Performs subtending and other control functions

- Provides the network OC-3c WAN trunk interface through connectors located on the NI-2 card faceplate. The following two versions of the OC-3c/OC-3c NI-2 card are available to support the WAN trunk interface:

  - SMF intermediate range.

  - MMF short range.

Note   The OC-3c/OC-3c NI-2 card cannot be used in an outside-plant environment.

Use of the OC-3c/OC-3c NI-2 card in the Cisco 6015 disables whichever I/O module is installed in the chassis. Therefore, neither I/O module will affect the OC-3c/OC-3c NI-2 card operation in the Cisco 6015.

For hardware specifications for the OC-3c/OC-3c NI-2 card, see the "OC-3c/OC-3c NI-2 Card Specifications" section on page A-8.

The OC-3c/OC-3c NI-2 card functions are managed by Cisco IOS software. The IOS software operates and integrates controller, network trunk, and subtending functionality from this single NI-2 card.

The SMF and MMF OC-3c/OC-3c NI-2 cards operate in conjunction with network interfaces that are supplied by optical interface connectors on the OC-3c/OC-3c NI-2 card faceplate. The OC-3c/OC-3c NI-2 card faceplates have two optical connector pairs:

- The top optical connector pair receives OC-3c ATM network transmit and receive trunk optical cables or OC-3c transmit and receive optical cables from the NI-2 card of a subtending host chassis.

- The bottom optical connector pair accommodates receive and transmit optical cables from the NI-2 card of a subtended node chassis that is configured for operation in an OC-3c network.

Both the SMF and MMF OC-3c/OC-3c NI-2 cards support the aggregation of up to 12 additional subtended Cisco 6015 chassis in a daisy chain configuration.

Figure 1-14 shows a close-up of the OC-3c/OC-3c NI-2 card faceplate.

Figure 1-14   OC-3c/OC-3c NI-2 Card Faceplate
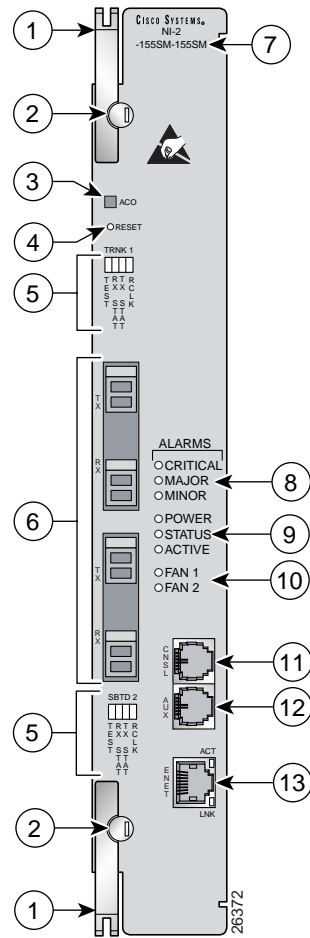
1	Ejector lever	8	System alarm LED group
2	Locking tab	9	Card status LED group
3	ACO button	10	Fan alarm LED group
4	Maintenance RESET port	11	CNSL—An RJ-45 receptacle that provides a serial connection to a system console.

5	Interface status LED groups: TRNK 1 and SBTD 2, which show the status of the network trunk and subtend connections.	12	AUX—An RJ-45 receptacle that provides connection to an auxiliary device (such as a modem) used to remotely configure the system.
6	Two optical interface connector pairs: TRNK 1 and SBTD 2 • TRNK 1—for network trunk interface TX and RX data optical cables. On a subtended node chassis, these TX and RX cables connect to SBTD 2 on the subtending host chassis. • SBTD 2—for subtended node chassis TX and RX data optical cables.	13	ENET—An RJ-45 10BaseT receptacle that complies with Ethernet standards and that provides connection to a system Ethernet.
7	Model number		

Table 1-7 describes the LED group indicators and their functions.

Table 1-7   OC-3c/OC-3c NI-2 Card LED Group Indicators

LED Group	LED	State	Function
Interface status LED (**5** in Figure 1-14)	TEST	Amber solid	Cisco IOS detects that an obtrusive test (loopback) is active on this interface.
		Off	Cisco IOS does not detect obtrusive test activity.
	RX STAT	Amber solid	The receiver detects a physical layer problem.
		Off	The receiver does not detect a physical layer problem.
	TX STAT	Amber solid	The transmitter detects a physical layer problem.
		Off	The transmitter does not detect a physical layer problem.
	RCLK	Green solid	Hardware detects an incoming clock signal.
		Off	Hardware does not detect an incoming clock signal.
System alarm (**7** in Figure 1-14)	CRITICAL	Red	A critical alarm is active.
	MAJOR	Red	A major alarm is active.
	MINOR	Amber	A minor alarm is active.
Card status (**8** in Figure 1-14)	POWER	Green	The NI-2 card has power.
	STATUS	Green	The operational status of the NI-2 card. • On—There are no internal faults or problems. • Off—The NI-2 card has not booted properly, or a problem is preventing normal operation.
	ACTIVE	Green	When lit, this LED indicates that the NI-2 card is operating as the active network interface in the chassis.

Table 1-7   OC-3c/OC-3c NI-2 Card LED Group Indicators (continued)

LED Group	LED	State	Function
Fan alarm (**9** in Figure 1-14)	FAN 1	Red	The fan module or fan tray is not operational and is in alarm mode.
	FAN 2	Red	The fan module or fan tray is not operational and is in alarm mode. **Note** Because there is only one fan module in the Cisco 6015, this LED is not operational.
ENET interface LED (**12** in Figure 1-14)	ACT	Green solid or blinking	The Ethernet interface is active.
		Off	The Ethernet interface is inactive.
	LNK	Green solid	The Ethernet link is connected and enabled.

1.2.1.7 I/O Module Overview

The I/O module performs the following system tasks:

- Provides the network WAN trunk physical interface
- Provides the subtending physical interfaces to subtended node chassis

Figure 1-15 shows the location of the I/O module in the Cisco 6015 chassis.

Figure 1-15   I/O Module Location in the Cisco 6015 Chassis
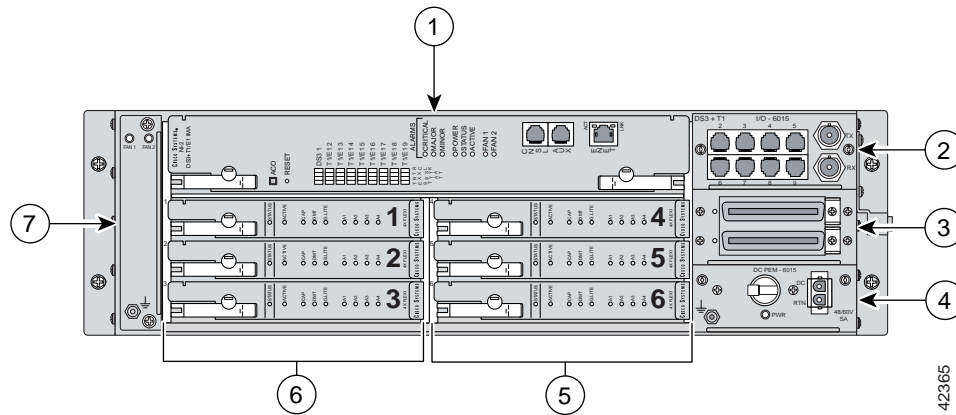
1	NI-2 card	5	xDSL line cards (slots 4 to 6)
2	I/O[1] module	6	xDSL line cards (slots 1 to 3)
3	DSL[2] interface module	7	Fan module
4	DC PEM[3]		

1. I/O = input/output

2. DSL = digital subscriber line

3. PEM = power entry module

Currently, there are two versions of the I/O module:

- DS3+T1
- E1

Note   Use of the OC-3c/OC-3c NI-2 card in the Cisco 6015 disables whichever I/O module is installed in the chassis. However, an I/O module must be installed in the chassis for the system to operate correctly. The OC-3c/OC-3c NI-2 card does not support the DS3, E1, or T1 interfaces found on the front of the I/O modules. Therefore, the trunk and subtending interfaces are provided on the front of the OC-3c/OC-3c NI-2 card.
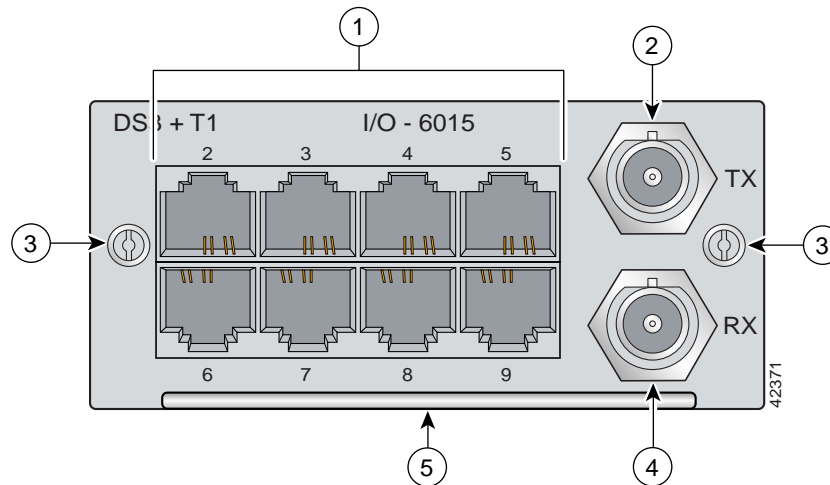
For hardware specifications for the I/O module, see the "I/O Module Specifications" section on page A-9.

The two versions of the I/O module are detailed in the following sections.

1.2.1.7.1 DS3+T1 I/O module

The DS3+T1 I/O module is used in North America. Figure 1-16 shows a close-up of the DS3+T1 I/O module faceplate.

Figure 1-16   DS3+T1 I/O module Faceplate

1	Eight RJ-48[1] receptacle connectors for eight T1 trunk or subtending interfaces	4	RX[2] BNC connector for the DS3 trunk interface
2	TX[3] BNC connector for the DS3 trunk interface	5	Extraction handle
3	Screws to secure the I/O module in the chassis		

1. An RJ-48 is a receptacle for an RJ-45 connection.
2. RX = receive.
3. TX = transmit.

1.2.1.7.2 E1 I/O module

The E1 I/O module is used world wide, except for North America. Figure 1-17 shows a close-up of the E1 I/O module faceplate.

Figure 1-17   E1 I/O module Faceplate
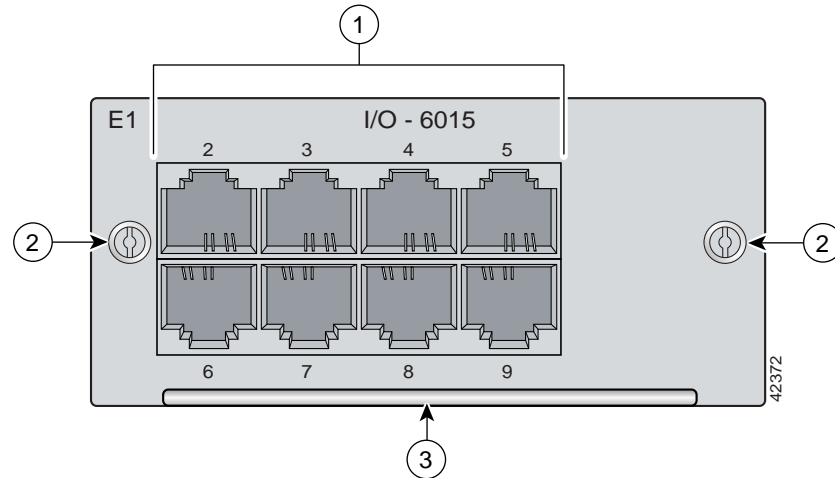
1	Eight RJ-48[1] receptacle connectors for eight E1 trunk or subtending interfaces	**3**	Extraction handle
2	Screws to secure the I/O module in the chassis		

1. An RJ-48 is a receptacle for an RJ-45 connection.

1.2.1.8 DSL Interface Module Overview

The DSL interface module enables you to

- Connect the Cisco 6015 to a POTS splitter in a Cisco 6015 with a POTS splitter configuration.
- Connect the Cisco 6015 to the MDF or enclosure protection block in a Cisco 6015 without a POTS splitter configuration.
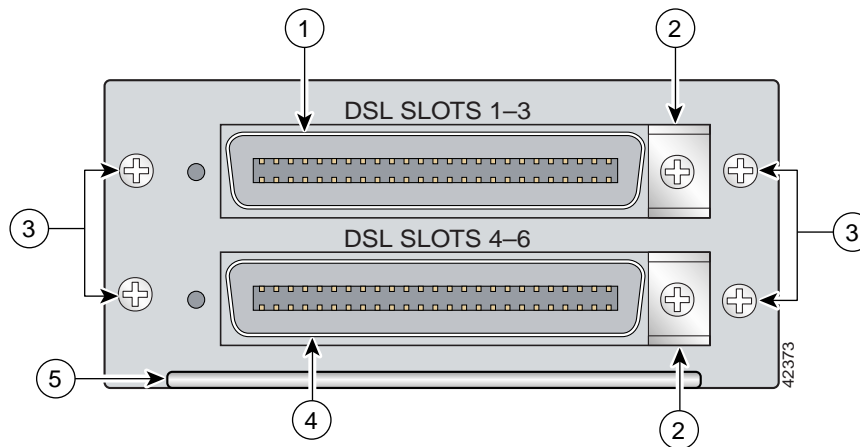
Note   For hardware specifications for the DSL interface module, see the "DSL Interface Module Specifications" section on page A-10.

Figure 1-18 shows a close-up of the DSL interface module faceplate.

Figure 1-18   DSL Interface Module Faceplate

1	50-pin Champ connector for DSL slots 1 through 3	**4**	50-pin Champ connector for DSL slots 4 through 6
2	Cable tie-downs	**5**	Extraction handle
3	Screws to secure the DSL interface module to the chassis		

The Cisco 6015 chassis follows the FCC part 68 industry standard convention for Tip and Ring connections on the twisted pairs of the 50-pin Champ connector. The Champ connectors are pinned out to accommodate quad-port or octal-port *x*TU-C line cards. If you are not currently using octal-port *x*TU-C line cards but plan to in the future, Cisco recommends that you use Champ cables that can accommodate higher density line cards.

Note   See Table 2-6, "Tool and Equipment Requirements Checklist" for information on the types of cables needed.

See Appendix B, "Cable and Port Mapping Specifications" for port mapping tables.

1.2.1.9 DC PEM Overview

Each Cisco 6015 is equipped with a –48/–60V DC PEM, which distributes DC power within the chassis. Each DC PEM can be connected in one of the following ways:

- To the fuse and alarm panel for DC power.
- To the AC/DC converter, which is mounted below the Cisco 6015 chassis. The AC/DC converter converts AC power to usable DC power for the Cisco 6015.

Note   The AC/DC converter can be used only in a commercial environment. It cannot be used in an outside-plant environment.
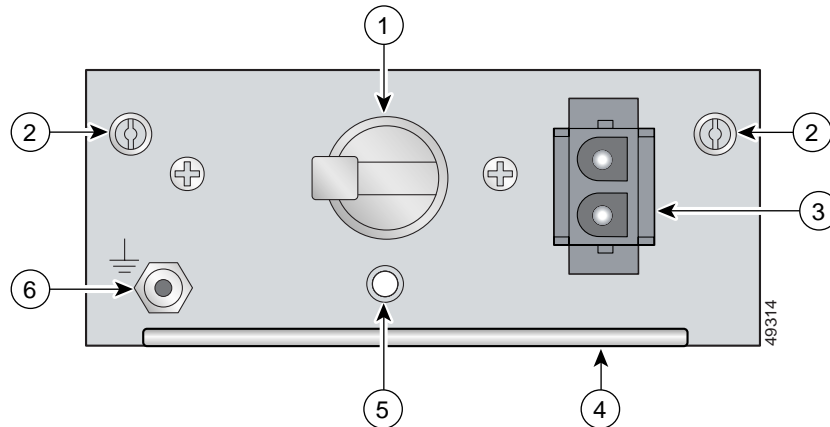
> **Note**   For hardware specifications for the DC PEM, see the "DC PEM Specifications" section on page A-10.

Figure 1-19 shows a close-up of the DC PEM faceplate.

Figure 1-19   DC PEM Faceplate

1	Two-position circuit breaker. The positions are Off (0) and On (1).	4	Extraction handle.
2	Screws to secure the DC PEM to the chassis.	5	LED showing the status of the DC PEM. • Green—Output is correct. • Off—DC PEM is not operational or input is not correct.
3	Two-pin connector to cable to the facility DC power or the AC/DC converter.	6	ESD grounding jack.

1.2.1.10 Fan Module Overview

The fan module houses two fans that provide system cooling. The Cisco 6015 requires that a fan module be installed when the system is in operation. Figure 1-20 shows the fan module.

Figure 1-20   Fan Module for the Cisco 6015
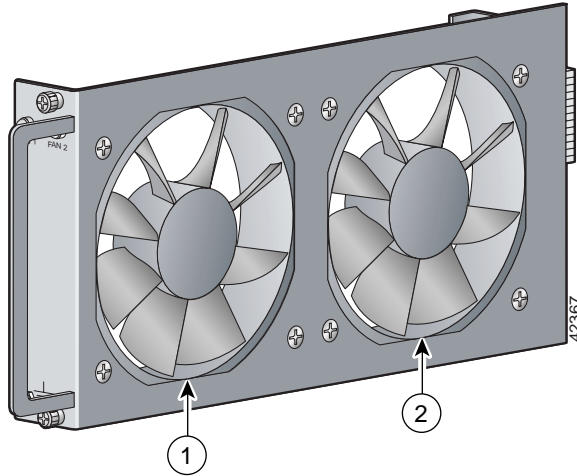
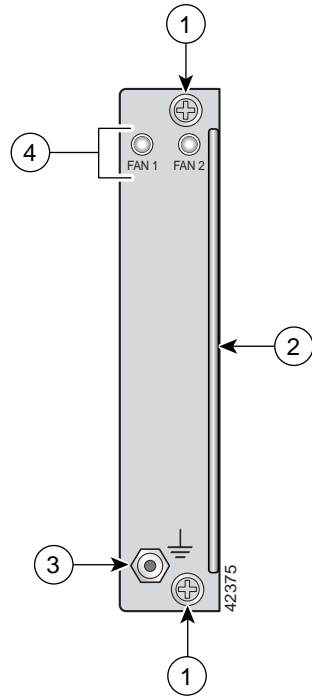| 1	Fan 2	2	Fan 1

Note   The fan module is installed in the chassis when it is shipped. If the fan module fails, replace it immediately.

Note   For hardware specifications for the fan module, see the "Fan Module Specifications" section on page A-11.

Figure 1-21 shows a close-up of the fan module faceplate.

Figure 1-21   Fan Module Faceplate

1	Screws to secure the fan module to the chassis.	3	ESD grounding jack.
2	Extraction handle.	4	Fan LEDs. The LED on the left is for the fan that is located closest to the back of the chassis (Fan 1). The LED on the right is for the fan that is located closest to the front of the chassis (Fan 2).

The fan module pulls air from the right of the chassis, through the modules, and out the left of the chassis, as shown in Figure 1-22.

*Figure 1-22   Air Flow Through Intake and Exhaust Vents on the Chassis*
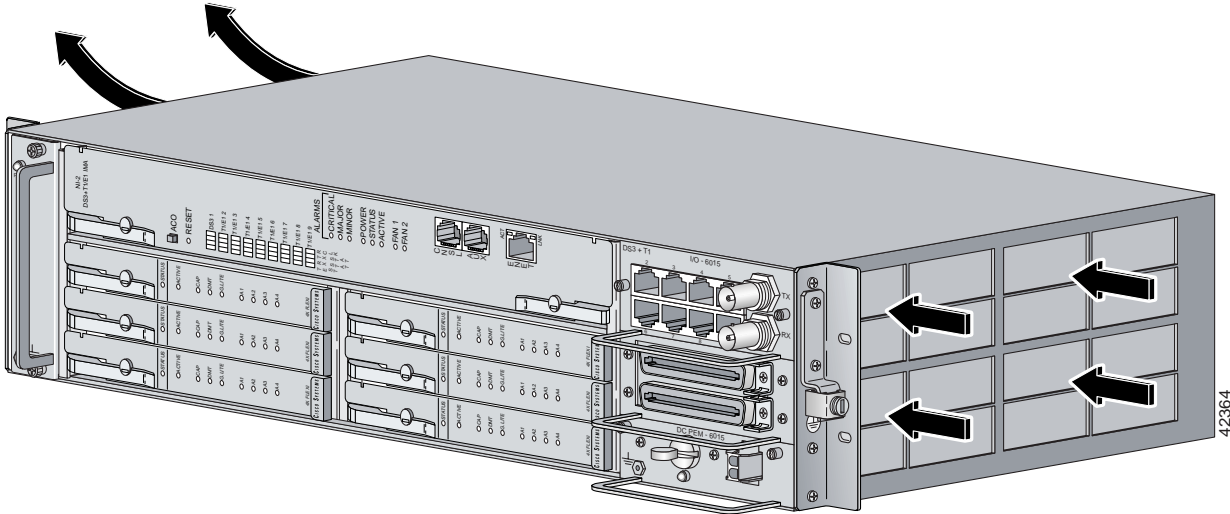
1.2.2 Rear Interface Header

The only rear-accessible chassis component is the 5-pin header that connects the BITS interface (network clocking) and the facility alarm input.

See Figure 1-23 for a close view of the pinouts that are located on the back of the Cisco 6015 chassis.

Figure 1-23   Cisco 6015 5-Pin Header
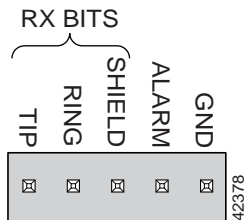
Table 1-8 lists the pinout descriptions for the header contacts.

Table 1-8   Cisco 6015 5-Pin Header Contact Pinouts

Function	Connector	Pin
BITS Interface	Tip	1
	Ring	2
	Shield	3
Facility Alarm Input	Alarm	4
	Ground	5

1.2.3 AC/DC Converter

An optional AC/DC converter must be installed and connected to the DC PEM if the system is powered by AC power. The AC/DC converter converts 120/240V AC power to –48V DC power for the Cisco 6015 system. The AC/DC converter is orderable through Cisco.
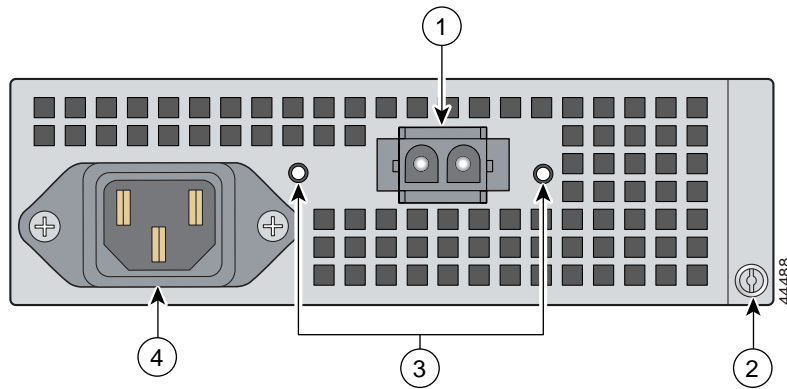
Note   The AC/DC converter can be used only in a commercial environment. It cannot be used in an outside-plant environment.

Figure 1-24 shows a close-up of the AC/DC converter faceplate.

Figure 1-24   AC/DC Converter Faceplate

1	2-pin connector	3	LEDs. When green, the left LED indicates that there is good AC input. When the right LED is green, it indicates that there is good DC output between the AC/DC converter and the DC PEM. If either LED is off, troubleshoot the AC/DC converter or the AC input.
2	Screw	4	AC power receptacle

> **Note** An AC power cord applicable to your country's electrical specifications will accompany the AC/DC converter.

An AC/DC converter tray is available to house up to three AC/DC converters. The AC/DC converter tray is installed directly below the Cisco 6015 chassis. Extenders are available for the tray if you are installing the system in a 23-inch rack.

> **Note** For hardware specifications for the AC/DC converter, see the "Cisco 6015 System Specifications" section on page A-2.

1.3 Management Software

You can provision and manage the Cisco 6015 system through the following management software:

- Cisco IOS—A CLI that is available for network element provisioning.
- CDM—A GUI designed to configure and manage the 6xxx series of Cisco IOS software-based DSLAMs. CDM provides the following areas of network management—fault, configuration, performance, and security. CDM runs with the Cisco EMF; both are installed on Sun workstations.

  Cisco EMF is based on an object model in which network elements or modules represent the managed entity. Each object is defined by a class and specific attributes. An object can represent a network element or a more abstract entity such as a link relationship, a network, or a container such as a site, shelf, or region.

> **Note** If your network contains multiple Sun workstations, you must dedicate one workstation as the server and all additional workstations as clients. The server should be the repository and distributor of database information from which the clients request information. The client workstations allow multiple users to monitor the managed network.

> **Note** See the "Hardware Specifications" section on page A-1 for minimum software and network management release requirements per Cisco 6015 chassis component.

The supported alarms that are generated by the management software are

- Critical visual—A critical visual alarm condition is indicated when the CRITICAL LED in the NI-2 card faceplate system alarm group lights. Whenever a critical alarm occurs
  - The critical visual alarm relay is activated.
  - Many or all subscribers that are connected to the node are affected (for example, failure of the network timing clock [NTC] or the trunk can cause a critical alarm).

  Critical alarm indications are cleared when the alarm condition is resolved.

- Major visual—A major visual alarm condition is indicated when the MAJOR LED in the NI-2 card faceplate system alarm group lights. Whenever a major alarm occurs
  - The major visual alarm relay is activated.
  - Several subscribers that are connected to the node are affected.

Major alarm indications are cleared when the alarm condition is resolved.

- Minor visual—A minor visual alarm condition is indicated when the MINOR LED in the NI-2 card faceplate system alarm group lights. Whenever a minor alarm occurs

  - The minor visual alarm relay is activated.

  - A small number of subscribers that are connected to the node are affected.

  Minor alarm indications are cleared when the alarm condition is resolved.

The facility alarm input, which is located on the rear of the chassis, allows an external event to trigger an alarm on the NI-2 card. (See the "Rear Interface Header" section on page 1-36 for more information.)

Audible alarms can be turned off by pressing the ACO button.

For more information on alarms that are generated in the management software, see Chapter 6, "Troubleshooting".