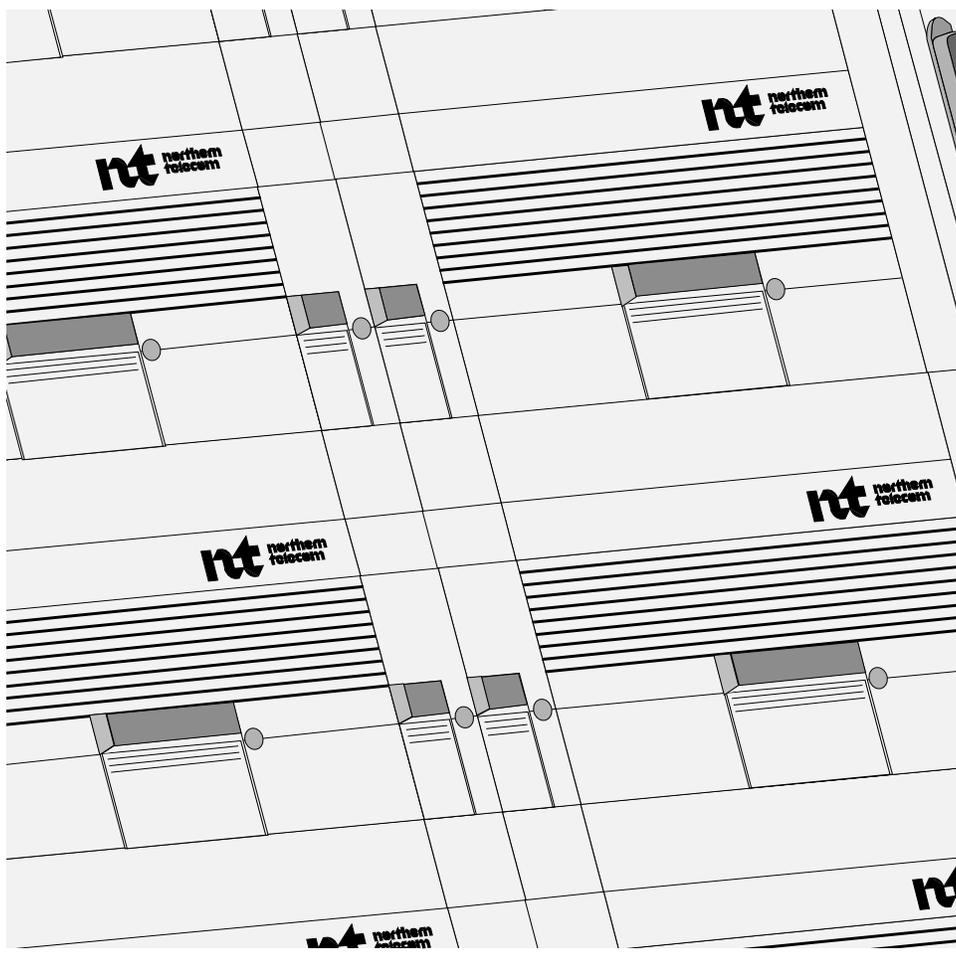


SONET Products

AccessNode

Signal Flow and Circuit Pack Description

Issue 2.0 June 1999



SONET Products

AccessNode

Signal Flow and Circuit Pack Description

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- moved equipping rules and restrictions and default and non-default mapping information for the DS1, DS3, and OC-3 tributary circuit packs formerly in Chapter 5 of this document to the new *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.
- added information on the OC-12 VTBM circuit pack
- added information on the metallic test access card 2

November 1995

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An updated AN10 standard version of the document was released on compact disc. In the updated version, information about the equipping rules for the ESI card was changed on pages 5-52, 5-58, and 5-59. In the updated version, the following parts of the document bore the date May 1995: the front and back covers, the title page, the publication history, and Chapter 5. (The other parts of the document continued to bear the date April 1995.)

April 1995

Standard AN10 release of the document. For this release, the following material has been added to this document:

- illustrations of the layouts of OPC shelves in Chapter 2
- a description of the operations maintenance channel in Chapter 3
- information about STS-1 mappings in DS1-fed systems in Chapter 5
- a description of the timing and cross-connect (TXC) card in Chapter 5

December 1994

Standard AN08 release of the document. For this release, the following material was added to this document:

- a description of the signal flow for TR08 traffic
- a description of the derived data link (DDL) for TR08 traffic
- a description of how the DS1/VT synchronous mapper supports TR08 traffic
- a description of how the transport interface card supports TR08 traffic

November 1994

Reissue of the standard AN07 release of the document.

April 1994

Standard AN07 release of the document. For this release, the following material was added to this document:

- descriptions of new cards and circuit packs for the common-equipment shelves:
 - the BNC I/O card
 - the DS3 protection switch card
 - the DS3/STS mapper
 - the integrated remote test unit
 - the OC-3 interface circuit pack
 - the serial I/O card
- descriptions of new line cards for the copper-distribution shelf:
 - the Epsilon station line card
 - the manual ringdown 2-wire line card
 - the universal voice grade station line card

May 1993

Standard FWP06 release of the document.

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About this document

This document describes the signal flow in AccessNode systems.

Audience

The intended audience for this document includes the following groups:

- strategic and current planners
- provisioners
- transmission engineers
- network administrators

How to use this document

Before using this document, you may want basic information on what AccessNode is, and on its role in the fiber optic network. For that information, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

Because an AccessNode system can be composed of varying numbers and types of network elements, and because each network element can be composed of varying numbers and types of shelf modules, the document explains signal flow at the shelf level.

Since the signal flow descriptions make frequent references to the circuit packs and cards that install in the shelves, this document also includes detailed circuit-pack descriptions.

FCC radio frequency emissions notice

The following regulatory notice applies to AccessNode systems:

“This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful

interference to radio communications. Operation of this equipment in a residential area may cause harmful interference, in which case the user will be required to correct the interference at his own expense.”

References in this document

This document refers to the following additional documents:

Engineering, Configuration, and Ordering Guide, Volume 1

- *Engineering and Ordering Information*, 323-3001-032
- *Mapper Layouts Planning Guide*, 323-3001-154
- *Line Card Application and Special Services Engineering*, 323-3001-155

Description, Volume 2A

- *Configuration and Equipment Description*, 323-3001-100

Description, Volume 2B

- *Line and Loop Testing Overview*, 323-3001-115
- *Line Card Specifications*, 323-3001-181

Operations, Administration, and Provisioning, Volume 4A

- *System Administration Procedures*, 323-3001-302

Operations, Administration, and Provisioning, Volume 4B

- *Provisioning and Operations Procedures*, 323-3001-310

Overview of AccessNode signal flow and circuit packs

AccessNode handles the physical interconnection and service-delivery functions within FiberWorld. The AccessNode products handle interconnection to the equipment at the subscriber's end of the line, and to the equipment at the central office, typically central-office switches and cross-connects.

For a detailed description of AccessNode, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

Topics of this document

This document explains the signal flow in AccessNode. The signals flowing through an AccessNode fall into the following categories:

- services
- control and status information

Focus on shelf types

All AccessNode network elements are composed of one or more shelves. Some network elements contain various types of shelves in combinations, and the number of shelves can vary from installation to installation. You can understand the signal flow in any individual AccessNode network element if you understand the signal flow in each one of the various shelf types. This is true regardless of the number or combination of shelves in an individual network element.

To explain the signal flow in AccessNode, this document focuses on the signal flows in the various types of shelves used in AccessNode network elements.

For each type of shelf, Chapter 2, "Signal flow in the shelves", explains the signals flowing into and out of the shelf, and explains the signals flowing among the components within the shelf.

Description of plug-in modules

In the explanations of signal flow in Chapter 2, there are frequent references to the plug-in modules used in the shelves.

If you want more information about the plug-in modules, you can refer to Chapter 4, “List of shelf types and modules” for a brief listing of which plug-in modules are used in each of the various shelves. More detailed descriptions can be found in Chapter 5, “Equipment in the common-equipment shelves” and Chapter 6, “Equipment in the copper-distribution shelf”.

Description of buses and links

As signals flow between and within shelves in an AccessNode, they travel by way of buses and links. If you want more information about a bus or link, refer to Chapter 3, “Buses and links”.

Signal flow in the shelves

This chapter describes the signal flow for each type of shelf used in AccessNodes. Illustrations show the positions of the plug-in modules in the shelves. (For shelves that have various layout options, typical layouts are illustrated. For detailed equipping rules for cards and circuit packs, see Chapters 5 and 6.)

The following shelf types are used in AccessNodes:

- the access bandwidth manager (ABM) shelf
- the transport bandwidth manager (TBM) shelf
- the copper-distribution shelf

Chapter contents

This chapter contains the following information:

Topic	See
Signal flow in common-equipment shelves	page 2-2
Signal flow in copper-distribution shelves	page 2-10

Signal flow in common-equipment shelves

There are two types of common-equipment shelves in the AccessNode: access bandwidth manager (ABM) and transport bandwidth manager (TBM). Refer to *Configuration and Equipment Description*, 323-3001-100, in this volume.

Signals flow in two directions through a common-equipment shelf: into the fiber optic feeder, and from the fiber optic feeder.

Transmission rate of a fiber optic feeder

The fiber optic feeder carries optical signals at the OC-3 rate or at the OC-12 rate.

Fiber-fed system

In a fiber-fed system, when you commission each network element you specify the transmission rate as either OC-3 or OC-12. The transmission rate determines whether you use OC-3 or OC-12 interface circuit packs in the network element. The FCOT and RFT must both contain the same type, OC-3 or OC-12.

Single-ended system

Each RFT in a single-ended system is fed by an OC-3 tributary or another system, and uses OC-3 interface circuit packs.

Transmitting into a fiber optic feeder

The following types of network elements interface to a fiber optic feeder:

- FCOTs in fiber-fed systems
- RFTs in fiber-fed systems
- RFTs in single-ended systems

To interface to the fiber optic feeder, a network element contains a pair of optical interface circuit packs, located in slots nine and ten in the common-equipment shelf (the access bandwidth manager shelf or the transport bandwidth manager shelf). The following types of optical interface circuit packs are available:

- OC-3 interface circuit packs
- OC-12 interface circuit packs
- OC-12 VTBM circuit packs

OC-3 interface circuit packs are used in FCOTs and RFTs in fiber-fed point-to-point systems in which the fiber optic feeder carries traffic at the OC-3 rate. OC-3 circuit packs are also used in single-ended RFTs.

OC-12 VTBM circuit packs are used in the network elements in fiber-fed ring systems.

OC-12 interface circuit packs are used in FCOTs and RFTs in fiber-fed point-to-point systems in which the fiber optic feeder carries traffic at the OC-12 rate.

Traffic to be transmitted into the fiber optic feeder comes to the common-equipment shelf from either digital equipment (as DS1s and DS3s) or optical equipment (as OC-3 tributaries). In the case of the access bandwidth manager shelf, traffic can also come in the form of DS0s carrying narrowband services. The access bandwidth manager shelf receives DS0s from copper-distribution shelves.

The common-equipment shelf converts all the traffic to STS-1s, which are electrical signals at the 51.84 Mb/s rate, and sends the STS-1s to the optical interface circuit packs (OC-3, OC-12, or OC-12 VTBM) for transmission into the fiber-optic feeder. (OC-3 tributary traffic is supported only if the fiber optic feeder is an OC-12 feeder.)

Each of the two optical interface circuit packs in slots nine and ten multiplexes the STS-1s into one STS-3 or STS-12, adds transport overhead, scrambles the electrical signal and converts the electrical (STS-3 or STS-12) signal into an optical (OC-3 or OC-12) signal, and transmits the optical signal into the fiber optic feeder.

If the network element contains OC-3 interface circuit packs or OC-12 interface circuit packs, then the circuit pack in slot nine and the circuit pack in slot ten both transmit an optical signal into the fiber, and the network element at the other end uses one or the other of the signals. If the network element contains OC-12 VTBM circuit packs, then it is a network element in a fiber-fed ring system, and each OC-12 VTBM circuit pack transmits an optical signal, one in the clockwise direction, and one in the counterclockwise direction. In each direction, STS-1s one to six carry traffic to the adjacent network element in the ring, and STS-1s seven to twelve are for protection. For more information about ring protection, see *Protection Switching Description*, 323-3001-103, in this volume.

Transmit-direction signal flow in an OC-12 VTBM circuit pack

In a network element installed in a fiber-fed ring, the OC-12 VTBM circuit pack receives serial STS-1 signals from the add bus and from the R-link. It multiplexes the received STS-1s into an STS-12 signal, performs VT pointer processing, and adds the SONET section and line overhead. The electro-optic subsystem of the circuit pack converts the STS-12 electrical signal to an OC-12 optical signal, and transmits the optical signal into the fiber optic feeder.

Note: For a more detailed description of the signal flow through the OC-12 VTBM circuit pack, see page 5-74.

Putting OC-3 tributaries into a fiber optic feeder

Optical OC-3 tributary signals enter the common-equipment shelf by way of the OC-3 interface circuit packs in the lower level of the shelf. (OC-3 interface circuit packs that handle tributaries are in slots other than nine and ten.) Each working OC-3 interface circuit pack handles both directions (transmit and receive) of one OC-3 tributary.

The OC-3 interface circuit pack receives the OC-3 tributary signal as either one OC-3 signal, which corresponds to one STS-3 signal, or as one OC-3c (concatenated) signal, which corresponds to one STS-3c signal. The OC-3 interface circuit pack then transmits the STS-3 to the OC-12 interface circuit packs in slots nine and ten by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.)

Putting DS3s into a fiber optic feeder

Digital DS3 signals enter the common-equipment shelf by way of the BNC I/O cards in the upper level of the shelf. Each BNC I/O card handles both directions of one DS3 line. Up to three BNC I/O cards can be associated with each DS3 mapper. Each BNC I/O card performs EMI filtering and routes the DS3 to the associated DS3 mapper by way of the backplane. Each DS3 mapper receives up to three DS3 signals.

The mapper maps each DS3 signal into an STS-1 signal, and transmits each STS-1 to each OC-3 or OC-12 interface circuit pack by way of an STS-link. (STS-links are in the backplane of the common-equipment shelf.)

Putting STS-1s into a fiber optic feeder

Digital STS-1 signals enter the common-equipment shelf by way of the BNC I/O cards in the upper level of the shelf. Each BNC I/O card handles both directions of one STS-1 line. Up to three BNC I/O cards can be associated with each STS-1 mapper. Each BNC I/O card performs EMI filtering and routes the STS-1 to the associated STS-1 mapper by way of the backplane. Each STS-1 mapper receives up to three STS-1 signals.

The mapper passes each STS-1 signal through to each OC-3 or OC-12 interface circuit pack.

Putting DS1s into a fiber optic feeder

Digital DS1 signals enter the common-equipment shelf by way of the DS1 input cards in the upper level of the shelf. Each DS1 input card handles the input for one DS1/VT mapper circuit pack, that is, up to 14 DS1 channels. The DS1 input card performs EMI filtering and routes the DS1s by way of the backplane of the common-equipment shelf to the associated DS1/VT mapper. Each DS1 is mapped into a VT1.5.

In an FCOT that handles TR-08 traffic, the DS1/VT mapper handling the TR-08 DS1s recovers the derived data link (DDL) from each incoming A span, and places the alarm and maintenance messages in reserved bytes in the VT1.5. (For descriptions of the A span and the derived data link, see page 3-11).

The VT1.5s are mapped into STS-1s. A single STS-1 can carry 28 VT1.5s, which is the equivalent of the traffic handled by two DS1/VT mappers.

If the system is one in which VT bandwidth management is not available, the 28 VT1.5s from a pair of mappers in contiguous odd and even slots (such as slots 1 and 2) are combined into a single STS-1 signal. The STS-1s are transmitted by way of STS-1 links to the optical interface circuit packs (OC-12 or OC-3) that interface to the fiber optic feeder. (STS-links are in the backplane of the common-equipment shelf.)

If the system is one in which VT bandwidth management (VTBM) is available, you can specify the location in OC-12 signal in which the DS1 is carried, that is, you can specify a VT1.5 within a VT-managed STS-1. This capability is called VT time slot assignment (VT TSA). (To specify VT time slot assignment, you use the Connection Manager, which is an OPC tool. For information on the Connection Manager, see *OPC User Interface Description*, 323-3001-301, in *Operations, Administration, and Provisioning*, Volume 4A.)

Note: VT bandwidth management is available only in fiber-fed ring systems.

If the system is one in which VT bandwidth management is available, the optical interface circuit packs that interface to the fiber optic feeder are OC-12 VTBM circuit packs. Each OC-12 VTBM circuit pack contains an ANSI switch, which implements your VT TSA specifications. The switch assembles the outgoing STS-12 signal. The switch can route any VT from a DS1 VT mapper to any VT time slot in the outgoing STS-12 signal. The outgoing STS-1 signal is available at the line port of the ANSI switch.

Note: Once assigned to a VT time slot, the DS1 travels through the network to its destination in that time slot. If the VT must pass through one or more intermediate network elements on its way to its destination, those network elements do not switch the VT into another time slot in the SONET signal.

Putting narrowband services from copper loops into a fiber optic feeder

Only the access bandwidth manager shelf puts services from copper loops into the fiber. The shelf handles traffic to and from one or more copper-distribution shelves.

The copper-distribution shelves contain the line cards that support narrowband services offered over conventional copper loops. The narrowband services are carried in DS0 channels.

DS0 signals carrying narrowband services come to the access bandwidth manager shelf from the line cards in the copper-distribution shelves. The DS0 signals enter the access bandwidth manager shelf by way of the D-links, and go to the access interface cards. Each access interface card sends the DS0s to each transport interface card by way of a T-link. The active transport interface card multiplexes the DS0s into VT1.5s.

In an RFT that handles TR-08 traffic, the processor card writes the alarm and maintenance messages for a TR-08 system into the registers of the transport interface cards, and the active transport interface card inserts the messages into the overhead of the VT1.5 that carries the A span for the TR-08 system. (For a description of the A span, see page 3-11). The active transport interface card combines the VT1.5s into STS-1s. The active transport interface card sends the STS-1s to both OC-3 or OC-12 interface circuit pack by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.)

Receiving from a fiber optic feeder

Each of the two optical interface circuit pack receives an optical OC-3 or OC-12 signal from the fiber optic feeder. Each one converts the optical signal to an equivalent electrical STS-3 or STS-12 signal. Each optical interface circuit pack then frames and de-scrambles the STS-3 or STS-12 signal, extracts the transport overhead, and demultiplexes the STS-3 or STS-12 signal into STS-1 signals. The OC-3 or OC-12 interface circuit pack that is receive-active (that is, responsible for receiving signals from the fiber optic feeder) then transmits the STS-1s to the other circuit packs in the common-equipment shelf by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.) Those circuit packs convert the signals as necessary and route the traffic to its proper destination.

Receive-direction signal flow in an OC-12 VTBM circuit pack

In a network element in a fiber-fed ring, the electro-optic subsystem of the OC-12 VTBM circuit pack receives an OC-12 optical signal from the fiber optic feeder, and converts it into a 622-Mb/s STS-12 electrical signal. The circuit pack then frames and descrambles the STS-12 signal and extracts the SONET line overhead (LOH) and section overhead (SOH). It performs STS pointer processing, to align the signal with local system timing, and VT pointer processing, to align all the VTs with a local frame reference.

Two STS-12 signals go to the receive backplane interface chip (RBIC). One comes from the add-drop port, the other, from the pass-through port. The RBIC takes the STS-12 signal from the add-drop port and demultiplexes it into 12

serial STS-1s, which are routed to tributary cards by way of the backplane drop bus. The RBIC takes the STS-12 signal from the pass-through port and routes it to the adjacent OC-12 VTBM circuit pack by way of the R-link.

Note: For a more detailed description of the signal flow through the OC-12 VTBM circuit pack, see page 5-74.

Taking OC-3s out of a fiber optic feeder

The receive-active OC-12 interface circuit pack transmits up to three STS-1s to each OC-3 optical circuit pack by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.)

The OC-3 optical circuit pack receives and re-times its OC-3. The optical circuit pack then transmits the three STS-1s by way of its fiber connection on the lower part of the shelf.

Taking DS3s out of a fiber optic feeder

The receive-active OC-3 or OC-12 interface circuit pack transmits up to three STS-1s to each DS3/STS mapper by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.) A single STS-1 can carry one DS3, and each DS3/STS mapper can handle up to three DS3s in each direction (input and output).

The DS3/STS mapper selects and re-times its one, two, or three STS-1s. For each STS-1, the mapper terminates the STS path overhead and extracts the DS3 signal. The mapper frames the DS3, monitors the parity, and performs zeros substitution according to the B3ZS scheme.

The mapper transmits the DS3 by way of the backplane to a BNC I/O card in the upper level of the shelf. (Each DS3/STS mapper is associated with up to three BNC I/O cards.) Each BNC I/O card can handle both directions (input and output) of one DS3 line. From the I/O card, the DS3 exits the network element.

Taking DS1s out of a fiber optic feeder

The optical interface circuit pack (OC-3, OC-12, or OC-12 VTBM) receives an OC-3 or OC-12 optical signal from the fiber optic feeder, converts the optical signal to an equivalent STS-3 or STS-12 electrical signal, and then frames, descrambles, and demultiplexes the electrical signal into STS-1 signals (each with a rate of 51.84Mb/s). It then transmits the STS-1s to the other circuit packs in the DS1/VT mappers by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.)

A single STS-1 can carry up to 28 DS1s, and each DS1/VT mapper can handle up to 14 DS1 channels in each direction (input and output).

If VT bandwidth management is not available in the system, one STS-1 carries the traffic handled by a pair of DS1/VT mappers in contiguous odd and even slots (such as slots 1 and 2). The STS-1s go to the DS1/VT mappers by way of STS-1 links in the shelf backplane.

If VT bandwidth management is available in the system, the optical interface circuit packs that interface to the fiber optic feeder are OC-12 VTBM circuit packs. Any VT1.5s that are to be dropped at a network element are in VT-managed STS-1s. Those STS-1s are available at the add-drop port of the ANSI switch in the OC-12 VTBM circuit pack. The VT-managed STS-1s go to the DS1/VT mappers by way of STS-1 links in the shelf backplane.

Note: VT bandwidth management is available only in fiber-fed ring systems.

Each DS1/VT mapper extracts the STS-1 path overhead and demultiplexes the STS-1 into 14 VT1.5s. For each of the VT1.5s, the mapper terminates the VT path overhead and extracts the DS1.

In an FCOT that handles TR-08 traffic, the mapper takes the TR-08 alarm and maintenance messages from reserved bytes in the VT1.5, and converts those messages into derived-data-link format for transmission in the DS1 framing bits. (For a description of the derived data link, see page 3-11).

The mapper transmits the DS1s by way of the shelf backplane to a DS1 output card located in the upper level of the shelf. (Each DS1/VT mapper is associated with a specific DS1 output card.) Each DS1 output card can handle all the output DS1 channels from a DS1/VT mapper, that is, up to 14 DS1s. From the DS1 output card, the DS1s exit the AccessNode.

Taking narrowband services out of a fiber optic feeder

The access bandwidth manager shelf can handle traffic to and from one or more copper-distribution shelves.

The copper-distribution shelves contain the line cards that support narrowband services offered over conventional copper loops. The narrowband services are carried in DS0 channels. All these services go through the transport interface card in the access bandwidth manager shelf.

The receive-active OC-3 or OC-12 interface circuit pack transmits STS-1s in parallel to the active transport interface card by way of STS-links. (STS-links are in the backplane of the common-equipment shelf.) For each of the STS-1s, the transport interface card processes the pointers to locate the VT1.5s. The transport interface card demultiplexes each STS-1 into 28 VT1.5s.

In an RFT that handles TR-08 traffic, each transport interface card extracts the TR-08 maintenance and alarm messages from the VT overhead. The working transport interface card interrupts the processor card if the messages are different from previous ones.

When it receives such an interrupt, the processor card processes the messages. (For more information on the maintenance and alarm messages, see the description of the derived data link on page 3-11.)

The transport interface card demultiplexes each VT1.5 to DS0s, and sends the DS0s to the access interface cards by way of the T-links. (The DS0s carry the narrowband services.) Each access interface cards sends the DS0s to the DS0-based line cards in the copper-distribution shelves by way of the D-links.

Note: TR-08 DS1s can be handled only by the pair of DS1/VT mappers whose traffic is carried in the STS-1 (of the SONET payload) that is mapped to the first port of the transport interface card (TIC) in the RFT. Four VT1.5s are required to carry the traffic to and from each copper-distribution shelf in the RFT that is designated as a TR-08 interface. One of the four VT1.5s for each TR-08 interface carries the maintenance and alarm messages in its VT overhead. The TIC can access those TR-08 messages only in the overhead of the first, fifth, ninth, thirteenth, seventeenth, twenty-first, and twenty-fifth VT1.5s carried in the STS-1. This corresponds to the following DS1 mapper ports: G1 (left) ports one, five, nine, and thirteen; G2 (right) ports three, seven, and eleven.

Signal flow in copper-distribution shelves

The copper-distribution shelf contains the line cards that support the narrowband services that are offered over conventional copper loops. To house the line cards, each copper-distribution shelf has two front-opening pull-out copper-distribution drawers, one on the left side of the shelf, and one on the right side. Inside each copper-distribution drawer there is a midplane that runs the length of the drawer from front to back. The line cards plug into slots in the midplane. For detailed information on the layout of the copper-distribution shelf and the copper-distribution drawers, see Chapter 6.

Signal flow in a copper-distribution shelf

This section explains how the signal flow for narrowband services moves between the AccessNode network element and external equipment. It also explains the narrowband test signals available for testing.

Narrowband services going toward external equipment

Services from the access bandwidth manager shelf enter the copper-distribution shelf by way of connectors located on the right-hand end cap of the shelf. There is one connector for each copper-distribution drawer. Each of the cables connected to these connectors carry D-links. The D-links carry DS0s between the access interface cards in the access bandwidth manager shelf and the narrowband line interface cards (NLICs) in the copper-distribution drawers.

There is one D-link cable for each copper-distribution drawer. Each cable carries the two D-links for the copper-distribution drawer. One D-link connects the access interface card in slot 13 in the access bandwidth manager shelf to the NLIC on the left side of the drawer midplane (NLIC A in the left-hand drawer, NLIC C in the right-hand drawer). The other D-link connects the access interface card in slot 16 in the access bandwidth manager shelf to the NLIC on the right side of the drawer midplane (NLIC B in the left-hand drawer, NLIC D in the right-hand drawer).

Each copper-distribution drawer contains two narrowband line interface cards (NLICs). At any given time, one of the NLICs is the working unit and the other is the protection unit. The working NLIC receives the DS0s from its D-link and transmits them to the line cards in the drawer by way of the A-link, which is in the midplane of the drawer.

The line cards support the DS0-based services. Some services (such as ISDN) require digital DS0 channels; some services require analog VF signals. The line cards convert DS0s to VF as required. The line cards transmit the DS0 and VF channels into the midplane of the copper-distribution drawer. The signals go from the midplane to the end cap of the copper-distribution shelf by way of the signal flex. There are two signal flexes, one linking the left-hand

copper-distribution drawer to the left-hand end cap of the shelf, the other linking the right-hand drawer to the right-hand end cap. The tip and ring pairs for the external lines exit the shelf at the end caps.

Narrowband services coming from external equipment

Signals carrying narrowband services from external equipment enter the AccessNode at the left-hand and right-hand end caps of the copper-distribution shelf. The end caps contain EMI circuit pack assemblies, which filter all pairs.

The signals for some narrowband services (such as ISDN) are DS0s; the signals for other narrowband services are analog VF signals. The signals travel by way of the signal flex from the end cap of the shelf to the midplane of the copper-distribution drawer. There are two signal flexes, one linking the left-hand end cap of the copper-distribution shelf to the left-hand copper-distribution drawer, the other linking the right-hand end cap to the right-hand drawer. The signals travel by way of the midplane of the drawer to the DS0-based line cards. The line cards convert analog voice-frequency signals to DS0s. The line cards transmit the DS0s to the narrowband line interface cards (NLICs) in the drawer.

Each drawer contains two NLICs, the working unit and the protection unit. The working NLIC receives the DS0s from the A-link and sends them to the access bandwidth manager shelf by way of a D-link.

For each copper-distribution drawer, there are two D-links. One D-link connects the NLIC on the left side of the drawer midplane (NLIC A in the left-hand drawer, NLIC C in the right-hand drawer) to the access interface card in slot 13 in the access bandwidth manager shelf. The other D-link connects the NLIC on the right side of the drawer midplane (NLIC B in the left-hand drawer, NLIC D in the right-hand drawer) to the access interface card in slot 16 in the access bandwidth manager shelf.

Signals for testing

The test access card in the access bandwidth manager shelf controls testing of the line cards in the copper-distribution drawers. Testing signals travel between shelves by way of the metallic test buses. The cable carrying the metallic test buses connects to a connector on the side interconnect left circuit pack on the access bandwidth manager shelf.

Each copper-distribution shelf has two connectors for the metallic test buses, located on the left-hand end cap of the shelf. The upper connector is for the incoming cable from the shelf above; the lower connector, for the outgoing connector to the copper-distribution shelf below.

There are two metallic test buses. One of them serves the copper-distribution drawers on the left sides of the copper-distribution shelves, and the other serves the drawers on the right. Within a copper-distribution shelf, the metallic test bus for the right-hand drawers travels from the left side to the right side by way of the daisy flex, which connects the two end caps of the shelf.

In each copper-distribution drawer, the metallic test bus connects to the midplane. The bus interfaces to the metallic test access card, which is located in the front-most slot on the left side of the midplane. The metallic test access card makes connections that are necessary for testing the line cards. The metallic test access card provides a connection between the metallic test bus for the copper-distribution drawer and the test buses that are distributed on the midplane of the drawer. The midplane has two test buses, one for the line cards on the right side of the midplane, and another for the line cards on the left side.

Buses and links

This chapter discusses the buses and links in AccessNode. It also explains how AccessNode handles the derived data link (DDL) for TR-08 interfaces, and it describes the operations maintenance channels used with DS1-fed AccessNode systems.

Chapter contents

This chapter contains the following information:

Topic	See
Buses within the common-equipment shelf	page 3-2
Buses extending outside the common-equipment shelf	page 3-6
Buses within the copper-distribution drawers	page 3-7
Links	page 3-8
Derived data link for TR-08 traffic	page 3-11
Operations maintenance channel used in DS1-fed systems	page 3-12

Buses within the common-equipment shelf

The following section explains the buses within the common-equipment shelf. These are as follows:

- control bus
- SONET overhead bus
- communication overhead bus
- maintenance overhead buses
- add-drop bus

Control bus

Control bus (CBUS) is the main communications path between circuit packs and cards in the common-equipment shelf. It links all the circuit packs and cards that install in the shelf. It carries information for the following control and maintenance functions: bandwidth management, protection (tributary) provisioning, and alarming.

CBUS can handle up to 12 circuit packs and cards. It is a low-level memory-mapped bus. A 16-Mbyte block of memory is allocated to each circuit pack or card. Both 16-bit and 8-bit data transfers are allowed.

For reliability, there are two control buses in each common-equipment shelf, CBUSA and CBUSB. For those circuit packs and cards that install in pairs, one of the units connects to CBUSA, the other, to CBUSB. The maintenance interface card connects to CBUSA; the test access card connects to CBUSB. (The maintenance interface card and the test access card are not duplicated.)

The only units that can access both CBUSA and CBUSB are the processor cards. If either CBUSA or CBUSB fails, the working processor card can continue to control all the circuit packs and cards connected to the other CBUS.

The CBUS protocol is a superset of the maintenance bus (MBUS) protocol. (MBUS is used in TransportNode.) CBUS supports the MBUS protocol.

The following modules use the CBUS protocol:

- access interface card
- transport interface card
- maintenance interface card
- test access card
- timing and cross-connect card
- integrated remote test unit

Note: All the modules in the preceding list can be used in the access bandwidth manager shelf. The maintenance interface card (MIC) can be used in the transport bandwidth manager, but all other modules in the list can not be used in the transport bandwidth manager shelf. The timing and cross-connect card is used only in network elements in DS1-fed systems.

The following modules use the MBUS protocol:

- OC-12 interface circuit pack
- OC-3 interface circuit pack
- DS1/VT mapper
- DS3/STS mapper
- DS3 protection switch card
- external synchronization interface (ESI) card
- operations controller (OPC) module

Note: All the modules in the preceding list can be used in the access bandwidth manager shelf and in the transport bandwidth manager shelf.

SONET overhead bus

In a network element in a fiber-fed system or in a single-ended system, there is one SONET overhead bus (SOH bus) for each optical interface (OC-12 or OC-3) circuit pack that interfaces to the fiber-optic feeder.

Each SOH bus provides a communication path for SONET overhead between the optical interface circuit pack and the following modules in the shelf:

- processor cards
- maintenance interface card

AccessNode uses only the following channels in the SOH bus:

- SONET section data communication channels, part of the SONET section overhead, occupying three channels on the SOH bus
- local orderwire, part of the SONET section overhead, occupying one channel on the SOH bus
- express orderwire, part of the SONET line overhead, occupying one channel on the SOH bus

System notes

The following items apply to SONET overhead bus:

- In the network elements in a DS1-fed system, the SONET overhead bus is not available because the network elements do not interface to SONET feeders.
- In the network elements in a single-ended system, the SONET overhead bus carries only the SONET section data communication channels. The orderwire channels are not available because the OC-3 tributaries that feed the single-ended RFTs do not support orderwire in the SONET overhead.
- When an OC-3 tributary is provisioned, the tributary does not carry SONET data communication channels.

For information on how to provision SONET data communication channels, see *Provisioning and Operations Procedures*, 323-3001-310, in *Operations, Administration, and Provisioning*, Volume 4B.

Communication overhead bus

In an access bandwidth manager shelf, there is one communication overhead bus (COH bus) for each access interface card.

Note: An access bandwidth manager shelf contains an access interface card if the shelf is in an FCOT or RFT that contains one or more copper-distribution shelves, or if the shelf is used as an OPC shelf for a DS1-fed system in which the connectivity between the operations controller and the RFTs is by way of OMC DS1s. If the network element contains copper-distribution shelves, the traffic to and from those shelves flows through the access interface card. If an access bandwidth manager shelf is used as an OPC shelf for a DS1-fed system in which the connectivity between the operations controller and the RFTs is by way of OMC DS1s, then within the OPC shelf there must be a communications path between the operations controller module and the DS1/VT mapper that handles the OMC DS1s. Part of that communications path is the communications overhead bus, which goes through the access interface card.

The COH bus links each processor card and each interface card. The bus carries the following communications channels:

- the common signaling channel (CSC)
- the embedded operations channel (EOC)
- the operations maintenance channel (OMC)
- the orderwire channels

Common signaling channel

The common signaling channel provides call-processing information and data-link protection between an RFT and the host switch at the central office.

Embedded operations channel

The embedded operations channel provides OAM&P functions. It is the communication path between the host switch, network operations systems (OSs), and an RFT.

Operations maintenance channel

The operations maintenance channel (OMC) is used only in DS1-fed systems, and it need not be used in every DS1-fed system. The operations maintenance channel carries operations, administration, maintenance, and provisioning (OAM&P) messages between an operations controller and an RFT.

The channel need not be used in every DS1-fed system because there are alternative means of establishing connectivity between the operations controller and the RFTs (such as control network and the SONET data communications channels). A description of the operations maintenance channel begins on page 3-12 in this chapter.

Orderwire channels

The COH bus carries both local and express orderwire channels.

Note: Orderwire is supported only by basic fiber-fed AccessNode systems. If you want orderwire service for an RFT in a DS1-fed system or in a single-ended system, you must use additional external equipment to implement it.

Maintenance overhead buses

For testing, the test access card interfaces to the other circuit packs and cards in the access bandwidth manager shelf through the maintenance overhead buses, MOH1 and MOH2. The MOH buses link the test access card to the access interface cards and to the maintenance interface card. The MOH buses carry test tones and trunk conditioning.

The MOH1 connects to access interface card A (in slot 13) and to the maintenance interface card; MOH2 connects to access interface card B (in slot 16) and to the maintenance interface card.

Add-drop bus

In a network element in a fiber-fed ring system, the add-drop buses carry the tributaries that are to be added to and dropped from the fiber optic feeder at the network element. In such a network element, two OC-12 VTBM interface circuit packs interface to the fiber optic feeder, one handling traffic in the clockwise direction in the ring, the other, traffic in the counterclockwise direction.

Each OC-12 VTBM circuit pack contains an ANSI switch, which places STS-1s and VT1.5s in time slots in the OC-12 signal. The ANSI switch has an add-drop port, which connects to an add-drop bus. The add-drop bus carries tributary traffic between the OC-12 VTBM circuit pack and other modules in the shelf. The other modules are the DS1/VT mappers, DS3/STS mappers, and OC-3 interface circuit packs that handle OC-3 tributaries.

Buses extending outside the common-equipment shelf

This sections explain the buses extending outside the common-equipment shelf. These are as follows:

- Metallic test buses
- Control network

Metallic test buses

Two metallic test buses link the test access card in the access bandwidth manager shelf to the copper-distribution drawers in the copper-distribution shelves. The test access card uses these buses to test the line cards in the copper-distribution drawers. One bus is for the copper-distribution drawers on the left sides of the copper-distribution shelves. The other bus is for the drawers on the right.

From the access bandwidth manager shelf, the metallic test buses are daisy-chained from one copper-distribution shelf to the next. At each copper-distribution drawer, the metallic test bus interfaces to the metallic test access card. The metallic test access card in each copper-distribution drawer in turn interfaces to test buses on the midplane of the drawer.

Control network

The control network is a token bus local-area network (LAN) that provides interprocessor communication. The LAN provides the communication link between the major processing circuit packs and cards equipped in a common-equipment shelf, in order to provide the higher-level control, maintenance, and communications functions.

Optionally, the control network can also provide communication between collocated common-equipment shelves. This makes it possible for the operating company to reduce equipment costs, because the shelves can share OAM&P functions and protection functions. A control-network LAN can link one or more access bandwidth manager shelves and one or more transport bandwidth manager shelves. The maximum length of the LAN is 400 ft.

If a control network links multiple FCOTs, a single operations controller can serve all of the FCOTs and the RFTs connected to those FCOTs. The operations controller can be in the common-equipment shelf of one of the FCOTs, or in an OPC shelf that is also connected to the control-network LAN. (An OPC shelf is a separate access or transport bandwidth manager shelf that serves to house an operations controller. For more information about OPC shelves, see *Configuration and Equipment Description*, 323-3001-100, in this volume.)

If control network links two RFTs in a DS1-fed AccessNode system, then both RFTs can communicate with the operations controller for the system by way of a single operations maintenance (OMC) channel. The operations maintenance channel (OMC), is carried by a DS1 that connects to the first RFT. Connectivity extends to the second RFT by way of control network. (For more information about the topology of DS1-fed systems, see *Configuration and Equipment Description*, 323-3001-100, in this volume. For more information about the operations maintenance channel, see page 3-12.)

Control network uses an RS-485 interface, and the routing is a shielded (EMI) twisted pair multiple-tap bus that is across the backplanes of the shelves and optionally between shelves. It is possible to tap on to the bus any point. At each end, the bus is terminated in the two DB-9 connectors that are located on each shelf.

Buses within the copper-distribution drawers

In each copper-distribution drawer, there are two test buses on the midplane. These buses are used for testing the line cards in the drawer.

The metallic test access card in the drawer interfaces these midplane test buses to the metallic test buses. The metallic test buses are daisy-chained down the copper-distribution shelves from the test access card in the access bandwidth manager shelf.

Links

The following sections describe the following links:

- A-link
- D-link
- T-link
- STS-link

The R-link is described separately, beginning on page 3-10.

The A-link, D-link, T-link, and STS-link are physical paths by which signals travel inside AccessNode. The signals are the services supported by the line cards in the copper-distribution shelves.

Inside the AccessNode, there are two parallel sets of links between the transport interface card in the access bandwidth manager shelf and the copper-distribution shelves, and there is a single link that carries services between the transport interface card and the optical interface circuit packs.

Figure 3-1 shows the functions and relationships of the links.

The following links carry narrowband services between the transport interface card in the access bandwidth manager shelf and the copper-distribution shelves located in an AccessNode:

- A-link
- D-link
- T-link

The following link carries services between the transport interface card and the optical interface circuit pack (OC-12 or OC-3):

- STS-link

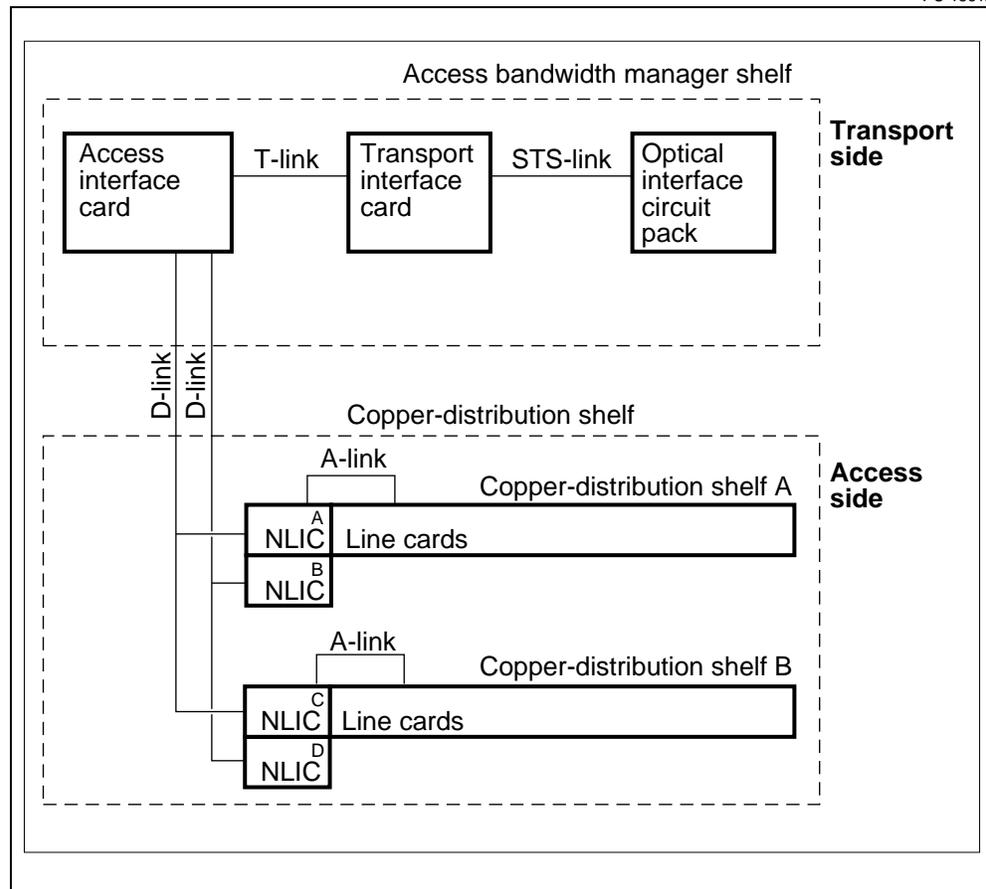
These links are explained in the following paragraphs.

A-link

A-link is the physical path between the line cards and the narrowband line-interface card in a copper-distribution drawer. A-link is in the midplane of the copper-distribution drawer. It carries narrowband services in the form of DS0s.

Figure 3-1
Links in AccessNode

PC-15612



D-link

Drawer-link (D-link) is the physical path between the narrowband line-interface card in the copper-distribution drawer and the access interface card in the access bandwidth manager shelf. Each D-link carries narrowband services in the form of DS0s.

There are two D-links for each copper-distribution drawer. One of the D-links connects the NLIC on the left side of the drawer midplane (NLIC A in the left-hand drawer, NLIC C in the right-hand drawer) to access interface card A, in slot 13 in the access bandwidth manager shelf. The other D-link connects the NLIC on the right side of the drawer midplane (NLIC B in the left-hand drawer, NLIC D in the right-hand drawer) to access interface card B, in slot 16 in the access bandwidth manager shelf.

T-link

Transport-link (T-link) is the physical path between the access interface card and the transport interface card within the access bandwidth manager shelf. It carries narrowband services in the form of DS0s between the access interface card and the transport interface card.

STS-link

In an access or transport bandwidth manager shelf, STS-links are the physical paths between the optical interface circuit packs (OC-12 or OC-3) and other circuit packs and cards in the shelf. STS-links carry information at multiples of the STS-1 rate (for example, STS-3, STS-9, and so on).

The following circuit packs and cards are linked to the optical interface circuit pack by way of STS-links: transport interface cards, OC-3 tributary optical circuit packs, DS1/VT mappers, and DS3/STS mappers.

In an access bandwidth manager shelf, STS-1s are used to carry traffic from the copper-distribution shelves between the transport interface cards and the optical interface circuit packs. STS-links do the following in either access or transport bandwidth manager shelves:

- One STS-1 can carry a single DS3 between a DS3/STS mapper and the optical interface circuit packs. (Each DS3/STS mapper can handle both directions of up to three DS3s.)
- One STS-1 can carry up to 28 DS1s between a pair of DS1/VT mappers in contiguous odd and even slots (such as slots 1 and 2) and the optical interface circuit packs. (Each DS1/VT mapper can handle both directions of up to 14 DS1s.)

R-link

In a network element in a fiber-fed ring system, the R-link carries traffic between the two OC-12 VTBM circuit packs. The two OC-12 VTBM circuit packs interface to the fiber optic feeder, one handling traffic in the clockwise direction in the ring, the other, traffic in the counterclockwise direction. Each OC-12 VTBM circuit pack contains an ANSI switch, which places STS-1s and VT1.5s in time slots in the OC-12 signal. The ANSI switch has a pass-through port, which connects to the R-link.

Traffic travels through the R-link when ring protection switching occurs in the network element. On such an occasion, all the traffic that normally flows around the ring in one direction must be rerouted to flow around the ring in the opposite direction. To reroute the traffic, the network element sends it from one OC-12 VTBM circuit pack to the other by way of the R-link.

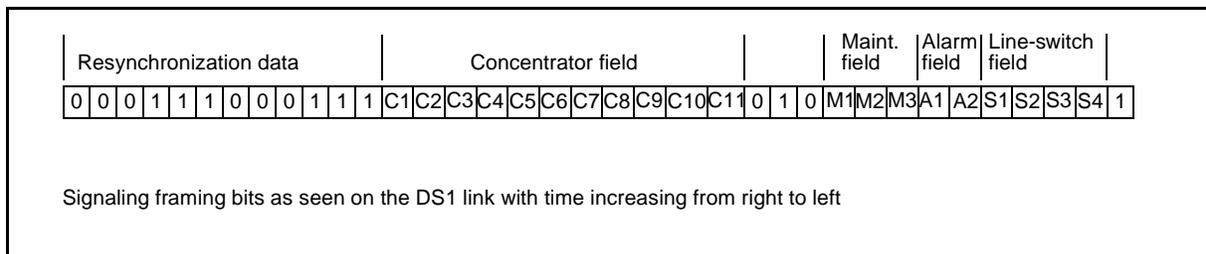
For detailed information on ring protection switching, see *Protection Switching Description*, 323-3001-103, in this volume.

Derived data link for TR-08 traffic

The derived data link (DDL) is a communication channel for TR-08 traffic. An SLC-96 system is the model for TR-08. The four shelves in the SLC-96 system are referred to as A, B, C, and D. Each shelf supports 24 DS0 channels. The 96 channels from the four shelves are carried in four DS1 channels, which are referred to as the A, B, C, and D spans. The DDL is carried in the framing bits for the A span. (The B, C, and D spans have superframe format.)

The framing pattern for the A span consists of alternating terminal framing bits (1, 0, 1, 0) and signaling framing bits. The signaling framing bits carry the DDL. Figure 3-2 shows the framing bits for the A span, with the DDL fields.

Figure 3-2
Format of the derived data link (DDL)



The concentrator field (bits C1 to C11) contains a static idle code. Because DS1 span protection switching is not supported, the line-switch field (bits S1 to S4) also contains a static idle code. The maintenance field (bits M1, M2, and M3) carries a three-bit maintenance message. The alarm field (bits A1 and A2) carries an alarm message spread over 13 or 16 DDL frames. If both alarm bits in a DDL frame are set to a one, that signifies the beginning of a message. The A1 bit is set to zero for the next 12 or 15 frames. The A2 bits carry the bit-oriented message.

The TR-08 interface provided by AccessNode enables the AccessNode to emulate one to seven SLC-96 systems operating in TR-08 mode I. Each SLC-96 system uses 96 DS0s, the equivalent of four DS1s. Those four DS1s are the A, B, C, and D spans for the SLC-96 system. Between the RFT and the FCOT, the spans are carried in VT1.5s. Each VT1.5 carries the 24 DS0s that compose a span.

The TR-08 maintenance and alarm messages travel between the transport interface card in the RFT and the DS1/VT mapper in the FCOT by way of reserved bytes in each VT1.5 that carries an A span. Only certain VT1.5s can carry A spans. Assuming that TR-08 traffic is handled at the FCOT by a pair of DS1/VT mappers in adjoining slots such as slots 1 and 2, the A spans can be connected only to the following ports of those mappers: ports 1, 5, 8, and 13 of the mapper in the lower (odd-numbered) slot, and ports 3, 7, and 11 of the mapper in the higher (even-numbered) slot.

Operations maintenance channel used in DS1-fed systems

The operations maintenance channel (OMC) is used only in DS1-fed systems, and does not need to be used in every DS1-fed system. The OMC carries operations, administration, maintenance, and provisioning (OAM&P) messages between an operations controller and an RFT. The channel does not need to be used in every DS1-fed system because there are alternative means of establishing connectivity between the operations controller and the RFTs (such as control network and the SONET data communications channels).

The operations maintenance channel is the functional equivalent of the SONET data communications channel in a basic fiber-fed system. In a DS1-fed system, the operations controller can serve multiple RFTs, so there can be multiple operations maintenance channels.

Each operations maintenance channel is carried in an OMC DS1. The OMC DS1 is dedicated to carrying the operations maintenance channel. The channel uses only the first few of the DS0s in the DS1. The other DS0s in the OMC DS1 cannot be used.

The number of DS0s used by the operations maintenance channel is provisionable. Each channel can be as wide as six DS0s, or as narrow as three DS0s. Note the following items in provisioning operations maintenance channels:

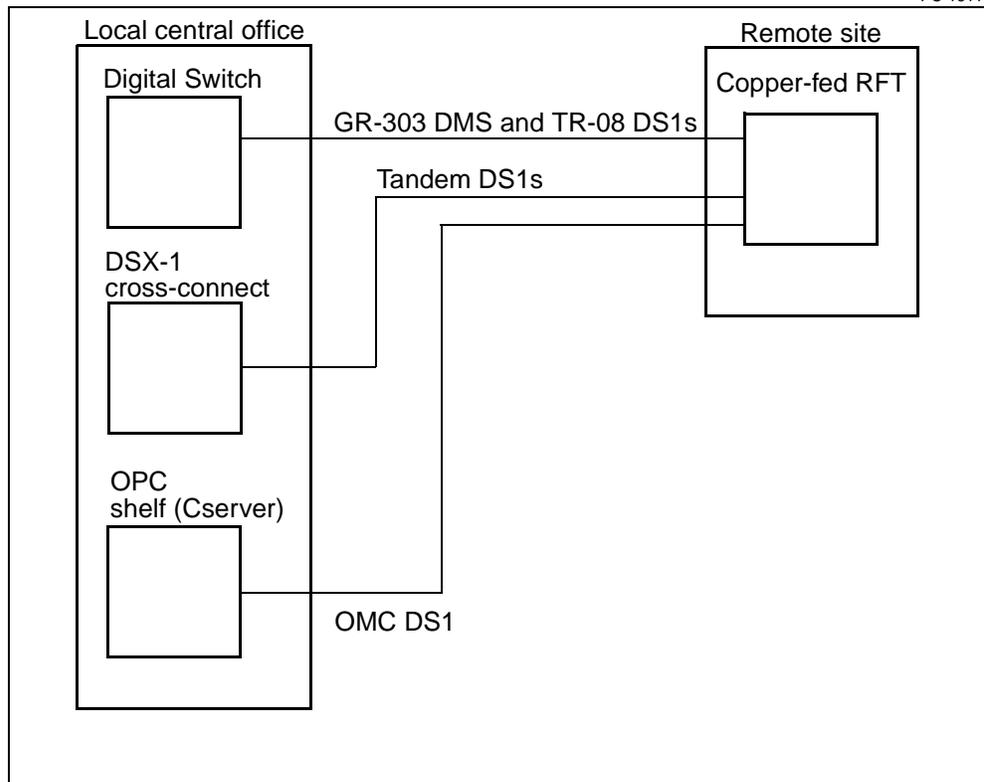
- If the operations maintenance channel for an RFT is wider, then the system-recovery time for the RFT is faster. (System-recovery time is the amount of time it takes for an RFT to recover after a failure.)
- If the operations maintenance channel is narrower, then there can be more operations maintenance channels connected to the operations controller.

The combined bandwidth of all the operations maintenance channels connected to an operations controller can be up to 31 DS0s. Therefore, in a DS1-fed system, there can be up to ten operations maintenance channels if each one uses three DS0s, or up to five if each one uses six DS0s. (All the operations maintenance channels connected to an operations controller do not need to use the same number of DS0s. You specify the bandwidth for each channel separately.)

Figure 3-3 shows the connectivity of a DS1 OMC between the operations controller and the RFT in a DS1-fed system. For more information on DS1-fed systems, see Chapter 2 of *Configuration and Equipment Description*, 323-3001-100, in this volume.

Figure 3-3
DS1-fed system with an OPC shelf in the local central office

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You designate the DS1s that carry OMCs by using a command-interface (CI) tool at the network element, that is, at the location of the operations controller and at the DS1-fed RFT.

For information on how to provision OMCs, see *Provisioning and Operations Procedures*, 323-3001-310, in *Operations, Administration, and Provisioning*, Volume 4B.

List of shelf types and modules

This chapter contains tables and lists showing which plug-in modules are used in AccessNodes. Plug-in modules can be installed in the following bay-assembly modules and shelf modules in an AccessNode:

- breaker interface panel, model NT4K14
- access bandwidth manager shelf
- transport bandwidth manager shelf
- copper-distribution shelf

Chapter contents

This chapter contains the following information:

Topic	See
Modules used in the breaker interface panel	page 4-2
Modules used in the common-equipment shelves	page 4-2

Modules used in the breaker interface panel

Plug-in modules can be installed in the NT4K14 breaker interface panel (BIP), which is used with the access bandwidth manager shelf.

Note: There are no plug-in modules in the NT7E56 breaker interface panel, which is used with the transport bandwidth manager shelf.

The BIP distributes battery power to the access bandwidth manager shelf, to the copper-distribution shelves, and to the cooling unit. The BIP distributes talk battery power to the copper-distribution shelves. It also processes alarms from within the AccessNode and from external equipment.

An NT4K14AB BIP contains the following field-replaceable modules:

- one alarm relay card (required)
- two talk battery filter cards (needed only if the network element contains copper-distribution shelves)

An NT4K14BA BIP contains the following field-replaceable modules:

- one alarm relay card (required)
- one talk battery filter card (required)

The alarm relay card has a red breaker-trip LED on the front panel. The LED is lit whenever any breaker is tripped or switched off.

Modules used in the common-equipment shelves

The common-equipment shelves are the access bandwidth manager shelf and the transport bandwidth manager shelf. The two shelves use much of the same equipment. Each shelf has a two-level layout, as shown in Figure 4-1 and Figure 4-2.

In the access and transport bandwidth manager shelves, the lower-level slots accept circuit packs and cards that are 11.5 in. high and 10.15 in. deep, and the upper-level slots accept cards that are 2.25 in. high and 7.1 in. deep. All the circuit cards plug in to the shelf backplane.

Figure 4-1
Layout of the access bandwidth manager shelf, with slot numbers shown

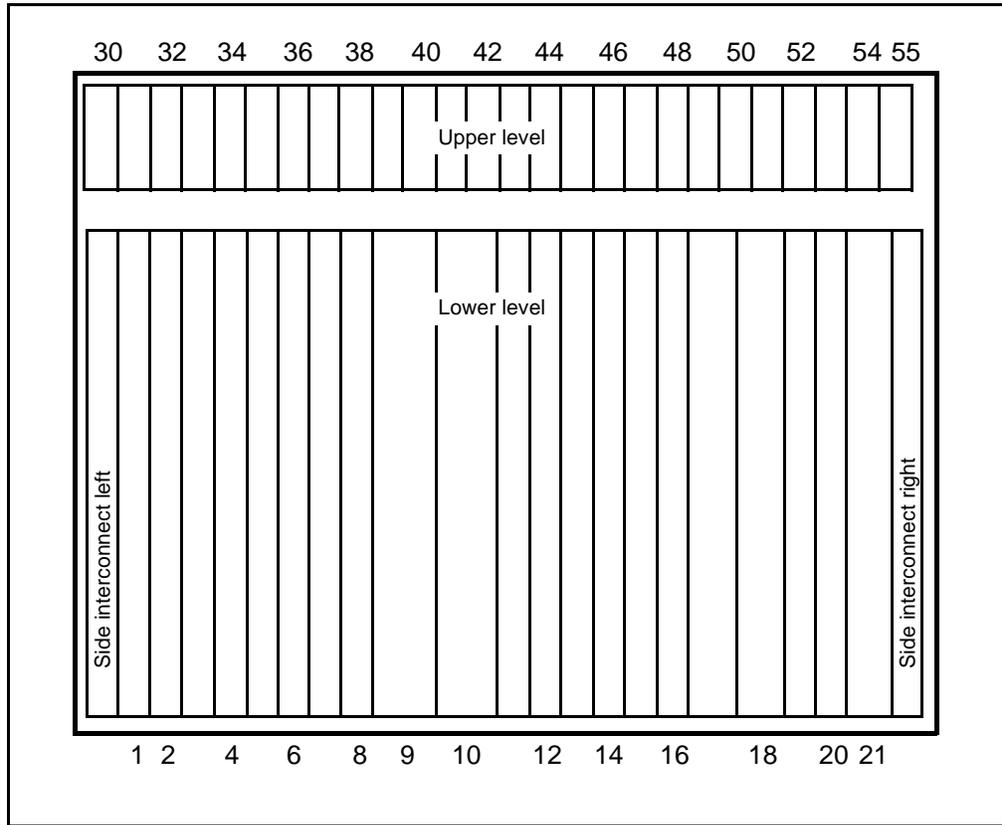
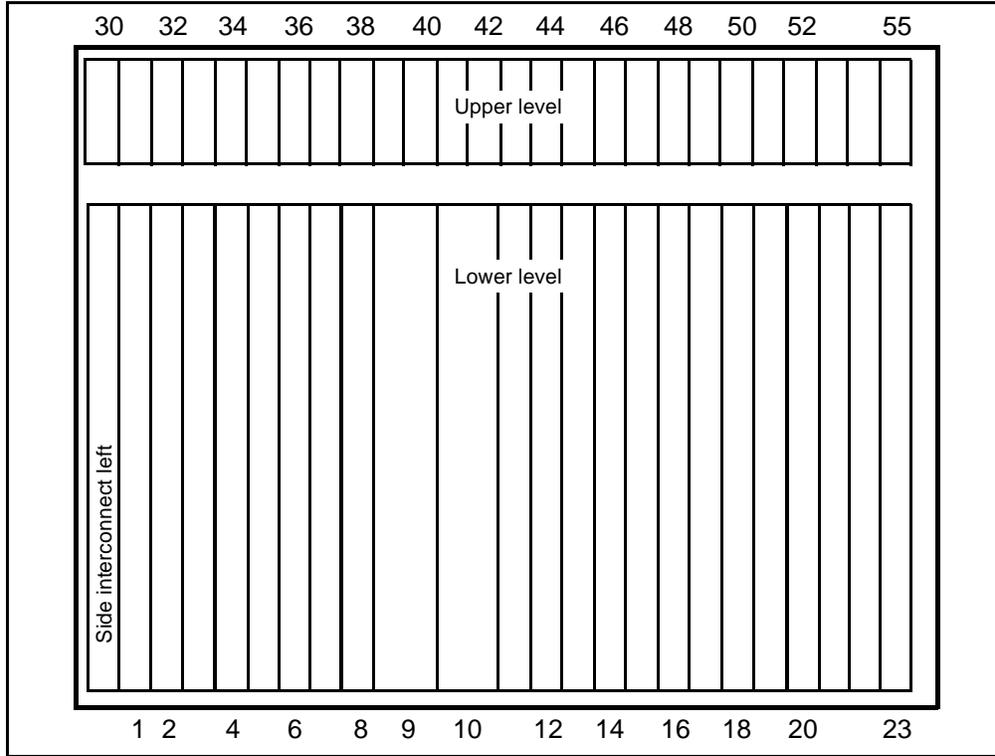


Figure 4-2
Layout of the transport bandwidth manager shelf, with slot numbers shown



As shown in Figure 4-1 and Figure 4-2, the lower-level slots in the access bandwidth manager shelf are numbered from 1 to 21, and those in the transport bandwidth manager shelf are numbered from 1 to 23. In both shelves, the upper-level slots are numbered from 30 to 55.

Note: As shown in Figure 4-1 and Figure 4-2, the slots containing the side interconnect circuit packs are unnumbered. These slots are unnumbered because the side interconnect circuit packs are parts of the shelf assemblies.

The access bandwidth manager shelf interfaces to OC-12 or OC-3 optical signals and DS1 and DS3 digital signals. The transport bandwidth manager shelf interface to OC-12 or OC-3 optical signals and DS1, DS3, and STS-1 digital signals. The functional difference between the two is that the access bandwidth manager shelf also supports narrowband services offered over conventional copper loops, but the transport bandwidth manager shelf does not. Because the transport bandwidth manager shelf does not support copper-based services, it can accommodate greater numbers of digital or optical interfaces than can the access bandwidth manager shelf.

For more information about the access bandwidth manager shelf and the transport bandwidth manager shelf, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

For an alphabetical list of the plug-in modules that can be installed in the access bandwidth manager shelf and the transport bandwidth manager shelf, see *Configuration and Equipment Description*, 323-3001-100, in this volume. For detailed information about a specific plug-in module, see Chapter 5 of this document.

Plug-in modules used in the copper-distribution shelf

Copper-distribution shelves are used in AccessNodes that interface to copper lines. In RFTs, the copper-distribution shelves interface to subscribers' copper lines. In FCOTs, the copper-distribution shelves interface to analog switches (or digital switches with analog interfaces).

Plug-in modules outside of the copper-distribution drawers

Of the plug-in modules used in the shelf, the copper-distribution-shelf power (CDSP) converters and power bridge circuit packs are the only ones that are not housed in the copper-distribution drawers. Every copper-distribution shelf has two (CDSP) converters. These units are located in the middle of the shelf, between the two copper-distribution drawers. Figure 4-3 shows the layout of the copper-distribution shelf power converters in a copper-distribution shelf.

Copper-distribution shelf power converters

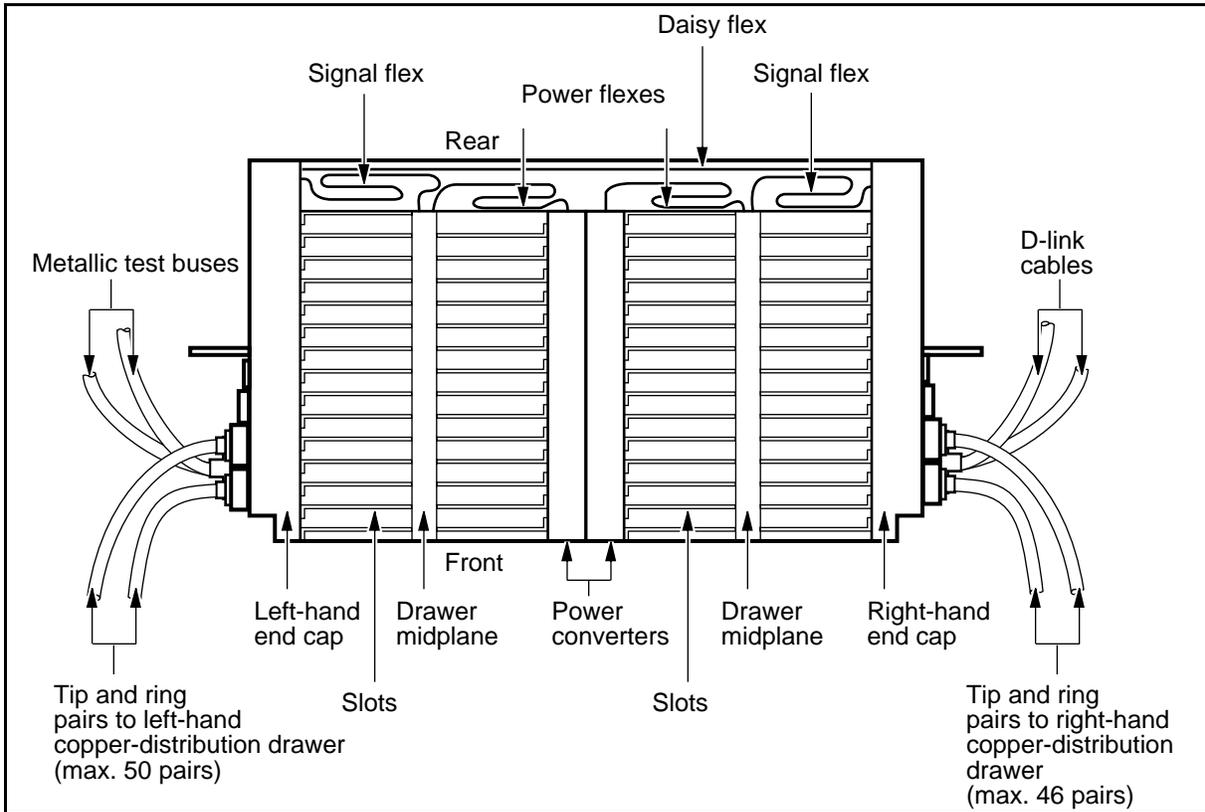
The copper-distribution shelf power (CDSP) converter converts the -48 V dc office supply to the specific regulated dc voltage levels required by the local circuitry.

Plug-in modules in the copper-distribution drawers

Most of the plug-in modules used in the copper-distribution shelf are housed in front-accessible pull-out copper-distribution drawers. Each drawer has a midplane running down the middle from front to back. The modules plug into slots on the sides of the midplane. Figure 4-3 shows the layout of the copper-distribution shelf and the drawers.

Figure 4-3
Top view of the copper-distribution shelf

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The modules that install in the copper-distribution drawers fall into the following categories: line cards and common-equipment modules.

Line cards

Line cards support the services that are offered over copper lines. The following types of line cards are used:

- Epsilon station line card
- Omega 2-wire station line card
- Omega 2-wire office line card
- Omega 4-wire line card
- Omega 6/8-wire line card
- Manual ringdown 2-wire line card
- Universal voice grade (UVG) station line card

For detailed information on the line cards, see Chapter 6 of this document.

Common-equipment modules in the copper-distribution drawer

Each copper-distribution drawer contains the following common-equipment modules:

- two narrowband line-interface cards (NLICs)
- one metallic test access card (for CDSs mounted in bays)
- one power filter

For detailed information on these modules, see Chapter 6 of this document.

Equipment in the common-equipment shelves

This chapter contains information about the circuit packs and cards that install in the access bandwidth manager shelf, and in the transport bandwidth manager shelf.

The access bandwidth manager shelf and the transport bandwidth manager shelf accept many of the same modules. Consequently, much of the material in this chapter is relevant to both types of shelf.

The modules discussed in this chapter are sequenced in alphabetic order. To find information on a specific module, consult the contents list below and refer to the appropriate page. For each module, the chapter contents shows whether it can be used in one or the other of the shelves, or in both.

Chapter contents

This chapter contains the following information:

Topic	See page	Shelf type where used:	
		Access	Transport
Access interface card	5-3	Yes	No
BNC I/O card	5-8	Yes	Yes
Common-equipment power card	5-14	Yes	Yes
Digital test access pair	5-15	Yes	No
DS1 input card	5-20	Yes	Yes
DS1 output card	5-22	Yes	Yes
DS1 protection bridge card	5-24	Yes	Yes
DS1 mapper	5-25	Yes	Yes
DS3 protection switch card	5-30	Yes	Yes
DS3 mapper	5-33	Yes	Yes
STS-1 mapper	5-37	No	Yes
External synchronization interface card	5-40	Yes	Yes
Integrated remote test unit	5-49	Yes	No
Maintenance interface card	5-55	Yes	Yes
OC-12 interface circuit pack	5-64	Yes	Yes
OC-12 VTBM circuit pack	5-71	Yes	Yes
OC-3 interface circuit pack	5-79	Yes	Yes
Operations controller (OPC) module	5-80	Yes	Yes
PGTC/MTA card	5-89	Yes	No
Processor card	5-91	Yes	Yes
Serial I/O card	5-95	Yes	No
Test access card	5-97	Yes	No
Test access path card	5-101	Yes	No
Test bypass pair card	5-103	Yes	No
Timing and cross-connect card	5-105	Yes	No
Transport interface card	5-111	Yes	No

Access interface card (NT4K55)

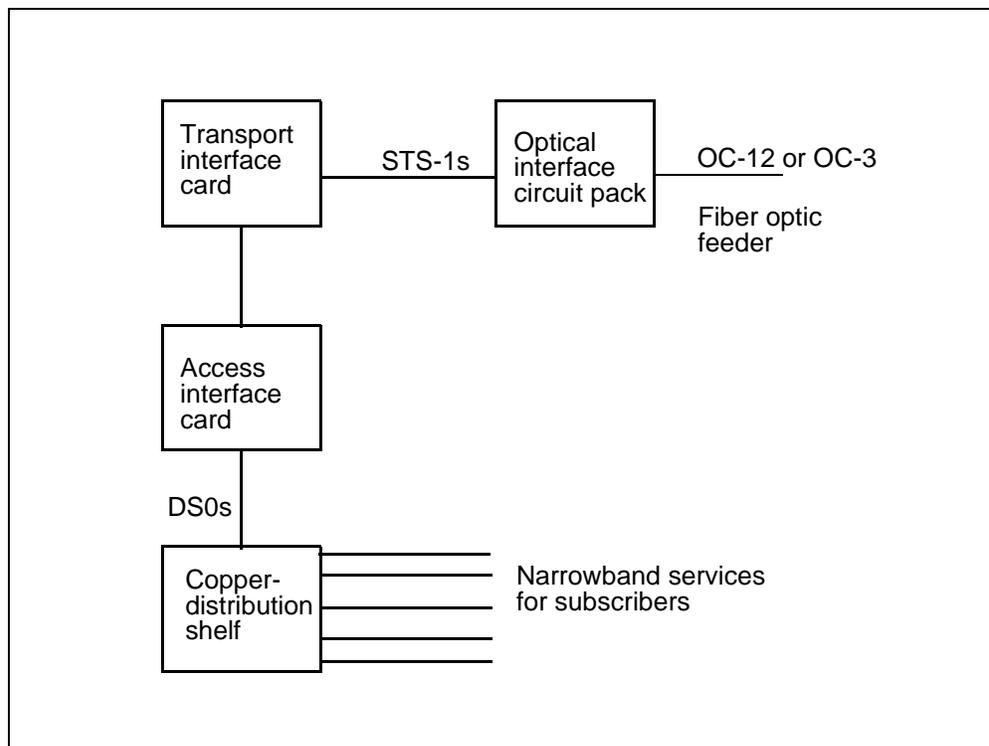
Access interface cards (AICs) install in the lower level of the access bandwidth manager shelf. Access interface cards are required in each access bandwidth manager shelf that supports one or more copper-distribution shelves.

The access interface cards interface between the working transport interface card and the equipment in the copper-distribution shelves. All the narrowband services from the copper-distribution shelves enter the access bandwidth manager shelf by way of the access interface cards, as shown in Figure 5-1.

The access interface cards are the central access point in the access bandwidth manager shelf for the DS0 channels carrying narrowband services. They provide the DS0-level bandwidth management, the messaging buffers for communication with the line cards in the copper-distribution shelves, and the D-link interfaces.

Figure 5-1

Each access interface card interfaces to the working transport interface card and to the copper-distribution shelves



Functional description

The access interface card is the central access point for all DS0-level pulse code modulation (PCM) and messaging in the access bandwidth manager shelf.

On the access side, the access interface card interfaces to the copper-distribution shelves by way of the D-links. (For detailed information about the copper-distribution shelves, see Chapter 6.)

On the transport side, the access interface card interfaces to the transport interface card by way of the T-link. The transport interface card interfaces to the optical interface circuit pack (OC-12 or OC-3), which interfaces to the fiber optic feeder.

For messaging, control, and maintenance, each access interface card interfaces to the processor card and to the maintenance interface card by way of the CBUS and the communication overhead bus (COH bus).

DS0 timeswitching on the access interface card

Each access interface card has a DS0 switching matrix that allows full nonblocking timeslot interchange between any DS0 channel on the access side and any DS0 channel on the transport side. The channels on the access side go to the line cards in the copper-distribution shelves by way of the D-links. The channels on the transport side go to the transport interface card by way of the T-link.

The DS0 switching matrix can handle all the DS0 traffic that a fully equipped AccessNode can support.

Signal flow from the copper-distribution drawers toward the transport interface card

DS0 signals from the line-interface cards in the copper-distribution drawers flow through the access interface card toward the working transport interface card. From each copper-distribution drawer, the DS0 signals travel from the working narrowband line interface card (NLIC) to one of the access interface cards. (In each drawer there are two NLICs, one on the left of the drawer midplane, and one on the right. One D-link links the left-hand NLIC to the access interface card in slot 13 of the access bandwidth manager shelf; another D-link links the right-hand NLIC to the access interface card in slot 16.)

The DS0 signals go to the access-side timeslots in the transmit DS0 timeswitches in the access interface cards. From the transport-side timeslots of each timeswitch, the DS0 signals travel by way of a T-link to the working and protection transport interface card.

Signal flow from the transport interface card toward the copper-distribution shelves

DS0 signals from the working transport interface card arrive at the transport-side timeslots of the receive DS0 timeswitches in the access interface cards. The DS0s travel from the transport interface card to the access interface cards by way of the T-links. The DS0s travel from the access interface cards to the copper-distribution shelves by way of the D-links.

Bus connections

This section explains the following types of bus connections:

- Control bus (CBUS)
- Maintenance Overhead bus (MOH bus)
- Communication Overhead bus (COH bus)

CBUS

Each access interface card is connected to the control bus (CBUS). CBUS is the means of accessing all the circuit packs and cards in the access bandwidth manager shelf.

MOH bus

The Maintenance Overhead bus (MOH bus) links each access interface card to the test access card and to the maintenance interface card.

The connection by way of the MOH bus allows the test access card to access the DS0 timeswitches for test access and trunk conditioning.

COH bus

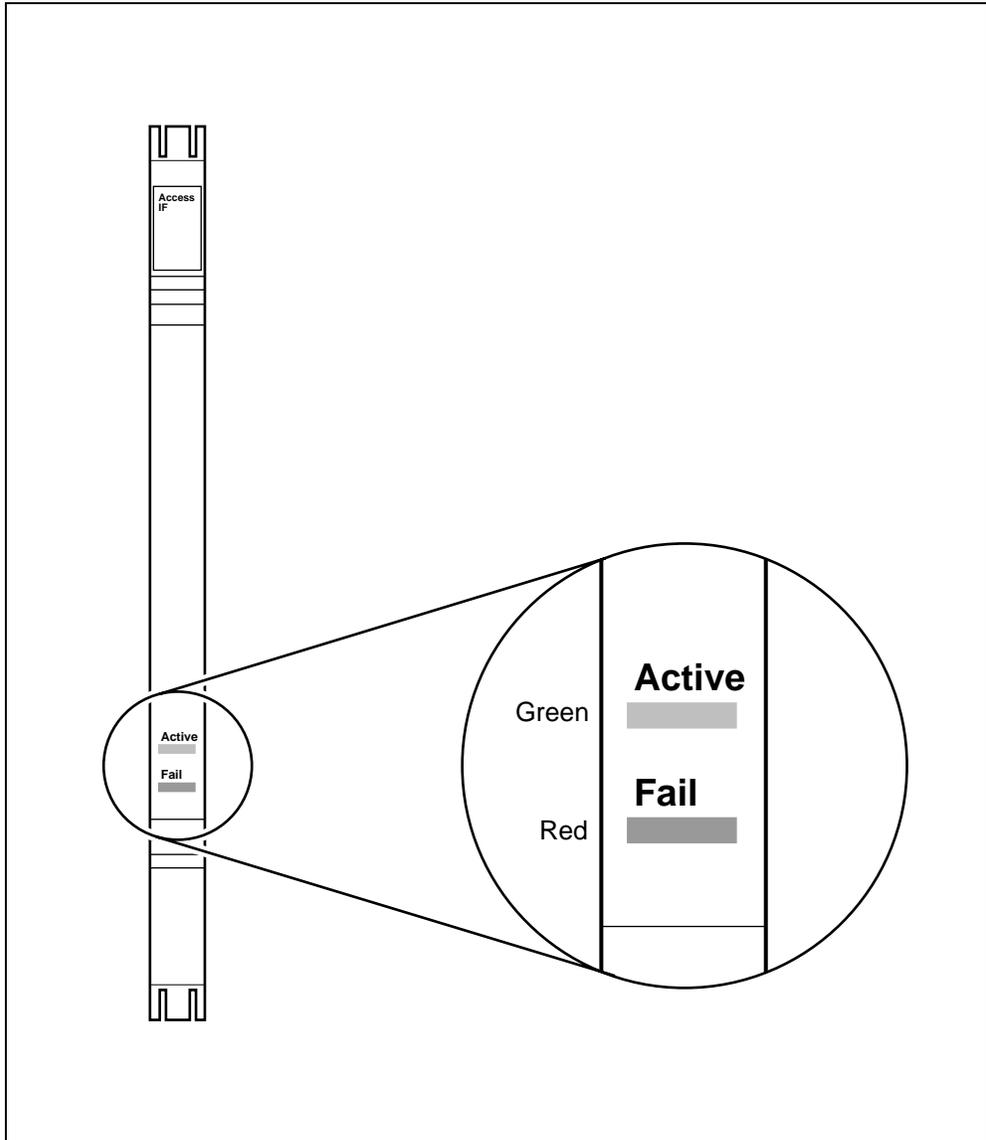
The communication overhead bus (COH bus) links each access interface card and each processor card. The bus carries communications channels that carry SONET overhead: the common signaling channel (CSC) and the embedded operations channel (EOC).

Physical appearance of the access interface card

The access interface card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-2 shows the front view of the access interface card.

Figure 5-2
Front view of the access interface card

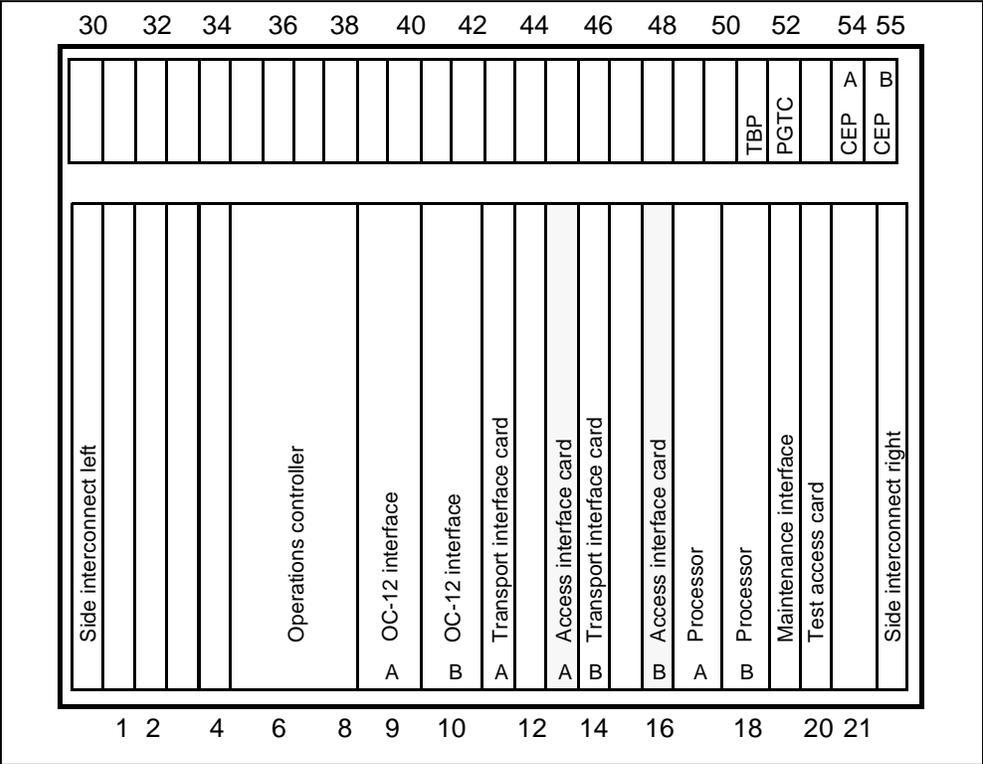
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Equipping rules

As shown in Figure 5-3, access interface cards install in slots 13 and 16 in the lower level of the access bandwidth manager shelf.

Figure 5-3
Where the access interface cards install in the access bandwidth manager shelf in an FCOT



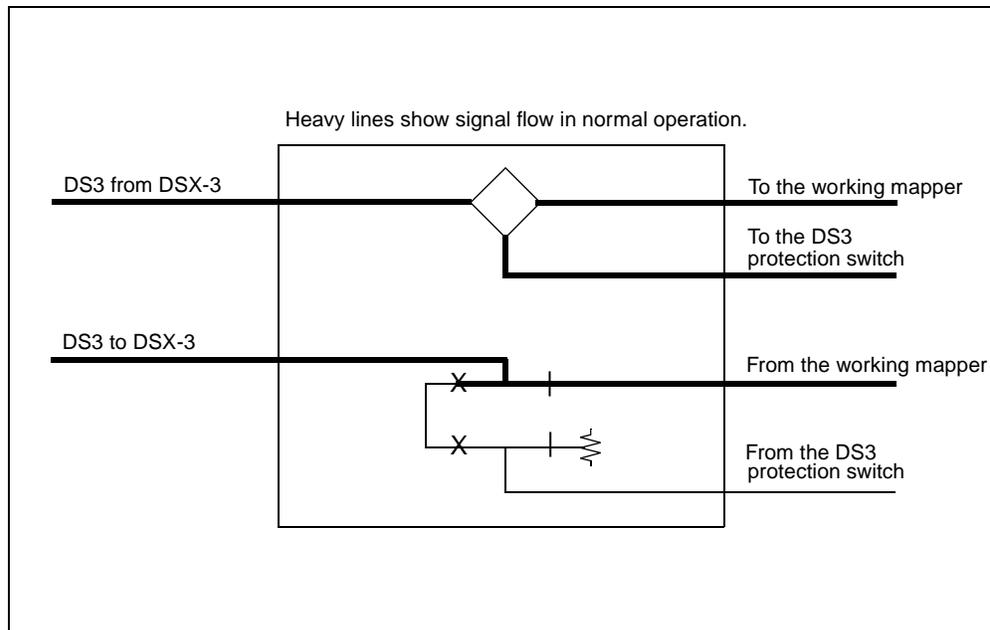
BNC I/O card (NT4K30)

The BNC I/O card installs in the upper level of an access bandwidth manager shelf or a transport bandwidth manager shelf. Each BNC I/O card handles both directions of one DS3 line: one DS3 coming into the AccessNode, and one DS3 going out. An input DS3 signal enters the AccessNode, goes to the BNC I/O card, and then to the associated DS3 mapper. An output DS3 signal goes from the DS3 mapper to the associated BNC I/O card, and then out of the AccessNode.

Functional description

Each BNC I/O card has a splitter that sends the DS3 signal to both the associated DS3 mapper and to the optional DS3 protection switch card. Each DS3 I/O card can receive signals either from the associated DS3 mapper or from the optional protection mapper (by way of the DS3 protection switch card). Figure 5-4 shows these connections.

Figure 5-4
Block diagram of the BNC I/O card



In normal operation, signal flow is as follows. An incoming DS3 signal goes through the splitter on the BNC I/O card, and then goes to the associated DS3 mapper. The signal that goes to the DS3 protection switch card is grounded on that card. The BNC I/O card receives a DS3 signal from the associated DS3 mapper, but does not receive any signal from the DS3 protection switch card.

If a protection-switching request occurs for the working DS3 mapper, the following occurs. The relays on the DS3 protection switch card close, to route the incoming DS3 traffic to the protection mapper. After the protection mapper

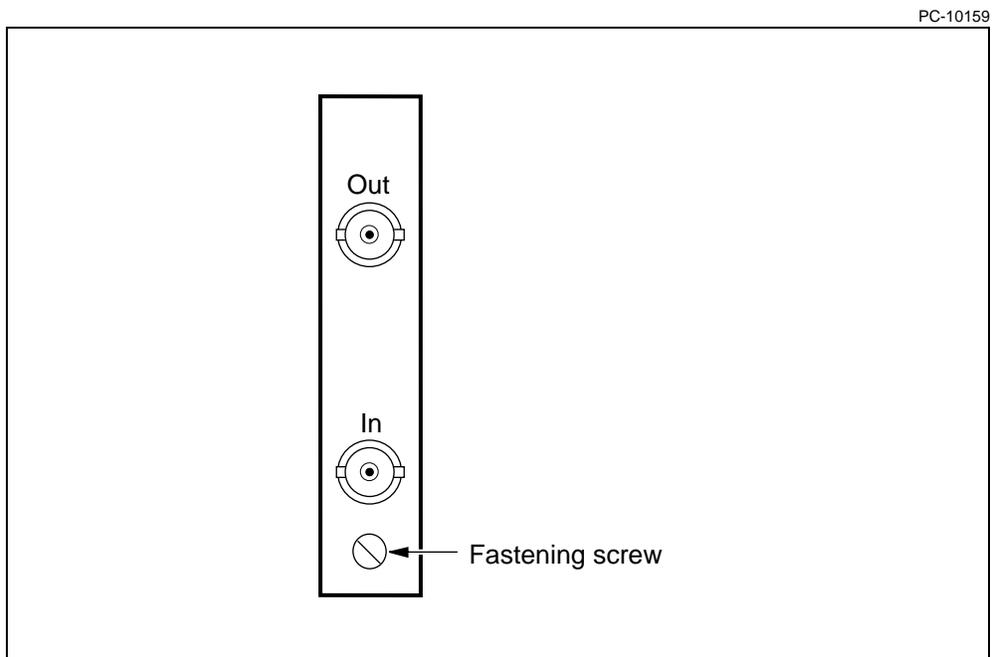
has been synchronized to the incoming DS3s, the relay on the BNC I/O card interrupts traffic coming from the working mapper, and accepts the traffic that comes from the protection mapper by way of the DS3 protection switch card.

Note: Each working DS3 mapper may be associated with up to three BNC I/O cards. A protection-switching request for the mapper affects each associated BNC I/O card as described above.

Physical appearance of the BNC I/O card

The BNC I/O card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. The card has two BNC-type connectors on the front. Figure 5-5 shows the front view of the BNC I/O card.

Figure 5-5
Front view of the BNC I/O card



Equipping rules for the access bandwidth manager shelf

An access bandwidth manager shelf can accommodate up to nine BNC I/O cards, as shown in Figure 5-6. Each card handles both directions of one DS3 line, and each set of three cards handles all the input and output for a DS3 mapper.

In the access bandwidth manager shelf, sets of three BNC I/O cards install in slots 34, 35, and 36, slots 38, 39, and 40, and slots 42, 43, and 44. Each set of three cards is associated with a specific DS3 mapper. Each mapper and its associated I/O cards compose a DS3 circuit-pack group, and each group is identified by a group number. Table 5-1 lists the slots and the group numbers.



CAUTION

Untraceable failures

BNC I/O cards should be installed only in the intended slots, and only if DS3 mappers are installed in the associated lower-level slots. If you install a BNC I/O card in the wrong slot, or install one without an associated mapper, failures may occur, and the resulting logs and alarms may not point to the improperly installed card.

Figure 5-6
Where the BNC I/O cards install in the access bandwidth manager shelf

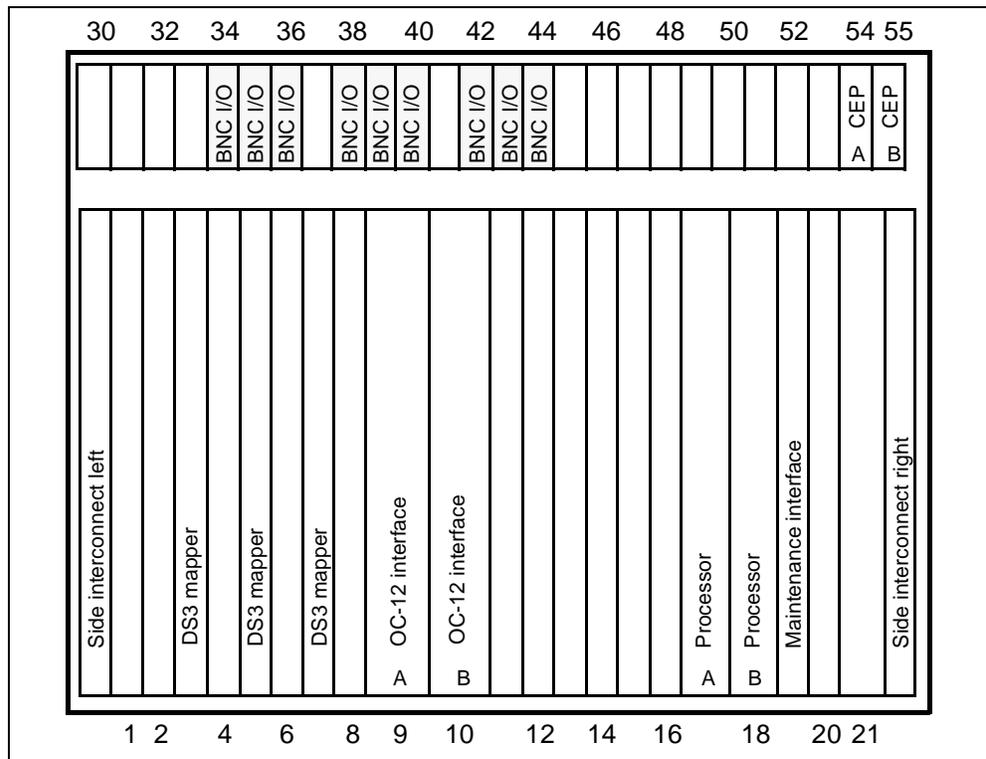


Table 5-1
DS3 circuit-pack groups in the access bandwidth manager shelf

	DS3 mapper	BNC I/O cards
Group 1	slot 3	slots 34, 35, 36
Group 2	slot 5	slots 38, 39, 40
Group 3	slot 7	slots 42, 43, 44

Equipping rules for the transport bandwidth manager shelf

A transport bandwidth manager shelf can accommodate up to 12 BNC I/O cards, as shown in Figure 5-7. Each card handles both directions of one DS3 line, and each set of three cards handles all the input and output for a DS3 mapper.

In the transport bandwidth manager shelf, sets of three BNC I/O cards install in slots 38, 39, and 40, slots 42, 43, and 44, slots 46, 47, and 48, and slots 50, 51, and 52. Each set of three cards is associated with a specific DS3 mapper. Each mapper and its associated I/O cards compose a DS3 circuit-pack group, and each group is identified by a group number. Table 5-2 lists the slots and the group numbers.



CAUTION

Untraceable failures

BNC I/O cards should be installed only in the intended slots, and only if DS3 mappers are installed in the associated lower-level slots. If you install a BNC I/O card in the wrong slot, or install one without an associated mapper, failures may occur, and the resulting logs and alarms may not point to the improperly installed card.

Figure 5-7
Where the BNC I/O cards install in the transport bandwidth manager shelf

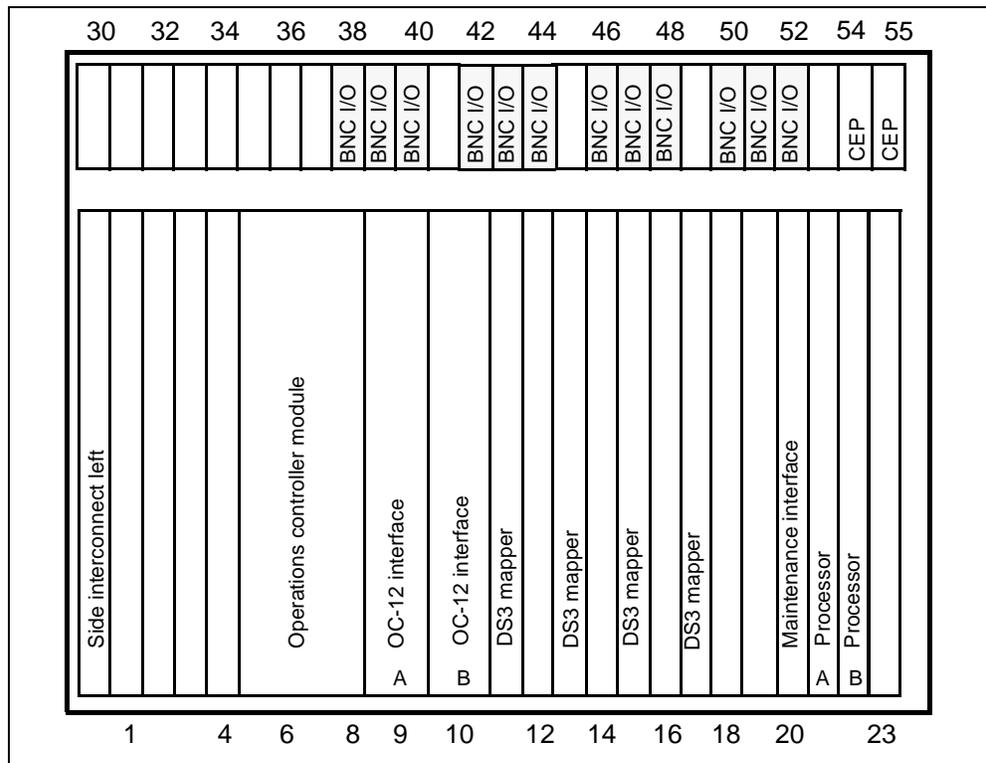


Table 5-2
DS3 circuit-pack groups in the transport bandwidth manager shelf

	DS3 mapper	BNC I/O cards
Group 1	slot 11	slots 38, 39, 40
Group 2	slot 13	slots 42, 43, 44
Group 3	slot 15	slots 46, 47, 48
Group 4	slot 17	slots 50, 51, 52

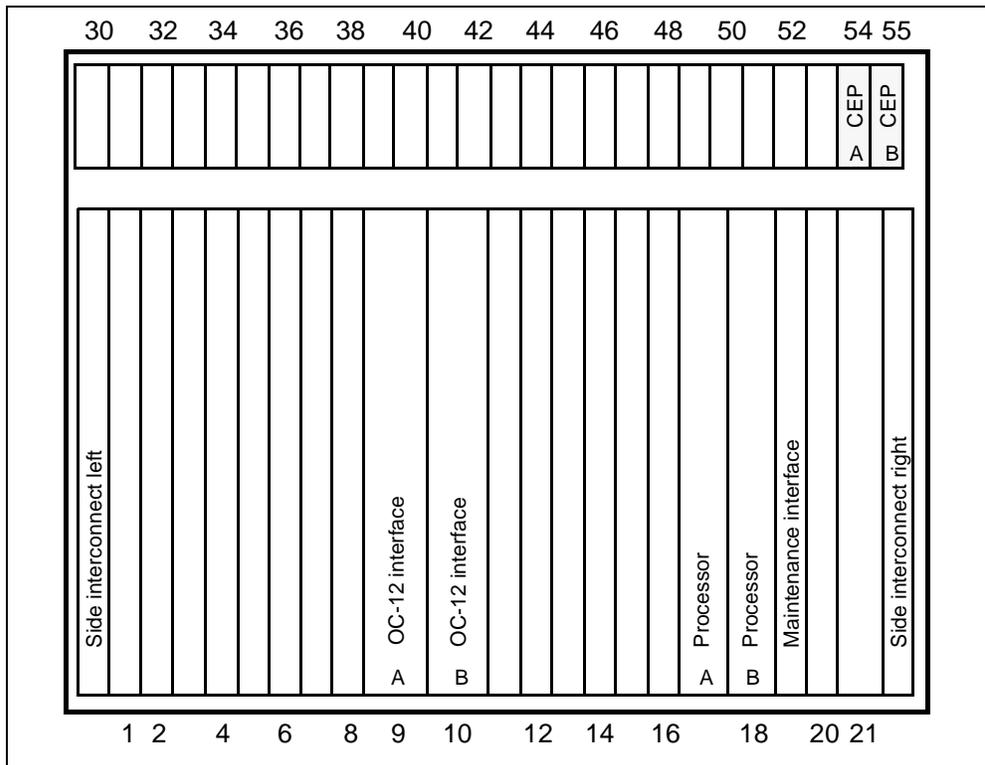
Common-equipment power card (NT4K58MA)

The common-equipment power (CEP) card interfaces the -48 V dc local battery feed to an access bandwidth manager shelf or a transport bandwidth manager shelf. The power cables from the breaker interface panel plug into the front of the common-equipment power card. Two common-equipment power cards are installed.

Equipping rules

In both the access bandwidth manager shelf and the transport bandwidth manager shelf, common-equipment power cards install in slots 54 and 55. Figure 5-8 shows the location of the cards, using an access bandwidth manager shelf as an example.

Figure 5-8
Where the CEPs install in the access bandwidth manager shelf



Digital test access pair (NT4K57GA & GB)

The digital test access pair (DTAP) provides one or two digital test bypass pairs from the central office (CO) to an AccessNode remote mechanized loop tester (MLT). It is available in two versions:

- single circuit (NT4K57GA)
- dual circuit (NT4K57GB)

Capabilities

The DTAP will integrate Tollgrade Communications' DTAP circuits for emulating a test bypass pair. Two DTAP circuits will be provisionable at a remote digital terminal (RDT) on the access bandwidth manager (ABM) shelf. The host DTAP could be residing in slot 21 of a single-ended AccessNode (SEAN) or it could be residing in a channel bank. The DTAP pack will support the emulation of two test bypass pairs. Each remote DTAP circuit will communicate with a corresponding unit at the host side using two DS0 channels.

Provisioning

The DTAP can be provisioned using CI commands. *See Installing or Replacing the Digital Test Access Pair Quick Reference Card, P0904831*

Configurations

The use of DTAP circuits for emulating test bypass pairs reduces the maximum measurable looplength possible with MLT testing. There are three types of DTAP configurations:

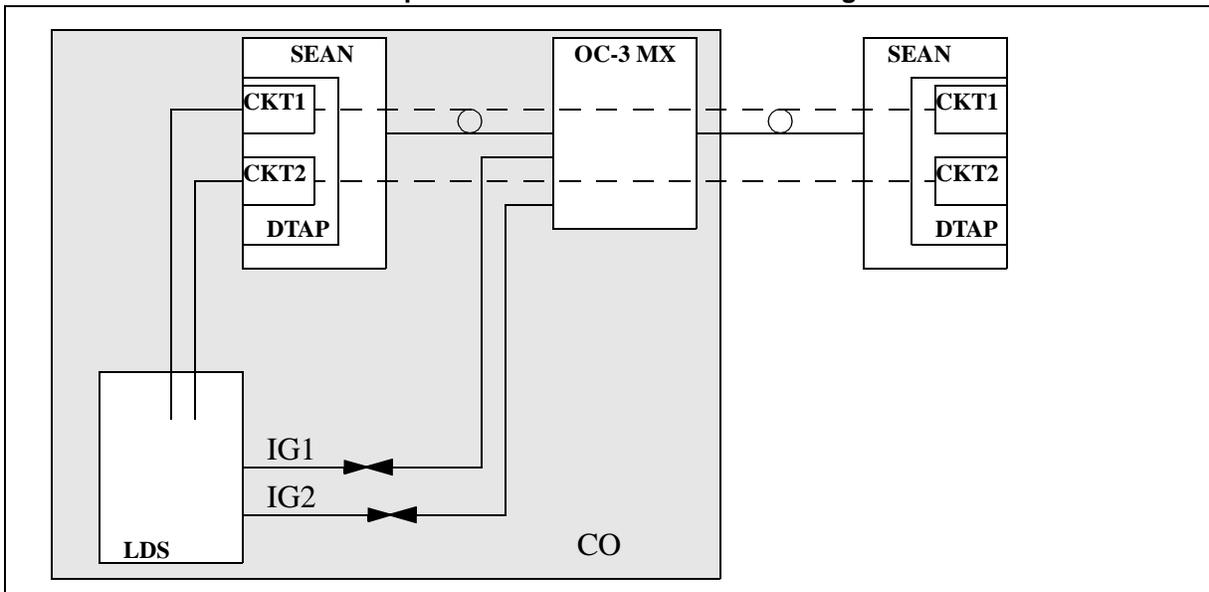
- Two host DTAP circuits nailed up to corresponding two DTAP circuits at the remote
- Two host metallic channel units (MCUs) nailed up to two remote DTAP circuits
- A pair gain test controller with an MCU in a channel bank nailed up to a DTAP at the RDT

Two host DTAP circuits

Two consecutive DS0 channels from a single DS1 will be assigned to maintain nailed up connectivity between DTAP circuits. DTAP circuits should not be configured in CO SEANs with subscriber line terminations. The reason is it removes the ability to perform line loop testing on the CO SEAN subscribers. If a CO SEAN has subscribers, then two MCUs in a channel bank should be used to connect to the two DTAP circuits at the remote. See Figure 5-9.

Figure 5-9 shows two host DTAP circuits nailed up to two corresponding DTAP circuits at the remote.

Figure 5-9
Two host DTAP circuits nailed up to two remote DTAP circuits using SEANs

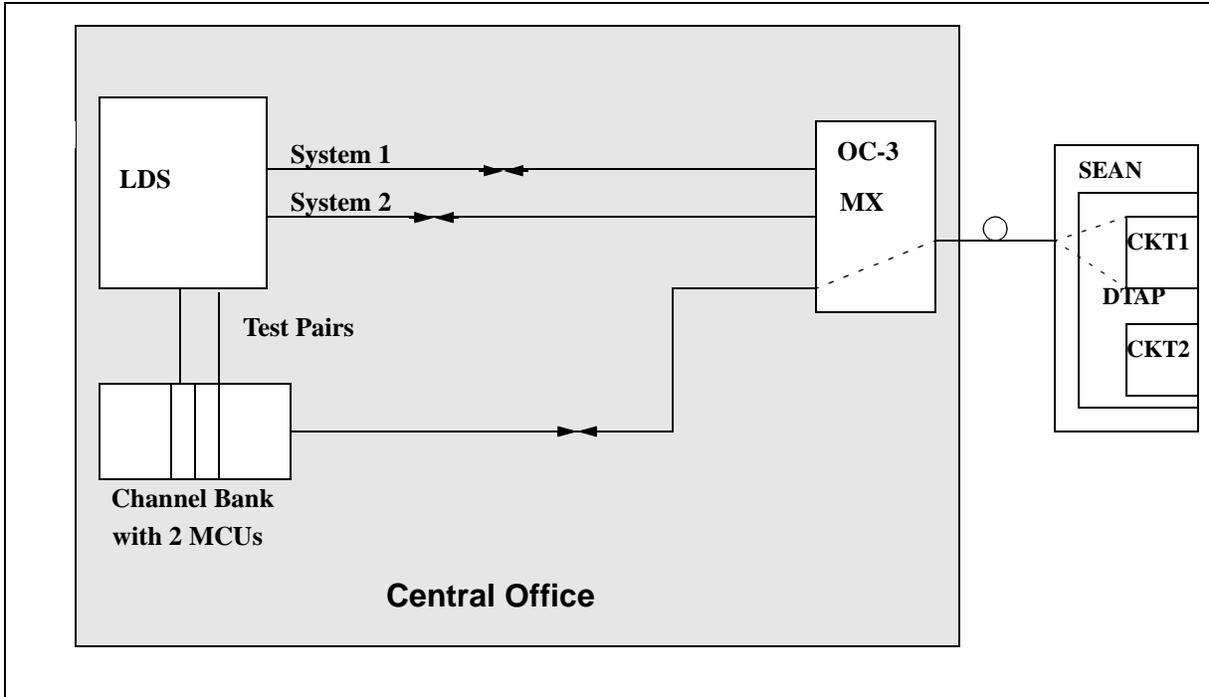


Two host MCUs

Two consecutive DS0 channels from a single DS1 will be assigned to maintain nailed up connectivity between a DTAP circuit and an MCU. See Figure 5-10.

Figure 5-10 shows two host MCUs in a channel bank nailed up to two corresponding DTAP circuits at the remote.

Figure 5-10
Two host MCUs nailed up to two remote DTAP circuits



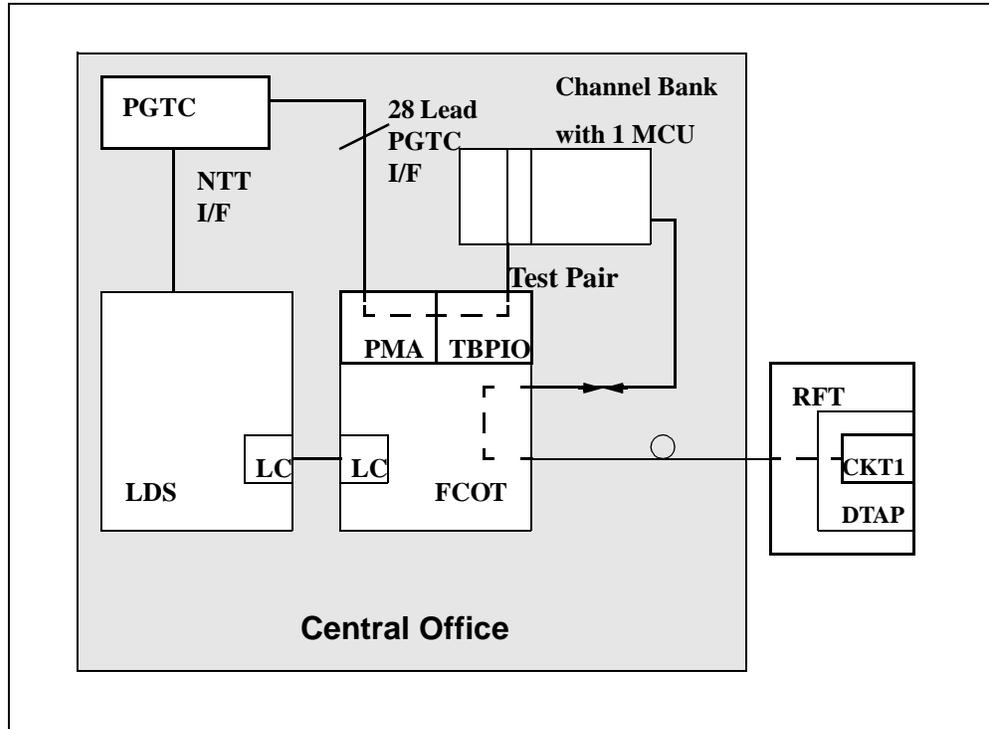
Pair gain test controller

DTAP circuits will be supported at the RDT in universal pair gain configurations. See Figure 5-11.

Figure 5-11 shows a pair gain test controller configuration with an MCU in the channel bank.

Figure 5-11

Pair gain test controller configuration with MCU in a channel bank and DTAP at RDT



DS1 input card (NT4K32)

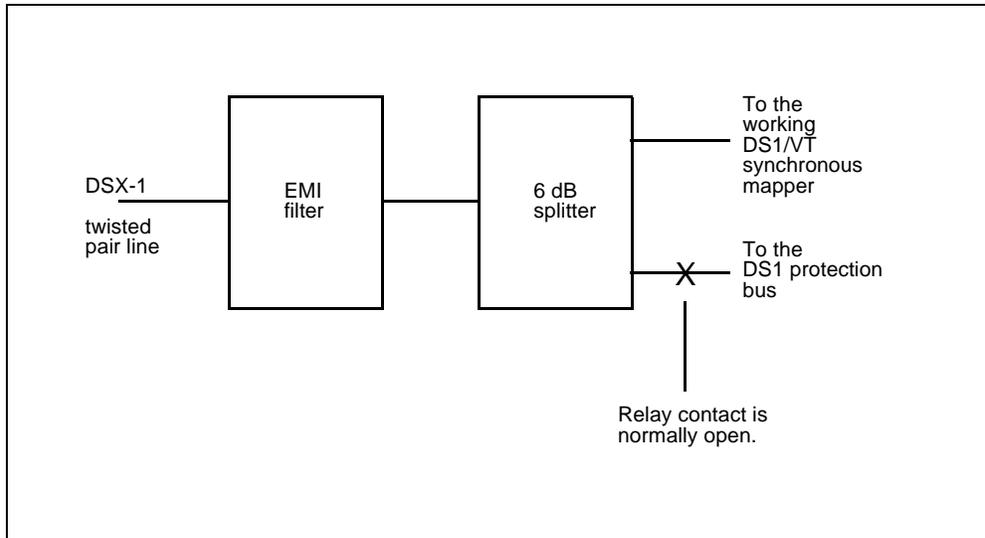
The DS1 input card installs in the upper level of an access bandwidth manager shelf or a transport bandwidth manager shelf. For each working DS1 mapper in the lower level of the shelf, there must be one DS1 input card and one DS1 output card in the upper level. Each DS1 input card handles 14 DS1 channels of input, that is, all the DS1 input to a DS1 mapper. Input DS1 signals enter the AccessNode, go to the DS1 input card, and then to the associated DS1 mapper.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Functional description

Figure 5-13 shows a block diagram of the DS1 input card. The card performs EMI filtering on the incoming DS1s. The signals go to a splitter and are routed to the associated working DS1 mapper and towards the DS1 protection bus in the shelf backplane. In normal operation, the signals do not reach the DS1 protection bus because an on-card relay is open. When a protection-switching request occurs for the associated working DS1 mapper, the relay closes and the DS1s go to the protection bus. (The DS1 protection bus routes the DS1s toward the protection DS1 mapper.)

Figure 5-13
Block diagram of the DS1 input card

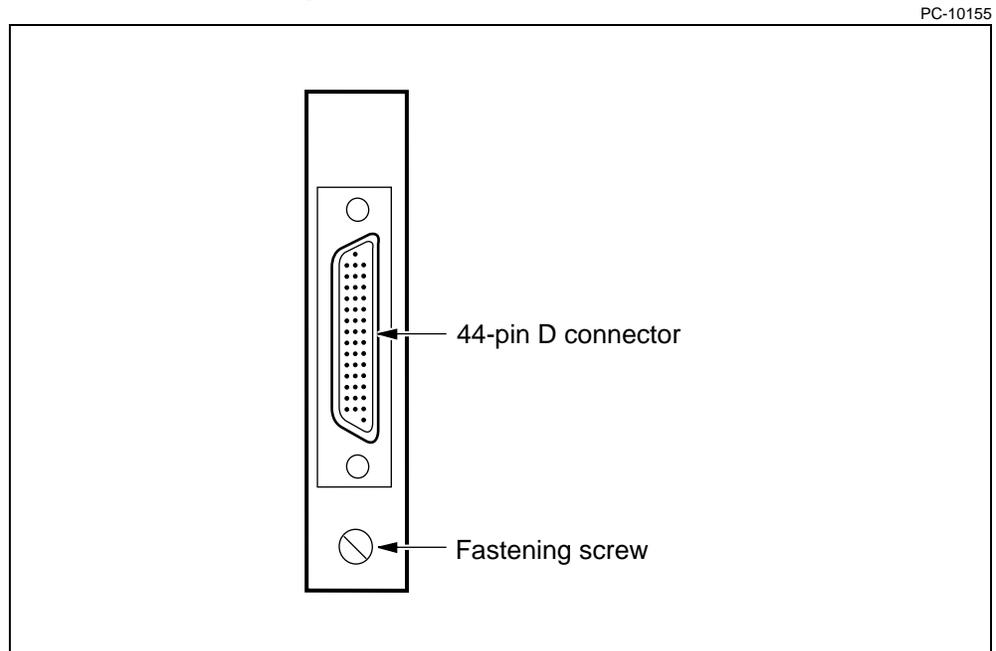


Physical appearance of the DS1 input card

The DS1 input card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-14 shows the front view of the DS1 input card.

This card has a D connector on the front.

Figure 5-14
Front view of the DS1 input card



DS1 output card (NT4K33)

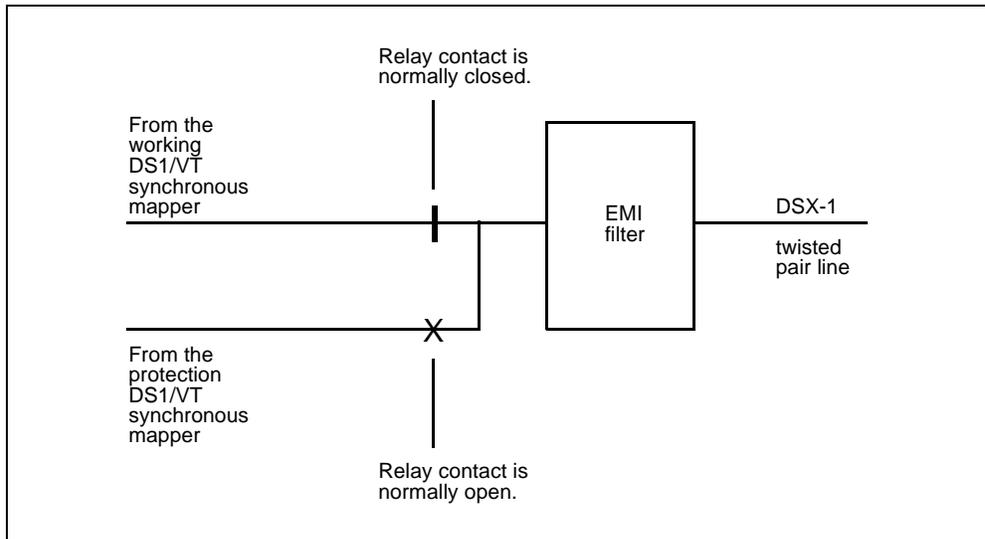
The DS1 output card installs in the upper level of an access bandwidth manager shelf or a transport bandwidth manager shelf. For each working DS1 mapper in the lower level of the shelf, there must be one DS1 output card and one DS1 input card in the upper level. Each DS1 output card handles 14 DS1 channels of output, that is, all the DS1 output from a DS1 mapper. Output DS1 signals go from the DS1 mapper to the associated DS1 output card, and then out of the AccessNode.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Functional description

Figure 5-15 shows a block diagram of the DS1 output card. The card is able to receive DS1s from either the associated working DS1 mapper or from the DS1 protection bus in the shelf backplane. In normal operation, it receives DS1s from the working mapper and not from the DS1 protection bus. When a protection-switching request occurs for the associated working mapper, the on-card relays break the connection to the associated working mapper and close the connection to the protection bus. The DS1 output card performs EMI filtering on the outgoing DS1s.

Figure 5-15
Block diagram of the DS1 output card

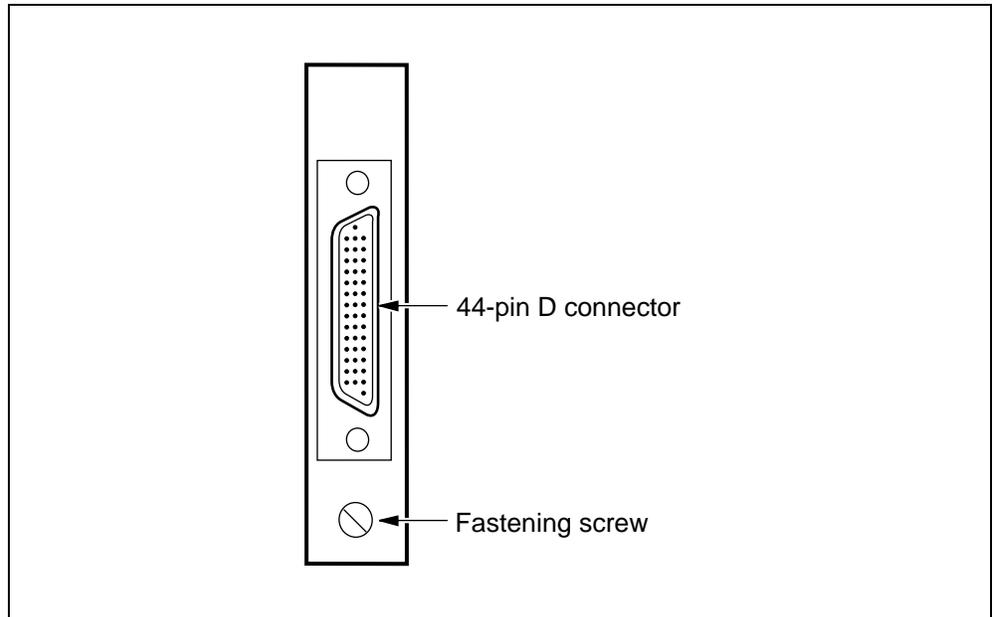


Physical appearance of the DS1 output card

The DS1 output card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-16 shows the front view of the DS1 output card.

This card has a D connector on the front.

Figure 5-16
Front view of the DS1 output card



DS1 protection bridge card (NT4K31)

The DS1 protection bridge card (DS1 PB) installs in the upper level of an access bandwidth manager shelf or a transport bandwidth manager shelf. You install the DS1 protection bridge cards in the upper-level slots that are associated with the lower-level slot that contains the protection mapper.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

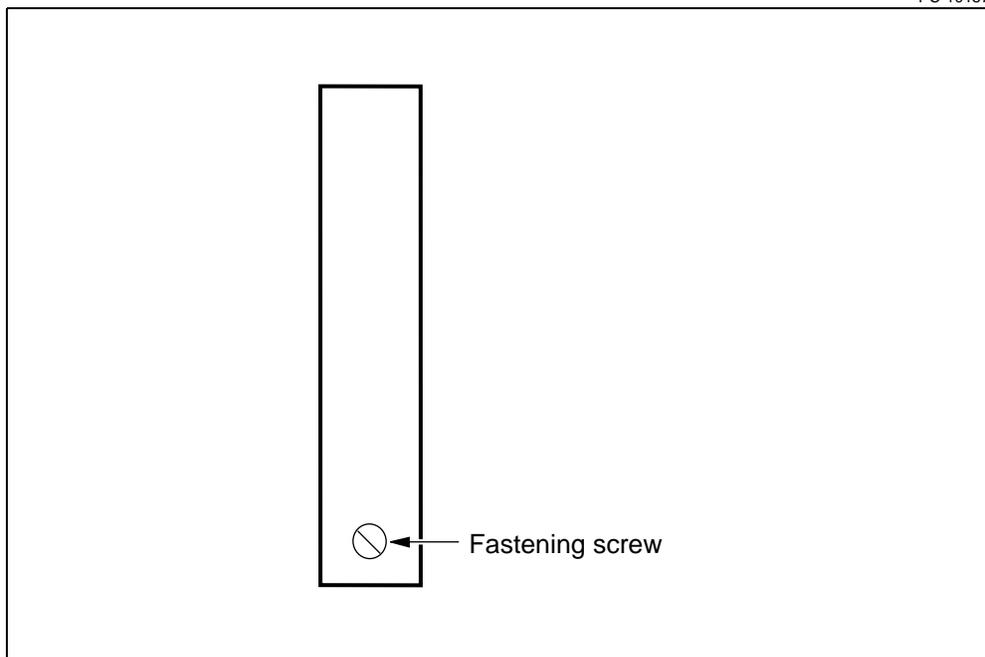
Functional description

The DS1 protection bridge card provides a connection between the DS1 protection bus in the shelf backplane and the DS1 mapper that is used as a protection unit. When a protection-switching request occurs for a working DS1 mapper, the DS1 input card associated with that mapper switches incoming DS1s to the protection bus, and the DS1 output card associated with that mapper switches to receive outgoing DS1s from the protection bus. The DS1 protection bridge card is the connector that bridges the protection bus to the tracks in the backplane that lead to the protection DS1 mapper.

Physical appearance of the DS1 protection bridge card

The DS1 protection bridge card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-17 shows the front view of the DS1 protection bridge card.

Figure 5-17
Front view of the DS1 protection bridge card



DS1 mapper (NT7E04)

The DS1 mapper installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. The DS1 mapper provides interface circuitry between the DS1 input and output cards and the optical interface circuit pack (OC-12 interface circuit pack, OC-12 VTBM interface circuit pack, or OC-3 interface circuit pack), or, in a DS1-fed RFT, between the DS1 input and output cards and the timing and cross-connect card. Each DS1 mapper can process up to 14 DS1 transmit and 14 DS1 receive signals independently. The DS1 mapper generates an STS-1 output from up to 14 DS1 signals. Each DS1 is mapped as a VT1.5, and the VT1.5s are multiplexed into an STS-1. The STS-1 goes to the optical interface circuit pack or to the timing and cross-connect card by way of the shelf backplane.

The NT7E04CA model of the mapper supports TR-08 DS1s. The mapper can operate in byte-synchronous mode, or in bit-synchronous or bit-asynchronous modes. (Bit-synchronous and bit-asynchronous modes are not generally used by AccessNode.) The byte-synchronous mode allows easy identification of the 24 DS0s in a VT1.5. This mode maintains the timing and phase of the signal throughout the network, and preserves superframe information. Byte-synchronous mode must be used if the mapper is to handle TR-08 DS1s.

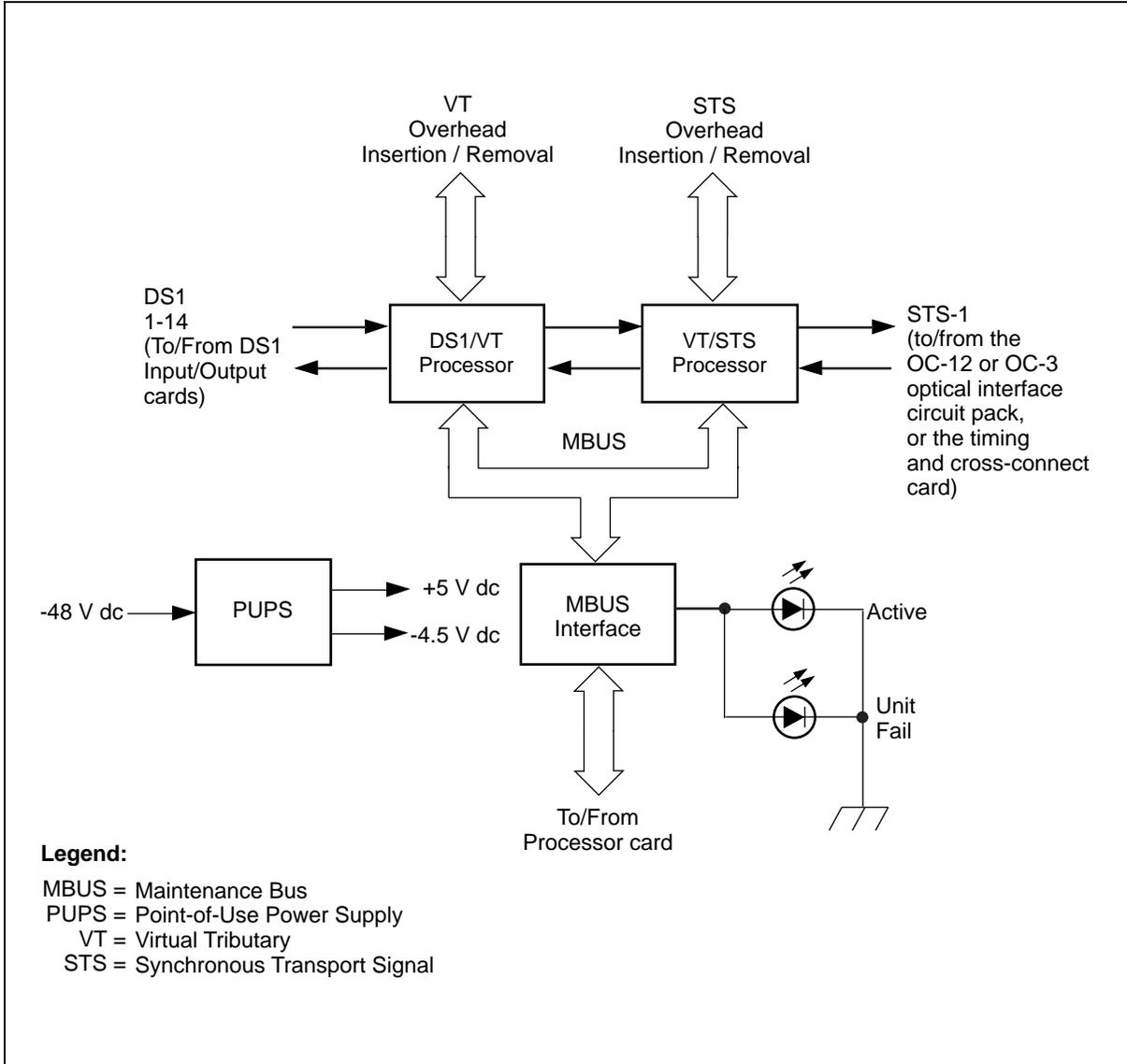
Loopbacks can be performed for link maintenance and fault detection. The line build-out (LBO) range selection is controlled by software and can be set to short (0–46 m or 0–150 ft), medium (46–137 m or 150–450 ft), or long (137–200 m or 450–655 ft). Both alternate mark inversion (AMI) line coding and bipolar 8-bit zero code suppression (B8ZS) line coding are accepted.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 5-18 is a block diagram of the DS1 mapper.

Figure 5-18
Block diagram of the DS1 mapper

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Signal flow for DS1s going into the optical or copper feeder

The 14 DS1 signals received from the DS1 input card are regenerated by a DS1/VT processor where DS1 clock recovery is performed using digital phase lock loops. The recovered clock is used in time-regenerating each DS1 line data.

Note: In a DS1-fed RFT, the mappers interface to a copper feeder rather than an optical feeder.

If the mapper is handling TR-08 DS1s, then the TR-08 maintenance and alarm messages are extracted from the derived data link in the TR-08 DS1s, and are put into reserved bytes in the VT1.5. (The derived data link is a communication channel for TR-08.

For a description of the derived data link, see page 3-11.) The VTs are byte-interleaved into a VT group that is sent to a VT/STS processor where each VT group is byte-interleaved into an STS-1 format. The STS path overhead is then added. The STS-1 signal is routed to the optical interface circuit pack, or, in a DS1-fed RFT, to the timing and cross-connect card.

Note: In a DS1-fed RFT, the mappers interface to a copper feeder rather than an optical feeder.

Signal flow for DS1s coming out of the optical or copper feeder

The STS-1 signal comes from the optical interface circuit pack, or, in a DS1-fed RFT, from the timing and cross-connect (TXC) card. The signal is sent to the VT/STS processor in the mapper. The STS path overhead is extracted and the STS-1 payload is demultiplexed into VT groups. The VT groups are sent to the DS1/VT processor where the DS1s are extracted and the VT path overhead is terminated.

Note: In a DS1-fed RFT, the mappers interface to a copper feeder rather than an optical feeder.

If the mapper is handling TR-08 DS1s, then the TR-08 maintenance and alarm messages are taken from the reserved bytes in the VT1.5, and are put into the derived data link in the TR-08 DS1s. (The derived data link is a communication channel for TR-08. For a description of the derived data link, see page 3-11.) The DS1s are then regenerated using a programmable LBO circuit.

Note: In a DS1-fed RFT, the mappers interface to one or more copper feeders rather than an optical feeder.

MBUS interface

The MBUS interface circuit (MBIF) provides software access to the DS1 mapper for control and status-monitoring purposes. (The DS1 mapper communicates by way of CBUS, but uses MBUS message protocol.)

The MBUS interface circuit controls the Active and Fail LEDs on the mapper (shown in Figure 5-19 on page 5-29), and broadcasts signals on the backplane to confirm that the mapper is present in the shelf.

Point-of-use power supply (PUPS)

The DS1 mapper is equipped with its own point-of-use power supply module (PUPS). The PUPS converts the -48 V dc office power supply to the specific regulated direct-current voltage levels required by the local circuitry.

Bus connections

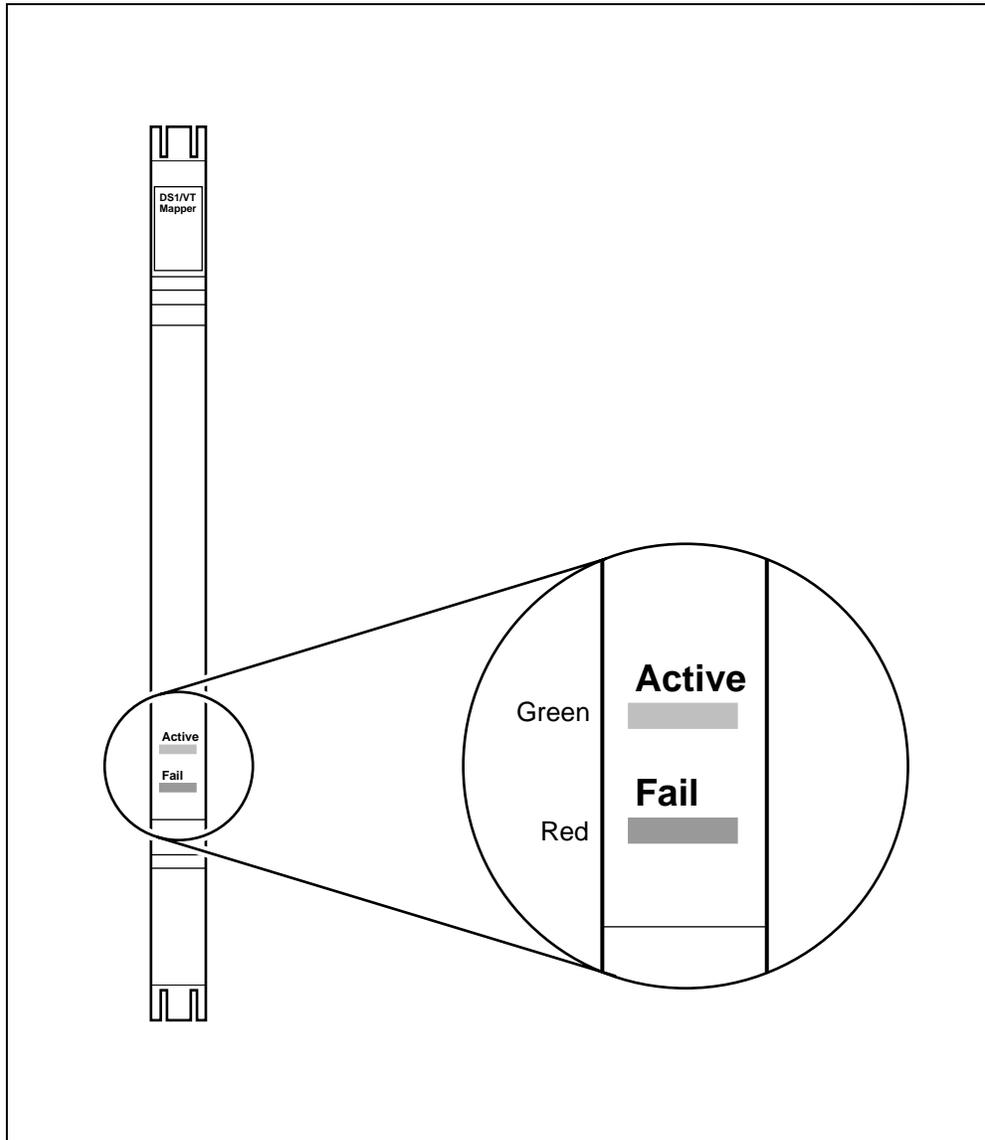
The DS1 mapper is connected to the CBUS. (The DS1 mapper communicates by way of CBUS, but uses MBUS message protocol.) Control and status monitoring for the mapper is done by the processor card.

Physical appearance of the DS1 mapper

The DS1 mapper is 11.5 in. (29.21 cm) high by 10.1 in. (25.65 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-19 shows the front view of the DS1 mapper.

Figure 5-19
Front view of the DS1 mapper

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DS3 protection switch card (NT4K60)

The DS3 protection switch card installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. It is an optional card that must be installed if protection switching is to be provided for the working DS3 mappers or STS-1 mappers (TN_BLSR only). If a fault occurs in a working DS3 mapper, the protection switch card routes the traffic away from the faulty mapper and to a protection mapper. It reroutes the traffic by switching the connections to the BNC I/O cards.

There are two versions of the DS3 protection switch card. The NT4K60BA is used only for TN_BLSR shelf functions. The NT4K60CA version is used for all other shelf functions.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Functional description

Each BNC I/O card sends incoming DS3 signals to the DS3 protection switch card as well as to the working DS3 mapper with which it is associated. In normal operation, the incoming signals are grounded at the DS3 protection switch card. When a protection-switching request occurs for a working mapper, the relays on the DS3 protection switch card route the affected DS3s to the protection mapper. The protection-switching arrangement is revertive (1:n). Therefore, when the fault clears, the relays on the DS3 protection switch card ground the signals once again.

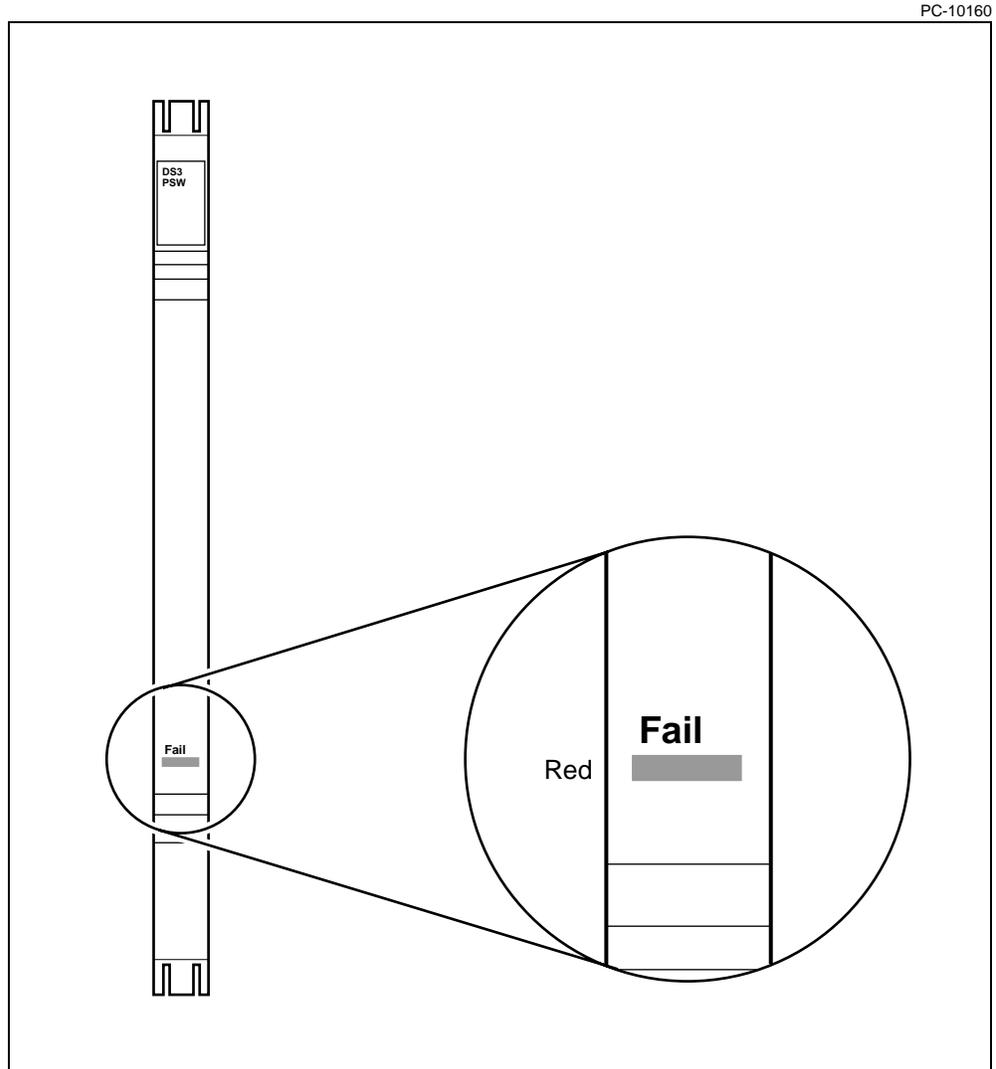
On the DS3 protection switch card there are separate connections and relays for each direction of traffic.

Bus connections

The DS3 protection switch is connected to the CBUS.

Physical appearance of the DS3 protection switch card

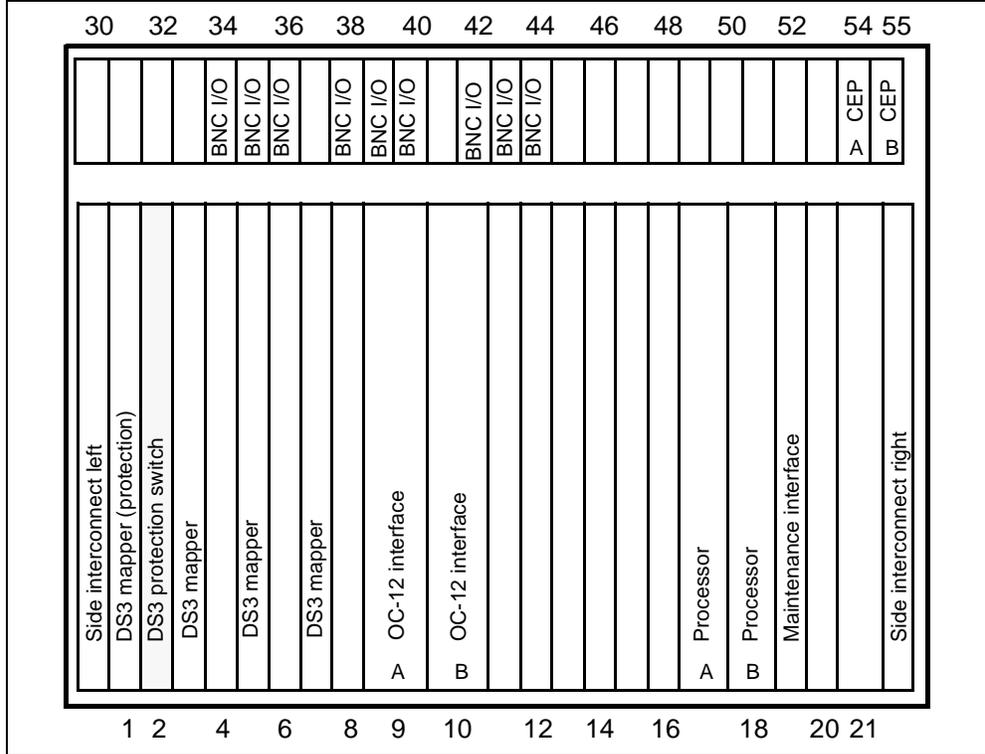
The DS3 protection switch card is 11.5 in. (29.21 cm) high by 10.1 in. (25.65 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-20 shows the front view of the protection switch card.

Figure 5-20**Front view of the DS3 protection switch card**

Equipping rules

In both the access bandwidth manager shelf and the transport bandwidth manager shelf, the DS3 protection switch card installs in slot 2 in the lower level of the shelf. Figure 5-21 shows an access bandwidth manager shelf with a protection switch card.

Figure 5-21
Where the DS3 protection switch card installs in the access bandwidth manager shelf



DS3 mapper (NT7E08)

The DS3 mapper installs in the lower level of the access bandwidth manager shelf or the transport bandwidth manager shelf.

For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

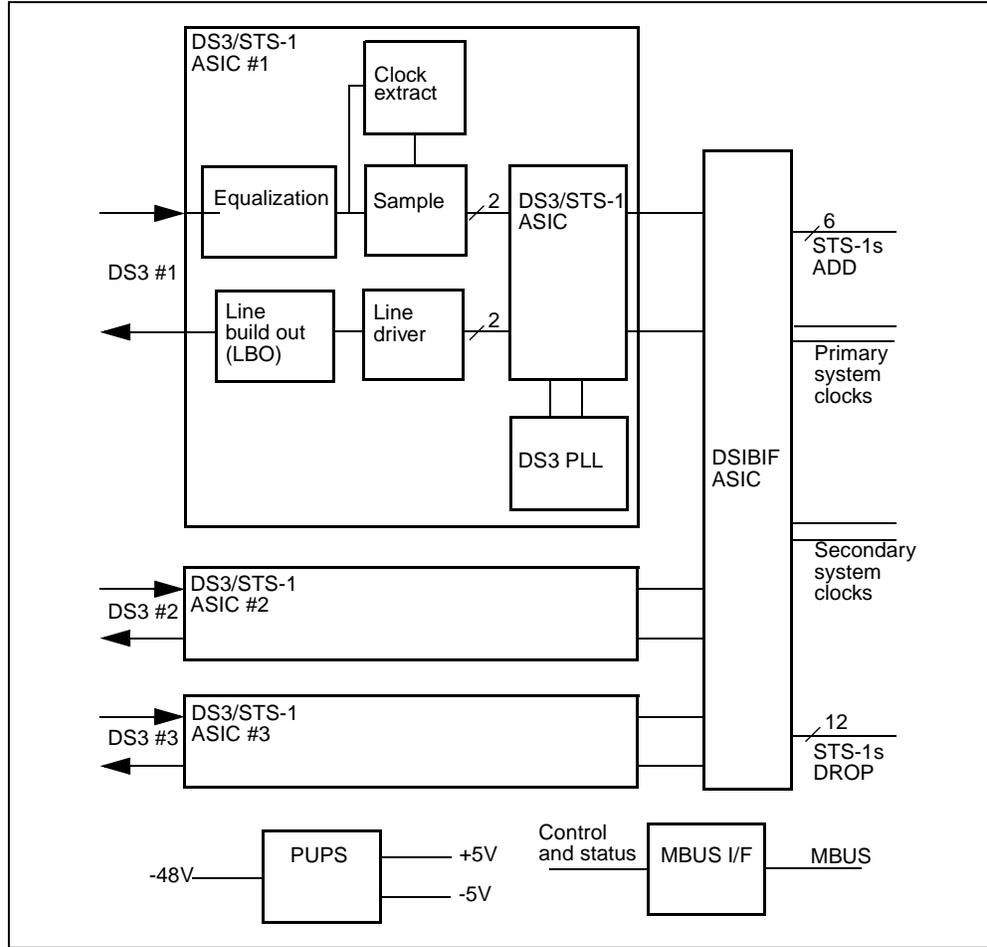
The DS3 mapper provides interface circuitry between one, two, or three BNC I/O cards and the optical interface circuit pack (OC-12 interface circuit pack or OC-3 interface circuit pack). Each DS3 channel (44.736 Mb/s) maps into an STS-1 signal (51.84 Mb/s), which goes to the optical interface circuit pack by way of the backplane.

Note: DS3s are supported by basic fiber-fed systems. DS3s are not supported by DS1-fed systems, nor by single-ended systems.

Functional description

Figure 5-22 is a block diagram of the DS3 mapper. As shown in the figure, the mapper contains three DS3/STS-1 application-specific integrated circuits (ASICs). Each one handles input and output for one DS3 channel.

Figure 5-22
Block diagram of the DS3 mapper



Signal flow for DS3s going into the optical feeder

DS3 signals enter the AccessNode by way of the BNC I/O cards. Each BNC I/O card can handle both directions of one DS3 line. The BNC I/O card sends the incoming DS3 to the associated DS3 mapper. Each mapper can handle up to three DS3s, one from each of three associated BNC I/O cards.

In the mapper, the DS3 circuitry receives the DS3 signal, does line equalization, recovers the DS3 clock, and regenerates the data. The recovered DS3 clock is used to time-regenerate and process the incoming DS3 signal. The DS3 signal then goes to a DS3/STS-1 ASIC in the mapper. The DS3/STS-1 ASIC receives a clock signal and a data signal. The ASIC does DS3 performance monitoring and maps both the DS3 and the STS path overhead into an STS-1 synchronous payload envelope. The serial STS-1 from the ASIC then goes to the DSIBIF ASIC, which retimes it and rebroadcasts it to the optical interface circuit packs (OC-12 or OC-3) by way of the shelf backplane.

Signal flow for DS3s coming out of the optical feeder

The DSIBIF ASIC receives the primary and secondary system clocks from the optical interface circuit pack (OC-12 or OC-3) by way of the shelf backplane.

The DSIBIF ASIC also receives multiple serial STS-1s from the optical interface circuit pack. The DSIBIF ASIC selects three of the STS-1s, retimes them, and sends them to the three DS3/STS-1 ASICs. Each DS3/STS-1 ASIC receives one STS-1. The ASIC uses an elastic store and a phase-locked loop to extract stuff pulses from the incoming data stream. The DS3/STS-1 ASIC terminates the STS-1 path overhead, extracts the DS3 signal, adds framing bits to the DS3 signal, monitors the parity, and substitutes zeros according to the B3ZS scheme (bipolar with three zero substitution). The ASIC then sends the DS3 signal to the DS3 interface circuitry on the mapper.

The DS3 interface circuitry has a DS3 coax output driver. The line build-out can be controlled by software, and can be set from 0 to 455 ft. The interface circuitry sends each DS3 to a BNC I/O card.

MBUS interface

The MBUS interface circuit (MBIF) provides software access to the DS3 mapper for control and status-monitoring purposes. (The DS3 mapper communicates by way of CBUS, but uses MBUS message protocol.) The MBUS interface circuit controls the Active and Fail LEDs on the mapper, and broadcasts signals on the backplane to confirm that the mapper is present in the shelf.

Point-of-use power supply (PUPS)

The DS3 mapper is equipped with its own point-of-use power supply module (PUPS). The PUPS converts the -48 V dc office power supply to the specific regulated direct-current voltage levels required by the local circuitry.

Bus connections

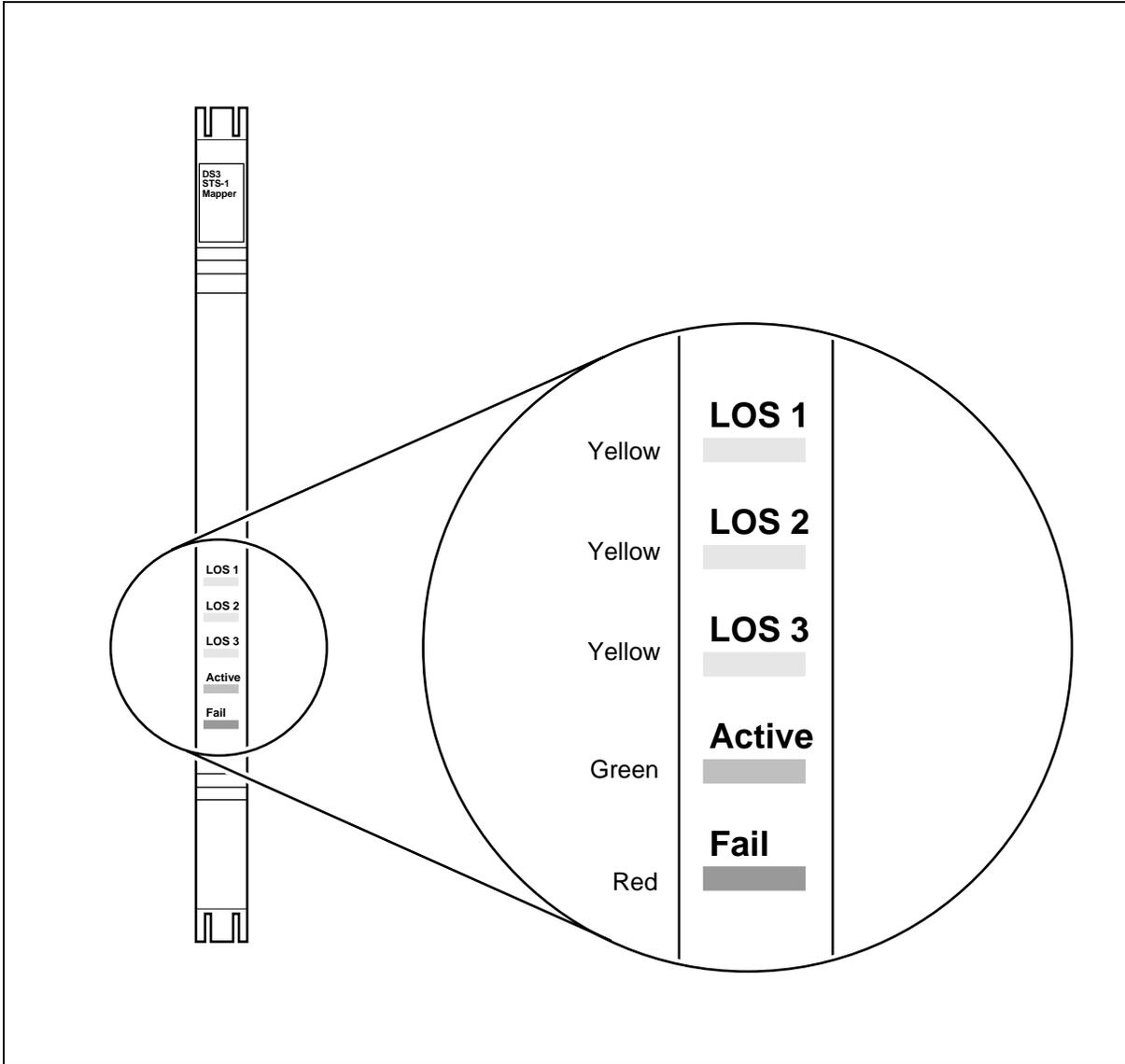
The DS3 mapper is connected to the CBUS. (The mapper communicates by way of CBUS, but uses MBUS message protocol.) Control and status monitoring for the mapper is done by the processor card.

Physical appearance of the DS3 mapper

The DS3 mapper is 11.5 in. (29.21 cm) high by 10.1 in. (25.65 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-23 shows the front view of the DS3 mapper.

Figure 5-23
Front view of the DS3 mapper

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I/O cards associated with the DS3 mappers

Each DS3 mapper is associated with up to three BNC I/O cards installed in associated slots the upper level of the shelf. Each mapper and the associated BNC I/O cards compose a DS3 circuit-pack group. Table 5-1 on page 5-11 shows the groupings and lists the names of the groups.

STS-1 mapper (NT7E09)

The STS-1 mapper installs in the TN-BLSR only. It provides interface circuitry between one, two, or three BNC I/O cards and the optical interface circuit pack (OC-12 interface circuit pack or OC-3 interface circuit pack). Each STS-1 mapper processes up to three STS-1 transmit and receive signals independently. The STS-1 signals are transmitted and received by way of the backplane STS buses.

Loopbacks can be performed for link maintenance and fault detection purposes. The line build-out (LBO) range selection is under software control and can be selected for long or short range (the length depends on the type of cable used).

Note: For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Functional description

The mapper contains three STS-1 application-specific integrated circuits (ASICs). Each one handles input and output for one STS-1 channel.

Signal flow for STS-1s going into the optical feeder

STS-1 signals enter the AccessNode by way of the BNC I/O cards. Each BNC I/O card can handle both directions of one STS-1 line. The BNC I/O card sends the incoming STS-1 to the associated STS-1 mapper. Each mapper can handle up to three STS-1s, one from each of three associated BNC I/O cards.

In the mapper, the STS-1 circuitry receives the STS-1 signal, does line equalization, recovers the STS-1 clock, and regenerates the data. The recovered STS-1 clock is used to time-regenerate and process the incoming STS-1 signal. Regenerated STS-1 signals are then routed to the STS-1 processor where B3ZS decoding, STS-1 framing, and performance monitoring are performed. Each STS-1 is then bulk mapped and the STS path overhead is added. Three STS-1 signals coming out of the STS-1 mapper are then routed to the OC-3 or OC-12 interface circuit packs.

Signal flow for DS3s coming out of the optical feeder

Three STS-1 signals are received from the OC-3 or OC-12 optical interface circuit pack. These STS-1 signals are retimed and the STS path overhead is removed. Outgoing STS-1 signals are framed and scrambled, and the signal parity is monitored prior to being B3ZS encoded. STS-1s are then routed through a line-driver circuit and the line signal is generated using a programmable LBO circuit.

MBUS interface

The MBUS interface circuit (MBIF) provides software access to the STS-1 mapper for control and status-monitoring purposes. (The mapper communicates by way of CBUS, but uses MBUS message protocol.) The MBUS interface circuit controls the Active and Fail LEDs on the mapper, and broadcasts signals on the backplane to confirm that the mapper is present in the shelf.

Point-of-use power supply (PUPS)

The STS-1 mapper is equipped with its own point-of-use power supply module (PUPS). The PUPS converts the -48 V dc office power supply to the specific regulated direct-current voltage levels required by the local circuitry.

Bus connections

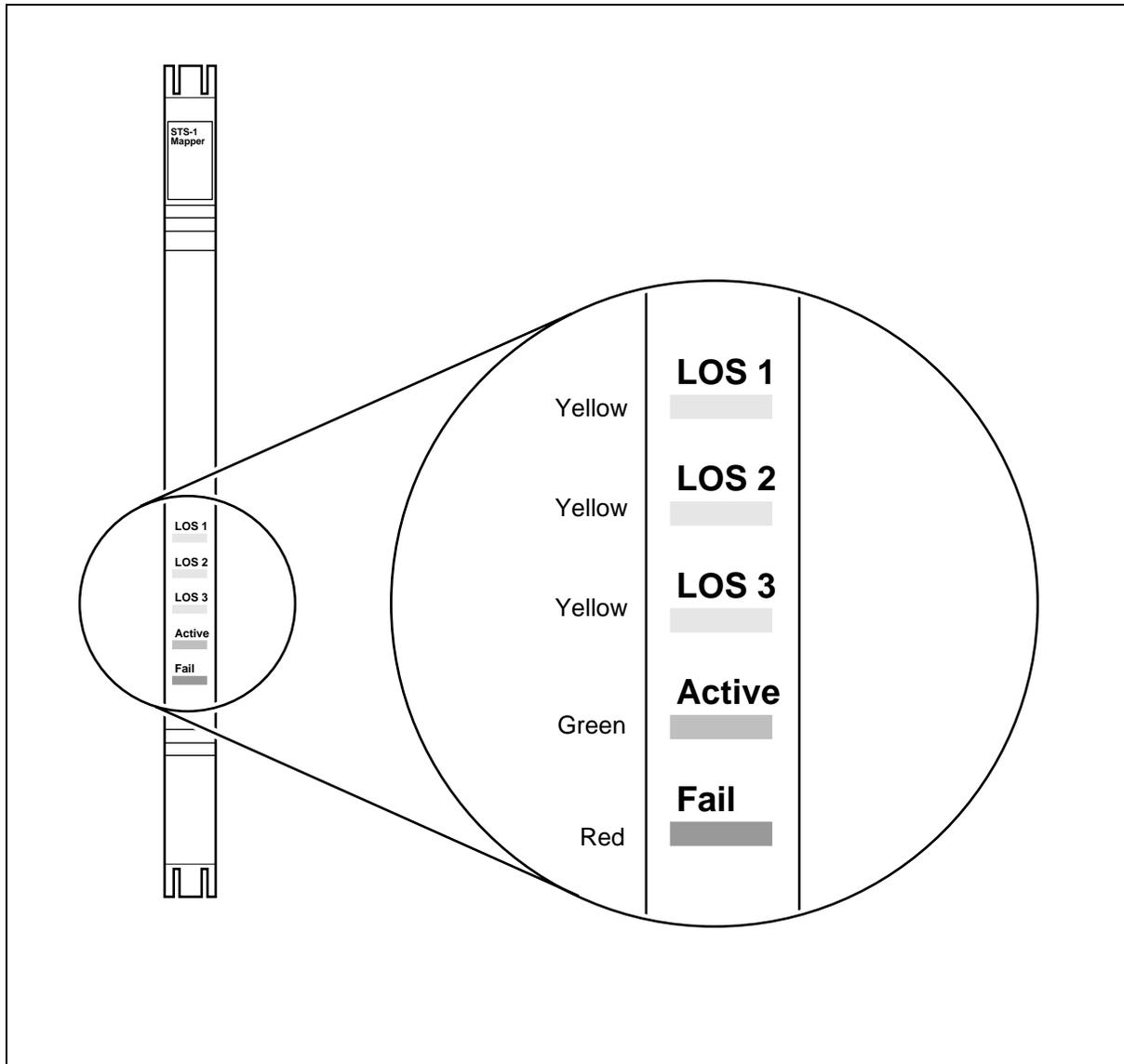
The STS-1 mapper is connected to the CBUS. (The mapper communicates by way of CBUS, but uses MBUS message protocol.) Control and status monitoring for the mapper is done by the processor card.

Physical appearance of the STS-1 mapper

The STS-1 mapper is 10.9 in. (27.7 cm) high by 10.1 in. (26.7 cm) deep. It is a single-width circuit pack, 0.8 in. (2.0 cm) wide. Figure 5-24 shows the front view of the STS-1 mapper.

Figure 5-24
Front view of the STS-1 mapper

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I/O cards associated with the STS-1 mappers

Each STS-1 mapper is associated with up to three BNC I/O cards installed in associated slots the upper level of the shelf. Each mapper and the associated BNC I/O cards compose a STS-1 circuit-pack group.

External synchronization interface card (NT7E27)

The external synchronization interface (ESI) card installs in the external synchronization carrier (NT7E19), and the carrier installs in a slot in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. One or two ESI cards can be installed in the carrier.

The ESI card is required in the FCOT in a system serving a GR-303 application or a TR-08 application, to synchronize the FCOT with the host switch. The ESI card is also required in the FCOT in a system that provides Digital Data Service (DDS). The ESI card receives timing reference signals from an external reference timing source. (Connection to the external timing source is by way of a cable that connects to a connector on the side interconnect left circuit pack.) The ESI card provides a stable reference frequency of 51.84 Mhz to the optical interface circuit packs (OC-12 or OC-3). The AccessNode derives its system clock from this reference frequency, and synchronizes all data transmission to this reference. This synchronization makes it possible to integrate AccessNode into a synchronous network.

The reference signal generated by the working ESI card is used by the optical interface circuit packs to phase lock the system clock that is used for local timing, and to provide the transmit system clock.

There are two modes of ESI card operation, external loop and internal loop. In external-loop mode, the card produces a 51.84 Mhz output frequency as a reference for system-clock generation while adjusting its output frequency to phase-align the frame generated by the system clock with the external reference clock. In internal-loop mode, the ESI card either does not receive the external reference signal or it ignores it. The ESI card generates a mock system-framing pulse for use as the reference. The function is otherwise identical to the external-loop case. The ESI card produces a stable fixed-output frequency for use as a reference input to the system-clock generators in the optical interface circuit packs.

Equipment protection switching by ESI cards

If two ESI cards are installed in the external synchronization carrier, then the cards protect each other. The protection switching is 1+1, that is, nonrevertive. At any time, one of the ESI cards acts as the active source of the reference signal to the optical interface circuit packs, and the other ESI card is the protection unit. If the working ESI card fails, then the optical circuit packs use the reference signal from the other ESI card. (If both ESI cards fail, the AccessNode uses the system clock generator on the optical interface circuit pack. For information on the system clock generator, see page 5-66.)

Timing-reference protection switching by ESI cards

Each ESI card can accept two external timing reference sources, and if one reference fails, the ESI card switches to the other reference. Reference protection switching is 1+1, that is, nonrevertive.

If both the primary and secondary references fail, the ESI card goes into holdover mode, meeting the stability requirements of a stratum-3 clock (two clocks removed from the primary reference). In holdover mode, the output frequency of the oscillator remains unchanged until one of the timing references is recovered.

External timing reference: from a BITS

An ESI card can accept the following types of external reference sources from the Building Integrated Timing Source (BITS):

- a DS1 timing reference
- an 8/64 kHz composite clock

The DS1 timing signal is a framed, all-ones, bipolar return-to-zero line format with a 50% duty cycle.

The composite clock signal is a return-to-zero format with a 5/8 duty cycle. The basic waveform provides the 64 kb/s clock, and a bipolar violation every eight pulses provides the 8 kb/s clock.

External timing reference: from a digital switch

If a timing reference from a BITS is not available for use as an input timing reference for external synchronization interface cards, you can use a dedicated non-traffic-carrying DS1 from a digital switch as a timing reference. Such a DS1 must meet the following requirements:

- It must not carry any traffic.
- It must have at least stratum-3 accuracy.
- It must have valid superframe format or valid extended superframe format.

Note: You cannot use a DS1 as a timing reference if that DS1 is a TR-08 A span, because such a DS1 does not have the required framing format. This is because the A span carries TR-08 alarm and maintenance messages in the framing bits. For more information, see the description of the derived data link on page 3-11.

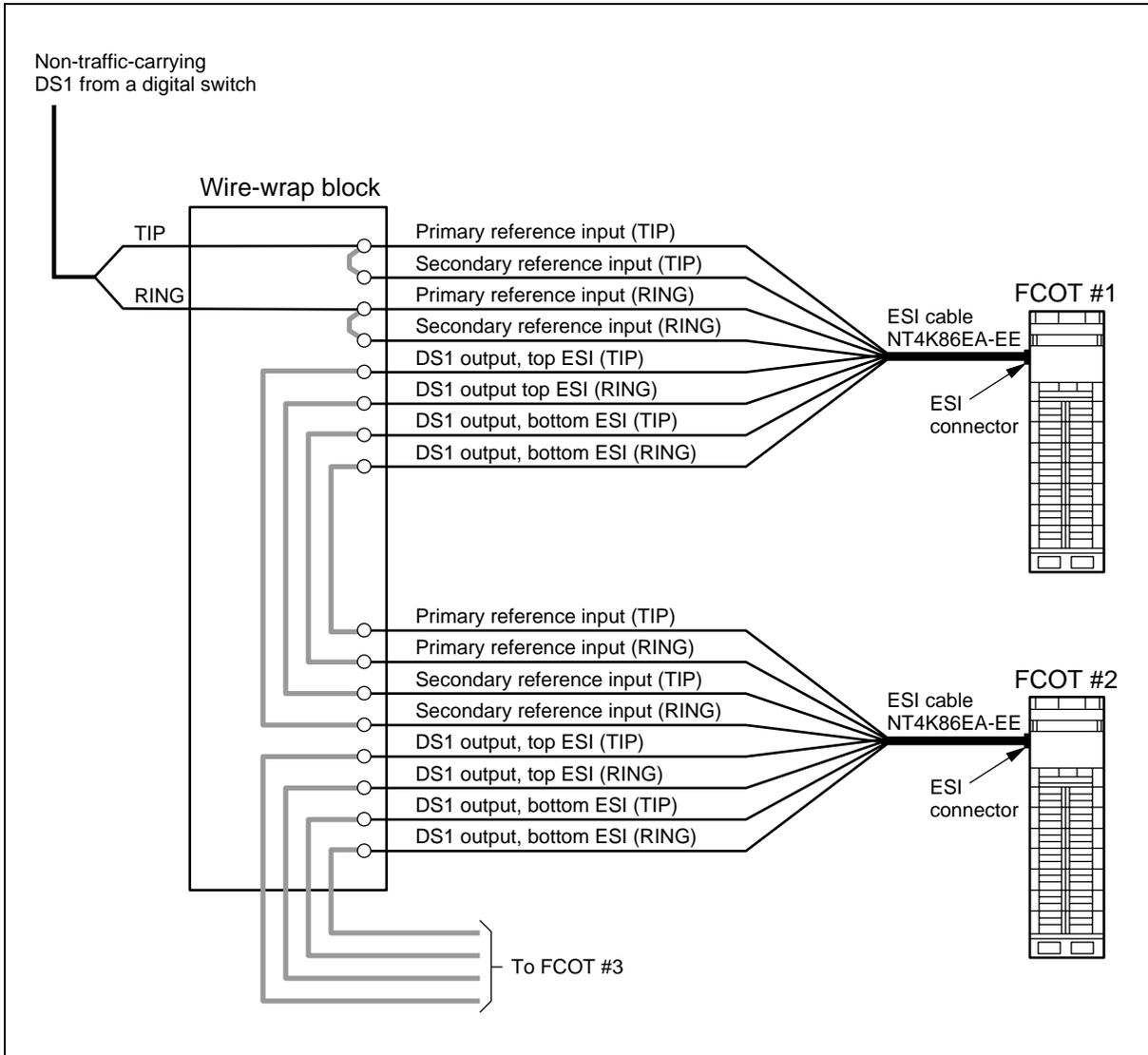
Daisy-chaining for timing multiple FCOTs from a single DS1

If you have multiple collocated FCOTs, you can derive timing for all the FCOTs from a single DS1 if you connect the ESI cables leading to the FCOTs in a daisy-chain pattern. You can interconnect the ESI cables because each ESI cable can carry both input and output timing signals, as shown in Figure 5-25.

Construct the daisy chain by bringing the timing DS1 and the ESI cables from the FCOTs to a wire-wrap block, and by making connections at the wire-wrap block as shown in Figure 5-25. Connect each subsequent FCOT in the same way as you connected the second FCOT to the first.

Figure 5-25
Daisy-chain connections to time multiple FCOTs from a single DS1

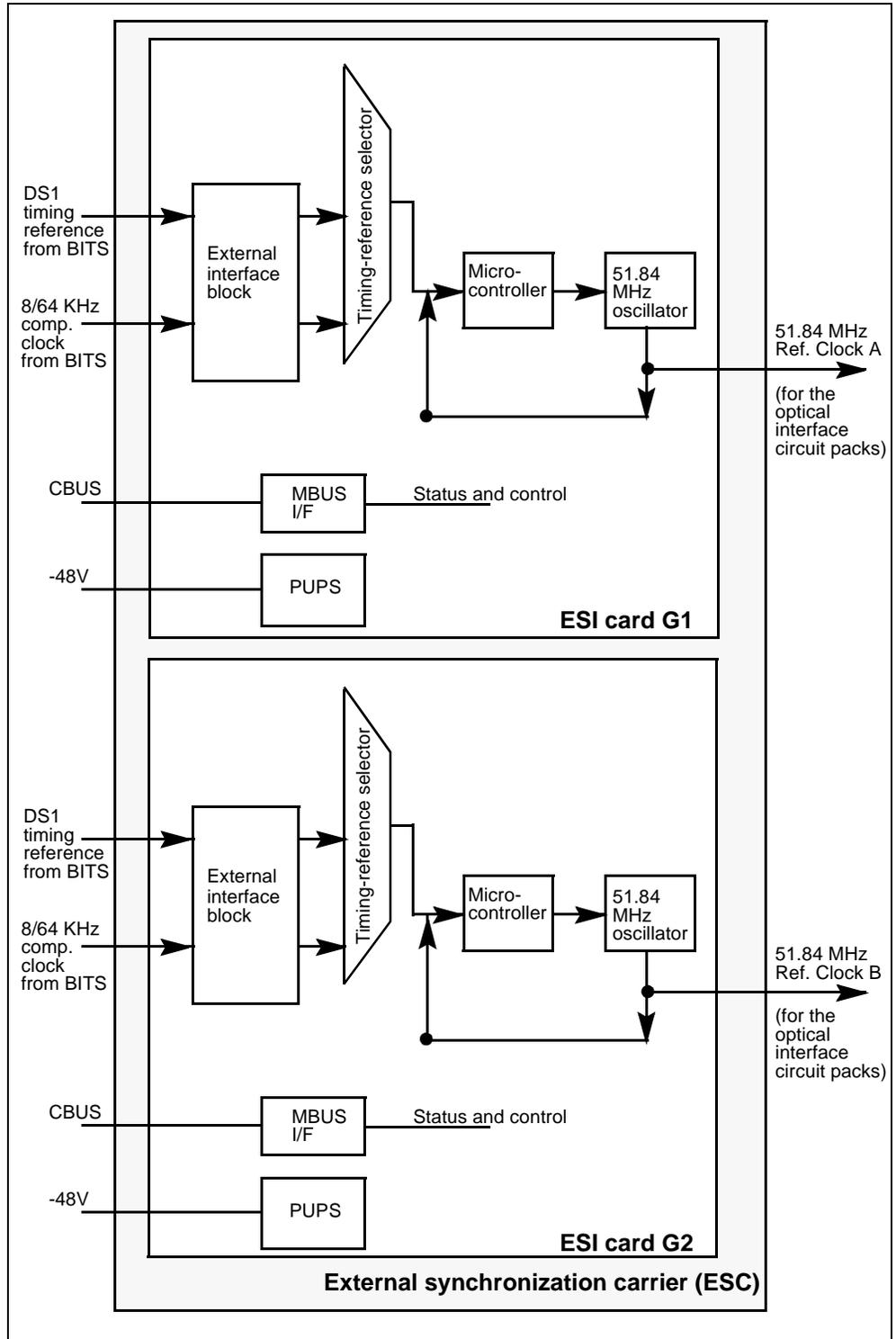
PC-11399



Block diagram

Figure 5-26 is a block diagram of two ESI cards on a carrier. Subsequent sections explain the functions of the parts shown in the diagram.

Figure 5-26
Block diagram of two ESI cards on the carrier



Timing-reference selector

The timing-reference selector does two things. First, under the control of the processor card, it selects an external timing reference signal that is to be used by the ESI card, and switches from one reference to another if a reference signal fails. Second, it compares the phasing of the external signal to the output of the oscillator (which is necessary when the ESI card is running in external-loop mode).

The interface to the processor card is by way of CBUS, but uses the MBUS protocol. The interface is for status and control information.

Oscillator

An oscillator produces the timing signals that the ESI card outputs. When the ESI card is receiving timing reference signals from an external source like a BITS, the output is synchronized to the external clock.

Point-of-use power supply (PUPS) on the ESI card

Each of the two ESI cards is individually powered by a point-of-use power supply (PUPS).

Bus connections

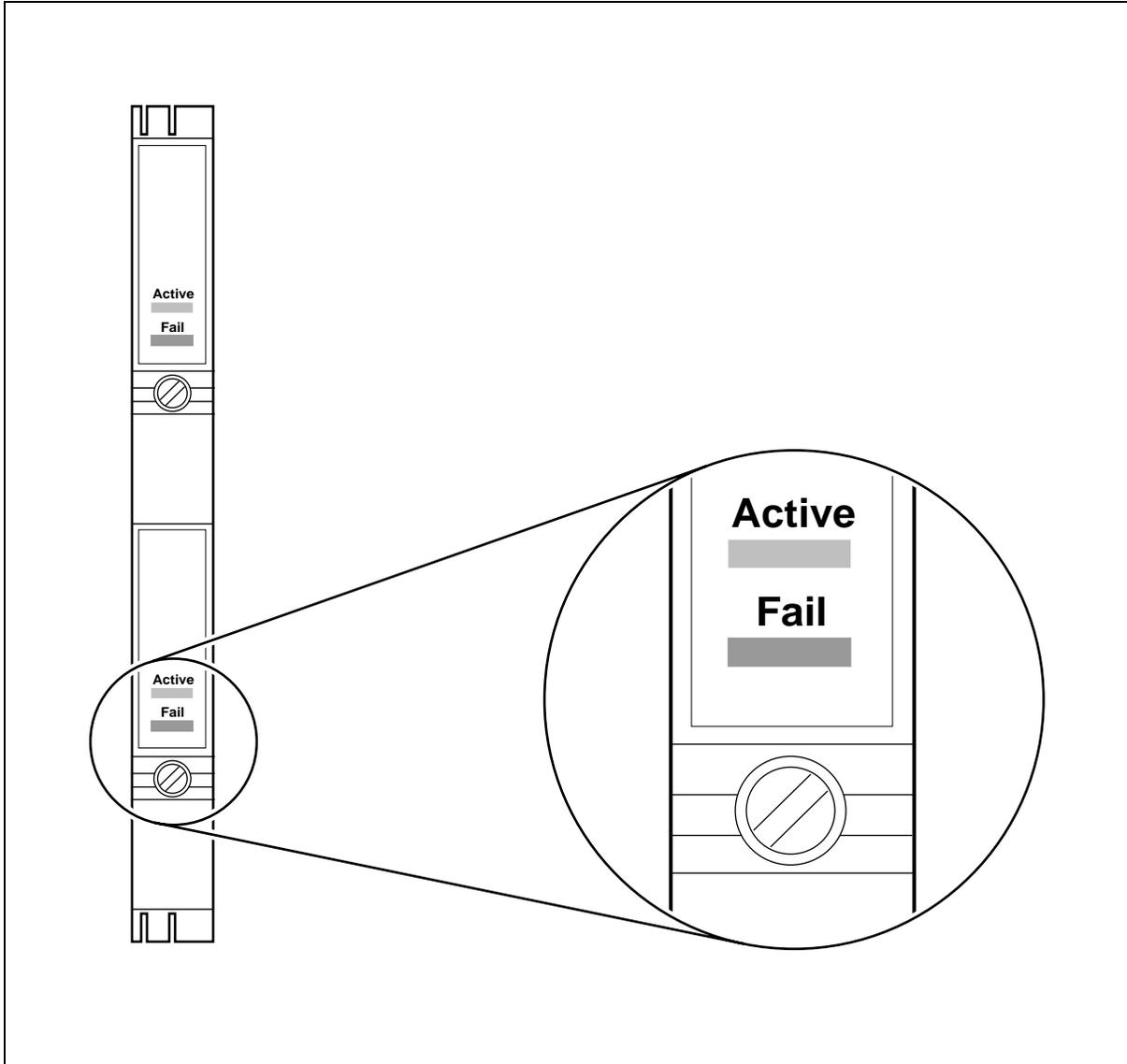
The ESI cards are connected to the CBUS. (The ESI cards communicate by way of CBUS, but use MBUS message protocol.)

Physical appearance of the ESI cards

One or two ESI cards can be installed in the external synchronization carrier. The carrier is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is 0.8 in. (2.03 cm) wide. Figure 5-27 shows the front view of the external synchronization carrier, with two ESI cards installed.

Figure 5-27
Front view of external synchronization interface carrier (ESC) with two ESI cards installed

PC-10162

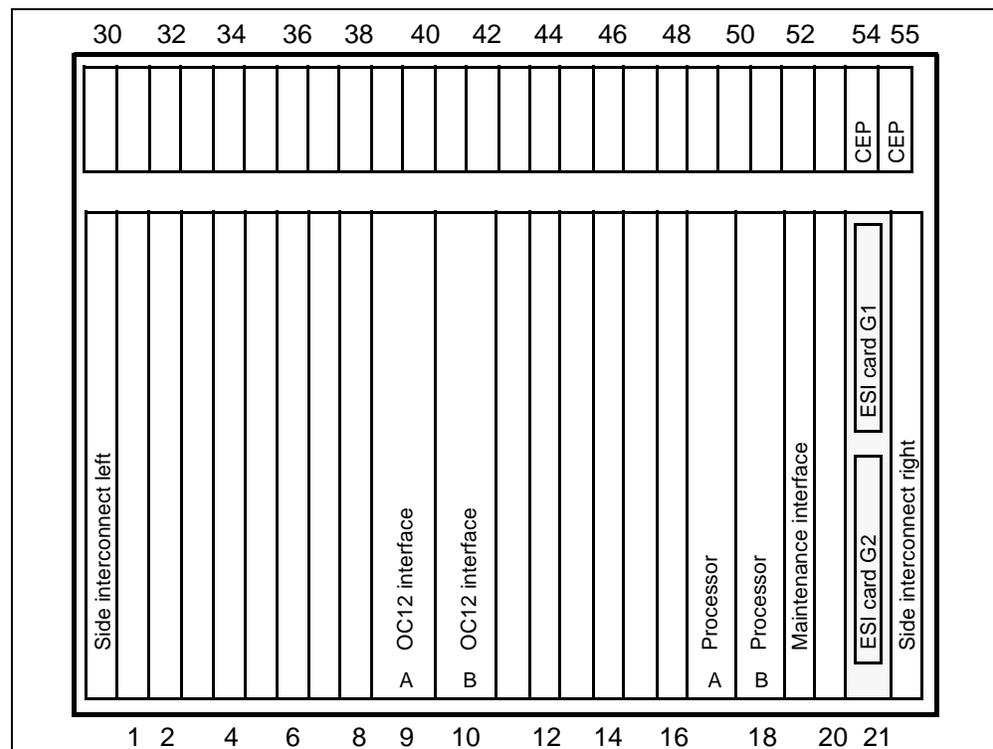


Equipping rules for the access bandwidth manager shelf

The ESI card is used only in FCOTs. It is required in the FCOT in a basic fiber-fed system that serves a GR-303 application or a TR-08 application or Digital Data Service (DDS). For more information on DDS, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

In an access bandwidth manager shelf, the carrier for the ESI cards can be installed in slot 21, as shown in Figure 5-28.

Figure 5-28
Where the ESI cards install in the access bandwidth manager shelf



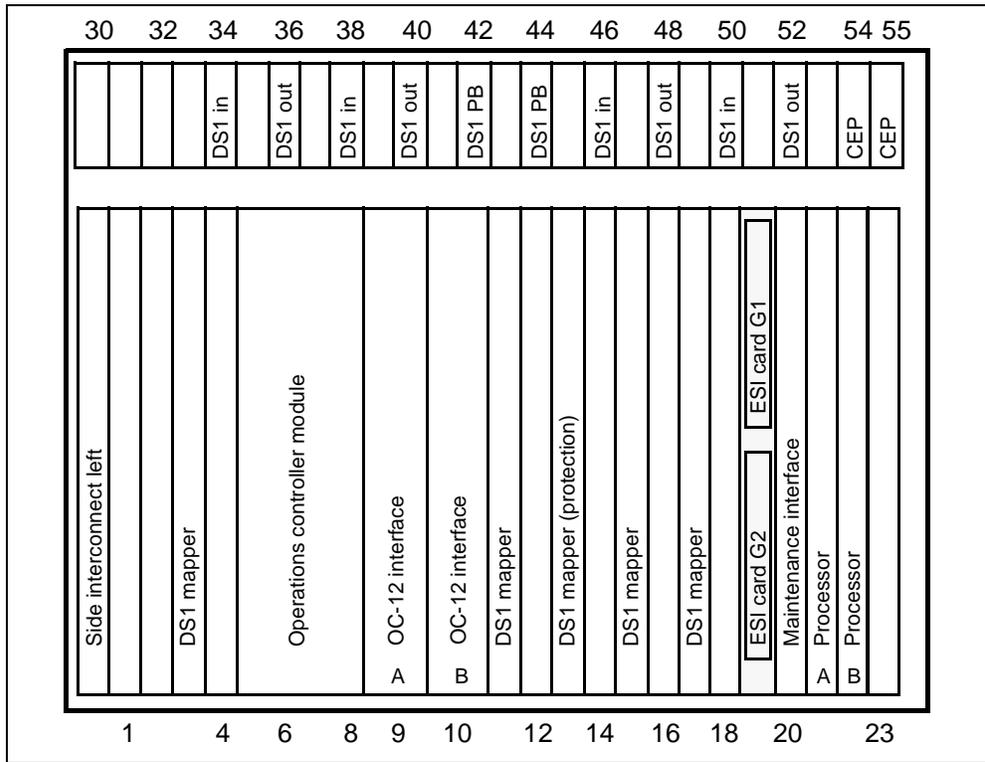
Note: If only one ESI card is installed, it is installed in the upper slot in the carrier.

Equipping rules for the transport bandwidth manager shelf

The ESI card is used only in FCOTs. It is required in the FCOT in a basic fiber-fed system that serves a GR-303 application or a TR-08 application or Digital Data Service (DDS). For more information on DDS, see *Line Card Application and Special Services Engineering, 323-3001-155*, in the *Engineering, Configuration, and Ordering Guide, Volume 1*.

In a transport bandwidth manager shelf, the carrier for the ESI cards can be installed in slot 19, as shown in Figure 5-29.

Figure 5-29
Where the ESI cards install in the transport bandwidth manager shelf



Note: If only one ESI card is installed, it is installed in the upper slot in the carrier.

Integrated remote test unit (NT4K57)

The integrated remote test unit (IRTU) provides enhanced testing capabilities for narrowband services supported by AccessNode. It is available in two versions:

- single test head
- dual test head

Capabilities

Both versions provide the following testing capabilities:

- testing locally switched services
- testing nonswitched services and nonlocally switched services

For testing locally switched services, the integrated remote test unit emulates a Northern Telecom model 3704 digital remote test unit (DRTU). DRTU-type testing of locally switched services is directed from Northern Telecom's Centralized Automated Loop Reporting System/Line Test Cabinet (CALRS/LTC). For detailed information about IRTU testing, see *Line and Loop Testing Overview*, 323-3001-115, in *Description*, Volume 2B.

Advantages of the IRTU

If an RFT is equipped with an integrated remote test unit, then you do not need a test bypass pair between the FCOT and the RFT, and you do not need dedicated line cards for testing in the RFT. A test bypass pair is not required because the test DS0 (the DS0 used for testing) can be carried in the SONET payload. You do not need dedicated line cards because the test DS0 can be connected to the integrated remote test unit without using a line card. This is the "IRTU-line-card" feature.

IRTU line cards

Each test head in the IRTU can support three IRTU line cards, which can be used as follows:

- one line for dial-up control
- one line for dedicated control
- one line for talk/monitor

In the dual test head version, a total of six lines can be supported. In the single test head version, a total of three lines can be supported.

Sources of control for IRTU testing

Testing by the integrated remote test unit can be directed

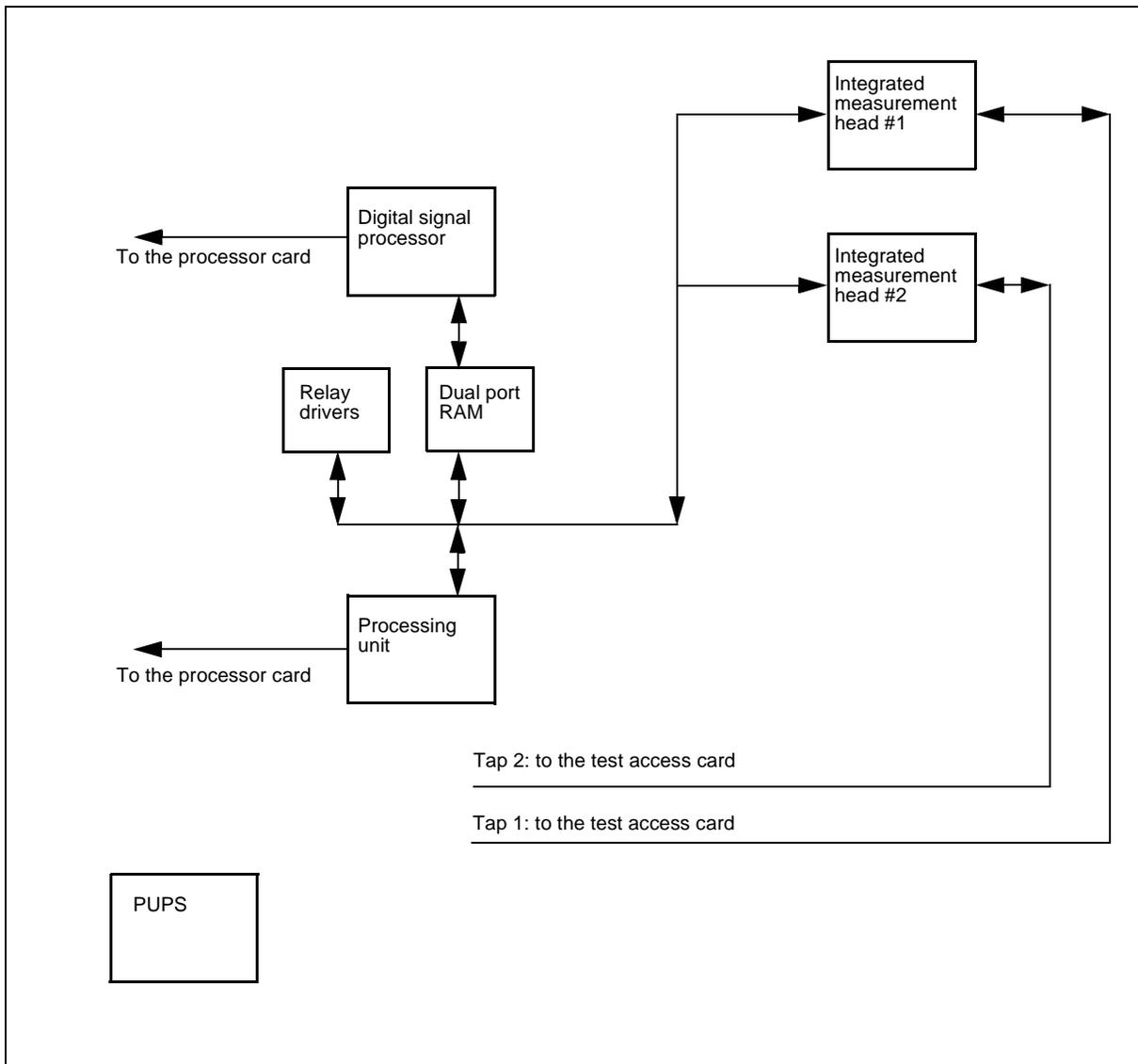
- by the Test Manager tool in the OPC user interface
- by one of the following external operations systems:
 - Switched Access Remote Test System (SARTS)
 - Digital Analog Remote Testing System (DARTS)
- by the Maintenance Administration Position (MAP) in a DMS SuperNode switch (if the AccessNode is integrated with such a switch)

Regardless of whether the testing is directed by the test manager tool, an external operations system, or the MAP, the integrated remote test unit receives commands from the operations controller.

Dual test head IRTU functional description

Figure 5-30 shows the block diagram of the dual test head IRTU. As shown in the figure, the dual test head IRTU has two integrated measurement heads to support simultaneous testing of locally switched services and of special services. The integrated measurement heads are connected to a test-access path that is provided by the test access card. (Figure 5-57 on page 5-99 shows how the integrated remote test unit is related to the test access card and the other modules involved in testing line cards.)

Figure 5-30
Block diagram of the integrated remote test unit

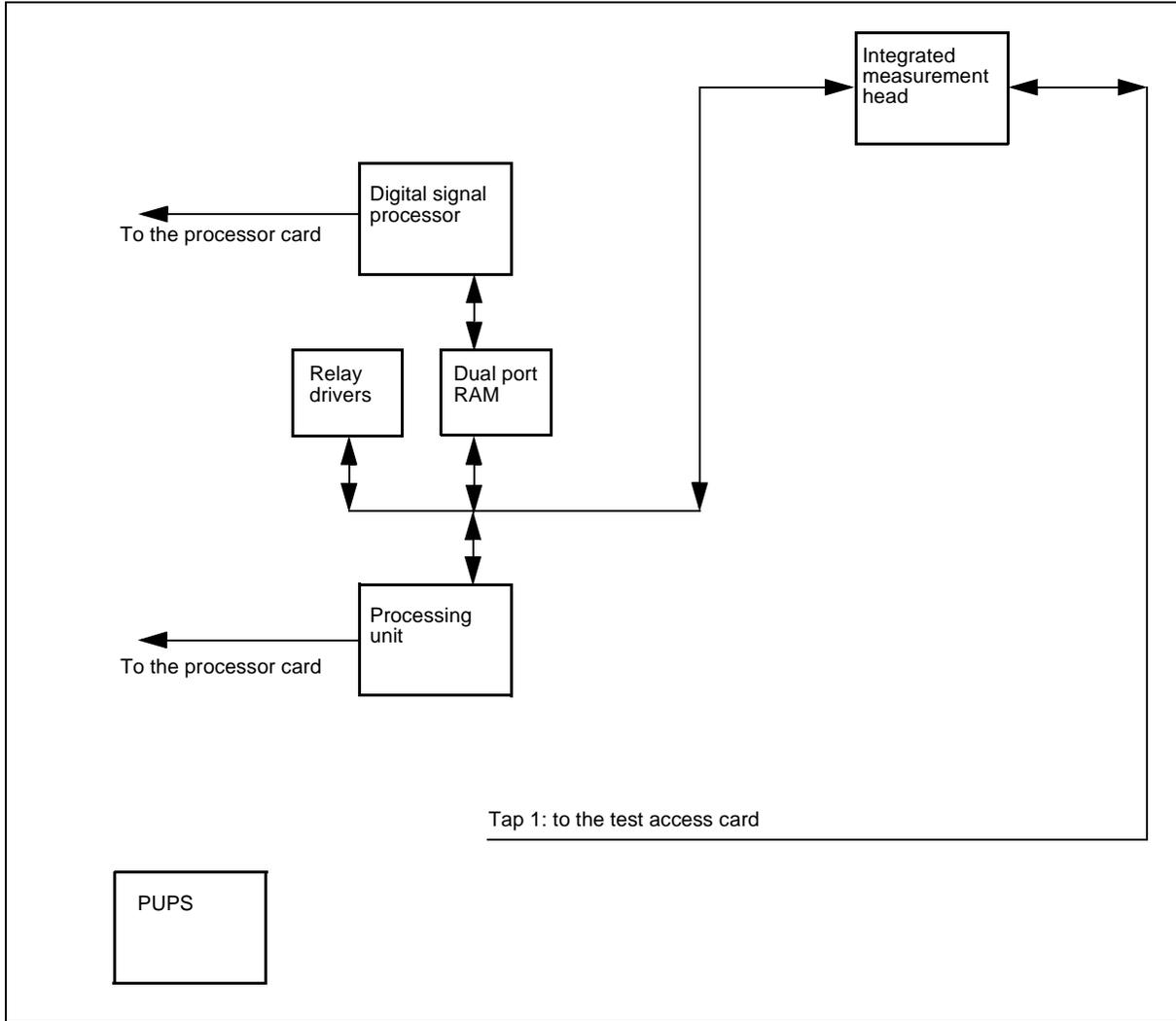


Single test head IRTU functional description

Figure 5-31 shows the block diagram of the single test head IRTU. As shown in the figure, the single test head IRTU has one integrated measurement head that supports testing of locally switched services and of special services. The integrated measurement head is connected to a test-access path that is provided by the test access card. (Figure 5-57 on page 5-99 shows how the integrated remote test unit is related to the test access card and the other modules involved in testing line cards.)

Note: When a single test head IRTU is removed and a dual test head IRTU is inserted after the IRTU initializes and completes the diagnosis process, the second test head is out of service. The craftsman must manually put the second test in service from the eq irtu screen.

Figure 5-31
Block diagram of the single test head IRTU

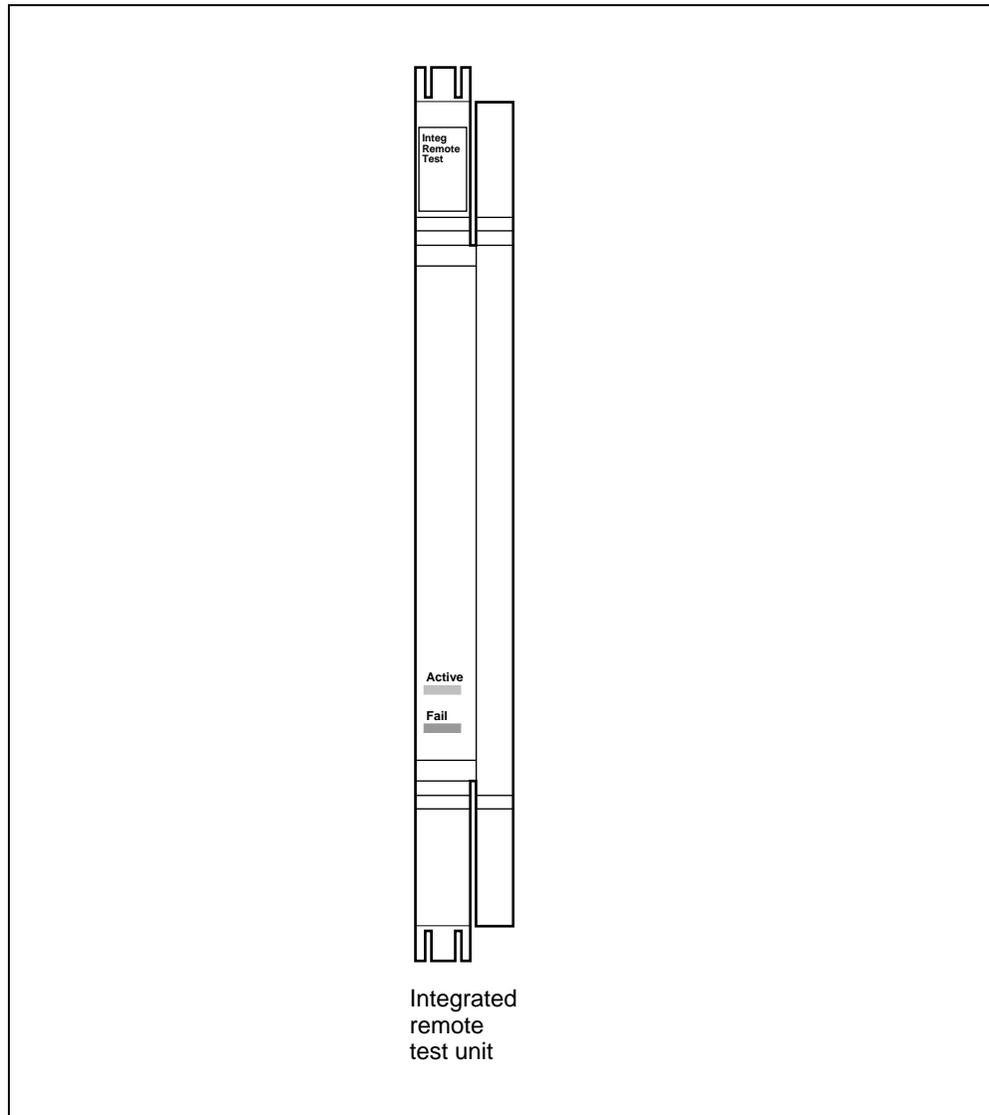


Physical appearance of the integrated remote test unit

The integrated remote test unit is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is 1.35 in. (3.43 cm) wide. Figure 5-32 shows the front view of the integrated remote test unit.

Figure 5-32
Front view of the integrated remote test unit

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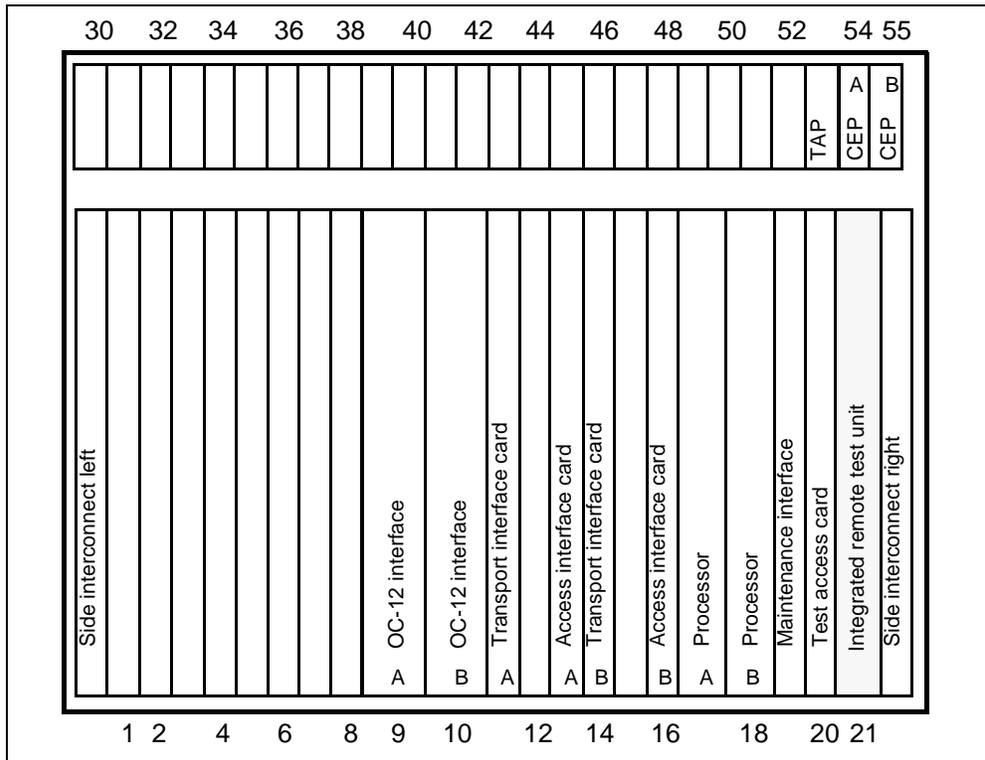
Equipping rules

The integrated remote test unit is optional, and can be used only in the access bandwidth manager shelf, and only in an RFT. As shown in Figure 5-33, the integrated remote test unit installs in slot 21 in the access bandwidth manager shelf in an RFT.

The integrated remote test unit must be accompanied by the test access card, which installs in slot 20. It needs the test access card for the following reasons:

- Test access to the line cards is by way of the metallic test buses, and those buses connect to the test access card.
- The integrated remote test unit accesses the maintenance overhead (MOH) bus by way of the test access card, to provide the voice-band monitor and talk testing functions. (These functions are available in SARTS testing, DARTS testing, and in testing directed by the Test Manager tool of the OPC.)
- The integrated remote test unit uses the Bell 212A 1200 b/s modem on the test access card, to provide the CALRS DRTU emulation.

Figure 5-33
Where the IRTU installs in the access bandwidth manager shelf



Maintenance interface card (NT4K53)

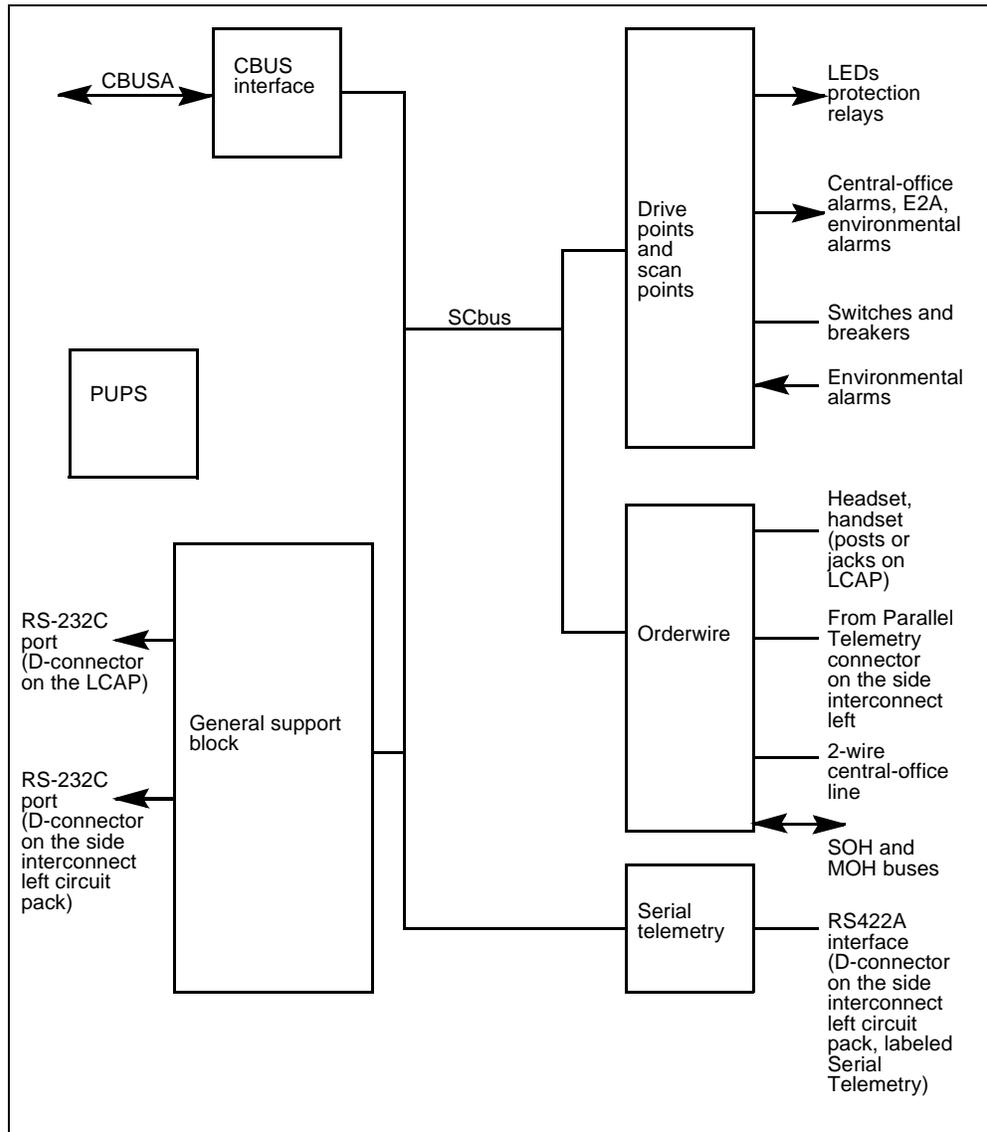
The maintenance interface card (MIC) installs in the lower level of an access bandwidth manager shelf or a transport manager shelf. It performs the following major functions:

- It gathers and distributes alarm data:
 - It scans the on/off condition of internal and external hardware: breakers, switches, and miscellaneous internal hardware, and it notifies the processor card when a state change occurs.
 - It can receive parallel-telemetry data.
 - It drives signals for the red Fail LEDs on the circuit packs and cards.
 - It controls circuits for alarm lights on the breaker interface panel (BIP).
 - It controls the signal-distribution relays that can send signals (such as alarms) to parallel-telemetry systems.
- It activates signals that open and close the relays in the DS1 signal path (on the DS1 input card and DS1 output card).
- It activates signals that open and close the relays in the DS3 signal path (on the DS3 protection switch card).
- It supports human-machine interfaces. It has two ports, one for DTE-type devices, and one for DCE-type devices.
- It handles orderwire for voice-frequency communication by way of the SONET overhead bus (SOH bus).

Functional description

Figure 5-34 shows the block diagram of the maintenance interface card. Subsequent sections explain the functions of the parts shown in the diagram.

Figure 5-34
Block diagram of the maintenance interface card



CBUS interface

The maintenance interface card is connected to CBUSA. The interface to CBUSA is the main control interface of the maintenance interface card. When the processor card gains control of CBUSA, it can read and write various registers in the maintenance interface card. (There is no access to the maintenance interface card by way of CBUSB.)

General-support block

The maintenance interface card includes the following components:

- dual serial communications ports:
 - a port to which you can connect a DTE-type device such as a local VT100-type terminal
 - a port to which you can connect a line from a DCE device, that is, a modem
- a performance-monitoring clock and a time-of-day clock

The dual serial communications ports provide the serial communication links that are used for human-machine interfaces.

One serial port is an RS-232C port with a 25-pin D connector on the local craft access panel (LCAP). This port provides a direct interface (no modem required) for a DTE-type device such as a VT100-type terminal. This port is the human-machine interface to the processor card.

The other serial port is an RS-232C port with a 9-pin D connector on the side interconnect left circuit pack on the shelf. This port provides an interface for a remote terminal. The remote terminal must be connected to an external modem, and the line from the modem connects to the 9-pin connector on the side interconnect left circuit pack. This is configured for a DCE-type device.

The maintenance interface card also includes two clocks: the performance-monitoring clock and the time-of-day clock. The performance-monitoring clock provides a one-second-rate clock for performance monitoring. The time-of-day clock is accessible to the processors over CBUSA, to time-stamp events.

Scan points, internal and external

The scan points provide a means for AccessNode to monitor on/off conditions, both inside the bay (internal conditions) and outside it (external conditions). An on or off condition is represented by the presence or absence of logic ground at a scan point. There are 17 internal scan points and 11 external scan points.

In an FCOT, the external scan points are normally used to receive control signals from a parallel-telemetry system; in an RFT, the external scan points are normally used to receive information about environmental conditions (for example, whether a door is opened or closed).

Drive points, internal and external

The maintenance interface card contains internal drive points and external drive points.

Internal drive points control the LEDs mounted on the circuit packs and cards, and on the local craft access panel (LCAP). Internal drive points also control the relays that reroute DS1 or DS3 traffic when protection switching is required. (The relays for DS1 traffic are located on the DS1 input cards and on the DS1 output cards. The relays for DS3 traffic are located on the DS3 protection switch card.)

Under normal conditions, the processor card controls local alarms. It writes the internal drive points by way of the CBUS.

Note: If the processor card fails or if the maintenance interface card fails, the alarms are still generated in an unambiguous manner. Hardware on the maintenance interface card and the breaker interface panel (BIP) provides this fail-safe feature.

External drive points are drivers for the relays on the alarm card on the BIP. Other external drive points control signal-distribution relays on the maintenance interface card. The relays can send signals to parallel-telemetry systems.

Dual ports for serial telemetry

The maintenance interface card has two ports that can be used for general-purpose communication with the processor card. The connection to the ports is by way of a single 25-pin connector located on the side interconnect left circuit pack. For the physical layer, each port uses the RS-422 standard, which requires two twisted pairs per port, one for each direction of transmission. The processor card can configure each port independently, controlling baud rate, parity, and synchronous or asynchronous operation. Shielded or unshielded cable can be used, tied at one end or at both ends to equipment ground.

The maintenance interface card uses these two ports for serial telemetry.

One example of a serial-telemetry system is Telemetry Byte Oriented Serial (TBOS), which is a 2400-baud ASCII-format asynchronous alarm-reporting system. If a port is used for the TBOS application, 26-gauge cable must be used. The external cable, if shielded, can be grounded only at the transmitting end.

Orderwire

The orderwire feature is a means of providing VF communications between maintenance personnel at different sites or network elements. The orderwire service complies with SONET orderwire requirements and maintains commonality where necessary with existing orderwire procedures in transport products that are not SONET-based (products such as T1).

Note: Orderwire is not available in single-ended systems, nor in DS1-fed systems. If you need orderwire service, you must implement it by using additional equipment.

The orderwire feature supports local orderwire and express orderwire. The express and local orderwire channels enable craftspersons at different network elements to communicate with each other. Express and local orderwire channels are carried in the SONET overhead, and carried between the processor card and the maintenance interface card by the SONET overhead bus (SOH bus).

Note: Craftspersons can continue to use orderwire as long as the maintenance interface card and the SONET links are functional, even if there is not a working processor card in the shelf.

The orderwire feature contains a conference bridge. The conference bridge monitors all the links and monitors the VF ports on the maintenance interface card, and connects the two strongest speakers to the listener. The conference bridge monitors the SOH buses, which carry the express and local orderwire channels.

The orderwire feature contains a two-wire port that can be wired to the central-office switch. This connection enables the craftsperson to use orderwire to originate outgoing public-network calls (originate only, DTMF class of service).

Signaling to the remote end of orderwire is done by DTMF tones.

Using orderwire

To make a call using local orderwire, a craftsperson plugs a handset or headset into the LCAP jacks, and pushes the LCAP broadcast call button. If the craftsperson is at the FCOT in a basic fiber-fed system, then a buzzer sounds and a lamp lights at each RFT in the system. If the craftsperson is at an RFT, then a buzzer sounds and a lamp lights at the FCOT, and at every RFT between the craftsperson and the FCOT.

To make a call using express orderwire, a craftsperson plugs a handset or headset into the LCAP jacks, pushes the express orderwire button on the LCAP, and then presses LCAP broadcast call button. If the craftsperson is at the FCOT in a basic fiber-fed system, then a buzzer sounds and a lamp lights at the RFT at the other end of the system. If the craftsperson is at an RFT, then a buzzer sounds and a lamp lights at the FCOT.

Using orderwire to access the public network

The craftsperson can use local or express orderwire to access the public network. Access to the public network is by way of a two-wire port on the maintenance interface card. In the AccessNode in the central office, that two-wire port connects to pins 25 (tip) and 28 (ring) on the wirewrap pin field on the breaker interface panel. The line connected to pins 25 and 28 can be wired to the local switch. To access the public network, the craftsperson plugs a handset or headset into the LCAP jacks and dials 9. This causes the maintenance interface card in the FCOT to connect the VF path to the central-office line by way of the two-wire port. (When the craftsperson dials 9, the buzzer and lamp do not sound.) Then the craftsperson can dial a number. To release the connection, the craftsperson just unplugs the headset or handset.

PUPS

The maintenance interface card has a point-of-use power supply (PUPS) that supplies dc voltages.

Bus connections

CBUS

The processor card accesses the maintenance interface card by way of control bus (CBUS) for status and control.

SOH bus

The maintenance interface card is connected to each SONET overhead bus (SOH bus) in the shelf. In a shelf, there is one SOH bus for each optical interface circuit pack (OC-12 or OC-3). Each SOH bus links its optical interface circuit pack to the processor card and the maintenance interface card. The SOH bus carries the SONET data communications channels (DCCs), the section data communications channel and the line data communications channel.

The SOH bus also carries the express orderwire channel and the local orderwire channel.

MOH bus

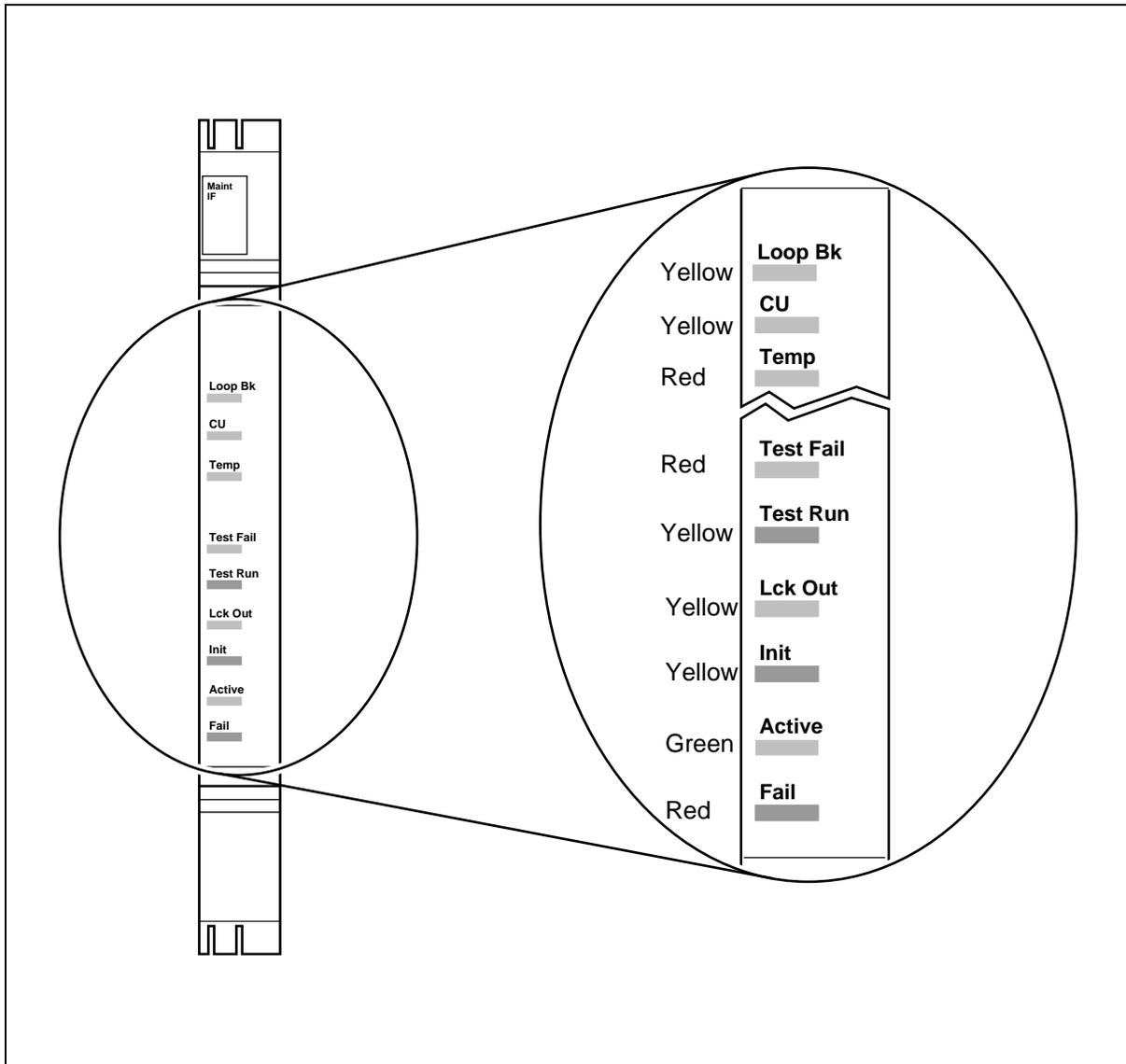
The maintenance interface card is connected to the maintenance overhead bus (MOH bus). This bus links the access interface card, the test access card, and the maintenance interface card, and carries test tones and trunk conditioning.

Physical appearance of the maintenance interface card

The maintenance interface card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-35 shows the front view of the maintenance interface card.

Figure 5-35
Front view of the maintenance interface card

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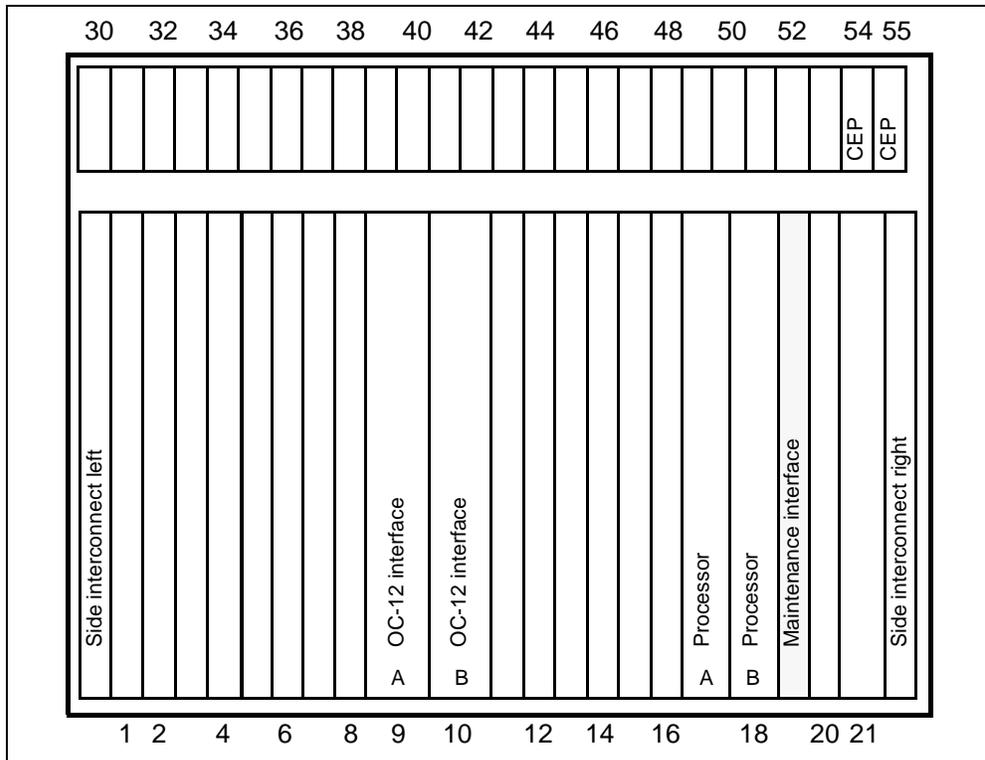
The meanings of the LEDs on the maintenance interface card are as follows:

- LoopBk. The transport loopback is active.
- CU. Reserved for future use.
- Temp. The shelf is over temperature.
- TestFail. An exerciser test (for OC-12s, OC-3s, or the processor card) has failed.
- TestRun. An exerciser test (for OC-12s, OC-3s, or the processor card) is running.
- LckOut. Protection for DS1s, DS3s, OC-3s, or OC-12s is locked out.
- Init. The transport system is initializing.
- Active. The maintenance interface card is working.
- Fail. The maintenance interface card is in the failed state.

Equipping rules for the access bandwidth manager shelf

As shown in Figure 5-36, the maintenance interface card installs in slot 19 in the access bandwidth manager shelf. Because the functionality of the maintenance interface card is not service-affecting, the card is not duplicated.

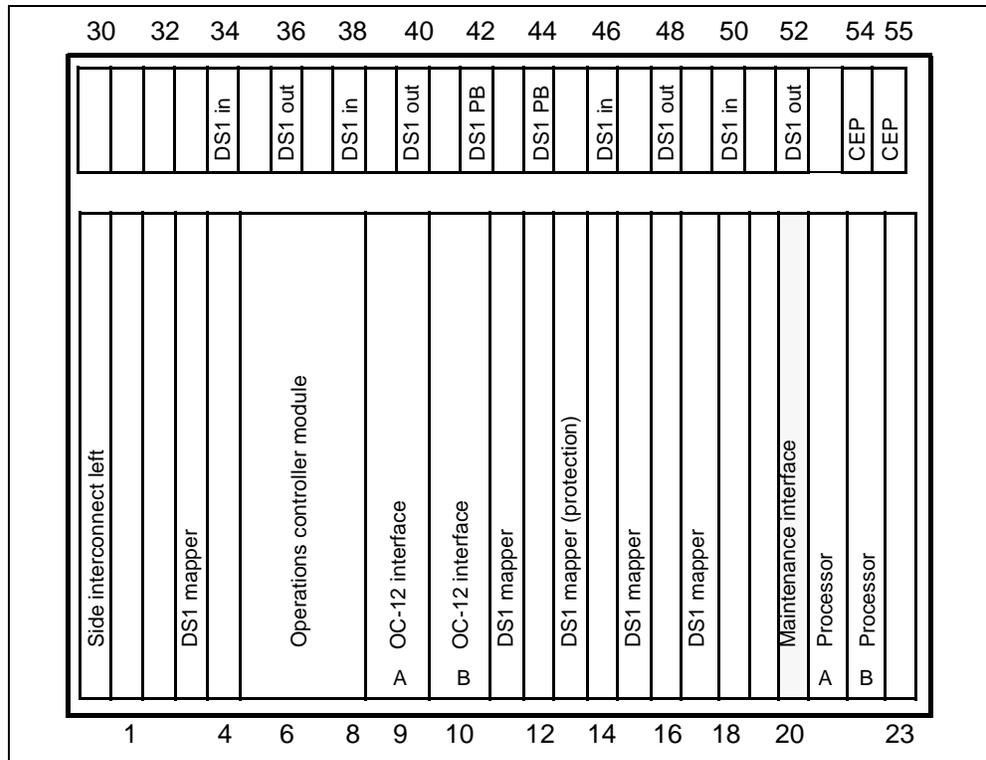
Figure 5-36
Where the maintenance interface card installs in the access bandwidth manager shelf



Equipping rules for the transport bandwidth manager shelf

As shown in Figure 5-37, the maintenance interface card installs in slot 20 in the transport bandwidth manager shelf. Because the functionality of the maintenance interface card is not service-affecting, the card is not duplicated.

Figure 5-37
Where the maintenance interface card installs in the transport bandwidth manager shelf



OC-12 interface circuit pack (NT7E02)

The OC-12 interface circuit pack installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. These circuit packs install in pairs, which are in nonrevertive protection-switching arrangements.

The two OC-12 interface circuit packs act as the primary interface to the fiber optic feeder.

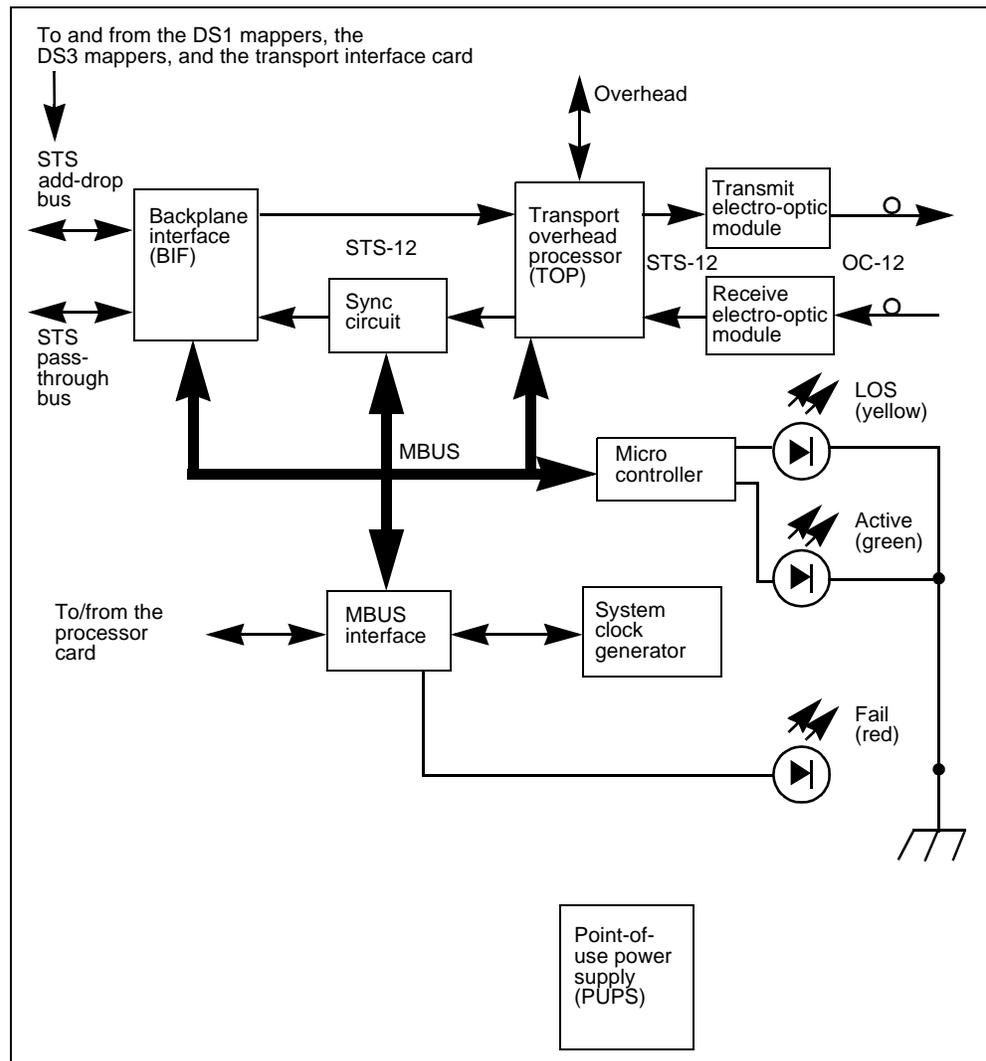
Both OC-12 interface circuit packs (working and protection) receive electrical STS-1 signals by way of STS-links, which are in the backplane of the shelf. The STS-1 signals come from the working transport interface card, the DS1 mappers, and the DS3 mappers. Each OC-12 interface circuit pack processes a maximum of 12 STS-1 signals in each direction (transmit and receive). Each OC-12 interface circuit pack performs electrical-to-optical conversion, and transmits optical signals at an OC-12 rate over the fiber optic link. (The far end uses the signal from the working OC-12 interface circuit pack.) Both OC-12 interface circuit packs (working and protection) receive optical signals at an OC-12 rate from fiber optic links, and perform optical-to-electrical conversion. The working OC-12 interface circuit pack transmits STS-1 signals by way of STS-links, which are in the backplane of the shelf

There are two types of OC-12 interface circuit packs: long-reach and intermediate-reach. The customer has the choice of biconic, ST, or FC connectors.

Functional description

Figure 5-38 is a block diagram of the OC-12 interface circuit pack. Subsequent sections explain the functions of the parts shown in the diagram.

Figure 5-38
Block diagram of the OC-12 interface circuit pack



MBUS interface

Control and status monitoring for the OC-12 interface circuit pack is provided by the MBUS interface circuit, which provides communication with the processor card. (The interface is through control bus (CBUS), which is a superset of MBUS.) The MBUS interface circuit also controls the red Fail LED on the faceplate of the circuit pack.

System clock generator

The system clock generator in the optical interface circuit pack sources system clocks: a 51.84 MHz clock, a 38.88 MHz clock, and a 2 kHz clock. The circuit pack can lock to an external clock by way of the working external synchronization interface card. (For information on the external synchronization interface card, see the section on the external synchronization interface card, beginning on page 5-40.) The optical interface circuit pack can also lock to a timing source derived from the incoming signal on the fiber (looptimed mode).

Electro-optical modules

Each electro-optical module converts between electrical signals and optical signals. The electrical signal is an STS-12 signal with a data rate of 622 Mb/s; the optical signal is an OC-12 signal, also with a data rate of 622 Mb/s.

Transport overhead processor

The transport overhead processor handles signals traveling in both directions (toward the fiber and from the fiber). For signals going toward the fiber, it multiplexes 12 STS-1s into a serial STS-12, and it inserts transport overhead. For signals received from the fiber, it extracts transport overhead. The transport overhead is composed of the SONET line overhead and the SONET section overhead.

Backplane interface

The backplane interface handles signals traveling in both directions (toward the fiber and from the fiber). For signals going toward the fiber, it selects 12 STS-1s to be transmitted into the fiber. For signals received from the fiber, it converts the serial STS-12 into 12 STS-1s, and it routes the STS-1s to the STS-links in the shelf backplane.

Microcontroller

The microcontroller controls real-time events such as 1+1 protection arbitration, and monitors the functioning of the OC-12 interface circuit pack.

Signal flow from the fiber optic link toward the shelf

In each OC-12 interface circuit pack (working and protection), the following processes occur. The circuit pack receives an OC-12 signal from the fiber optic link. The electro-optic receiver module converts the OC-12 signal into a serial STS-12 electrical signal whose data rate is 622 Mb/s. The transport overhead processor extracts transport overhead (that is, line overhead and section overhead), reframes, and descrambles the STS-12. The STS-12 then goes to the sync circuit, which performs STS-level pointer processing, to synchronize the payload with the system clock and frame. Then the STS-12 signal goes to the backplane interface, which converts the STS-12 signal into 12 serial STS-1s.

The working OC-12 interface circuit pack transmits the STS-1s by way of the STS-links in the shelf backplane.

Signal flow from the shelf toward the fiber optic link

In each OC-12 interface circuit pack (working and protection), the following processes occur. The circuit pack receives 12 STS-1 signals from the STS-links in the shelf backplane. The backplane interface circuit selects 12 STS-1s to be multiplexed. The transport overhead processor inserts the transport overhead (that is, line overhead and section overhead), and multiplexes and scrambles the 12 STS-1s, to produce a serial STS-12 signal, whose data rate is 622 Mb/s. Then the electro-optical transmitter converts the STS-12 electrical signal into an OC-12 optical signal and transmits the OC-12.

Both OC-12 interface circuit packs (working and protection) transmit an optical signal; the far end uses the signal from the working circuit pack.

Bus connections**CBUS**

The processor card accesses the OC-12 interface circuit pack by way of CBUS for status and control.

SOH bus

In an access bandwidth manager shelf or a transport bandwidth manager shelf, there is one SOH bus for each OC-12 interface circuit pack. Each SOH bus links the OC-12 interface circuit pack to the maintenance interface card.

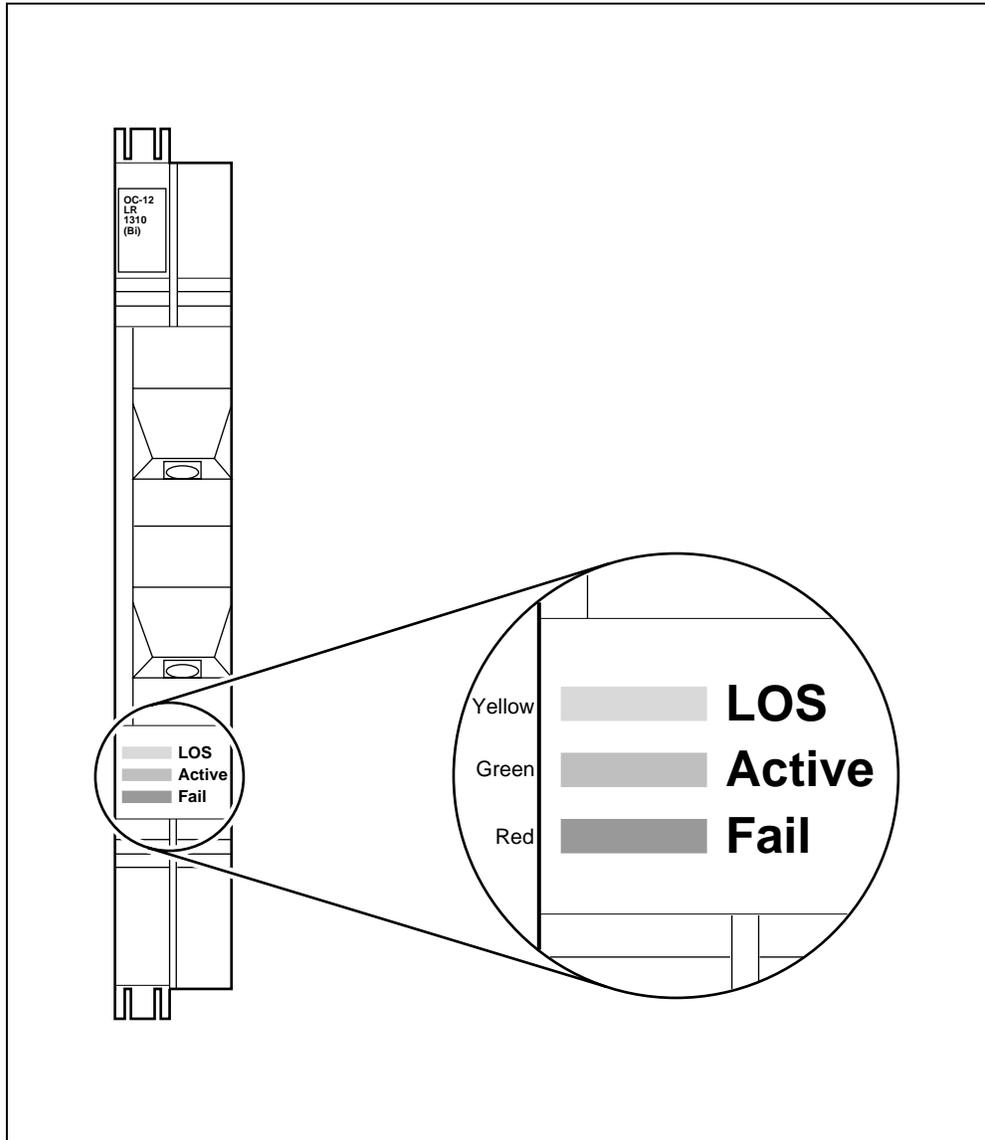
The SOH bus carries the SONET section data communications channel and the SONET line data communications channel. This makes the SONET overhead available to the processor card. The SOH bus also carries orderwire channels. This makes the orderwire channels available to the maintenance interface card.

Physical appearance of the OC-12 interface circuit pack

The OC-12 interface circuit pack is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a double-width circuit pack, 1.6 in. (4.06 cm) wide. Each OC-12 interface circuit pack has three indicator lamps on its faceplate: a green Active lamp, a red Fail lamp, and a yellow lamp labeled LOS, which is lit to indicate loss of the optical input signal. Figure 5-39 shows the front view of the circuit pack.

Figure 5-39
Front view of the OC-12 interface circuit pack

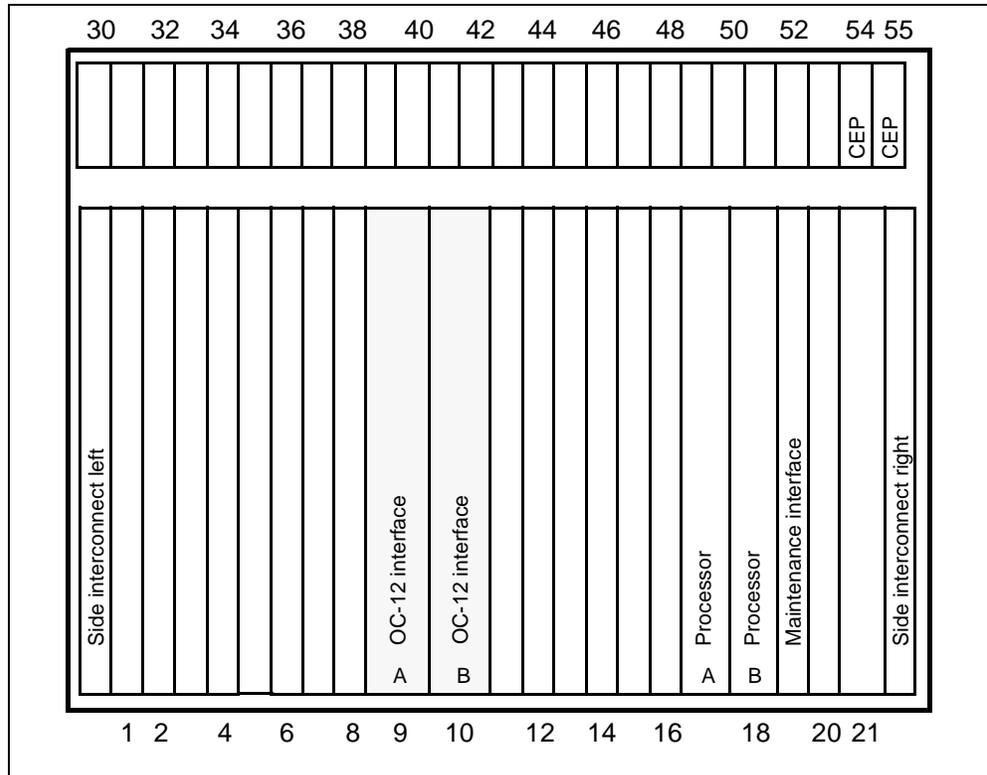
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Equipping rules for the access bandwidth manager shelf

OC-12 interface circuit packs are installed in pairs so that they can be in nonrevertive protection-switching arrangements. In an access bandwidth manager shelf, the OC-12 interface circuit packs are installed in slots 9 and 10. See Figure 5-40.

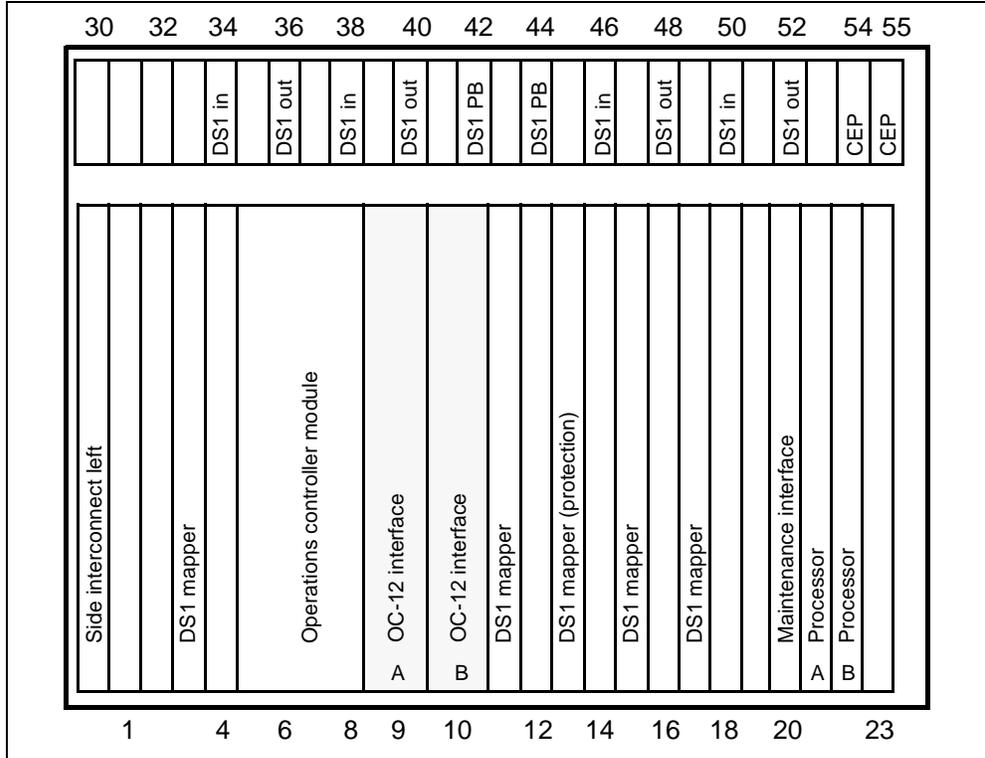
Figure 5-40
Where the pairs of OC-12 interface circuit packs install in the access bandwidth manager shelf



Equipping rules for the transport bandwidth manager shelf

OC-12 interface circuit packs are installed in pairs so that they can be in nonrevertive protection-switching arrangements. In a transport bandwidth manager shelf, the OC-12 interface circuit packs are installed in slots 9 and 10. See Figure 5-41.

Figure 5-41
Where the OC-12 circuit packs install in the transport bandwidth manager shelf



OC-12 VTBM circuit pack (NT7E05)

The OC-12 VTBM circuit pack is used as the interface to the primary fiber optic feeder in network elements in fiber-fed systems that have bidirectional line-switched ring (BLSR) topology. Two units are required in each network element. One unit handles the working and protection channels traveling in the east-to-west direction of the ring, and the other unit handles the working and protection channels traveling in the west-to-east direction.

The OC-12 VTBM circuit pack can be equipped with the following optical connectors:

- ferrule (FC)
- straight (ST)
- subscriber (SC)

VTBM support of OC-3 concatenated tributaries

There are two types of the VTBM optic cards, long-reach and intermediate-reach. There are two vintages of the VTBM optic cards: an initial release and an enhanced version. The initial version (listed in Table 5-3) does not support OC-3 concatenated (OC-3c) tributaries. The enhanced version (listed in Table 5-4) does support OC-3c tributaries. The initial cards are upgradable to the enhanced version.

In BLSR ring configurations supporting OC-3c tributaries, the enhanced VTBM optic cards are required in both the network element where the OC-3c tributary originates and in the network element where the OC-3c tributary terminates.

Table 5-3
OC-12 VTBM hardware not supporting OC-3c tributaries

PEC	Description
NT7E05AB	OC-12 VTBM Long Reach (FC)
NT7E05AC	OC-12 VTBM Long Reach (ST)
NT7E05AD	OC-12 VTBM Long Reach (SC)
NT7E05BB	OC-12 VTBM Intermediate Reach (FC)
NT7E05BC	OC-12 VTBM Intermediate Reach (ST)
NT7E05BD	OC-12 VTBM Intermediate Reach (SC)

Table 5-4
OC-12 VTBM hardware supporting OC-3c tributaries

PEC	Description
NT7E05AF	OC-12 VTBM Enhanced Long Reach (FC)
NT7E05AG	OC-12 VTBM Enhanced Long Reach (ST)
NT7E05AH	OC-12 VTBM Enhanced Long Reach (SC)
NT7E05BF	OC-12 VTBM Enhanced Intermediate Reach (FC)
NT7E05BG	OC-12 VTBM Enhanced Intermediate Reach (ST)
NT7E05BH	OC-12 VTBM Enhanced Intermediate Reach (SC)

OC-12 VTBM circuit packs interfacing the optical feeder

The OC-12 VTBM circuit pack provides

- interface to the OC-12 signal
- bandwidth management at the STS-1 level and at the VT level
- timing to maintain the synchronization of the network element

These are explained in the following paragraphs.

Interface to the OC-12 signal

The OC-12 VTBM circuit pack generates an OC-12 signal from STS-1 electrical signals. The optical signal is an intermediate reach (IR) 1310-nm wavelength. Each circuit pack processes a maximum of 12 STS-1 transmit and receive signals independently. The STS-1 signals are exchanged with tributary circuit packs by way of the backplane add and drop buses.

Bandwidth management

The OC-12 VTBM circuit pack can perform bandwidth management at the STS-1 level and at the VT1.5 level. To perform bandwidth management, the circuit pack must perform both of the following functions:

- synchronization
- switching

Synchronization

The synchronization function aligns the STS-1 and VT signals so that the ANSI switch application specific integrated circuit (ASIC) can perform time slot alignment (see Figure 5-42 on page 5-75). Alignment enables the ANSI switch ASIC to locate the constituent STS-1 or VT time slots of the signals received at its input ports. Switching at the STS level requires STS-level synchronization; switching at the VT level requires VT-level synchronization.

Synchronization means that the received SONET signal must be aligned to the system clock. STS-level synchronization is achieved by performing STS pointer justification on the STS synchronous payload envelope (SPE) extracted from the received SONET signal. VT-level synchronization aligns the VT frames within an STS-1 to the 2 kHz system clock. This requires VT pointer processing on each VT1.5.

Switching

To perform switching, the OC-12 VTBM circuit pack contains a central STS-1 and VT cross-connect located in the ANSI switch ASIC. The ANSI switch ASIC has three bidirectional STS-12 ports and is fully nonblocking. This means that any VT1.5 at any input port can be connected to any VT1.5 in any of the three output ports. The three output ports are:

- the add-drop port, which is dedicated to the add-drop bus
- the line port, which is dedicated to the unit's STS-12 line interface
- the pass-through port, which interfaces to the R-link

Note 1: The pass-through port can interface to the pass-through bus. However, the pass-through bus is not used in network elements in fiber-fed ring systems.

Note 2: VT-mapped STS-1s that are not VT-synchronized can be cross-connected at the STS-1 level but not at the VT level.

Timing

When equipped in the primary transport slots (slots nine and ten), the OC-12 VTBM circuit packs are responsible for generating shelf timing. Each OC-12 VTBM circuit pack has a system clock generator that generates a 51 MHz clock, a 38 MHz clock, and a 2 kHz clock. The clocks are distributed to the tributary interfaces in the shelf.

The active OC-12 VTBM circuit pack is locked to the selected timing reference for the shelf, and the backup unit is locked to a timing reference provided by the active unit. The active OC-12 VTBM circuit pack can lock its system clock generator to any of the following timing references:

- a 51.84 MHz timing reference supplied by an ESI card in the shelf
- timing signals in the received OC-12 signal
- an OC-3 SONET tributary
- a received OC-12 or STS-12 signal from the secondary transport slots

In the event that the timing reference is lost, the OC-12 VTBM circuit pack provides a holdover capability that can maintain the frequency to within 4.6 ppm for a period of 24 hours. The OC-12 VTBM circuit pack has a free-run capability with a frequency accuracy of ± 20 ppm.

The OC-12 VTBM circuit packs provide access to the synchronization-status messages that are contained in bits five to eight of the Z1 byte of the SONET line overhead. In a VTBM ring, each network element encodes the synchronization status message in the outgoing SONET signal. The message informs the adjacent network element of the quality level of the timing of the SONET signal. If a network element must choose a new timing source, because the active timing source has degraded or has been lost, then it chooses the highest-quality timing source that is available. For detailed information on synchronization-status messages, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

Signal flow

Figure 5-42 on page 5-75 shows the transmit-direction and receive-direction signal flow in the OC-12 VTBM circuit pack.

Transmit direction signal flow—going into the fiber

The transmit backplane interface chip (TBIC) shown in Figure 5-42 on page 5-75, receives 12 serial STS-1 signals from the R-link. The TBIC multiplexes the received STS-1s into an STS-12 signal, and routes that signal to the pass-through port of the ANSI switch ASIC. The TBIC receives STS-1s from the add-drop bus, multiplexes them into an STS-12, and routes that signal to the add-drop port of the ANSI switch ASIC.

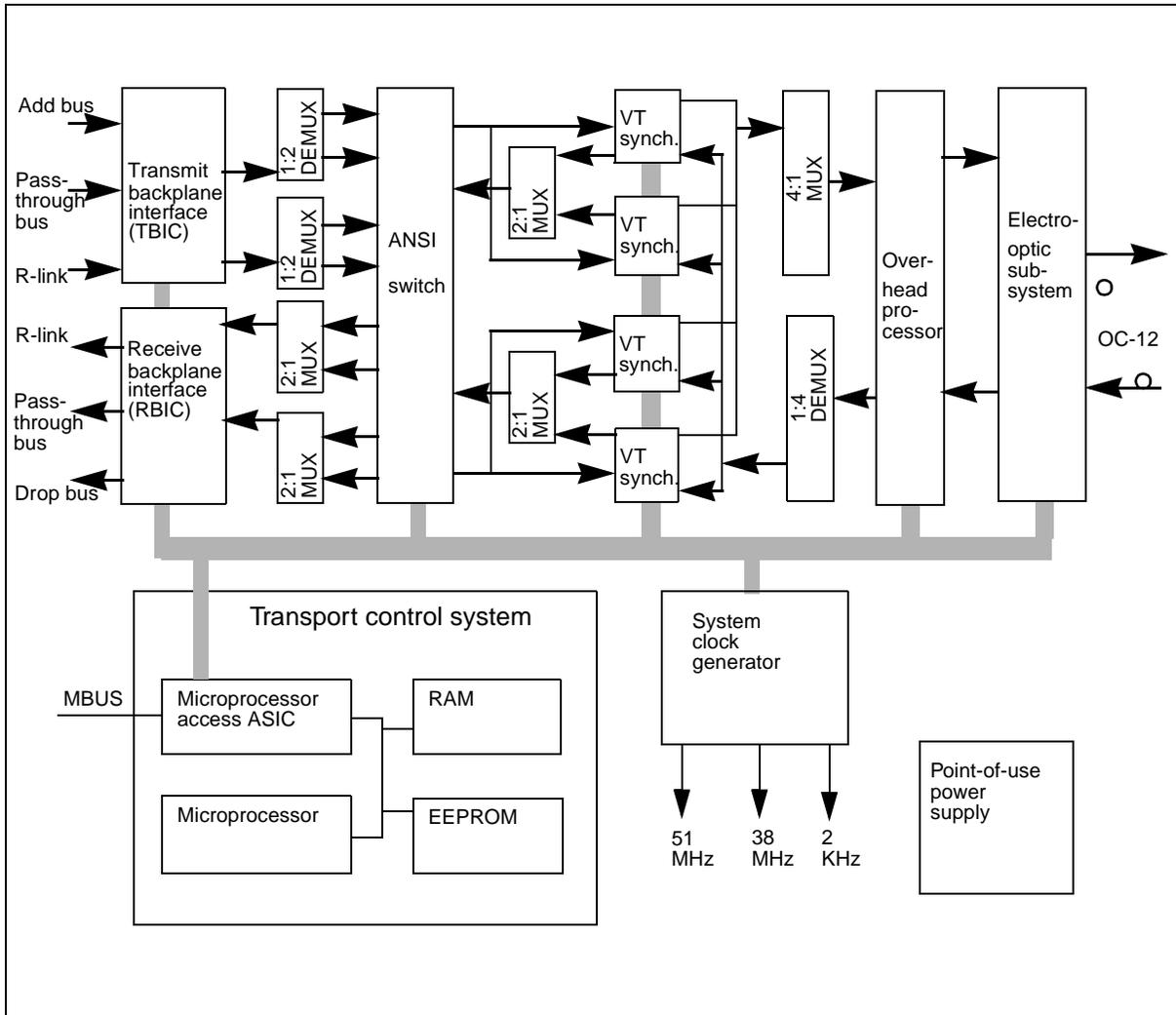
Note: If the OC-12 VTBM circuit pack were used in a network element in a linear system, the TBIC would receive STS-1s from the A or B pass-through bus in the backplane rather than from the R-link. However, the OC-12 VTBM circuit pack is not used in linear AccessNode systems.

From the ANSI switch ASIC, the STS traffic goes to the VT synchronizer ASICs, and then to the overhead processor. Each VT synchronizer ASIC performs VT pointer processing for a single STS-3 signal. The overhead processor adds the SONET section and line overhead and scrambles the result. From the overhead processor, the STS-12 goes to the electro-optic subsystem, where it is multiplexed to the 622 Mb/s line rate.

Receive direction signal flow—coming out of the fiber

The OC-12 signal from the fiber optic feeder is converted into a 622-Mb/s STS-12 electrical signal by the electro-optic subsystem. The STS-12 then goes to the overhead processor (see Figure 5-42 on page 5-75). The overhead processor frames and descrambles the STS-12 signal, extracts the SONET line overhead (LOH) and section overhead (SOH), and performs STS pointer processing to align the signal with local system timing. From the overhead processor, the STS-12 goes to the VT synchronizer ASICs, which provide VT pointer processing to align all the VTs with a local frame reference. Each VT synchronizer ASIC performs VT pointer processing for a single STS-3 signal. From the VT synchronizer ASICs, the STS-12 goes to the line port of the ANSI switch ASIC.

Figure 5-42
Block diagram of signal flow of the OC-12 VTBM circuit pack



From the ANSI switch ASIC, two STS-12 signals go to the receive backplane interface chip (RBIC). One comes from the add-drop port of the ANSI switch, the other, from the pass-through port of the ANSI switch. The RBIC takes the STS-12 signal from the add-drop port and demultiplexes it into 12 serial STS-1s, which are routed to tributary cards by way of the backplane drop bus. The RBIC takes the STS-12 signal from the pass-through port and routes it to the adjacent OC-12 VTBM circuit pack by way of the R-link.

The OC-12 VTBM circuit pack can derive its timing reference signals from the received optical signal. The active OC-12 VTBM circuit pack can lock its system clock generator to these timing reference signals. The system clock generator in the active OC-12 VTBM circuit pack provides the 51 MHz clock, the 38 MHz clock, and the 2 kHz clock.

STS-1 channel usage

In the bidirectional line-switched ring (BLSR) add/drop multiplexer (ADM) configuration, STS-1 channels 1 to 6 carry working traffic, and STS-1 channels 7 to 12 carry protection traffic.

Bus interface

The OC-12 VTBM circuit pack interfaces to the processor card by way of the maintenance bus (MBUS), which is a subset of the control bus (CBUS). The processor card interfaces to the transport control subsystem (TCS) of the OC-12 VTBM circuit pack, and that subsystem interfaces to the hardware on the circuit pack.

Note: The control bus, which is mentioned elsewhere in this document, is a superset of the maintenance bus.

Transport control subsystem

The transport control subsystem is shown in Figure 5-42. The main parts of the subsystem are

- the microcontroller
- the microprocessor access ASIC, which provides the interface between the microcontroller and the processor card
- electronically erasable programmable read-only memory (EEPROM), for nonvolatile storage of bootload firmware and circuit-pack identification data (product engineering code and vintage)
- random access memory (RAM) for use by the microcontroller

Point-of-use power supply (PUPS)

The OC-12 VTBM circuit pack is equipped with its own PUPS that converts the -48 V dc office supply to the specific regulated dc voltage levels required by the local circuitry.

Equipping rules for the OC-12 shelf

In a network element in an AccessNode fiber-fed ring system, the OC-12 VTBM circuit packs (G1 and G2) are installed in slots 9 and 10. For detailed equipping rules for this card, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

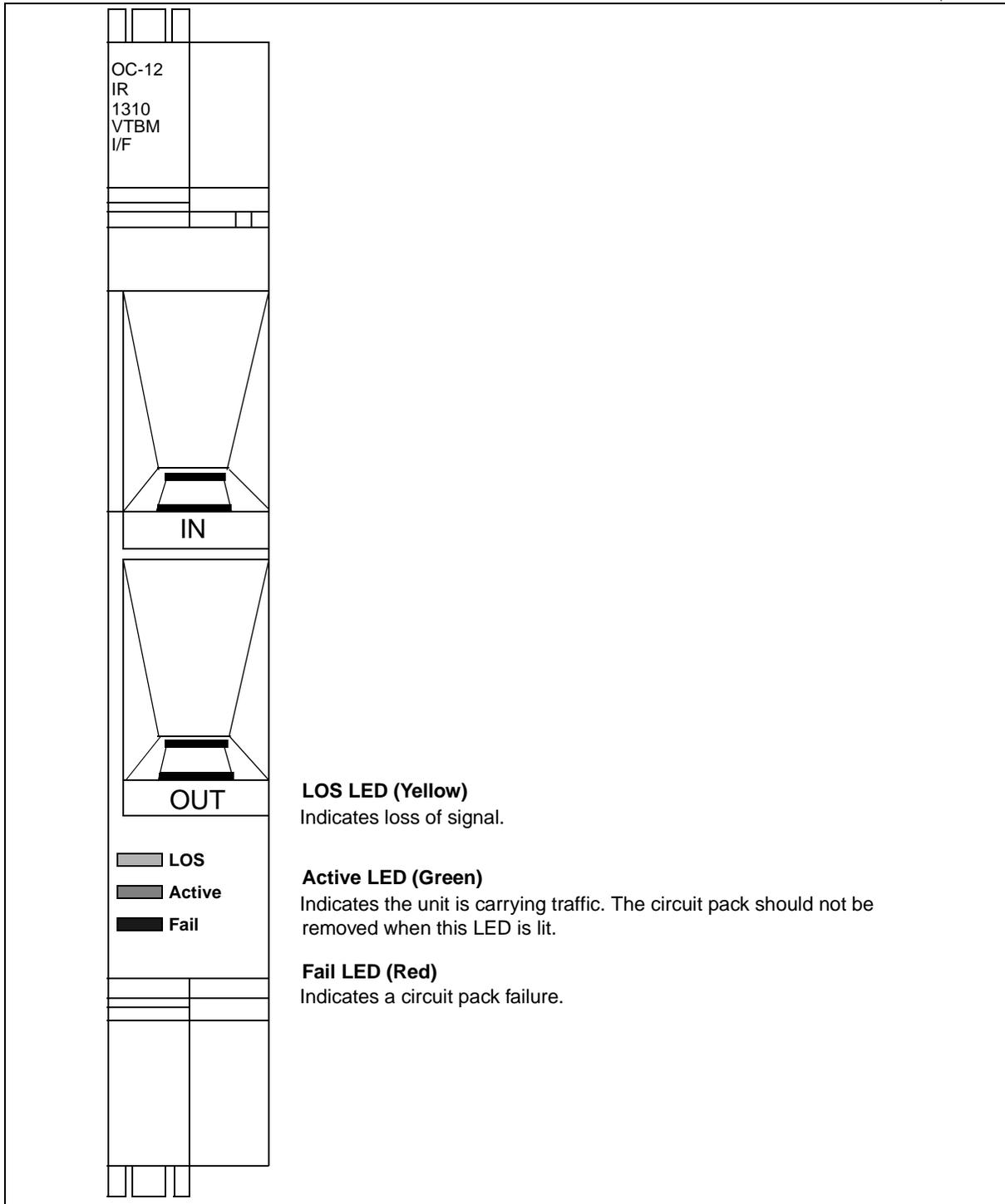
Alarm LED definitions

The following table lists the names of the OC-12 VTBM circuit pack LEDs, and the possible causes for the activation of each LED. Figure 5-43 shows the faceplate layout of the OC-12 VTBM circuit pack.

LED name	Possible cause
Fail	Failed circuit pack
Active	Active circuit pack
LOS	Loss of signal

Figure 5-43
OC-12 VTBM circuit pack faceplate layout

PC-0121 (OC12 R11)



OC-3 interface circuit pack (NT7E01)

The OC-3 interface circuit pack is like the OC-12 interface circuit pack, with the exception that it processes a maximum of only three rather than 12 STS-1 signals in each direction (transmit and receive).

The OC-3 interface circuit pack installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. These circuit packs install in pairs, which are in nonrevertive protection-switching arrangements.

The OC-3 interface circuit pack interfaces between the AccessNode and a fiber optic link. That link can be either the primary fiber optic feeder for the network element, or an OC-3 tributary.

OC-3 circuit packs interfacing to the fiber optic feeder

If OC-3 interface circuit packs interface to the primary fiber optic feeder for the network element in an AccessNode system, they are installed in slots nine and ten in the access or transport bandwidth manager shelf in that network element. If the network element is an RFT in a single-ended system, the primary fiber optic feeder for the RFT is an OC-3 that is dropped as a tributary by an S/DMS TransportNode OC-12 network element.

For information on the OC-3 interface circuit pack as the interface to the primary fiber optic feeder, see the information on the OC-12 interface circuit pack, beginning on page 5-64. All the information about the OC-12 interface circuit pack is also true of the OC-3 interface circuit pack, except for the fact that the OC-3 handles only three STS-1s rather than 12. OC-3 interface circuit packs interface to the following STS-1s in an optical signal: STS-1 #1, STS-1 #2, and STS-1 #3.

OC-3 circuit packs interfacing to OC-3 tributaries

If OC-3 interface circuit packs interface to OC-3 tributaries in an AccessNode system, they are installed in slots other than slots nine and ten in the access or transport bandwidth manager shelf in the network element.

For detailed equipping rules for the OC-3 as a tributary interface, refer to the *Mapper Layouts Planning Guide*, 323-3001-154, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Operations controller module (NT7E24)

The operations controller (OPC) module is a circuit pack that installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. An OPC module serves all the AccessNode network elements in a system.

A single OPC module can serve multiple systems, up to a maximum of 16 network elements. (An operations controller can serve one or more entire systems, but not parts of systems. For each system that is served, all the network elements in the must be included in the span of control.) There must be connectivity between the operations controller and each network element that it serves. For descriptions of the means by which connectivity can be established, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

One version of the OPC module includes a tape drive for 4-mm DAT tape cartridges.

The major functions of the OPC module are the following:

- The OPC provides and controls local OAM&P for the AccessNode.
- The OPC provides and controls OAM&P for other network elements in its system, and, optionally, in other systems. (In this release, an OPC can control a maximum of sixteen network elements.)
- The OPC acts as an OS gateway device, that is, as a mediation device for communication between the network elements and network operations systems (OSs).
- The OPC performs software management. It stores software on its hard disk. When a component in the system needs to have its software reloaded or upgraded, the software is downloaded to the component from the OPC.

Ports of the OPC

The operations controller module can be accessed by way of an Ethernet port and by way of multiple serial data-terminal-equipment (DTE) ports. The Ethernet port supports X11 terminals for the graphical user interface. The serial ports support VT100-type user interfaces and OS interfaces.

For detailed information about the ports of the OPC, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

Interfaces supported by the OPC

The OPC supports two levels of interfaces: operations systems and user interfaces.

OS interfaces

The OPC software supports communications between the network-level operations systems (OSs) and the network elements in the system.

User interfaces

The OPC software supports a graphical interface and a character-mode user interface. The multiple-window graphical interface is mouse-driven and requires the use of an NCD X terminal. The character-mode user interface is window-based and requires the use of a VT100-type terminal. The NE Login Manager OPC tool can display the network-element user interface session on any network element that is within the span of control of the OPC.

The multiple-window graphical interface allows the user to perform operations at the network-element level from the network-element user interface in one window, while simultaneously using the Network Surveillance OPC tool to monitor all alarms on the system in a second window.

User access and security at the OPC

The OPC software provides user-management functionality. User management includes functions such as the creation of authorized users of the OPC, the creation and maintenance of user groups, and security checking that occurs when a user signs on to use the OPC or tries to access a remote network element from the OPC.

System-wide OAM&P services at the OPC

The OAM&P software running in the OPC makes it possible for a user working at a central location to control all the network elements in the system. Using the OPC, a user can perform system-wide OAM&P functions. Some of the functions supported by this OAM&P software are:

- system lineup and test (SLAT) testing
- OPC operations, administration, and maintenance
 - OPC performance-monitoring service
 - OPC data collector
 - performance monitoring (of the OPC)
 - fault management (for the OPC)
 - OPC application-configuration-management service (controls parameters that refer to operation of the OPC)
- configuration and maintenance of the system
- maintaining an inventory of components in each network element

- the recording and reporting of alarms, logs, and performance-monitoring data from all network elements
- performance analysis for all network elements
- fault detection and reporting for all network elements
- software management (provisioning) and recovery

Software management functions of the OPC

The software management functions performed by the OPC include initial software loading, recovery, and upgrades.

The OPC module has a hard disk that stores master copies of the software used in all the network elements in the system. Whenever a processor in a network element needs a software load, such as after a failure, the software is downloaded to the processor from the OPC.

Some of the modules used in AccessNode are software-provisionable. The capabilities of a software-provisionable module are determined by the software that is downloaded from the OPC. The software-provisionable modules are:

- the processor cards
- the service-adaptive line cards

Point-of-use power supply (PUPS)

The OPC module has a point-of-use power supply (PUPS) that converts the -48 V dc office supply to the specific regulated direct-current voltage levels required by the local circuitry.

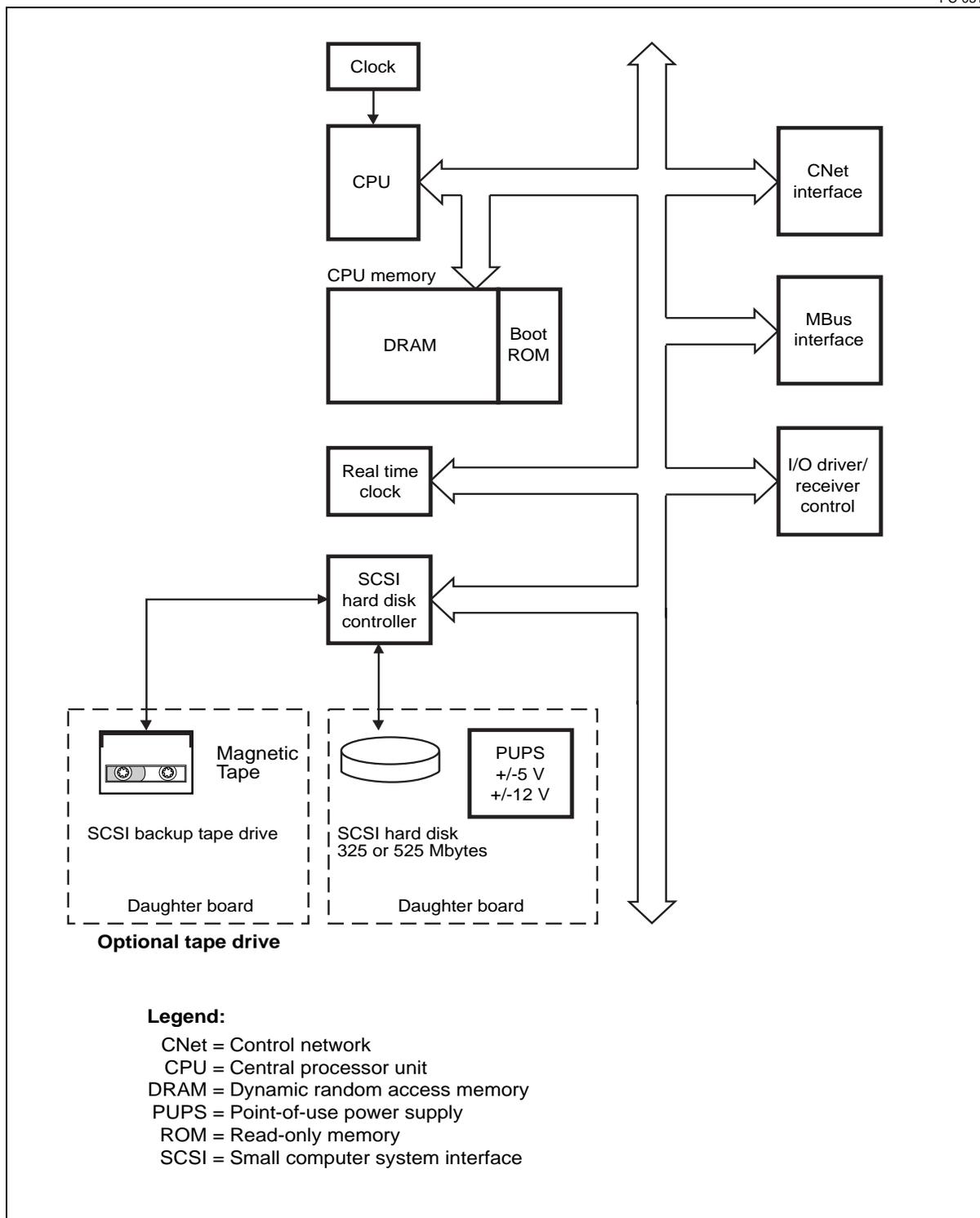
Bus connections

The OPC module is connected to the control bus (CBUS). CBUS is the means of accessing all the circuit packs and cards in the shelf. (The OPC module communicates by way of CBUS, but uses MBUS message protocol.)

Figure 5-44 is a block diagram of the OPC module.

Figure 5-44
Block diagram of the operations controller module

PC-0316



Physical appearance of the OPC module

The OPC module is a single four-slot-wide circuit pack, 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep, and 3.2 in. (8.13 cm) wide. The OPC module consists of a mother card, a daughter card, a disk-mounting frame, and a faceplate. The unit is not enclosed. The mother card supports all the logic devices. The hard disk and PUPS components are surface-mounted on the daughter card.

One version of the OPC module includes a tape drive for 4-mm DAT tape cartridges.

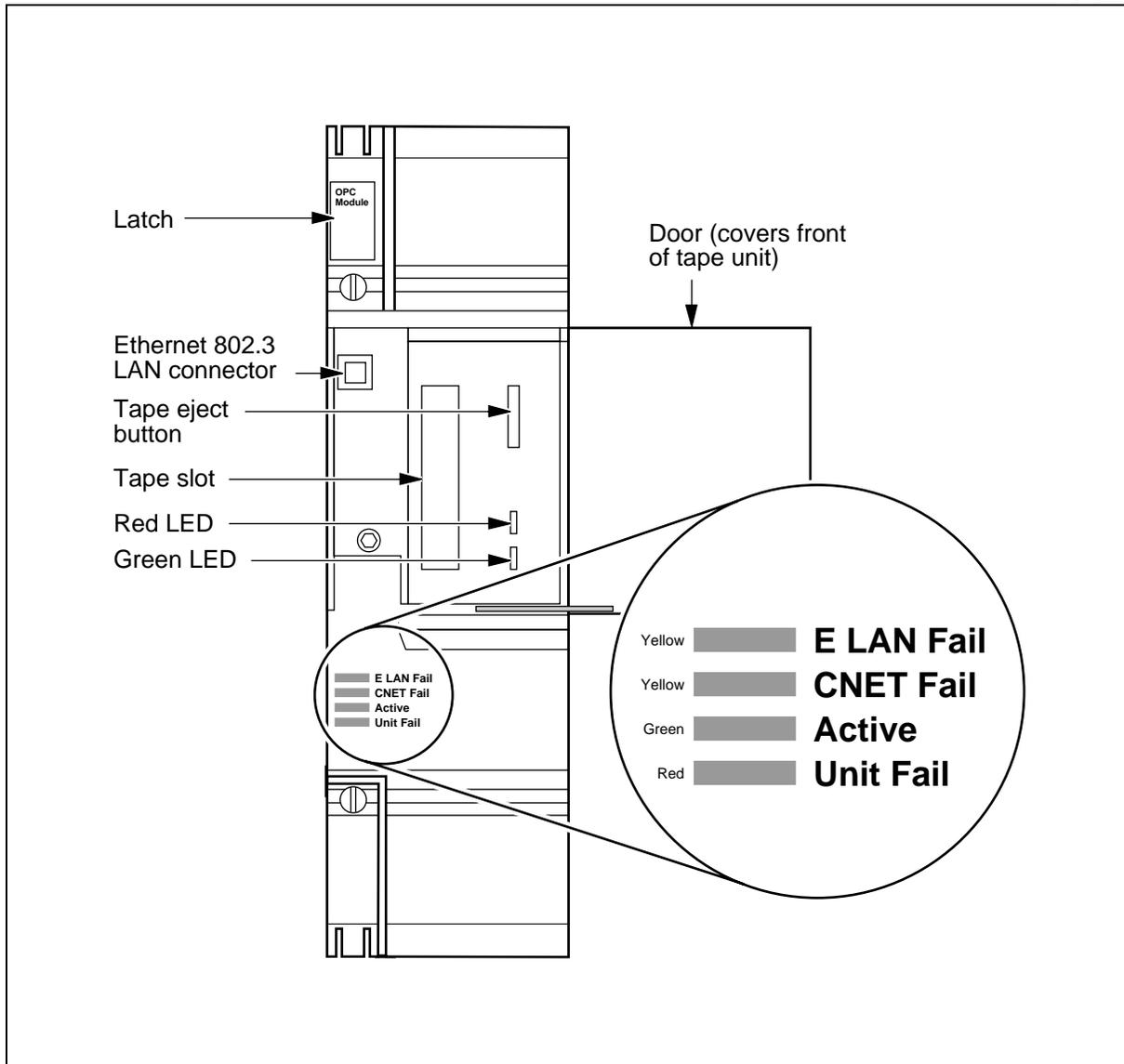
Note: If an OPC module has a tape drive, you can use it to load AccessNode software, which is delivered on 4-mm tape cartridges. If an OPC module does not have a tape drive, it can best be used as a standby OPC.

OPC module with a tape drive

Figure 5-45 shows the front view of an OPC module that includes a tape drive for 4-mm tape cartridges. The tape drive is located behind a spring-hinged door. The tape drive has red and green indicator lights. The green light is lit whenever a tape is loaded. The red light is lit whenever tape activity is in progress. The OPC Ethernet connector is also located behind the spring-hinged door. There is a semi-circular cutout in the upper edge of the door, to allow the OPC Ethernet cable to pass through.

Figure 5-45
Front view of an operations controller (OPC) module with a tape drive

PC-10246

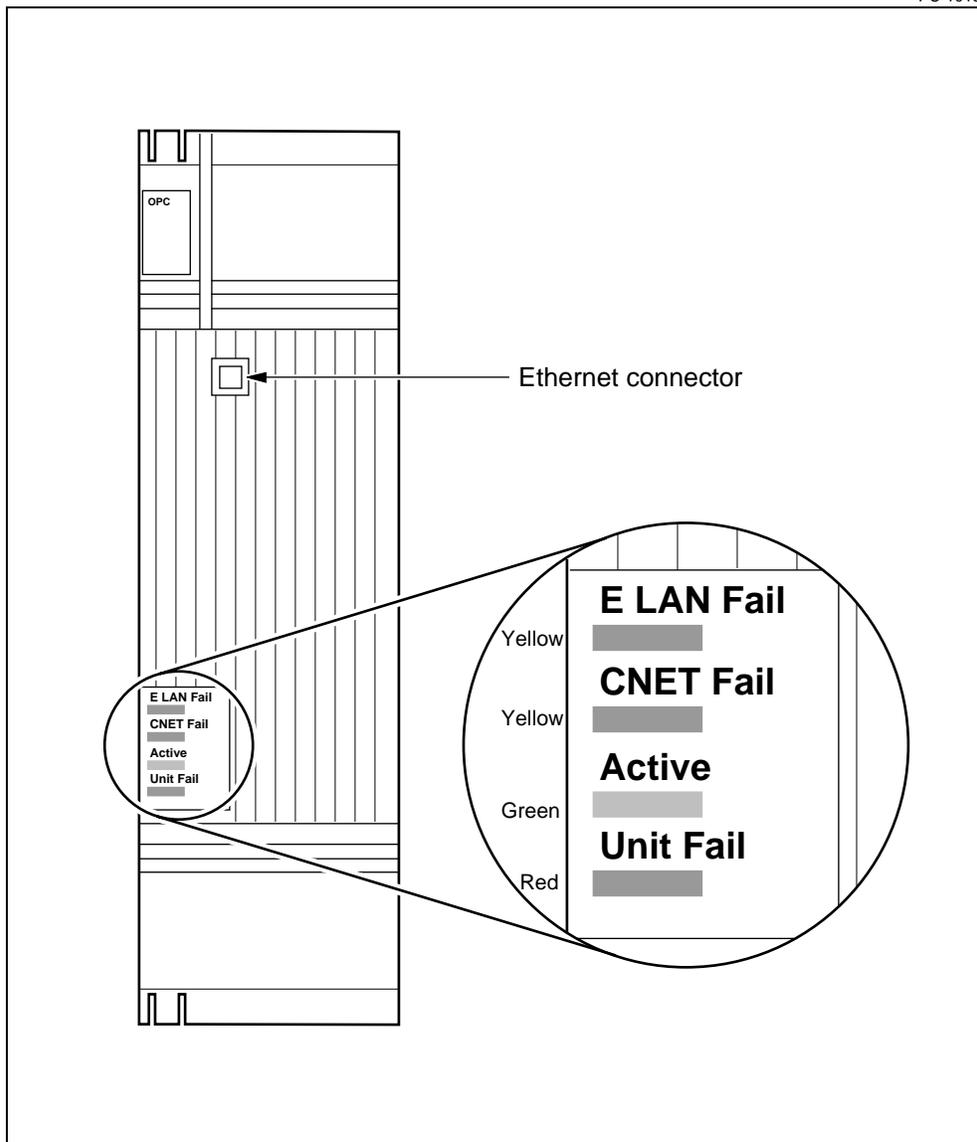


OPC module without a tape drive

Figure 5-46 shows a front view of an OPC module that does not include a tape drive. On the faceplate there is a connector for the OPC Ethernet cable.

Figure 5-46
Front view of an operations controller (OPC) module without a tape drive

PC-10164



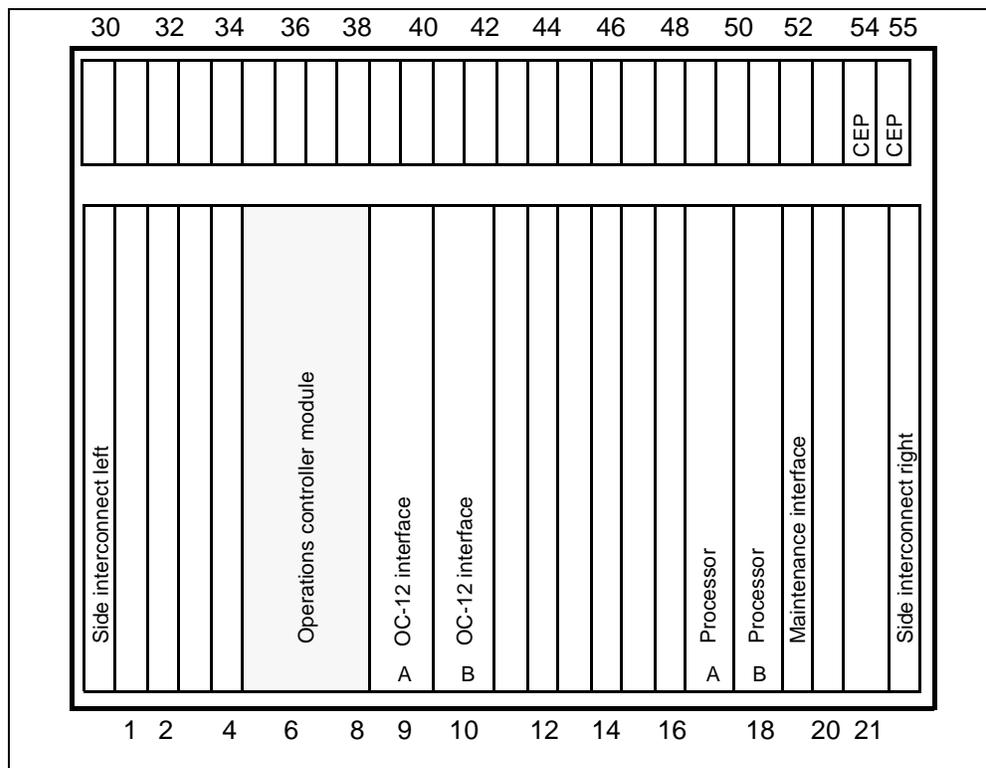
As shown in Figure 5-45 and Figure 5-46, each OPC module has four LEDs on its faceplate. The meanings of the LEDs are as follows:

- E LAN Fail. The OPC cannot communicate through the Ethernet port. (The connector for this port is on the front of the OPC module.)
- CNET Fail. The OPC cannot communicate through the control-network port. (As an option, the OPC may be linked to multiple network elements by way of control network.)
- Active. The operations controller module is provisioned and in service.
- Unit Fail. The operations controller module is in the failed state.

Equipping rules for the access bandwidth manager shelf

Figure 5-47 shows the location of the OPC module in an access bandwidth manager shelf. The OPC module is installed in slot 5 and occupies slots 5 to 8.

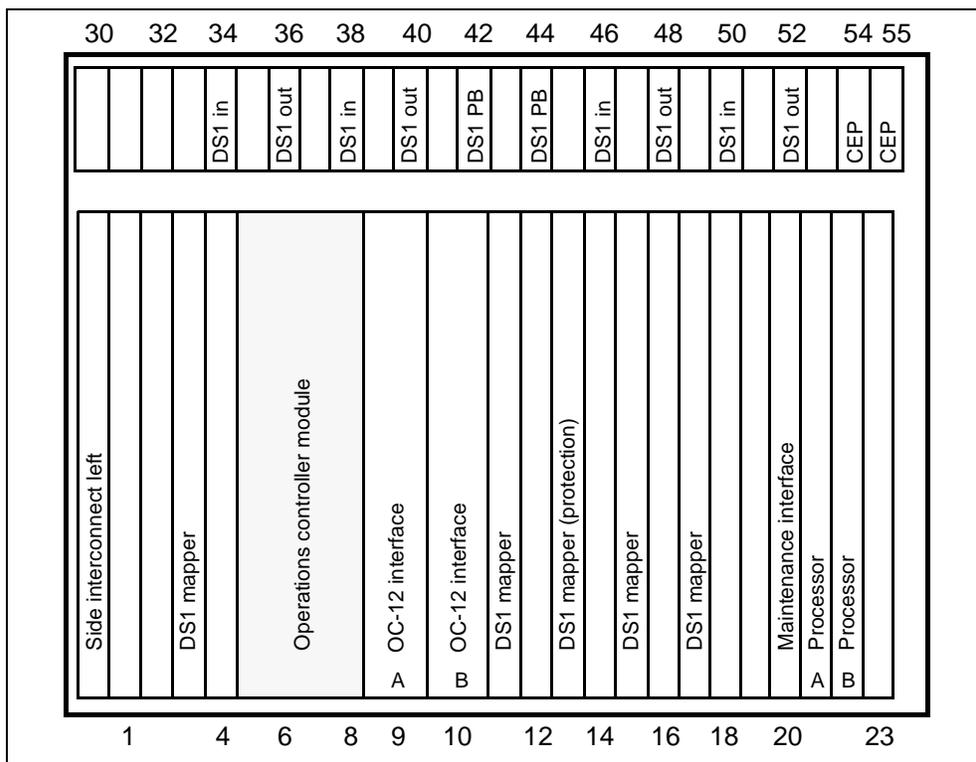
Figure 5-47
Where the OPC module installs in the access bandwidth manager shelf



Equipping rules for the transport bandwidth manager shelf

Figure 5-48 shows the location of the OPC module in a transport bandwidth manager shelf. The OPC module is installed in slot 5 and occupies slots 5 to 8.

Figure 5-48
Where the OPC module installs in the transport bandwidth manager shelf



PGTC/MTA card (NT4K58DA)

The PGTC/MTA card installs in the upper level of the access bandwidth manager shelf. The PGTC/MTA card is used only in FCOTs. The card performs the following functions that are required by the test access card:

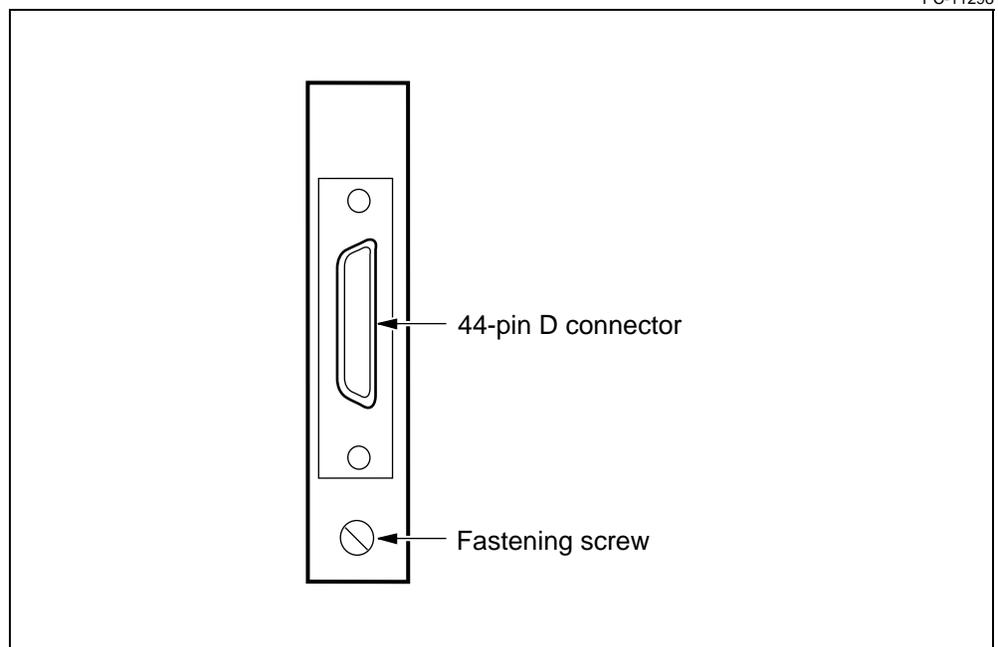
- It provides relays for the 28-lead pair-gain-test-controller (PGTC) interface.
- It provides relays and resistive terminations for the metallic-test-access (MTA) interface.

Figure 5-57 on page 5-99 shows how the PGTC/MTA card is related to the other modules that are involved in testing line cards.

Physical appearance of the PGTC/MTA card

The PGTC/MTA card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-49 shows the front view of the card.

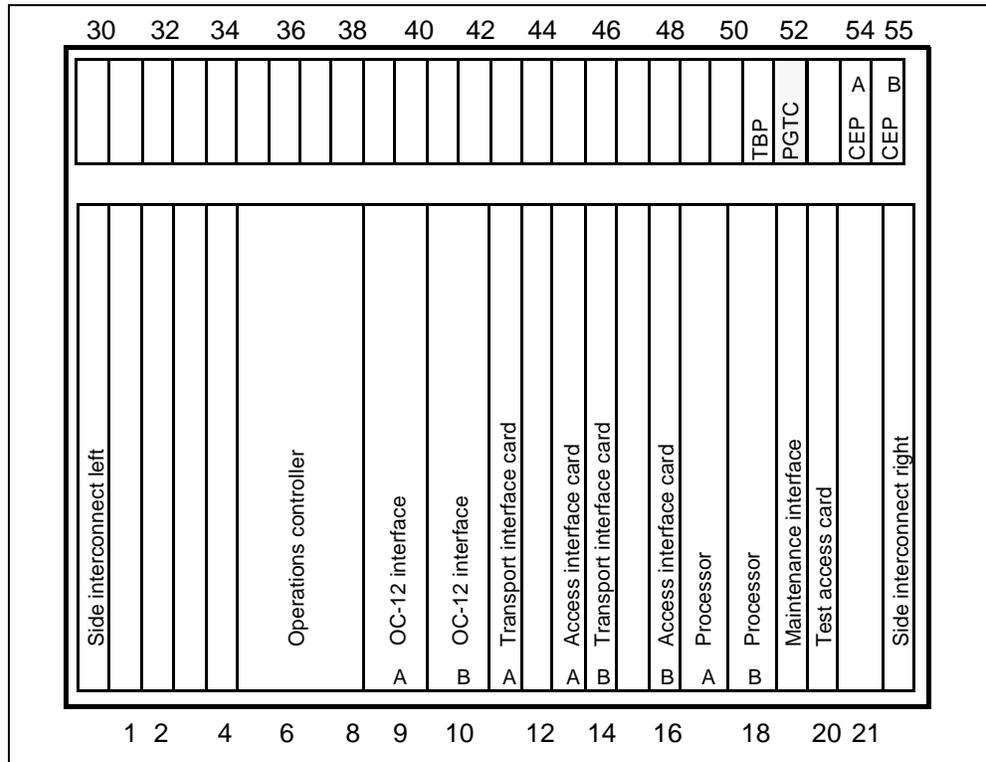
Figure 5-49
Front view of the PGTC/MTA card



Equipping rules

The PGTC/MTA card is used only in the access bandwidth manager shelf, and only in FCOTs. The card installs in slot 52 of the access bandwidth manager shelf. See Figure 5-50.

Figure 5-50
Where the PGTC/MTA card installs in the access bandwidth manager shelf



Processor card (NT4K52)

The processor card installs in the lower level of an access bandwidth manager shelf or a transport bandwidth manager shelf. It is the main processor in the shelf. It provides central control functions for the shelf and for the AccessNode as a whole. Every access bandwidth manager shelf and every transport bandwidth manager shelf contains one processor card, and a second can be installed for protection.

Functional description

The principal functions performed by the processor card are:

- call processing
- host communications
- operations, administration, and maintenance (OAM)

The processor card is divided into two functional blocks, the access processing unit (APU) and the host messaging unit (HMU).

The APU is responsible for all access functions except messaging. The HMU handles all messaging links and their protocols (except line-drawer messaging links). The link and protocol used for a message are transparent to the APU.

Bus connections

CBUS

The processor card is connected to the control bus (CBUS). CBUS is the means by which the processor accesses all the circuit packs and cards in the shelf.

COH bus

The communication overhead bus (COH bus) links each processor card and each access interface card. The bus carries the following communications channels: the common signaling channel (CSC) and the embedded operations channel (EOC).

SOH bus

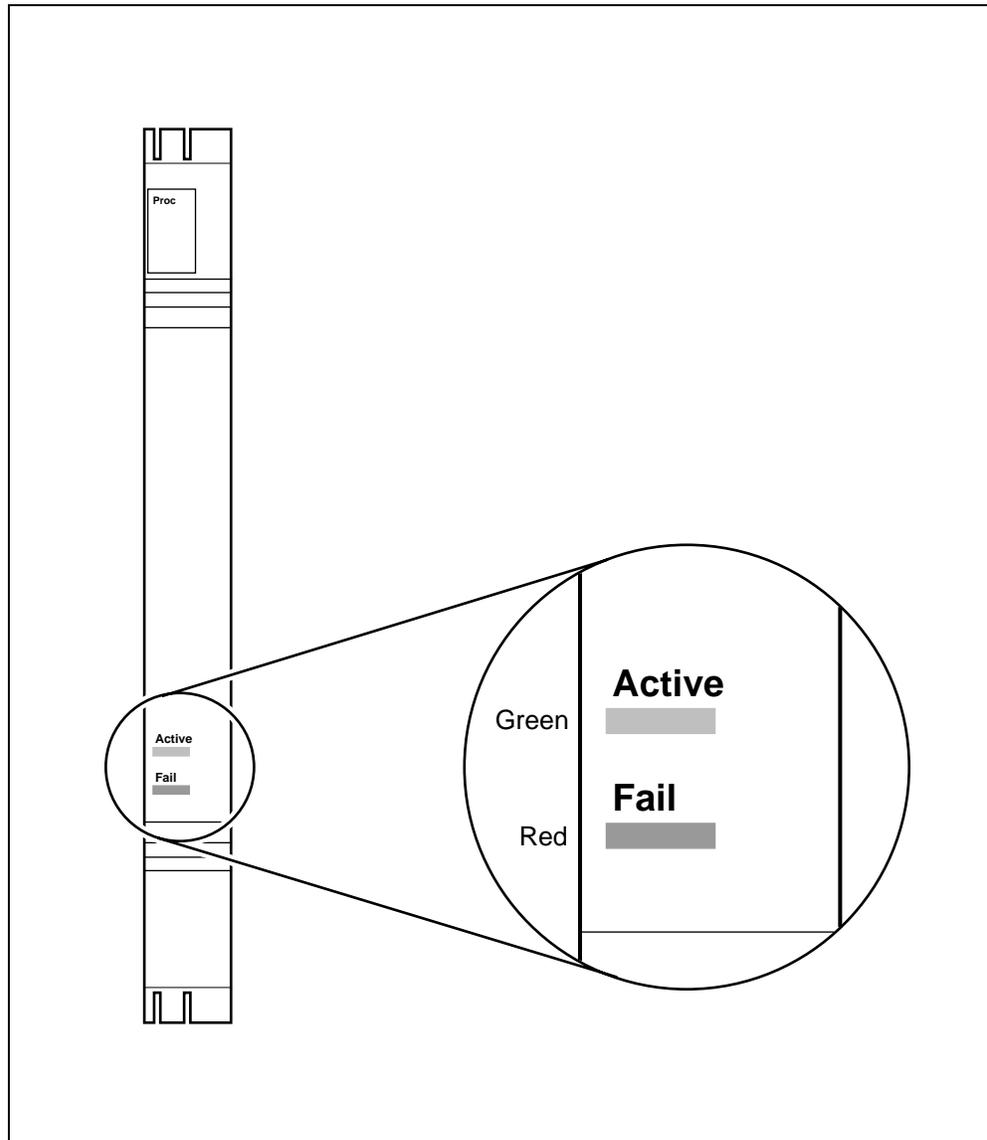
The processor card is connected to each SONET overhead bus (SOH bus) in the shelf. In a shelf, there is one SOH bus for each optical interface circuit pack (OC-12 or OC-3). Each SOH bus links its optical interface circuit pack to the processor card and the maintenance interface card in the shelf. The SOH bus carries the SONET data communications channel (DCC), which includes the section data communications channel and the line data communications channel. The SOH bus also carries orderwire channels.

Physical appearance of the processor card

The processor card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-51 shows the front view of the processor card.

Figure 5-51
Front view of the processor card

PC-10154

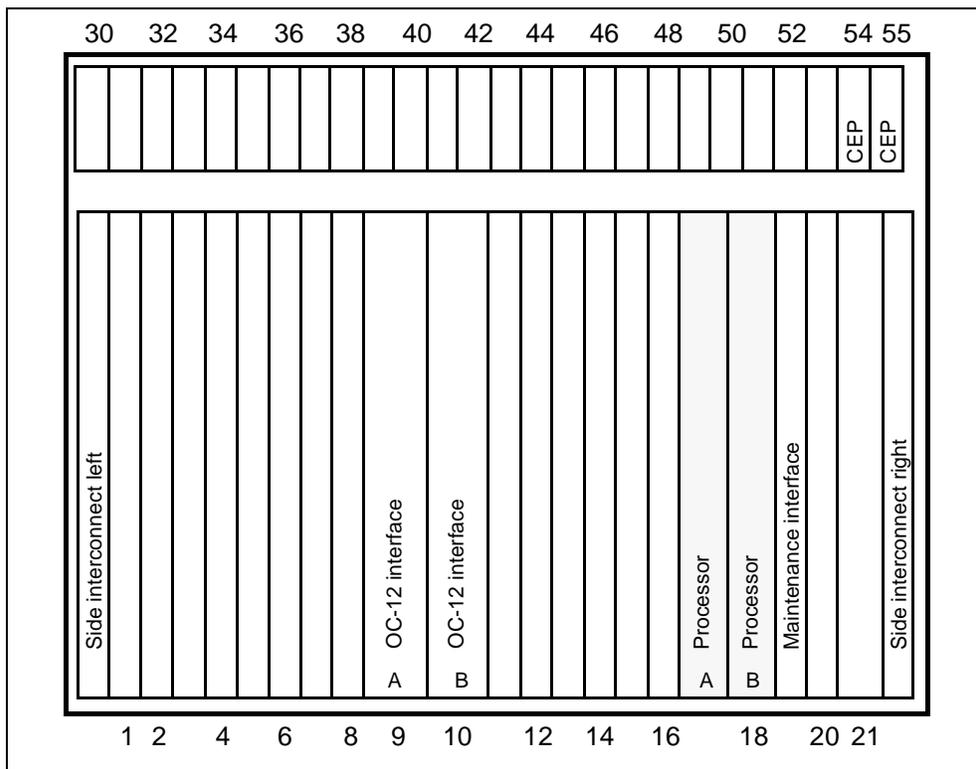


Equipping rules for the access bandwidth manager shelf

In an access bandwidth manager shelf, the primary processor card installs in slot 17. If a second processor is installed for protection, it goes into slot 18 as shown in Figure 5-52.

For information about required processors, see *Engineering and Ordering Information*, 323-3001-032, in *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 5-52
Where the processor cards install in the access bandwidth manager shelf

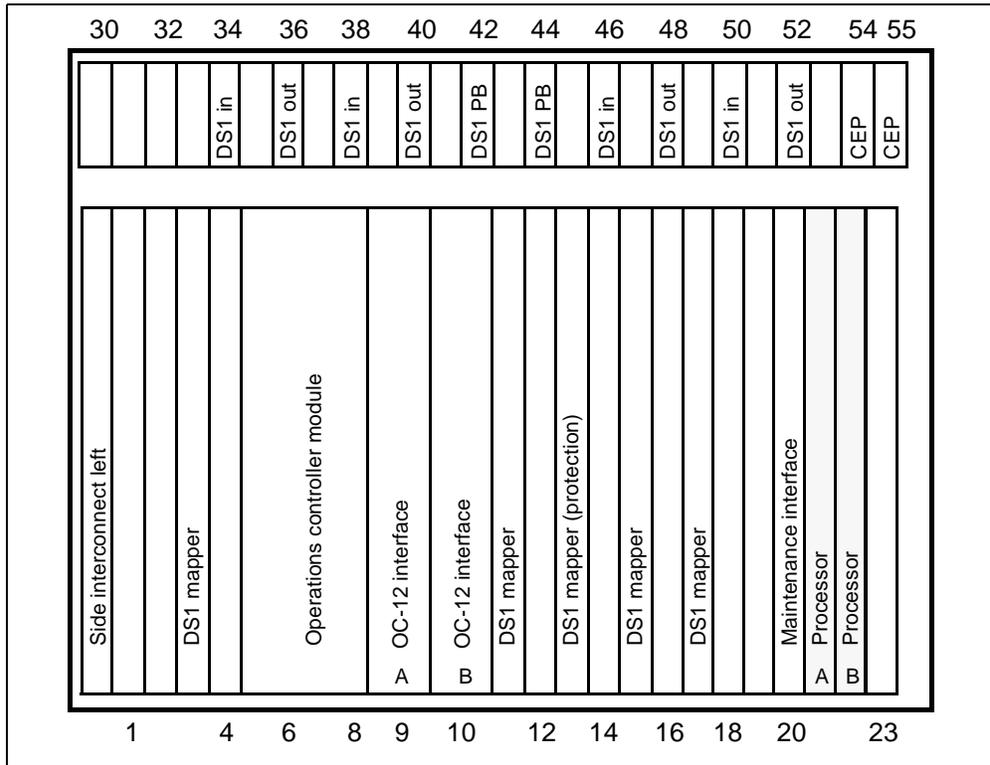


Equipping rules for the transport bandwidth manager shelf

In a transport bandwidth manager shelf, the primary processor card installs in slot 21. If a second processor is installed for protection, it goes into slot 22 as shown in Figure 5-53.

For information about required processors, see *Engineering and Ordering Information*, 323-3001-032, in *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 5-53
Where the processor cards install in the transport bandwidth manager shelf



Serial I/O card (NT4K58LA)

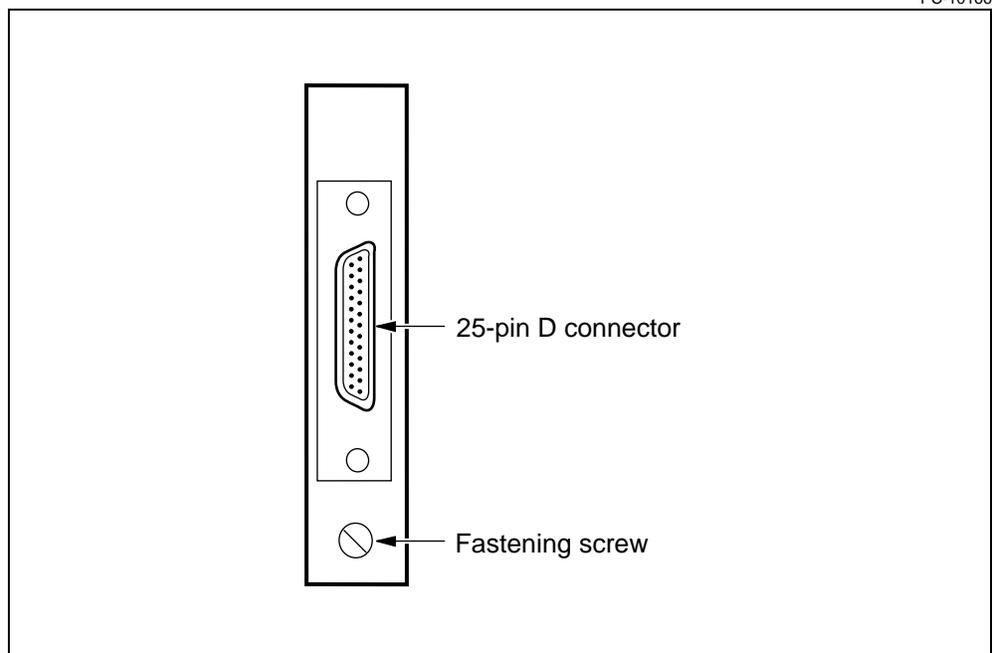
Serial I/O cards are optional cards that can be used in an access bandwidth manager shelf. The cards provide the connectors for serial ports 2 and 3 of the operations controller. Each serial I/O card is an independent serial port of the operations controller, capable of handling input and output. Each serial I/O card is connected to the operations controller module by tracks in the backplane of the shelf. For information on the serial ports of the operations controller, see *Configuration and Equipment Description*, 323-3001-100, in this volume.

Note: Serial ports 2 and 3 of the operations controller are supported only if you have purchased the enhanced-administration optional software feature package.

Physical appearance of the serial I/O card

The serial I/O card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-54 shows the front view of the card.

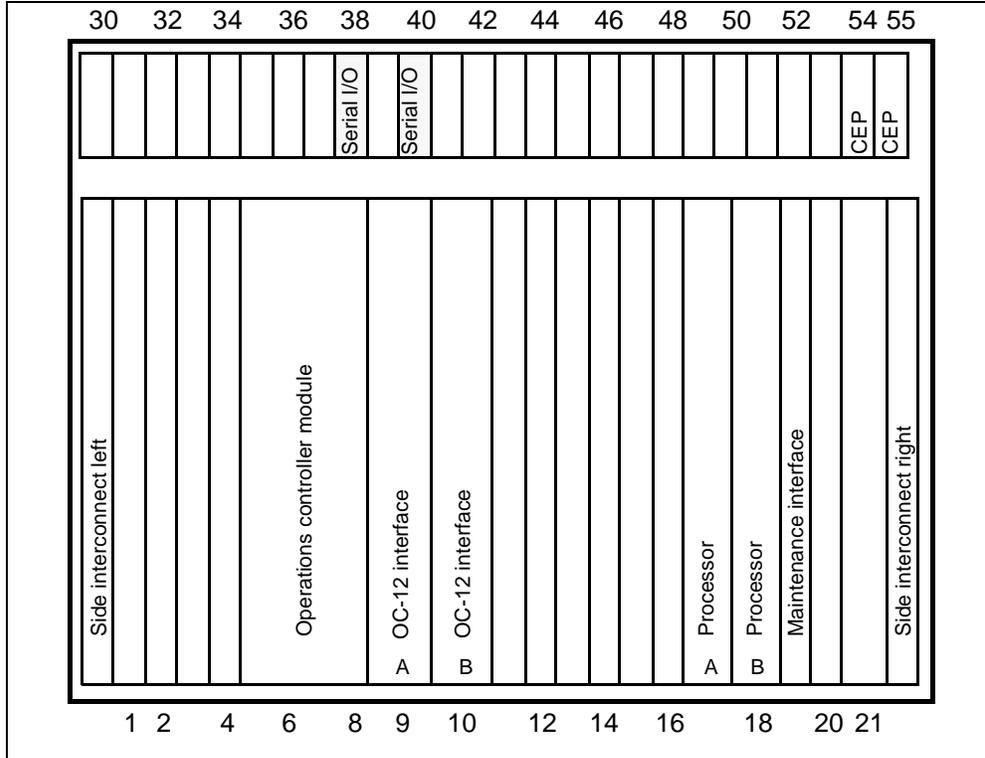
Figure 5-54
Front view of the serial I/O card



Equipping rules

Serial I/O cards are used only in the access bandwidth manager shelf. Two such cards can be installed, in slots 38 and 40. (These slots are the same ones in which you would install a DS1 input card and a DS1 output card if a DS1 mapper were installed in slot 5.) Figure 5-55 shows the location of the cards.

Figure 5-55
Where the serial I/O cards install in the access bandwidth manager shelf



Test access card (NT4K54)

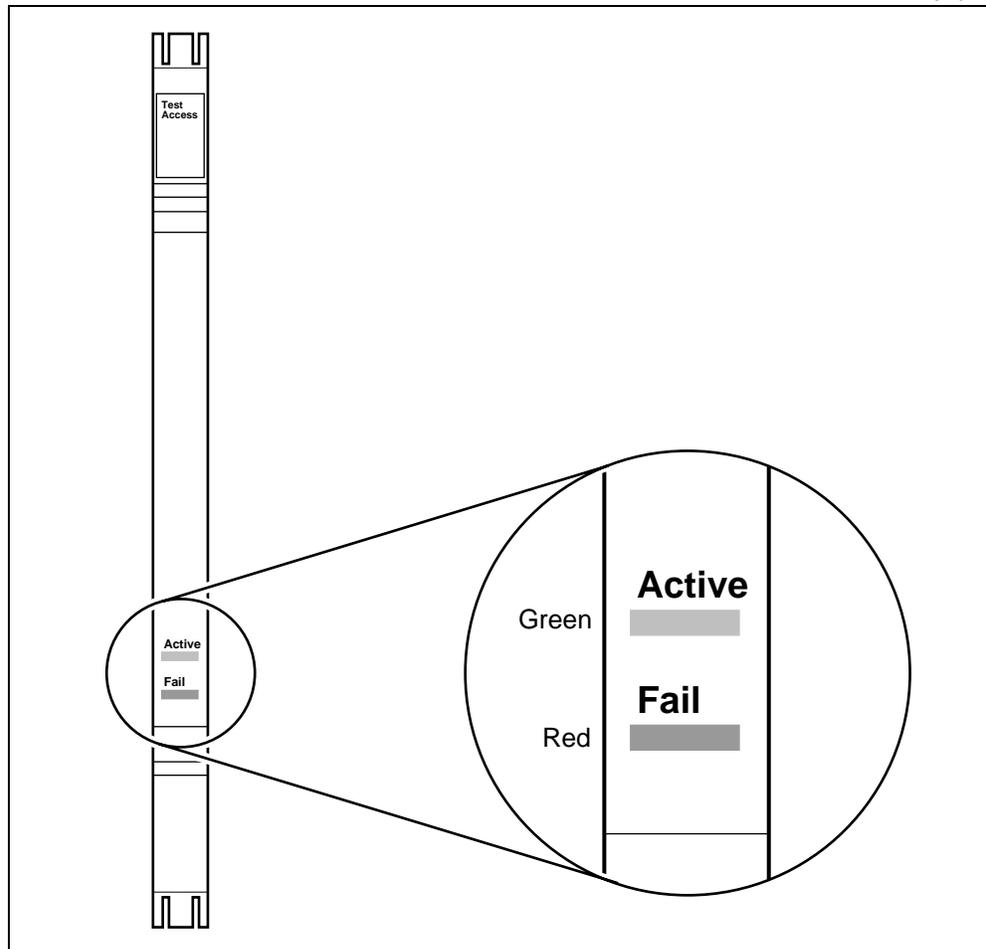
The test access card (TAC) installs in the lower level of the access bandwidth manager shelf. It is used only in AccessNodes that contain copper-distribution shelves. It provides circuit-test access to the line cards in the copper-distribution shelves.

Physical appearance of the test access card

The test access card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-56 shows the front view of the test access card.

Figure 5-56
Front view of the test access card

PC-10723



Functional description

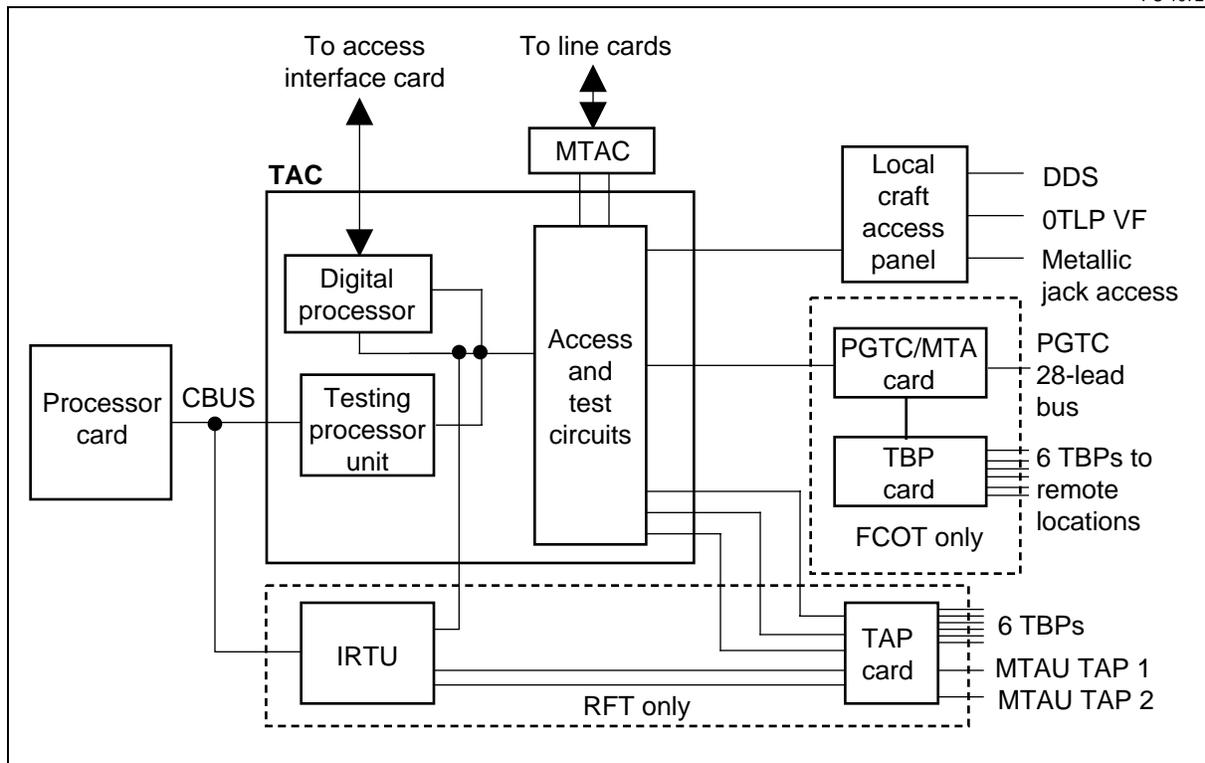
The functionality provided by the test access card includes the following:

- It acts as a test head for DS0 channels, providing the following functions:
 - single-tone and dual-tone generator with optional U-bit signaling
 - signaling and/or PCM read and write
 - signaling-state monitor
 - A-link message read and write
 - pulse-code-modulation (PCM) power measurement
 - impulse-noise counter
 - Bell 212A 1200 b/s modem with fallback to 300 b/s for the CALRS DRTU emulation performed by the integrated remote test unit
- It provides metallic-test-access-unit (MTAU) interface with hitless monitor compliant with GR-303 and TR476 from the test access path card.
- It provides pair-gain-test-controller (PGTC) interface compliant with TR4665 from the PGTC/MTA card and the test bypass pair card.
- It provides a metallic-test-access (MTA) feature from the PGTC/MTA card and the test bypass pair card.
- It can access the DS0 switching matrix on the access interface card, by way of the maintenance overhead bus (MOH bus). By way of this bus, it provides test access and trunk conditioning. The integrated remote test unit, if equipped, also accesses the maintenance overhead bus by way of the test access card, to provide the voice-band monitor and talk function.
- It provides two test-response circuits compliant with GR-303.
- It provides diagnostic terminations, stimulus, and measurement for the line cards.
- It provides DS0 test access for Digital Data Service (DDS) from the local craft access panel (LCAP).
- It provides zero transmission level access point (OTLP) for special service line-up from the local craft access panel (LCAP).

Figure 5-57 is a block diagram of the test access card. The figure shows how the test access card interacts with the I/O cards that provide connections that are used for testing.

Figure 5-57
Block diagram of the test access card

PC-10724



Bus connections

There are three types of bus connections: the CBUS, MOH bus, and metallic test buses. These are described below.

CBUS

The test access card is connected to the CBUS in an access bandwidth manager shelf.

MOH bus

For testing, the test access card interfaces to the other circuit packs in the access bandwidth manager shelf by way of the maintenance overhead bus (MOH bus). This bus links the test access card to the access interface card and the maintenance interface card. The MOH bus carries test tones and trunk conditioning.

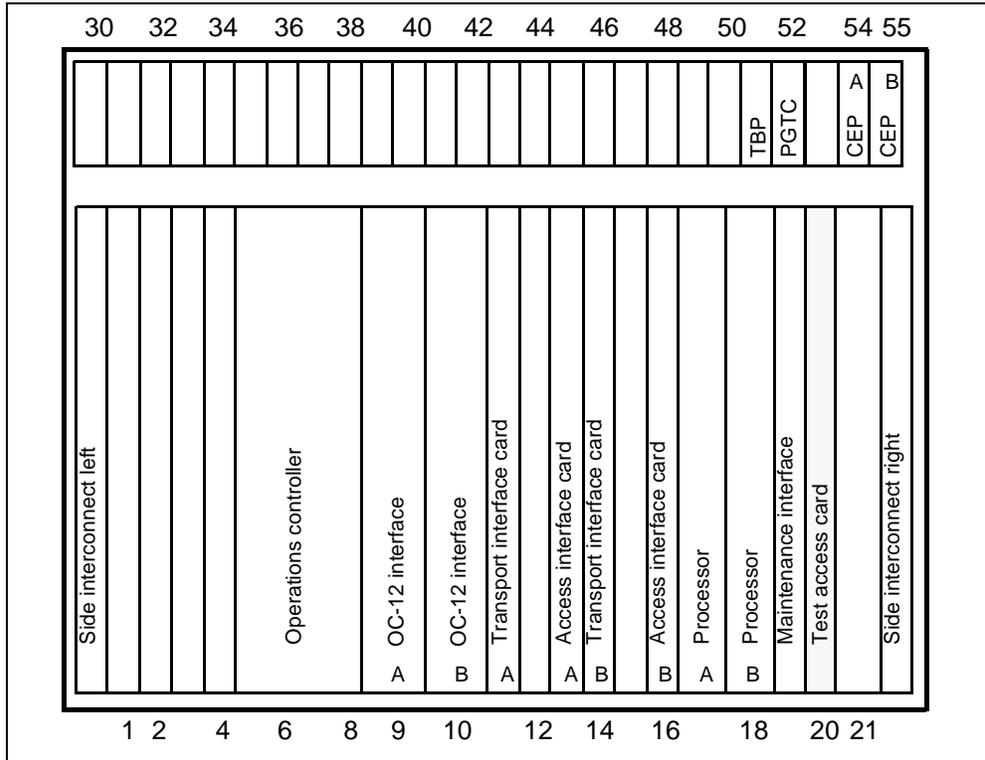
Metallic test buses

The test access card interfaces to the metallic test buses, which go to the metallic test access cards in the copper-distribution shelves. The test access card uses the metallic test buses for test access to the line cards.

Equipping rules

The test access card installs in slot 20 in the access bandwidth manager shelf. See Figure 5-58.

Figure 5-58
Where the test access card installs in the access bandwidth manager shelf



The test access card works in conjunction with one or more cards that install in the upper level of the access bandwidth manager shelf. Those cards are:

- the test access path card (used in RFTs)
- the test bypass pair card (used in FCOTs)
- the PGTC/MTA card (used in FCOTs)

These cards provide the connections that are required in order to test line cards. In addition, these cards have relay functions and passive components required for the interfaces. The test access card controls the relay functions.

Test access path card (NT4K58KA)

The test access path card (TAP card) installs in the upper level of the access bandwidth manager shelf. The TAP card is used only in RFTs that contain copper-distribution shelves.

The test access path card can perform the following functions:

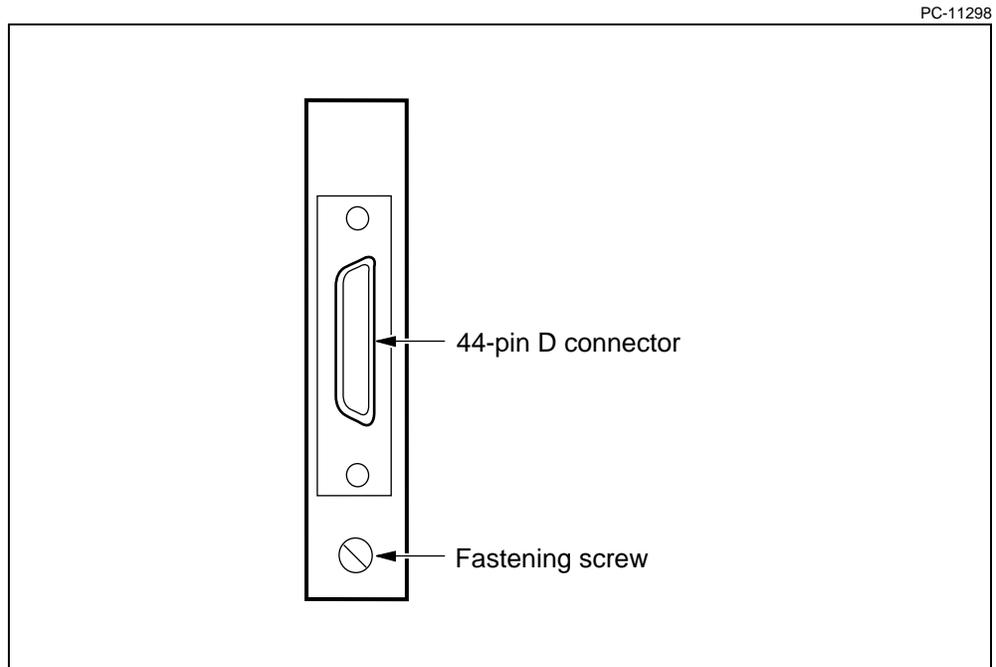
- It can provide the external interface connection required for metallic-test-access-unit (MTAU) testing. This connection is required by the test access card.
- It can provide the external interface for the test bypass pairs.

Figure 5-57 on page 5-99 shows how the test access path card is related to the other modules that are involved in testing line cards.

Physical appearance of the test access path card

The test access path card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-59 shows the front view of the card.

Figure 5-59
Front view of the test access path card



Test bypass pair card (NT4K58CA)

The test bypass pair card (TBP card) installs in the upper level of the access bandwidth manager shelf. The TBP card is used only in FCOTs that contain copper-distribution shelves.

The function of the test bypass pair card is to provide the external interface connection for six test bypass pairs. This connection is required by the test access card.

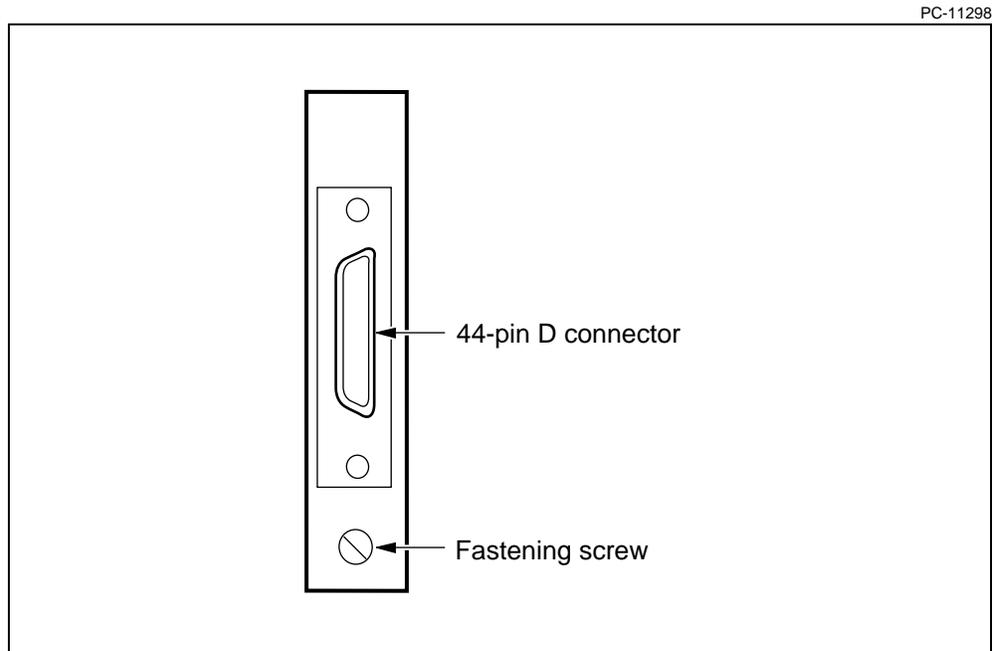
The test-bypass-pair interface consists of a test pair and an inhibit lead. The inhibit lead prevents multiple test trunks from seizing the same test pair.

Figure 5-57 on page 5-99 shows how the test bypass pair card is related to the other modules that are involved in testing line cards.

Physical appearance of the test bypass pair card

The test bypass pair card is 2.25 in. (5.72 cm) high by 10.15 in. (25.78 cm) deep by 0.8 in. (2.03 cm) wide. Figure 5-61 shows the front view of the card.

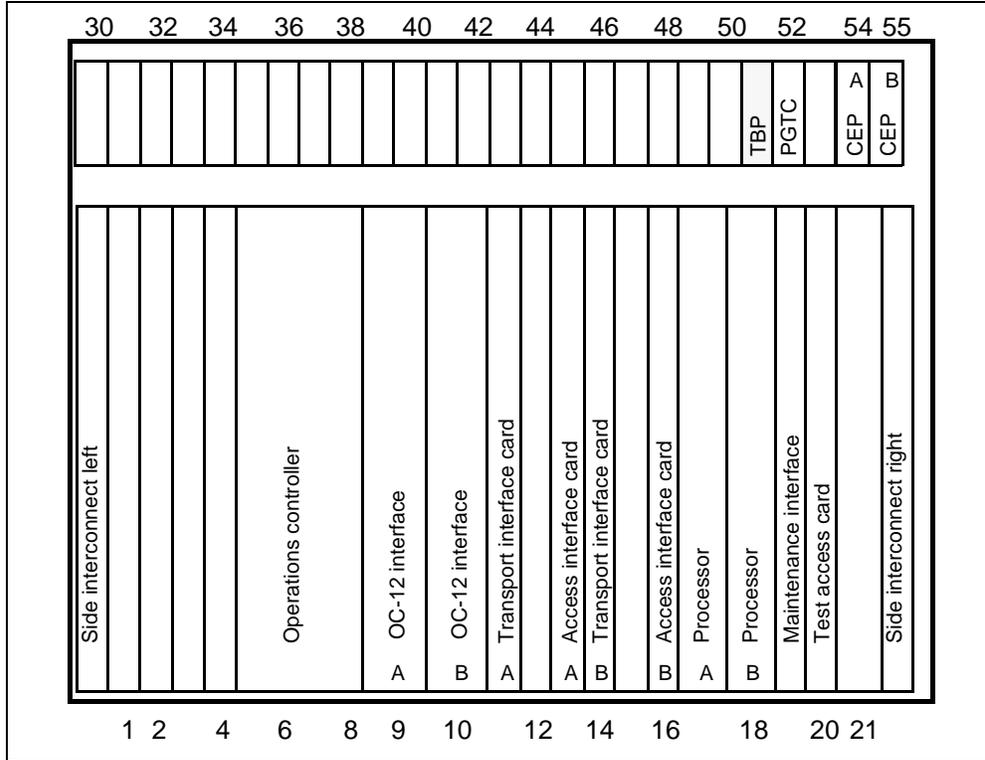
Figure 5-61
Front view of the test bypass pair card



Equipping rules

The test bypass pair card installs only in the access bandwidth manager shelf, and only in FCOTs that contain copper-distribution shelves. (In an RFT, the test-bypass-pair interface is by way of the test access path card.) The test bypass pair card installs in slot 51. See Figure 5-62.

Figure 5-62
Where the test bypass pair card installs in the access bandwidth manager shelf

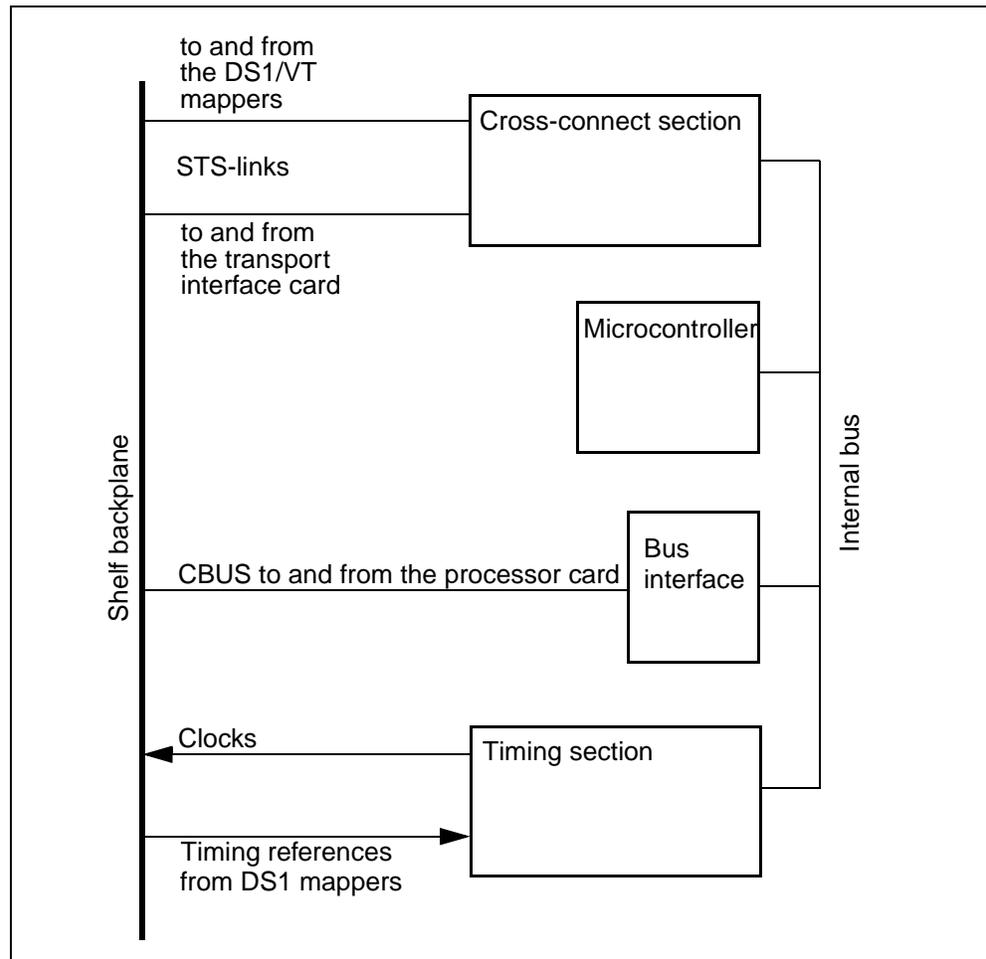


Timing and cross-connect card (NT4K75)

The timing and cross-connect card (TXC) is used in DS1-fed RFTs. It is also used in stand-alone ABM OPC shelves serving DS1-fed systems, if connectivity between the OPC shelf and the DS1-fed RFTs is to be by way of OMC DS1s. It installs in the lower level of the access bandwidth manager shelf.

Figure 5-63 is a functional block diagram of the timing and cross-connect card.

Figure 5-63
Functional block diagram of the timing and cross-connect card



The timing and cross-connect card performs two major functions:

- It provides the system clocks from which the other cards take their timing.
- It cross-connects STS-1 signals between the transport interface card and the DS1 mappers.

Note: Because the timing is provided by the timing and cross-connect cards, ESI cards are not needed. Because ESI cards are not needed at the RFT, slot 21 in the access bandwidth manager shelf is available for the IRTU card.

Timing functions of the card

The timing and cross-connect card can receive two incoming 8 kHz references, a primary and a secondary reference. The 8 kHz reference are derived from cards in the tributary slots, that is, slots 1 to 4. The primary and secondary references must come from different DS1 mapper cards. (In a network element is a DS1-fed system, the cards in slots 1 to 4 are DS1 mappers.)

If both input 8 kHz references are lost, the timing section goes into holdover mode for a timed period. If after this period the references are still lost, the card goes into freerun mode at ± 32 ppm.

System timing is achieved by phase-locked loops. The first phase-locked loop is a 51.84 phase-locked loop, similar to the digital phase-locked loop used on the external synchronization interface card. The phase-locked loop locks to one of the input 8 kHz clock references (primary or secondary). The output of this phase-locked loop is a 51.84 MHz clock.

If a shelf contains two timing and cross-connect cards, each one outputs a 51.84 MHz clock as the output of the first phase-locked loop. The active timing and cross-reference card chooses one of the two 51.84 MHz clocks to serve as the input for the second phase-locked loop.

The second phase-locked loop on each timing and cross-connect card locks a 155.52 MHz oscillator to the 51.84 MHz clock. The 155.52 MHz clock is then divided down to provide the backplane system clocks with rates of 51.84 MHz, 38.88 MHz, and 2 kHz. All common-equipment cards receive their timing from the backplane clocks. The second phase-locked loop is based on the one used on the optical interface (OC-12 and OC-3) circuit packs.

Cross-connect functions of the card

The cross-connect function involves mapping STS-1 signals between the DS1 mappers and the transport interface cards in the shelf. The TXC card selects 12 STS-1 signals from the shelf backplane. The 12 signals are multiplexed into two STS-6 signals, and those are retimed and hairpinned to the backplane STS-1 DROP and DPT buses.

Each DS1 mapper generates and receives one STS-1 signal from the shelf backplane. The STS-1 signals from the mappers go to the TXC card. The TXC card cross-connects these three STS-1 signals to the transport interface cards

Control

A microcontroller provides for the control and protection of the TXC card. This microcontroller can communicate with all the ASICs on the card. It monitors various parameters to decide the status and protection needs of the TXC card. It also communicates with the microcontroller of the second TXC card (if such a card is installed).

Signal flow in the transmit direction

Transmit-direction traffic is traffic from the subscriber toward the central office.

In a DS1-fed RFT, each transport interface card transmits two active STS-1 signals by way of STS-links in the backplane of the shelf. From the STS-1 signals that are available on the backplane, the TXC card selects the two active transmit-direction STS-1 signals, and it selects four other transmit-direction STS-1s, to bring the total of selected transmit-direction STS-1s to six. It also selects six receive-direction STS-1s (as explained in the following section).

It multiplexes the 12 selected STS-1 signals into two STS-6 signals and synchronizes the two STS-6 signals to the system frame clock, that is, the clock and frame incoming from the shelf. It then demultiplexes the two STS-6 signals into 12 STS-1s and transmits the two active transmit-direction STS-1s to the DS1 mappers by way of STS-links in the backplane of the shelf.

Each working mapper selects half of an STS-1 signal to convert into DS1 signals as follows:

- The mapper in slot 1 uses the traffic from the lower half of TIC port 1 (STS-1 #3).
- The mapper in slot 2 uses the traffic from the upper half of TIC port 1 (STS-1 #3).
- The mapper in slot 4, if equipped, uses the traffic from the upper half of TIC port 2 (STS-1 #4).

Signal flow in the receive direction

Receive-direction traffic is traffic from the central office toward the subscriber.

In a DS1-fed RFT, there can be up to three working DS1 mapper cards, and each one transmits a half-filled STS-1 to the TXC card by way of STS-links in the backplane of the shelf. The STS-1 transmitted by a mapper is half-filled because the traffic from the mapper (up to 14 DS1s) uses only half the capacity of the STS-1 signal.

From the STS-1 signals that are available on the backplane, the TXC card selects the incoming half-filled STS-1 signals from the mappers.

The TXC card merges the traffic from the mappers in slots 1 and 2, to form one active receive-direction STS-1. If a mapper is installed in slot 4, the TXC card puts the traffic from that mapper into a second active receive-direction STS-1. The TXC card selects the one or two active receive-direction STS-1s, and it selects other receive-direction STS-1s, to bring the total of selected receive-direction STS-1s to six. It also selects six transmit-direction STS-1s (as explained in the preceding section).

It multiplexes the 12 selected STS-1 signals into two STS-6 signals and synchronizes the two STS-6 signals to the system frame clock, that is, the clock and frame incoming from the shelf. It then demultiplexes the two STS-6 signals into 12 STS-1s and transmits the two active receive-direction STS-1s to the transport interface cards through STS-links in the backplane of the shelf.

Each working mapper selects half of an STS-1 signal to convert into DS1 signals as follows:

- STS-1 #1 and STS-1 #2 go to ports 1 and 4, respectively, of the transport interface card.
- The lower half of TIC port 1 (STS-1 #1) contains the traffic from the mapper in slot 1. The upper half of TIC port 1 (STS-1 #1) contains the traffic from the mapper in slot 2.
- The lower half of TIC port 2 (STS-1 #2) contains the traffic from the mapper in slot 4, if such a mapper is equipped.

Bus connections

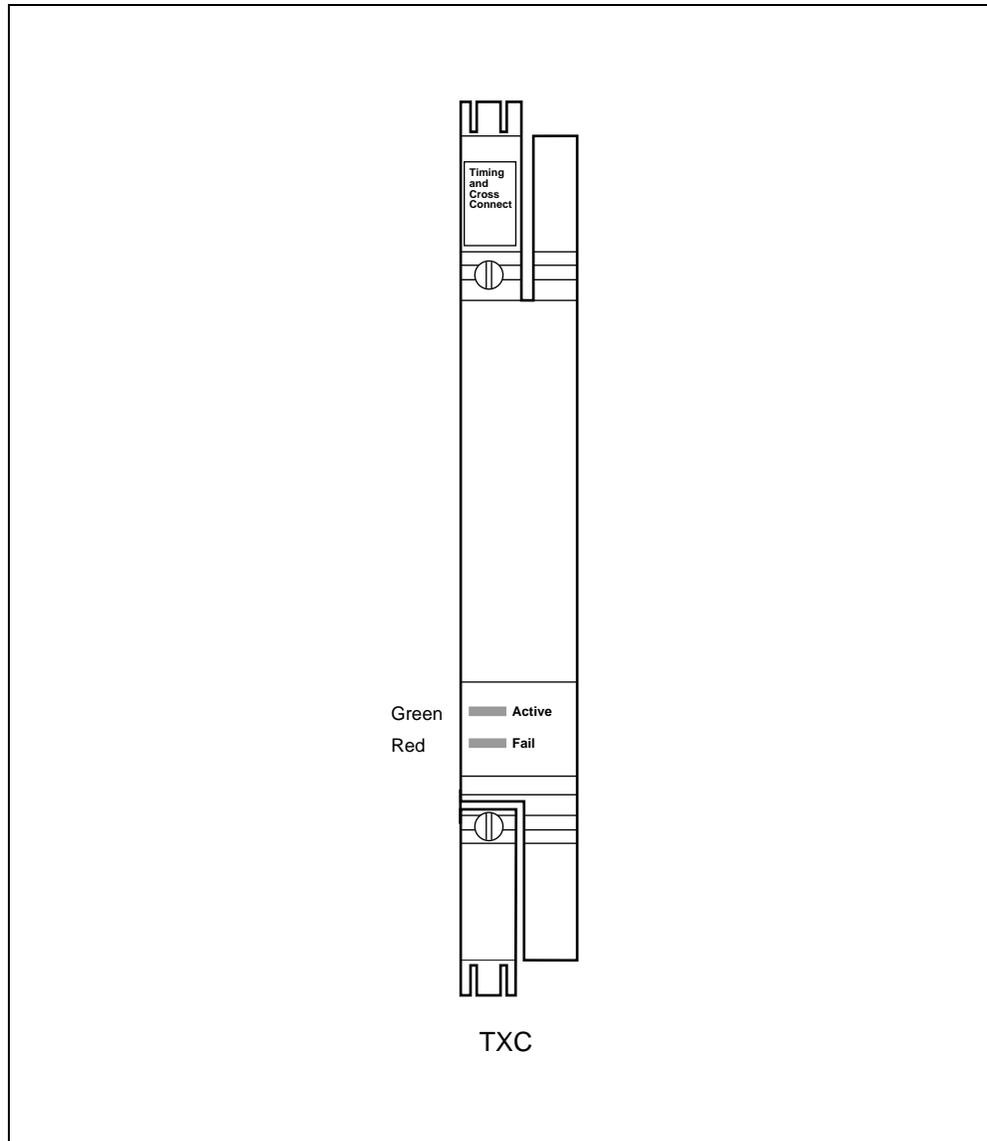
The processor card accesses the timing and cross-connect card by way of the CBUS.

Physical appearance of the timing and cross-connect card

The timing and cross-connect card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a double-width circuit pack, 1.6 in. (4.06 cm) wide. Each timing and cross-connect card has two indicator lamps on its faceplate: a green Active lamp and a red Fail lamp. Figure 5-64 shows the front view of the card.

Figure 5-64
Front view of the timing and cross-connect card

PC-11495



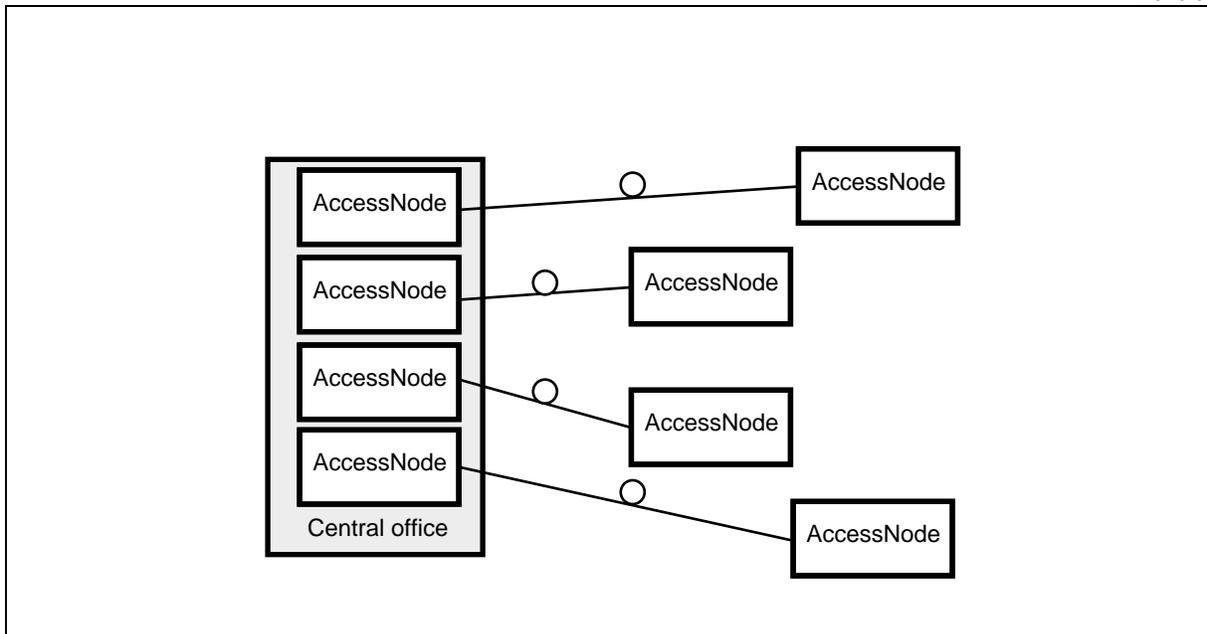
Transport interface card (NT4K56)

The transport interface card (TIC) installs in the lower level of the access bandwidth manager shelf. The transport interface card is the transport formatter that interfaces with the optical interface circuit packs (OC-12 or OC-3), or, in a network element in a DS1-fed system, with the timing and cross-connect cards. The working transport interface card provides SONET formatting of DS0s into virtual tributaries (VT1.5s). The transport interface card combines the VT1.5s to form STS-1s.

Figure 5-66 is a block diagram of the transport interface card.

Figure 5-66
Block diagram of the transport interface card

PC-16169



Signal flow toward the fiber optic or copper feeder

Each transport interface card (the primary and the secondary) receives up to 2016 DS0s from the access interface cards by way of the T-links. Each transport interface card multiplexes the DS0s into byte-synchronous VT1.5s (floating mode). The narrowband traffic from the access interface cards can occupy up to 84 VT1.5s. (Each VT1.5 carries 24 DS0s.) The U-bit signaling in the DS0s is translated into the A/B/C/D out-of-band signaling in the VT1.5s. The VT path-layer overhead is inserted in the appropriate timeslots. In an RFT that handles TR-08 traffic, the processor card writes the alarm and maintenance messages for a TR-08 system into the registers of the transport interface cards, and the active transport interface card inserts the messages into reserved bytes in the VT1.5 that carries the A span for the TR-08 system. (For a description of the A span, see page 3-11).

The working transport interface card transmits STS-1s by way of STS-links, which are in the backplane of the shelf. The STS-1s go to the OC-12 or OC-3 interface circuit packs, or, in a network element in a DS1-fed system, with the timing and cross-connect cards.

Signal flow from the fiber optic or copper feeder

Each of the transport interface cards (working and protection) receives three STS-1 signals by way of the STS-links. The STS-1 signals come from the working optical interface circuit pack, or, in a DS1-fed RFT, from the working timing and cross-connect card. Each transport interface card processes the pointers to locate the path layer overhead for each STS-1 and for the VT1.5s.

In an RFT that handles TR-08 traffic, each transport interface card takes the TR-08 maintenance and alarm messages from the reserved bytes in the VT1.5. The working transport interface card interrupts the processor card if the messages are different from previous ones. When it receives such an interrupt, the processor card processes the messages. (For more information on the TR-08 maintenance and alarm messages, see the description of the derived data link on page 3-11.) The working transport interface card transmits the VT1.5s to the access interface cards via the T-links.

Note: TR-08 traffic must be in STS-1 #1. Four VT1.5s are required to carry the traffic to and from each copper-distribution shelf in the RFT that is designated as a TR-08 interface. One of the four VT1.5s for each TR-08 interface carries the maintenance and alarm messages. The messages use reserved bytes in the VT1.5. The transport interface card can access the TR-08 messages only in the first, fifth, ninth, thirteenth, seventeenth, twenty-first, and twenty-fifth VT1.5s carried in the STS-1. (For more information on the TR-08 maintenance and alarm messages, see the description of the derived data link on page 3-11.)

Bus connections

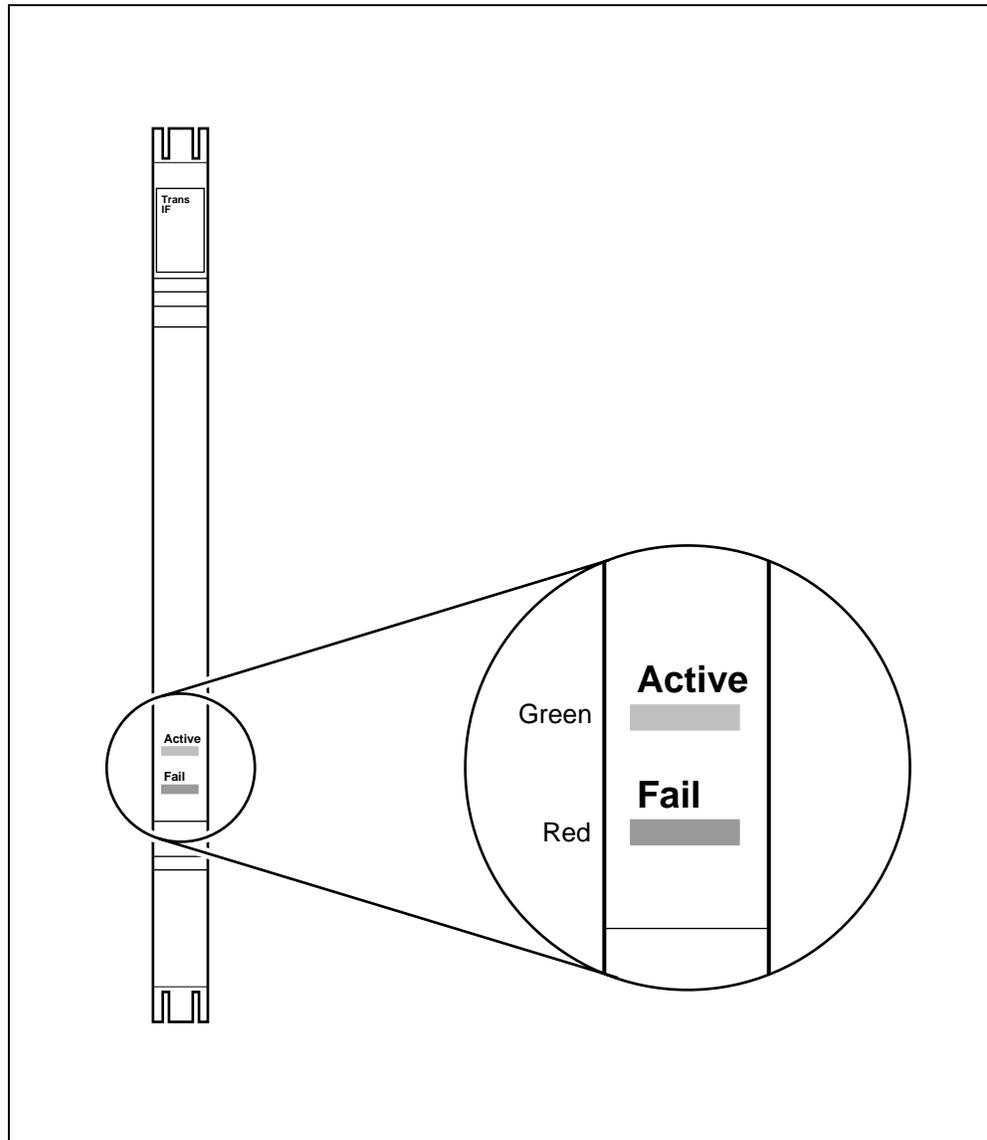
The processor card accesses the transport interface card by way of the CBUS.

Physical appearance of the transport interface card

The transport interface card is 11.5 in. (29.21 cm) high by 10.15 in. (25.78 cm) deep. It is a single-width circuit pack, 0.8 in. (2.03 cm) wide. Figure 5-67 shows the front view of the transport interface card.

Figure 5-67
Front view of the transport interface card

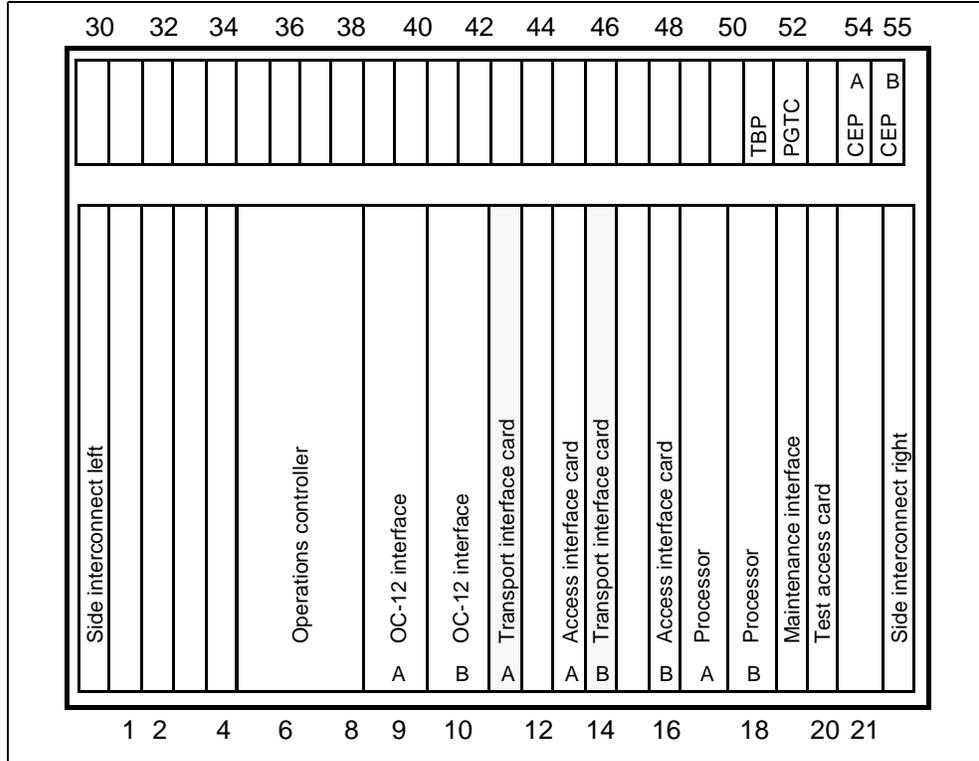
PC-10722



Equipping rules for the access bandwidth manager shelf

As shown in Figure 5-68, the primary transport interface card installs in slot 11 in the lower level of the access bandwidth manager shelf. For protection, a second, optional transport interface card can be installed in slot 14.

Figure 5-68
Where the transport interface cards install in the access bandwidth manager shelf



Equipment in the copper-distribution shelf

This chapter describes the copper-distribution shelf and its equipment. It briefly describes the structure of the shelf (on pages 6-2 and 6-3), and then describes the modules used in the shelf.

Chapter contents

If you want to find information about a specific module, consult Table 6-1 and refer to the appropriate page.

Table 6-1
Modules discussed in this chapter

Topic	See
Copper-distribution-shelf power converter	page 6-4
Epsilon station line card	page 6-11
Manual ringdown 2-wire line card	page 6-12
Omega 2-wire office line card	page 6-13
Omega 2-wire station line card	page 6-14
Omega 4-wire line card	page 6-15
Omega 6/8-wire line card	page 6-16
Universal voice grade (UVG) station line card	page 6-17
Narrowband line-interface card	page 6-20
Metallic test access card	page 6-22
Power filter	page 6-24

Function of the copper-distribution shelf

The copper-distribution shelf interfaces up to 96 subscriber lines (loops). The shelf supports the full range of narrowband copper services.

Layout of the copper-distribution shelf

The copper-distribution shelf is designed for full front access. The dimensions of the shelf are:

- width 23 in. (584 mm)
- height 7 in. (178 mm)
- depth 12.2 in. (310 mm)

Figure 6-1 shows the front view of the copper-distribution shelf.

Figure 6-1
Front view of the copper-distribution shelf

PC-10039

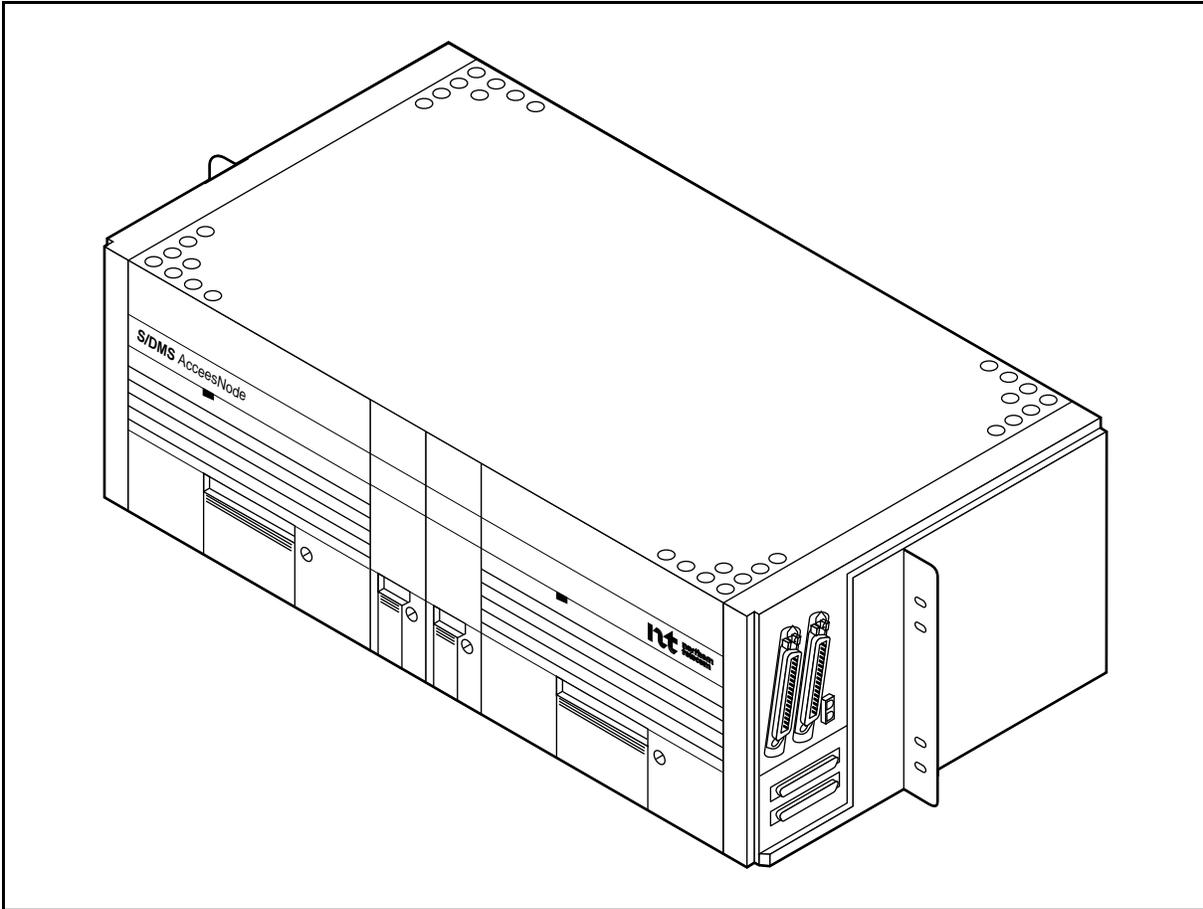
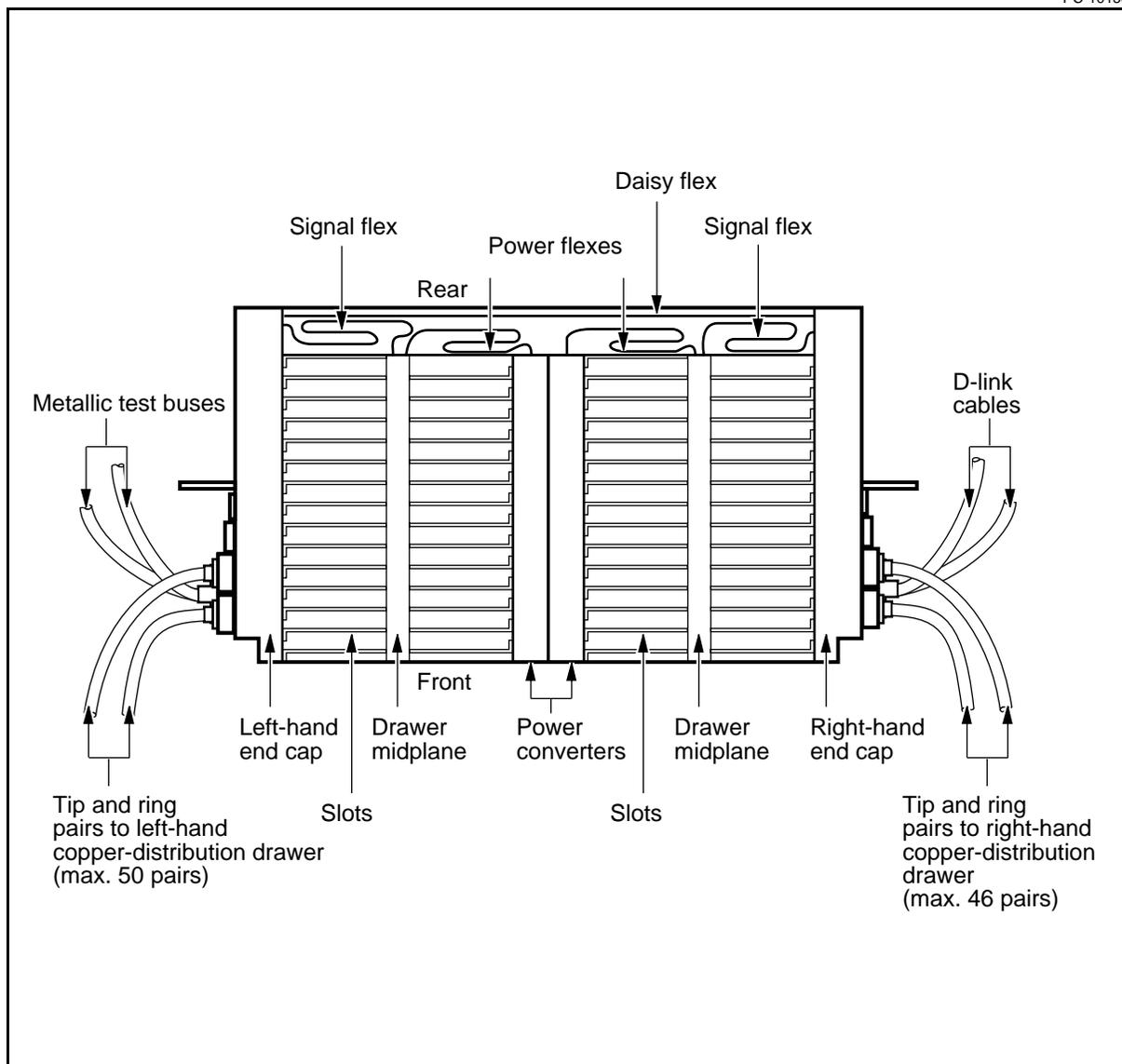


Figure 6-2 shows the layout of the shelf. The copper-distribution shelf contains two front-accessible pull-out copper-distribution drawers, one on the left and one on the right. Between the two drawers are the two copper-distribution-shelf power converters. The copper lines enter the shelf at the left-hand and right-hand ends of the shelf. The cables carrying the D-links enter the copper-distribution shelf at the right-hand end. (The D-links carry narrowband traffic between the copper-distribution drawers and the access bandwidth manager shelf.) The cables carrying the two metallic test buses (used for testing the line cards in the copper-distribution drawers) enter the copper-distribution shelf at the left-hand end.

Figure 6-2
Layout of components in the copper-distribution shelf, viewed from above

PC-10153



Components outside of the copper-distribution drawers

The following paragraphs cover the components outside of the copper-distribution drawer.

Copper-distribution shelf power converter (NT4K62)

Two copper-distribution shelf power (CDSP) converters are installed in each copper-distribution shelf. They are located in the middle of the copper-distribution shelf, between the two copper-distribution drawers.

A copper-distribution shelf must contain two CDSP converters. The CDSP converter converts the -48 V dc office supply to the specific regulated dc voltage levels required by the line cards. It has only one register, to monitor the status of the card. If a shelf contains two CDSP converters, they work in load-sharing mode. Each CDSP converter has two power converters, as shown in Figure 6-3.

Figure 6-3
Load sharing by the copper-distribution-shelf power converters

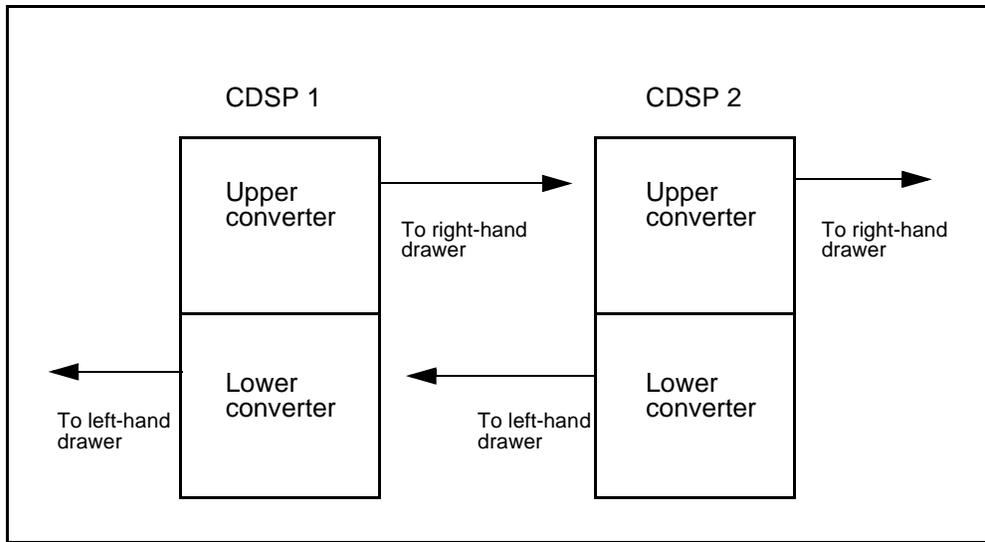
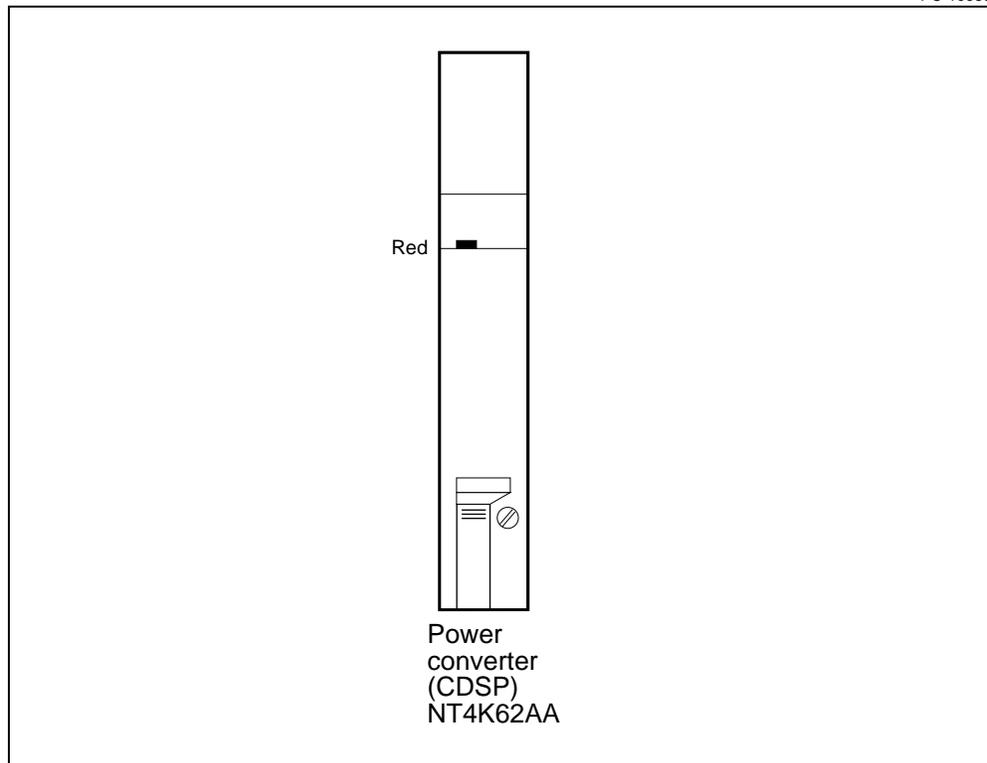


Figure 6-4 shows the faceplate of the copper-distribution-shelf power converter.

Figure 6-4
Front view of the copper-distribution-shelf power converter



Each CDSP converter has a red fail LED on its faceplate.

EMI cards

There are two electro-magnetic interference (EMI) cards built into the copper-distribution shelf. These cards are located inside the left-hand end cap and the right-hand end cap of the copper-distribution shelf, respectively. The EMI cards filter the tip and ring pairs suitably for all services.

Signal flexes

There is one signal flex for each copper-distribution drawer. The signal flex carries signals between the EMI circuit pack assembly in the end cap of the shelf and the midplane of the copper-distribution drawer.

Power flexes

There is one power flex for each copper-distribution drawer. The power flex carries power from the power converters to the midplane of the copper-distribution drawer.

Daisy flex

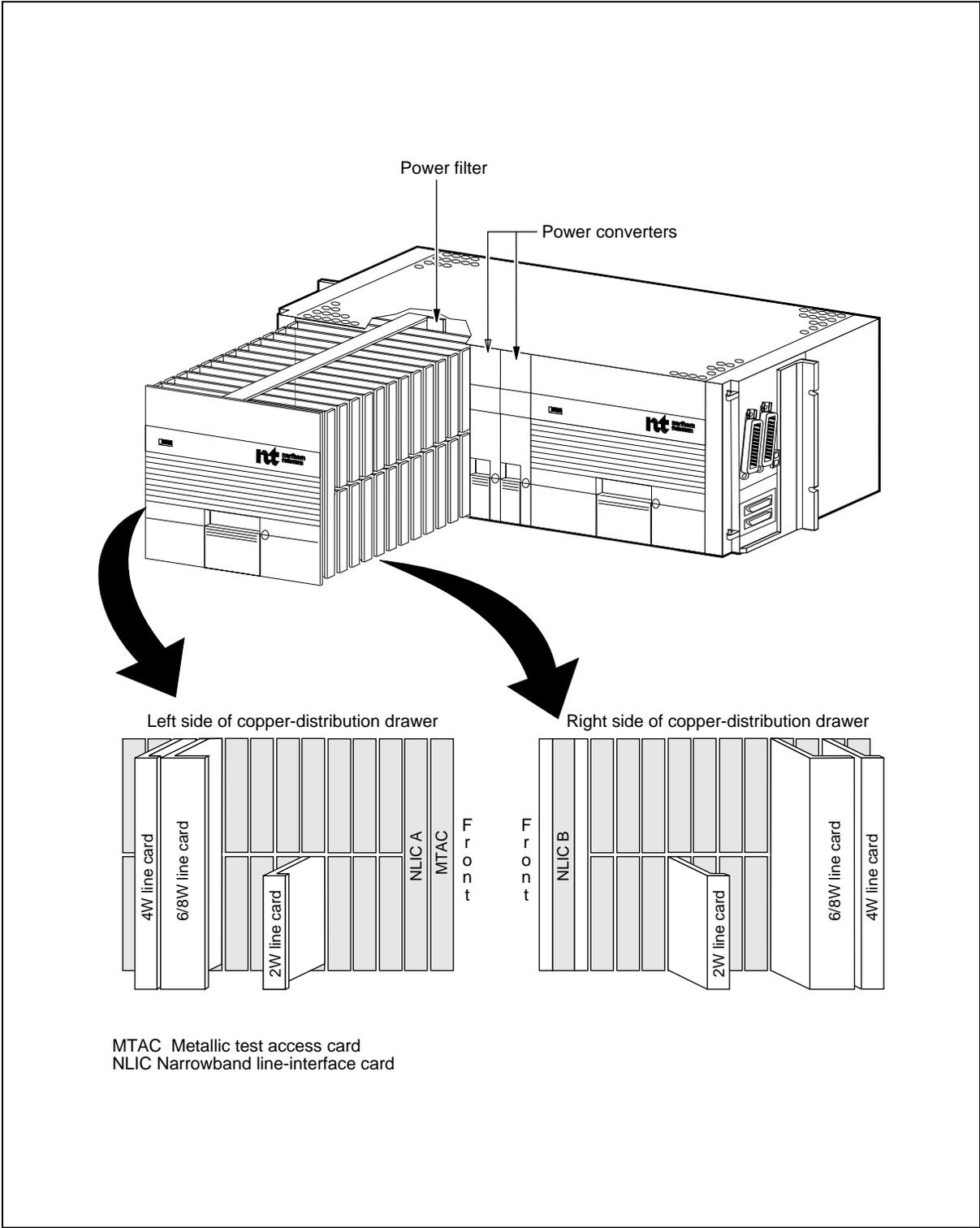
There is one daisy flex in each copper-distribution shelf. The daisy flex links the EMI circuit pack assemblies in the left-hand and right-hand end caps of the shelf. The two EMI circuit pack assemblies must be linked because the D-links from the access bandwidth manager shelf connect to the right side of the copper-distribution shelf, and the metallic test buses connect to the left side. (For more information on the metallic test buses, see the discussion of the metallic test access card on page 6-22.)

Copper-distribution drawers

Figure 6-5 shows the copper-distribution shelf and the copper-distribution drawer.

Figure 6-5
Copper-distribution drawer in a copper-distribution shelf

PC-10431



6-8 Equipment in the copper-distribution shelf

Each copper-distribution drawer has a midplane running down the middle from front to back. The line cards fit into slots on each side of the midplane. The slots radiate from the midplane at 90-degree angles. Each copper-distribution drawer has 48 slots for line cards: 24 radiating from the left side of the midplane and 24 radiating from the right side of the midplane. On each side of the midplane, the slots are arranged in two rows of 12, an upper row and a lower row.

Figure 6-6 shows both the layout of the copper-distribution drawers and the numbering of the line-card slots in the drawers.

Figure 6-6
Numbering of the line-card slots in a copper-distribution drawer

PC-10750

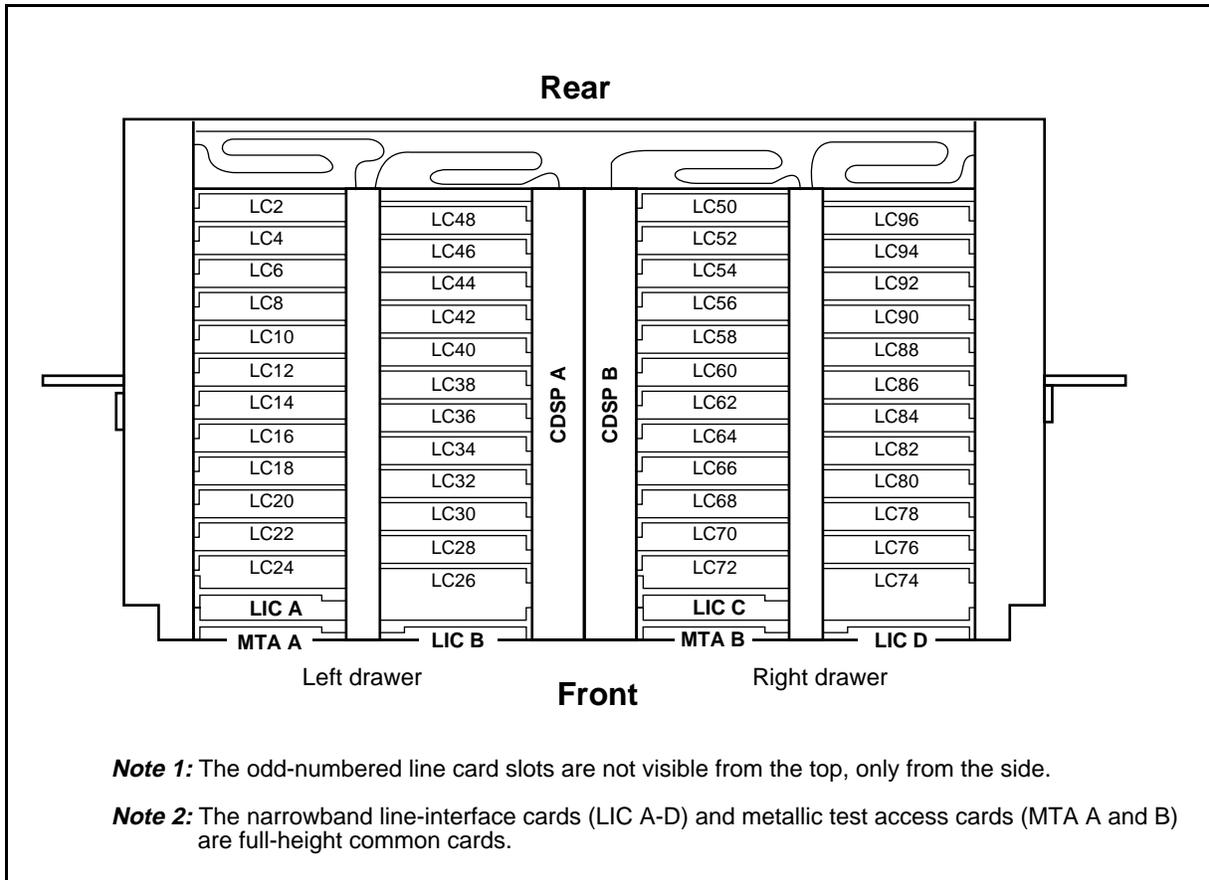
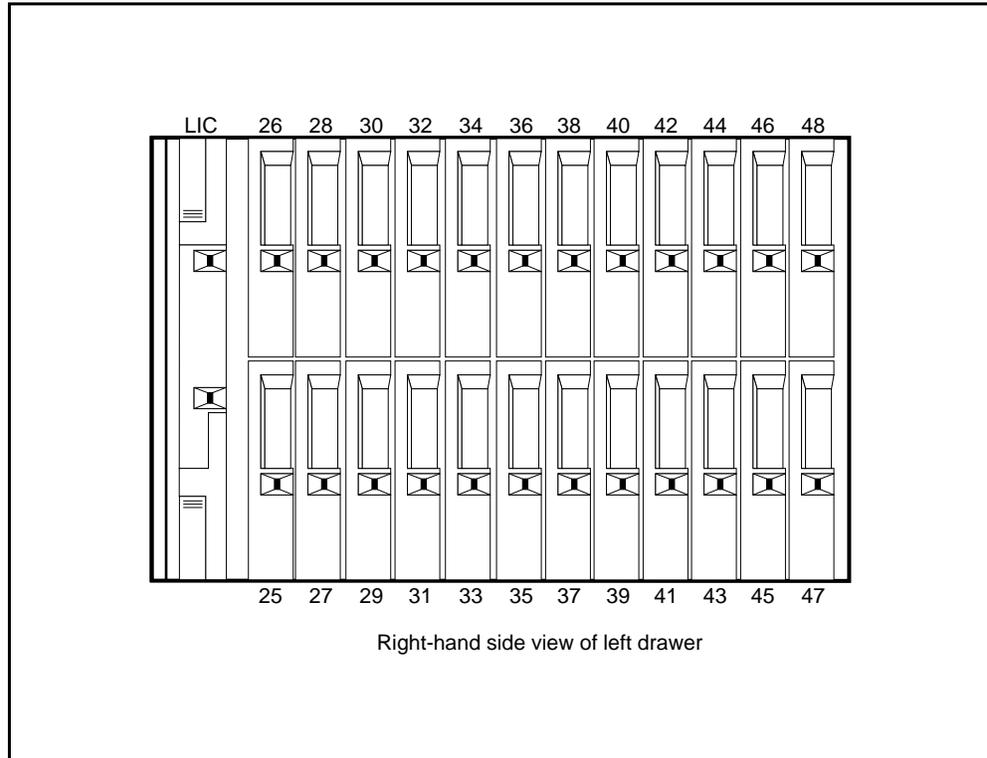


Figure 6-7 is a side view of the drawer, which you would see after pulling the drawer out. As shown in the figure, when you pull the drawer out, you can see the faceplates of line cards.

Figure 6-7
Right-hand side view of the left-hand copper-distribution drawer (drawer A)

PC-10751



Plug-in modules inside the copper-distribution drawer

The plug-in modules used in the copper-distribution drawer divide into the following categories: line cards and common-equipment modules.

Line cards

The copper-distribution drawers contain the line cards. The line cards support a full range of narrowband copper-based services. Each line card interfaces one line.

In this release, the following types of line cards are available:

- the Epsilon station line card
- the manual ringdown 2-wire line card
- the Omega 2-wire station line card
- the Omega 2-wire office line card
- the Omega 4-wire line card
- the Omega 6/8-wire line card
- the universal voice grade (UVG) station line card

Some of the line cards are service-adaptive, which means that a single line card can support any one of a variety of services. Therefore, a full range of narrowband copper services can be provided using only a few types of line cards. For information on the services supported by the line cards, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

You can remotely provision each service-adaptive line card, to enable it to support the desired service. To provision the line cards remotely, you use either the OPC user interface or the MAP position in the DMS-100.

Epsilon station line card (NT4K65)

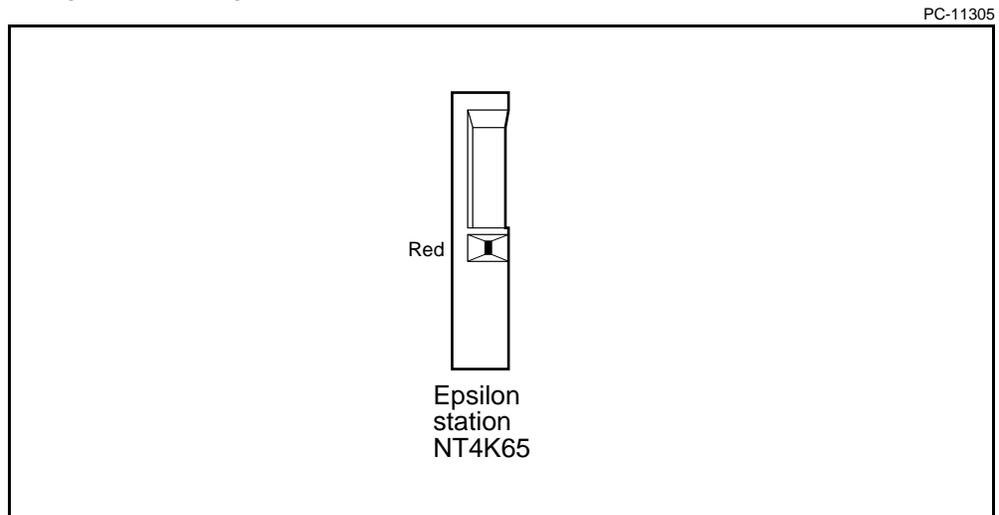
The Epsilon station line card is 2.9 in. x 3.5 in. (74 mm x 89 mm). It takes up half the height of the drawer, and occupies one slot, so up to 48 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The Epsilon station line card is not service-adaptive. It supports 2-wire POTS services only. If used to handle a TR-08 circuit, the Epsilon line card can support POTS service. The Epsilon station line card is a less costly alternative to the Omega 2-wire station line card. It is used only in RFTs. If you use this line card in an RFT in a basic fiber-fed system and if the line is served by an analog switch (or by a digital switch with an analog interface), the corresponding line card in the FCOT is an Omega 2-wire office line card.

The NT4K65CA Epsilon station line card supports POTS for Hong Kong. It meets Hong Kong's CR01 standards for ringing signal frequency, input impedance, and balance impedance.

Figure 6-8 shows the faceplate of the Epsilon station line card.

Figure 6-8
Faceplate of the Epsilon station line card



Note: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Manual ringdown 2-wire line card (NT4K78)

Note: Manual ringdown is a nonswitched special service. A customer who has this service is able to press a button at his or her telephone and thus generate ringing current to the line. The ringing is passed to the called end. When the called end answers, a conversation can take place. Transmission in the circuit is always enabled unless ringing is present. Manual ringdown is a two-way special service; therefore, both ends of the circuit must be able to send or receive ringing.

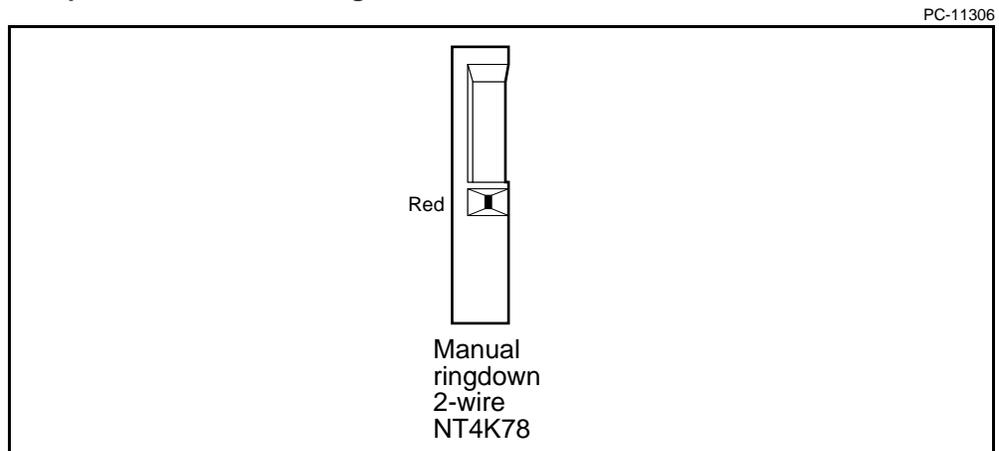
The manual ringdown 2-wire line card is 2.9 in. x 3.5 in. (74 mm x 89 mm). It takes up half the height of the drawer, and occupies one slot, so up to 48 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The manual ringdown 2-wire line card provides a 2-wire point-to-point private line, which is a nonswitched special service. The line card provides the interface to the ringdown signaling and an interface between the voice frequency and the AccessNode digital carrier.

AccessNode provides point-to-point manual ringdown service only. Multipoint configurations are accomplished with external bridging units, which are not supplied by NT. When external bridging is done, there must be a manual ringdown line card at the RFT and a line-card appearance of the service at the central office.

Figure 6-9 shows the faceplate of the manual ringdown 2-wire line card.

Figure 6-9
Faceplate of the manual ringdown 2-wire line card



Note: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Omega 2-wire office line card (NT4K68)

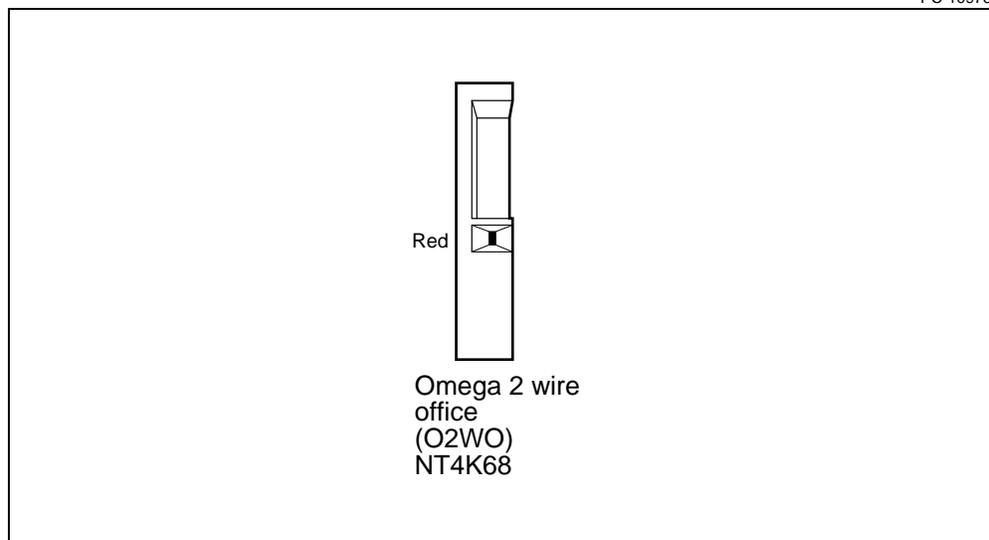
The Omega 2-wire office line card is 2.9 in. x 3.5 in. (74 mm x 89 mm). It has a red fail LED on its faceplate. As shown in Figure 6-5 on page 6-7, it takes up half the height of the drawer, and occupies one slot, so up to 48 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The Omega 2-wire office line card can be used in both FCOTs and RFTs. In FCOTs, it is used to support most 2-wire services. In RFTs, it is used to support the following 2-wire services: Direct Inward Dialing (DID) and Off Premise Station (OPS). For information on the services supported by the Omega 2-wire office line card, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

If used in an RFT to handle a TR-08 circuit, the Omega 2-wire line card can support Direct Inward Dialing service. For detailed information about the TR-08 services supported by the line cards, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 6-10 shows the faceplate of the Omega 2-wire office line card.

Figure 6-10
Faceplate of the Omega 2-wire office line card



Note 1: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Note 2: For the specifications of this line card, see *Line Card Specifications*, 323-3001-181, in *Description*, Volume 2B.

Omega 2-wire station line card (NT4K67)

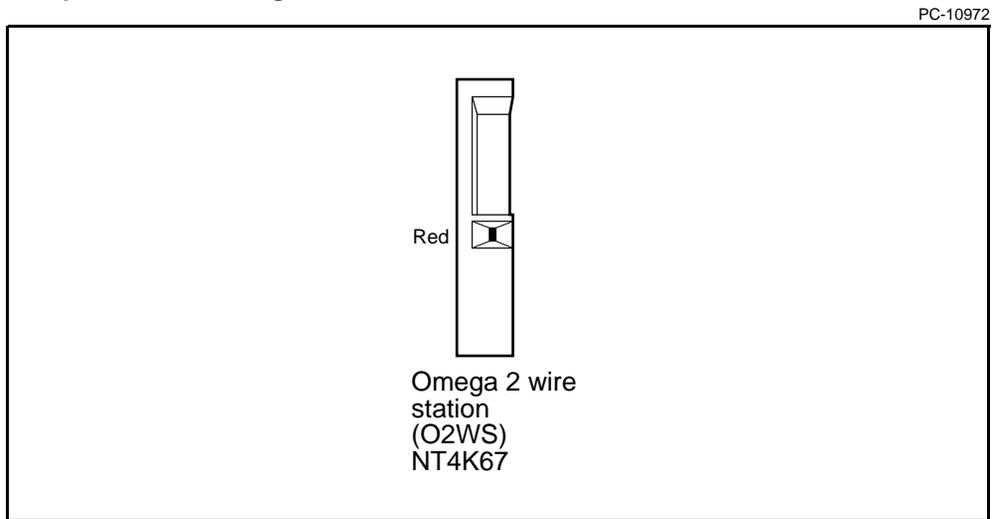
The Omega 2-wire office line card is 2.9 in. x 3.5 in. (74 mm x 89 mm). As shown in Figure 6-5 on page 6-7, it takes up half the height of the drawer, and occupies one slot, so up to 48 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The Omega 2-wire station line card can be used in both RFTs and FCOTs. In FCOTs, it is used to support the following 2-wire services: Direct Inward Dialing (DID) and Off Premise Station (OPS). In RFTs, it is used to support most 2-wire services. For information on the services supported by the Omega 2-wire station line card, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

If used in an RFT to handle a TR-08 circuit, it can support POTS service, coin service, business lines and PBX trunks, universal voice grade service, and CLASS features. For detailed information about the TR-08 services supported by the line cards, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 6-11 shows the faceplate of the Omega 2-wire station line card.

Figure 6-11
Faceplate of the Omega 2-wire station line card



Note 1: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Note 2: For the specifications of this line card, see *Line Card Specifications*, 323-3001-181, in *Description*, Volume 2B.

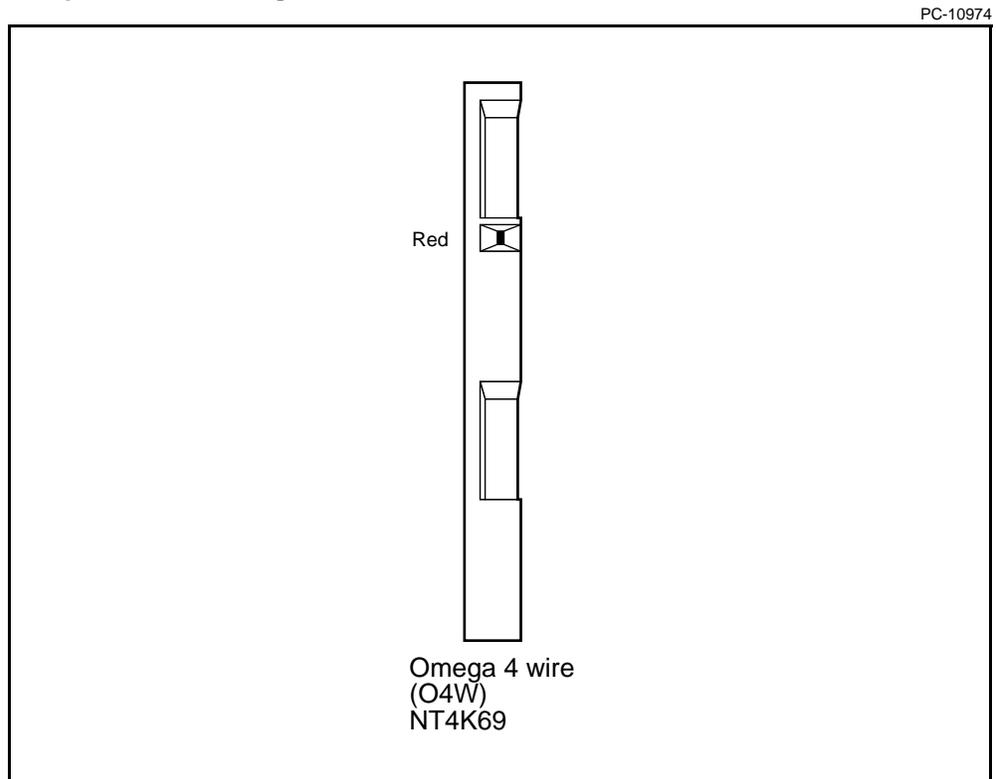
Omega 4-wire line card (NT4K69)

The Omega 4-wire line card is 6.0 in. x 3.5 in. (152 mm x 89 mm). As shown in Figure 6-5 on page 6-7, it takes up the full height of the drawer, and occupies two slots, so up to 24 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The Omega 4-wire line card can be used in both FCOTs and RFTs. It supports all 4-wire services except T1 and DS1-type services. For information on the services supported by the Omega 4-wire line card, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

Figure 6-12 shows the faceplate of the Omega 4-wire line card.

Figure 6-12
Faceplate of the Omega 4-wire line card



Note 1: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Note 2: For the specifications of this line card, see *Line Card Specifications*, 323-3001-181, in *Description*, Volume 2B.

Omega 6/8-wire line card (NT4K77)

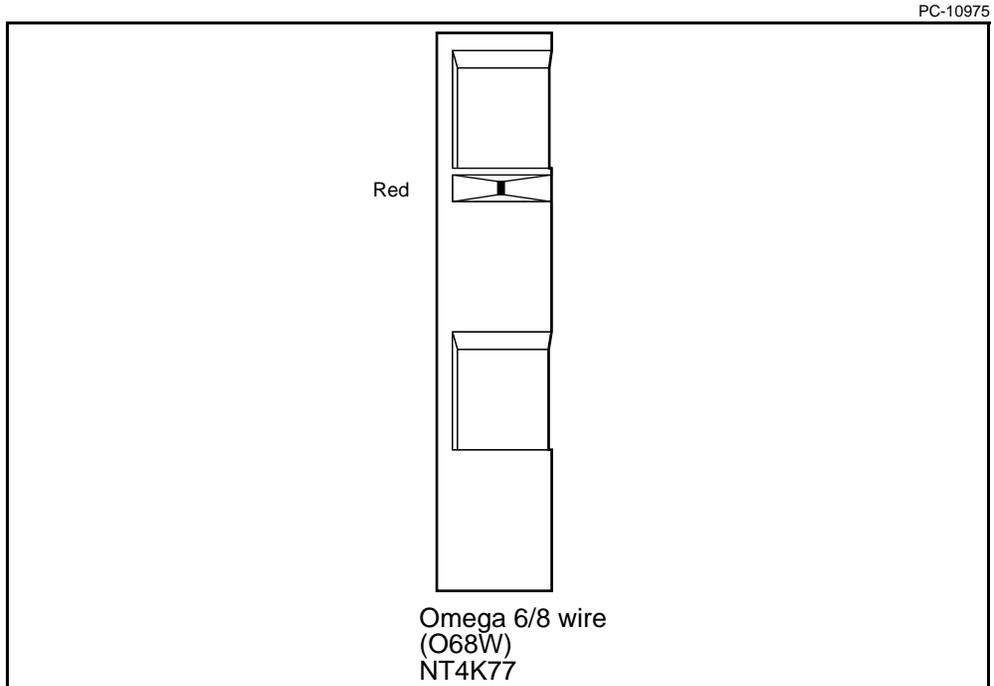
The Omega 6/8-wire line card is 6.0 in. x 3.5 in. (152 mm x 89 mm). As shown in Figure 6-13, it is twice as thick as the other types of line cards, and it takes up the full height of the drawer. It occupies four slots, so up to 12 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The Omega 6/8-wire line card can be used in both FCOTs and RFTs. It handles all special services employing E&M, tandem (TDM) or pulse link repeater (PLR) dc signaling on circuits having six or eight leads. For information on the services supported by the Omega 6/8-wire line card, see *Line Card Application and Special Services Engineering, 323-3001-155*, in the *Engineering, Configuration, and Ordering Guide, Volume 1*.

The line card is composed of a mother board and a daughter board. The mother board handles all the voice frequency and processing, and the daughter board provides most of the signaling and detection circuitry.

Figure 6-13 shows the faceplate of the Omega 6/8-wire line card.

Figure 6-13
Faceplate of the Omega 6/8-wire line card



Note 1: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Note 2: For the specifications of this line card, see *Line Card Specifications*, 323-3001-181, in *Description*, Volume 2B.

Universal voice grade station line card (NT4K79)

The universal voice grade (UVG) station line card is 2.9 in. x 3.5 in. (74 mm x 89 mm). It takes up half the height of the drawer, and occupies one slot, so up to 48 of them can fit into a drawer. The line card has a red fail LED on its faceplate.

The UVG line card is used only in RFTs. If you use this line card in an RFT in a basic fiber-fed system and if the line is served by an analog switch (or by a digital switch with an analog interface), the corresponding line card in the FCOT is an Omega 2-wire office line card.

The UVG line card is a low-cost alternative to the Omega 2-wire station line card. It provides POTS and UVG functionality, including PBX trunks and lines, WATS trunks and lines, 800 trunks and lines, and secretarial lines. The UVG line card does not support certain services and features that are supported by the Omega line cards, including ISDN, coin, P-phone, Direct Inward Dialing (DID), Datapath, and message waiting. For information on the services supported by the UVG line card, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

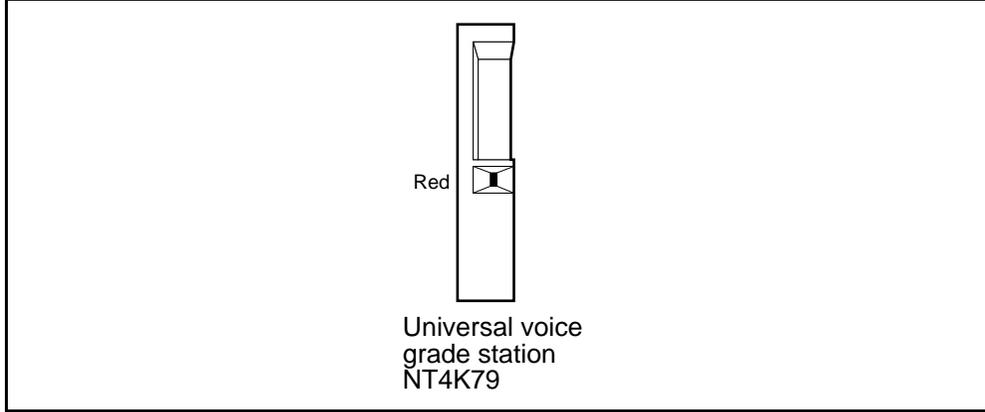
If used in an RFT to handle a TR-08 circuit, the UVG line card can support POTS service, business lines and PBX trunks, universal voice grade service, and CLASS features. For detailed information about the TR-08 services supported by the line cards, see *Line Card Application and Special Services Engineering*, 323-3001-155, in the *Engineering, Configuration, and Ordering Guide*, Volume 1.

There are no signaling or transmission options that need to be provisioned for the UVG line card, except the on-hook transmission feature (OHT), which may be provisioned if desired, or left in the default mode.

Figure 6-14 shows the faceplate of the universal voice grade station line card.

Figure 6-14
Faceplate of the universal voice grade station line card

PC-11307



Note 1: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Note 2: For the specifications of this line card, see *Line Card Specifications*, 323-3001-181, in *Description*, Volume 2B.

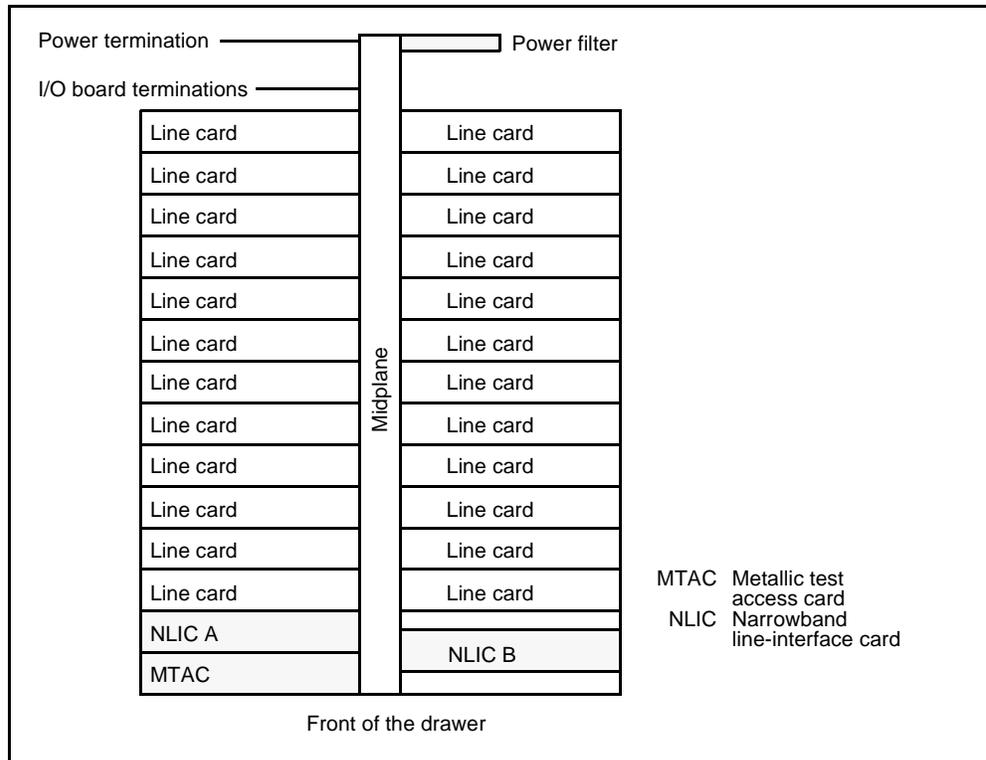
Common-equipment modules in the copper-distribution drawer

Each copper-distribution drawer contains the following common-equipment modules:

- two narrowband line-interface cards (NLICs)
- one metallic test access card or one metallic test access card 2
- one power filter

Figure 6-15 shows the locations of the common-equipment modules in a copper-distribution drawer.

Figure 6-15
Locations of the common-equipment modules in the left-hand copper-distribution drawer



Narrowband line interface card (NT4K70)

Each copper-distribution drawer contains two narrowband line interface cards (NLICs). The NLIC is the interface between the line cards in the copper-distribution drawer and the access interface card in the access bandwidth manager shelf. The connection from the NLIC to the access interface card is by way of the D-link; the connection from the NLIC to the line cards is by way of the A-links.

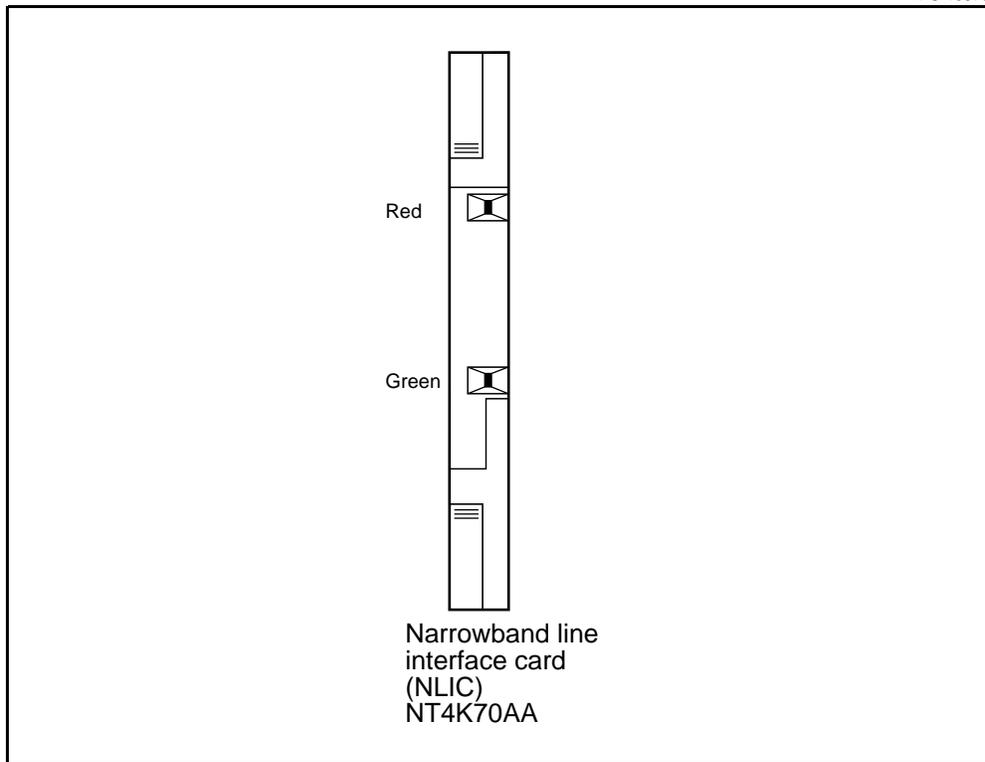
Other functions performed by the NLIC are:

- to control the relays on the metallic test access card
- to read the ID PROMS and alarms from the metallic test access card and from the power converters (CDSP converters) in the shelf

Figure 6-16 shows the faceplate of the narrowband line interface card.

Figure 6-16
Faceplate of the narrowband line-interface card

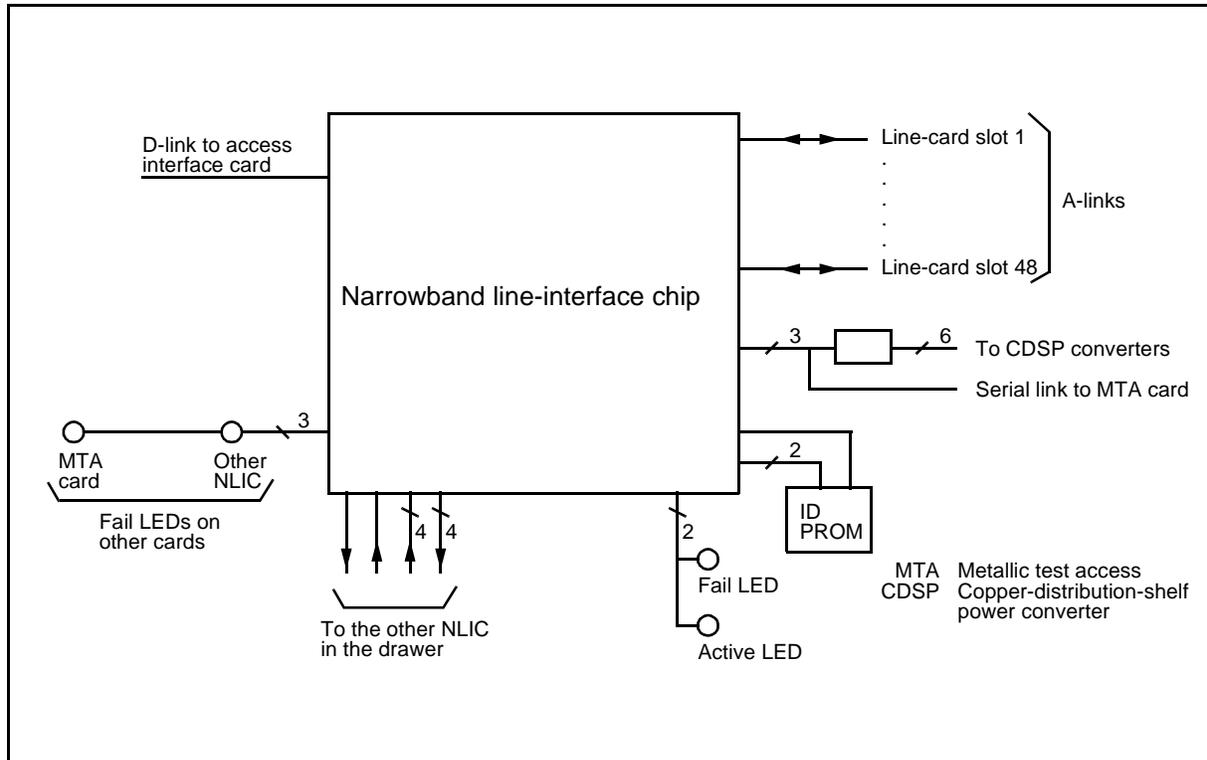
PC-10970



Note: To see the faceplate of a card in a copper-distribution drawer, you must pull the drawer out and look at it from the left or right side. For an example of the view from the side of the drawer, see Figure 6-7 on page 6-9.

Figure 6-17 is a block diagram of the NLIC.

Figure 6-17
Block diagram of the narrowband line-interface card



The two NLICs in a drawer are in a nonrevertive protection-switching arrangement. The two cards are located near the front of the drawer, on opposite sides of the drawer midplane, as shown in Figure 6-15 on page 6-19.

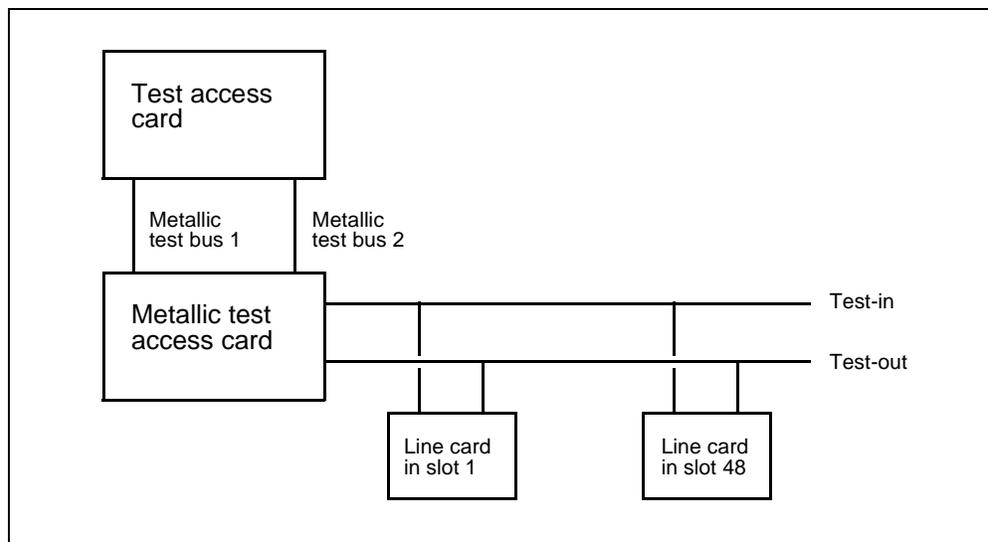
Each line interface card is 6.0 in. x 3.5 in. (152 mm x 89 mm), meaning that each one occupies the full height of the drawer. Each card has two LEDs on its faceplate: a red LED that indicates card failure, and a green LED that indicates that the card is active.

Metallic test access card (NT4K73AA)

Each copper-distribution drawer located in bays, modular business packages, and outside plant enclosures contains one metallic test access card. The metallic test access card occupies the frontmost slot on the left side of the drawer midplane. The card is 6.0 in. x 3.5 in. (152 mm x 89 mm), meaning that it occupies the full height of the drawer.

The metallic test access card makes connections that are necessary for testing the line cards. The metallic test access card provides a connection between the metallic test buses and the midplane test buses, as shown in Figure 6-18.

Figure 6-18
Metallic test access card and test buses for testing line cards



The metallic test buses come from the test access card in the access bandwidth manager shelf. There are two metallic test buses. One is for the copper-distribution drawers on the left sides of the copper-distribution shelves, the other, for the drawers on the right side.

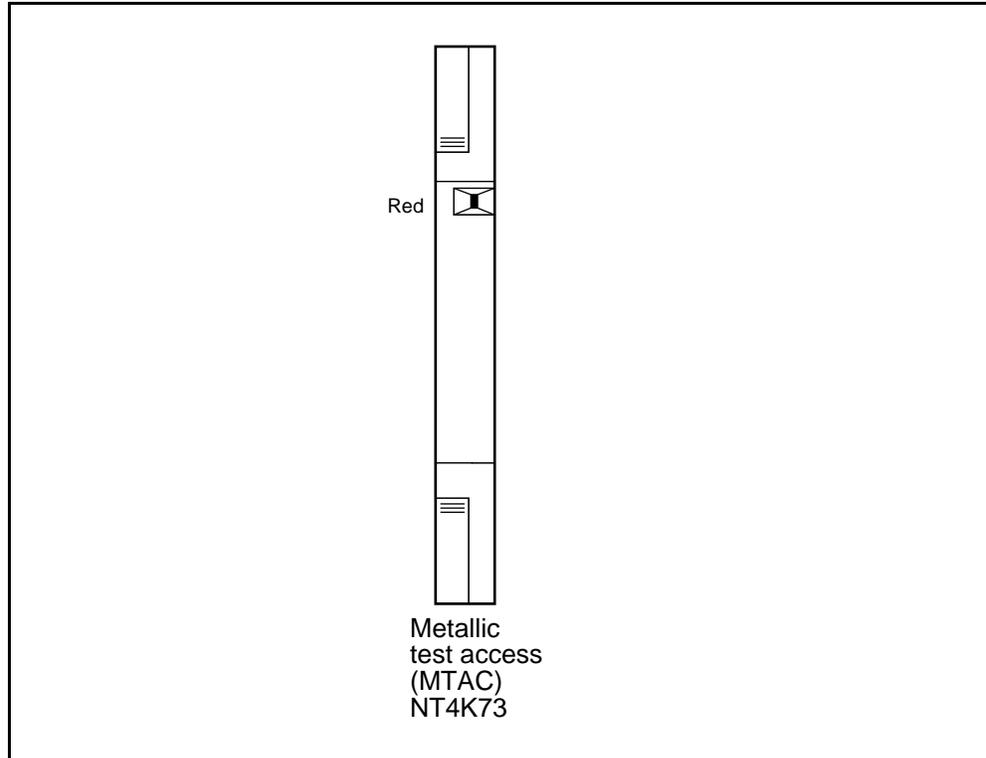
The cable carrying the two buses connects to a connector on the side interconnect left circuit pack on the access bandwidth manager shelf. Each copper-distribution shelf has two connectors for the metallic test buses, located on the left-hand end cap of the shelf. The upper connector is for the incoming cable from the shelf above; the lower connector, for the outgoing connector to the copper-distribution shelf below.

The midplane test buses are the two test buses that are distributed on the midplane of the copper-distribution drawer. There is one test bus for the line cards on the right side of the midplane, and another test bus for the line cards on the left side. The test buses support simultaneous access to T/R (in, out), T1/R1 (in, out), and E/M leads (in, out).

Figure 6-19 shows the faceplate of the metallic test access card.

Figure 6-19
Faceplate of the metallic test access card

PC-15668



Note: To see the faceplate of a metallic test access card in a copper-distribution drawer, you must pull the drawer out and look at it from the left side.

The metallic test access card has two red fail LEDs.

- The red fail LED on the faceplate of the card indicates a failure of the metallic test access card.
- The red fail LED on the surface of the printed circuit board shines through the front of the drawer, to indicate that a failure has occurred in one of the other cards in the drawer.

Metallic test access card (NT4K73CA)

The metallic test access card (MTAC) is used to switch the drawer test busses onto the shelf metallic test busses as required for metallic test access and sparing. Additional circuitry monitors for fault with any card in the CDS drawer and for Talk Battery loss at the drawer level. If a card fault is detected, the red fail LED remains constant. If loss of Talk Battery is detected, the red fail LED flashes. (The LED is located on the surface of the printed circuit board and shines through the front of the drawer.) A Talk Battery Loss alarm is also generated in the system software.

Power filter (NT4K63)

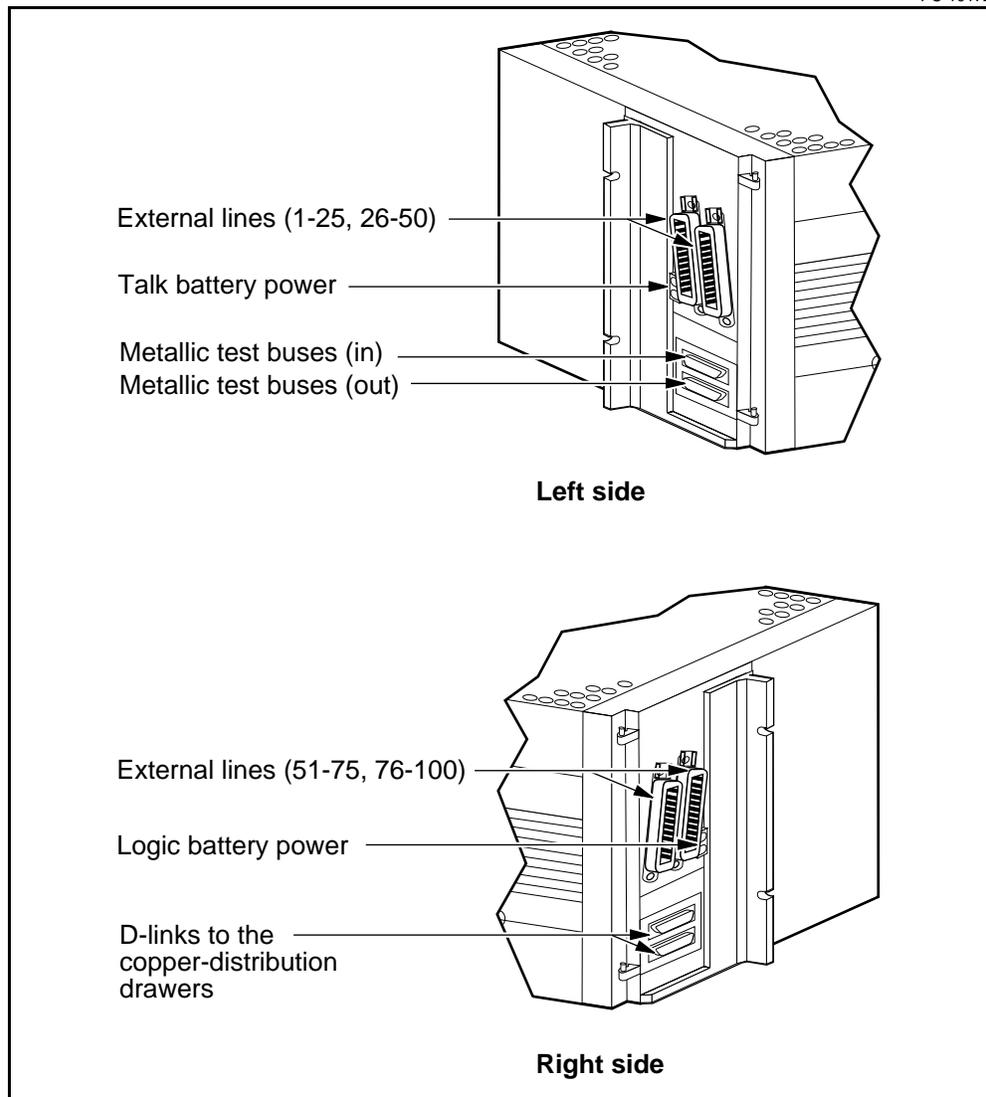
Each copper-distribution drawer contains a power filter. It plugs into the drawer midplane at the rear of the drawer, in a slot on the side of the midplane nearer the center of the shelf, that is, on the side of the midplane nearer the power converters. The power filter filters the power supply, which comes from the power converters by way of the power flex. It also provides termination for the clock lines in the drawer midplane.

Connectors on the end caps of the copper-distribution shelf

Figure 6-20 shows the locations of the connectors on the end caps of the copper-distribution shelf.

Figure 6-20
Connectors on the end caps of the copper-distribution shelf

PC-10172



As shown in Figure 6-20 on page 6-25, the left side of the copper-distribution shelf has the following connectors:

- two connectors, labeled Pairs 01-25 and Pairs 26-50, for cables carrying the external lines handled by the line cards in the left-hand copper-distribution drawer (drawer A)
- one connector, labeled TB, for a pair of wires bringing talk battery power from the breaker interface panel

- two connectors, labeled CDS MTA In and CDS MTA Out, for cables carrying the two metallic test buses, the upper connector carrying both buses in from the shelf above, the lower connector carrying both buses out to the copper-distribution shelf below

As shown in Figure 6-20 on page 6-25, the right side of the copper-distribution shelf has the following connectors:

- two connectors, labeled Pairs 51-75 and Pairs 76-100, for cables carrying the external lines handled by the line cards in the right-hand copper-distribution drawer (drawer B)
- one connector, labeled CDS Pwr, for a pair of wires bringing logic battery power from the breaker interface panel
- two connectors, labeled CDS A and CDS B, for the cables carrying the D-links between the copper-distribution drawers and the access bandwidth manager shelf, one cable carrying the D-links from the left-hand drawer (drawer A), and one cable carrying the D-links from the right-hand drawer (drawer B)

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AccessNode

Signal Flow and Circuit Pack Description

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