CHAPTER 4

AXIS Service Modules

In Release 3.0, AXIS offers the following types of service modules:

- Channelized T1/E1 frame service modules
- Fractional T1/E1 frame service modules
- T1/E1 ATM UNI service modules.
- T1/E1 Circuit Emulation service modules.

Up to a total of 10 service modules can be configured in an AXIS shelf in slots 5 through 14.

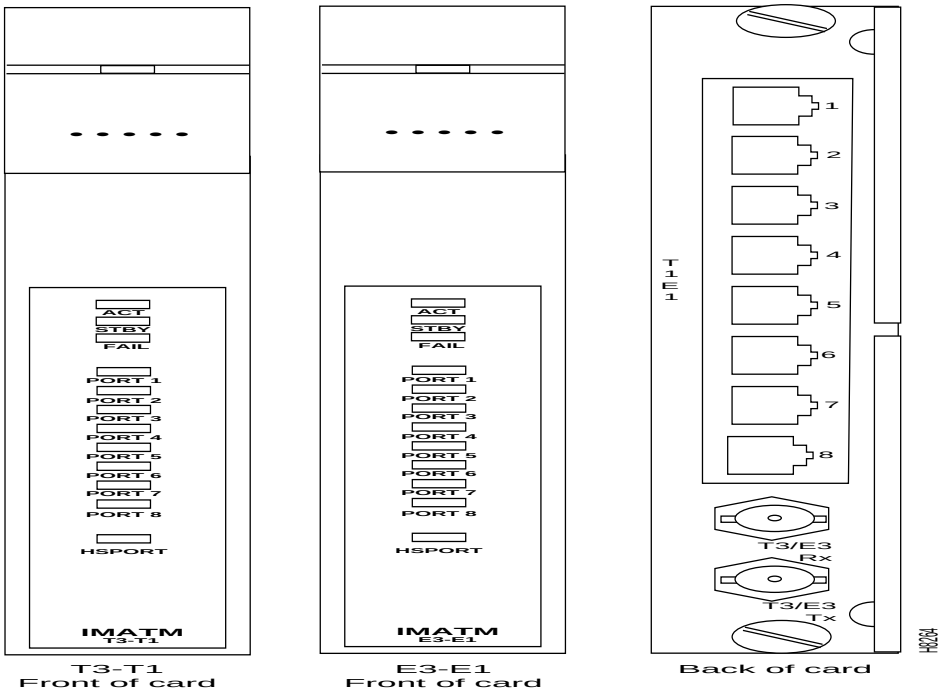
Current service modules (T1/E1 service modules) can be configured with 1:N redundancy protection if an optional SRM card is installed. For redundancy of a group of like service modules, a single spare service module (of identical type and version) is installed in slot 12, 13, or 14. Up to three groups (three types of service module) can be protected in this way.

AXIS Release 3.0 also offers the Inverse Multiplexing for ATM Trunk Module (IMATM) with support for 1:1 redundancy (no SRM required).

Inverse Multiplexer for ATM Trunk Module

An illustration of the IMATM cards is provided in Figure 4-1

Figure 4-1 IMATM-T3-T1 and IMATM-E3-E1 Front Cards and RJ48-T3T1/E3E1 Back Card



The IMATM is a two-card set consisting of a function module front card and a line module back card. The following front card and line module sets are available:

Front Card: IMATM-T3-T1
Back Card: RJ48-T3T1
T1 Line interface connector: Miniature RJ-48C
T3 Line interface connector: BNC

Front Card: IMATM-E3-E1
Back Card: RJ48-E3E1
E1 Line interface connector: Miniature RJ-48C
E3 Line interface connector: BNC, 75

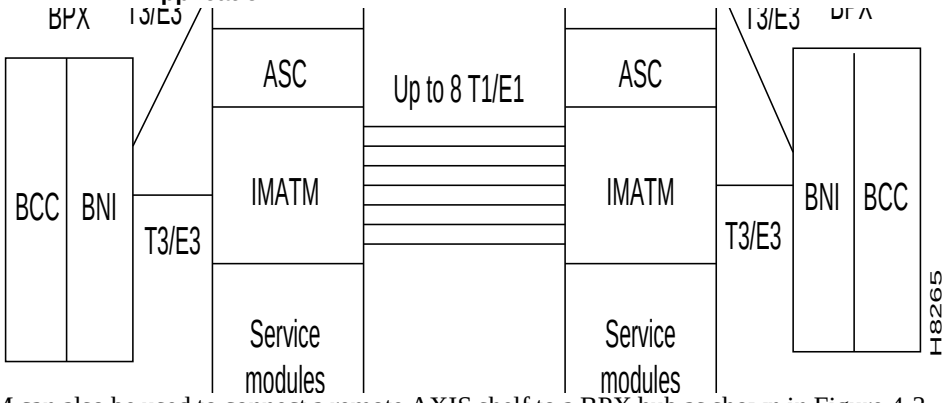
Front Card: IMATM-E3-E1
Back Card: SMB-E3E1
E1 Line interface connector: Miniature SMB
E3 Line interface connector: Miniature SMB

The shelf may contain one or multiple IMATM card sets in any available service module slot. 1:1 IMATM redundancy is achieved by installing two card sets and a Y-cable.

The IMATM performs no AXIS functions and is solely an extension to the BPX BNI card. The BPX can use up to 8 T1 or E1 lines as a trunk (instead of a single T3 or E3 line) by using an IMATM card in the AXIS shelf.

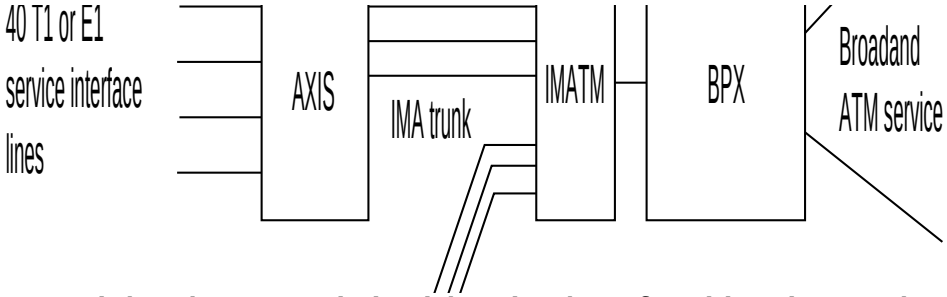
The IMATM accepts trunk signals from the BPX BNI over a single T3 or E3 connection and inverse multiplexes them over multiple T1 or E1 lines. The other end of the inversed multiplexed trunk is another IMATM card in a remote AXIS shelf (see Figure 4-2).

Figure 4-2 IMATM Application



The IMATM can also be used to connect a remote AXIS shelf to a BPX hub as shown in Figure 4-3.

Figure 4-3 IMATM used with remote AXIS



Up to eight T1 or E1 links in the inverse multiplexed channel can be configured depending upon the bandwidth desired. Bandwidth of T1 links range from 1.54 Mbps for one link to 12.35 Mbps for all 8 links. Bandwidth of E1 links range from 2 Mbps for one link to 16 Mbps for all 8 links. The BNI port bandwidth is configured to match the IMATM bandwidth.

Additional links can be provisioned to provide some protection against link failure. To achieve this, the BNI trunk should be programmed to have a statistical reserve equal to the bandwidth of the extra links. In the event of a link failure, a minor alarm occurs but no re-routing. Without this feature, a single link failure will cause a major alarm and all connections will be re-routed over another trunk

LED Indicators

The IMATM has the following LED indicators, all located on the faceplate of the front card.

ACTIVE (ACT) LED Green:

- On indicates that the card set is in active mode.

STANDBY (STBY) LED Yellow:

- On indicates that the card set is in standby mode.

FAIL (FAIL) LED Red:

- On indicates that the IMATM card set has failed or the line module is missing.

Port (PORT) LED Green, Red or Yellow, one LED per line:

- Green indicates that the line is active.
- Yellow indicates that there is a remote alarm on the line.
- Red indicates that there is a local alarm on the line.

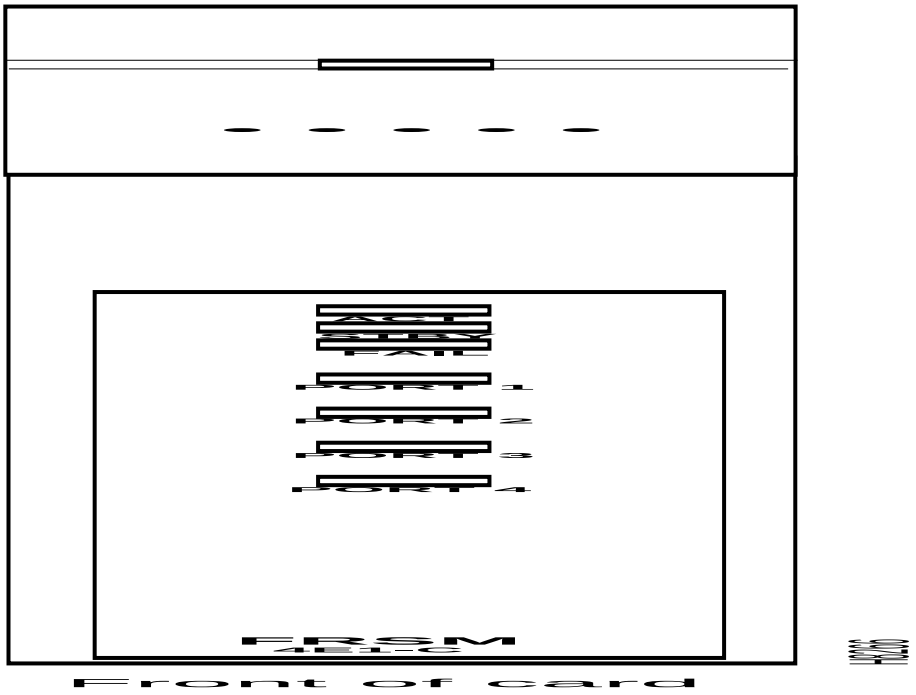
High Speed Port (HSPORT) Green, Red of Yellow

- Green indicates that the line is active.
- Yellow indicates that there is a remote alarm on the line.
- Red indicates that there is a local alarm on the line.

Frame Service Module

The Frame Service Module (FRSM) is a two-card set consisting of an FRSM front card (channelized or fractional, T1 or E1), and either a 4 T1 or a 4 E1 back card. Up to 10 FRSMs may be installed in a shelf in slots 5 through 14. An FRSM is shown in Figure 4-4.

Figure 4-4 Example FRSM Front Card



Fractional FRSMs support one 56 kbps or one Nx64 kbps customer port (FR-UNI, FR-NNI, ATM-FUNI, and Frame Forwarding) per T1/E1 line. Channelized FRSMs support multiple 56 kbps or Nx64 kbps customer ports per T1/E1 line, up to the physical line's bandwidth limitations.

The FRSM supports up to a maximum of 256 connections (virtual circuits) which can be allocated across the 4 T1 or E1 lines in any manner. The maximum frame size is 4510 bytes for frame relay and 4096 for ATM-FUNI.

The main function of the FRSM cards is to perform the necessary conversions between the frame formatted data on its 4 T1 or E1 lines and ATM/AAL5 cell formatted data received and transmitted over the Cell Bus. The FRSM performs the frame to cell segmentation and reassembly and the address translation between frame relay port/DLCIs, FUNI port/frame address, or Frame Forwarding port, and the ATM virtual connection identifiers (VPI/VCIs).

For frame relay, the FRSM can be configured to perform network interworking or service interworking. Network interworking and Service interworking connections can be freely intermixed on the same FRSM and the same physical port of the FRSM. The type of interworking is specified on a PVC by PVC basis.

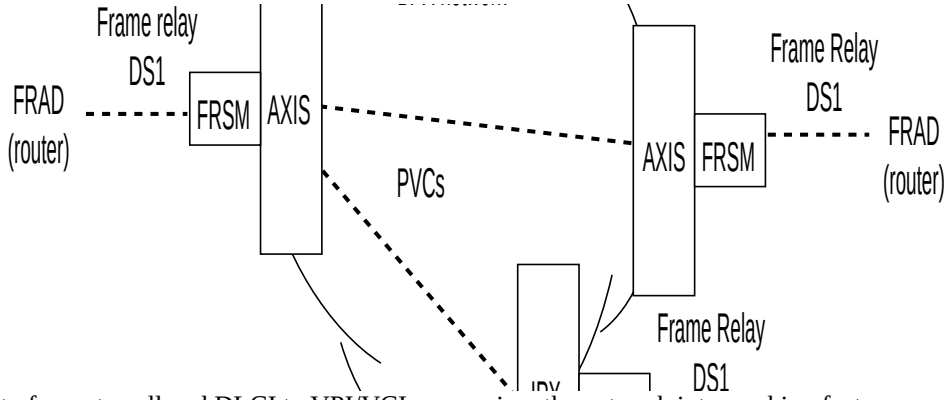
Fr to ATM Network Interworking

Using AXIS, FR-ATM network interworking permits a permanent virtual connection to be established between two frame relay service users over a StrataCom or multi-vendor network. Across the network the traffic is carried in ATM cells.

By specifying “network interworking” as the channel type when adding a frame relay PVC to an FRSM, all PVC data is subject to network interworking translation and mapping.

Figure 4-5 shows a BPX network with network interworking connections.

Figure 4-5 BPX Network with Networking Interworking Connections



In addition to frame to cell and DLCI to VPI/VCI conversion, the network interworking feature maps cell loss priority (CLP) and congestion information between frame relay and the intermediate ATM formats.

Cell Loss Priority

Frame Relay to ATM Direction

Each Frame Relay/ATM network interworking connection can be configured as one of the following DE to CLP mapping schemes:

- DE bit in the frame relay frame is mapped to the CLP bit of every ATM cell generated by the segmentation process.
- CLP is always 0.
- CLP is always 1.

ATM to Frame Relay Direction

Each Frame Relay/ATM network interworking connection can be configured as one of the following CLP to DE mapping schemes:

- If one or more ATM cells belonging to a frame has its CLP field set, the DE field of the frame relay frame will be set.
- no mapping from CLP to DE.

Congestion Indication

Frame Relay to ATM Direction

- EFCI is always set to 0.

ATM to Frame Relay Direction

If the EFCI field in the last ATM cell of a segmented frame received is set, then FECN of the frame relay frame will be set.

PVC Status Management

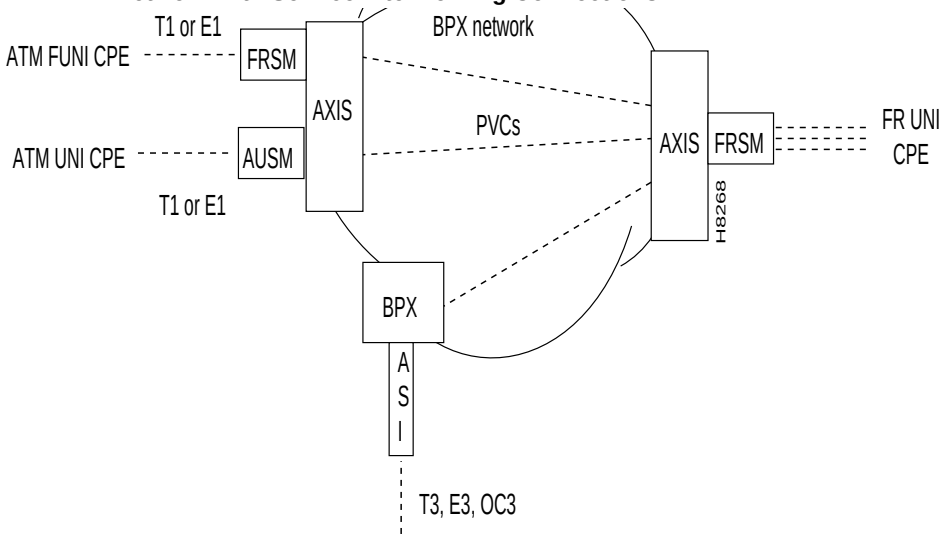
The management of ATM layer and FR PVC Status Management can operate independently. The PVC status from the ATM layer will be used when determining the status of the FR PVCs. However, no direct actions of mapping LMI A bit to OAM AIS will be performed.

FR to ATM Service Interworking

By specifying “service interworking” as the channel type when adding a frame relay PVC to an FRSM, all PVC data is subject to service interworking translation and mapping in both the frame relay to ATM and ATM to frame relay directions.

Figure 4-6 shows a StrataCom BPX network with service interworking connections.

Figure 4-6 BPX Network with Service Interworking Connections



The diagram shows an AXIS unit and an FRSM to the right with three frame relay connection endpoints. These connections indicate the frame relay ends of service interworking connections. The diagram shows some possibilities for terminating the other ends of the connections:

- An ATM FUNI (Framed UNI) port on an FRSM,
- An ATM UNI port on an AUSM,
- An ATM UNI port on a BPX ASI card.

In addition to frame to cell and DLCI to VPI/VCI conversion, the service interworking feature maps cell loss priority and congestion information between the frame relay and ATM formats. The service interworking is full Frame Relay Forum (FRF.8) compliant and provides full support for routed and bridged PDUs, transparent and translation modes, and VP translation.

Cell Loss Priority

Frame Relay to ATM Direction

Each frame relay to ATM service interworking connection can be configured as one of the following Discard Eligibility (DE) to Cell Loss Priority (CLP) schemes:

- DE bit in the frame relay frame is mapped to the CLP bit of every ATM cell generated by the segmentation process of the frame.
- CLP is always 0.
- CLP is always 1.

ATM to Frame Relay Direction

Each frame relay to ATM service interworking connection can be configured as one of the following CLP to DE mapping schemes:

- If one or more ATM cells belonging to a frame has its CLP set, the DE field of the frame relay frame will be set.
- DE is always 0.
- DE is always 1.

Setting up the cell loss priority option is accomplished through the AXIS configure channel map “cnfchanmap” command.

Congestion Indication

Frame Relay to ATM Direction

Each frame relay to ATM service interworking connection can be configured as one of the following Forward Explicit Congestion Notification (FECN) to Explicit Forward Congestion Indicator (EFCI) schemes:

- FECN bit in the frame relay frame is mapped to the EFCI bit of every ATM cell generated by the segmentation process of the frame.
- EFCI is always 0.
- EFCI is always 1.

ATM to Frame Relay Direction

Frame relay to ATM service interworking connections use the following EFCI to FECN/BECN mapping schemes:

- If the EFCI bit in the last ATM cell of a segmented frame received is set to 1, the FECN of the frame relay frame will be set to 1. BECN is always set to 0.

Setting up the congestion indication option is accomplished through the configure channel map "*cnfchanmap*" command.

Command/Response Mapping

Frame Relay to ATM Direction

The FRSM maps the C/R bit of the received frame relay frame to the CPCS-UU least significant bit of the AAL 5 CPCS PDU.

ATM to Frame Relay Direction

The least significant bit of the CPCS-UU is mapped to the C/R bit of the frame relay frame.

Translation and Transparent Modes

Service Interworking can operate in either Translation or Transparent mode on a per connection basis. In translation mode the FRSM performs protocol translation between the FR NLPID encapsulation (RFC 1490) and the ATM LCC encapsulation (RFC 1483). In transparent mode, no such translation takes place. Service Interworking also supports address resolution by transforming Address Resolution Protocol (ARP, RFC 826) and Inverse ARP (inARP, RFC 1293) between their Frame Relay and ATM formats when the PVC is configured as Translation Mode.

Frame Forwarding

The FRSM card can be configured as "Frame Forwarding" on a port by port basis.

When frame forwarding, the operation is the same as that for frame relay except:

- The 2 byte Q.922 header is not assumed/interpreted.
- All frames received are mapped to a specific connection if it exists. Otherwise, the frames are dropped.
- No DE/CLP or FECN/EFI mapping is performed.
- "Illegal header count" and "Invalid DLCI" statistics are not kept.
- A "Discarded frame count due to no connection" statistic is kept.

FUNI

The FRSM support the ATM Frame User to Network Interface (FUNI). Upon receiving a frame from the FUNI interface, the 2 byte FUNI header is removed and the frame is processed into ATM cells using AAL-5 for transmission over the network. In the reverse direction ATM cells are reassembled into frames using AAL-5, the FUNI header is added and the frame is sent to the FUNI port.

Loss Priority Indication

FUNI to ATM Direction

The CLP bit on the FUNI header is mapped to the CLP bit of every ATM cell that is generated for the FUNI frame.

ATM to FUNI Direction

CLP bit in the FUNI header is always set to 0.

Congestion Indication

FUNI to ATM Direction

EFCI is set to 0 for every ATM cell generated by the segmentation process.

ATM to FUNI Direction

If the EFCI field in the last ATM cell of a received segmented frame is set to 1, the CN bit in the FUNI header is set to 1. The two reserve bits (the same positions as C/R and BECN in Frame Relay header) are always set to 0.

ATM UNI Service Module

The ATM UNI Service Module (AUSM) is a two-card set consisting of an AUSM function module front card and either a 4 T1 or a 4 E1 line module back card. The E1 line module cards are further categorized by BNC or DB15 connector type.

Up to 10 AUSMs may be installed in a shelf in slots 5 through 14.

The main function of the AUSM cards is to provide an ATM UNI/NNI interface at T1 or E1 rates so that ATM UNI user devices can transmit and receive traffic over an ATM BPX network.

The AUSM supports up to a maximum of 256 connections which can be allocated across the 4 T1 or E1 lines in any manner, the connections can be either VPC or VCC as follows:

- VCCs have a VPI value of 0-16 to indicate slot number on the CellBus side
- VPCs have a VPI value of >16 on the cell bus side.
- The User side can have any values of VPI and VCI.

The BNM performs the appropriate header translation and routes cells to the correct slot.

The AUSM has extensive traffic control features. StrataCom's ForeSight feature, providing virtual circuit and virtual path end-to-end flow control is supported.

The AUSM contains 8000 cell queue buffers for each ingress and egress data flow. The Usage Parameter Control (UPC) algorithm and the queues are user configurable.

CAC is implemented to support separate% utilization factors, PCRs and MCRs for both ingress and egress CLI.

Illustrations of the AUSM card set are provided in Figure 4-7.

Figure 4-7 AUSM Cards

LED Indicators

The AUSM has the following LED indicators, all located on the faceplate of the front card.

PORT LED Green, Red or Yellow:

- Green indicates that the port is active.
- Red indicates that there is local alarm on the port.
- Yellow indicates that there is a remote alarm on the port.
- Off indicates that the port has not been activated (upped).

ACTIVE LED Green:

- On indicates that the card set is in active mode.

STANDBY LED Yellow:

- Slow blink without the Active LED indicates that the card is in the boot state.
- Fast blink with the Active LED indicates that the card is being downloaded.
- Fast blink indicates that the service module is passing BRAM channel information to the ASC.
- Steady yellow indicates that the card is in Standby mode and the firmware is executing ADMIN code.

FAIL LED Red:

- Steady Red with Active and Standby LEDs off indicates either that the card is in the Reset condition, the card had failed, or the card set is not complete (no line module).
- Steady Red with Active LED on indicates that the card was active prior to failing.
- Steady Red with Standby LED on indicates that the card was standby prior to failing

Circuit Emulation Service Module

The Circuit Emulation Service Module (CESM) is a two-card set consisting of an CESM function module front card and either a 4 T1 or a 4 E1 line module back card. The E1 line module cards are further categorized by BNC or DB15 connector type. The three possible line modules are:

- LM-DB15-4T1
- LM-DB15-4E1
- LM-BNC-4E1

Up to 10 CESMs may be installed in a shelf in slots 5 through 14. 1:N redundancy is supported through the SRM-T1E1 board.

The main function of the CESM cards is to provide a constant bit rate (CBR) service for T1/E1 ports over ATM BPX network.

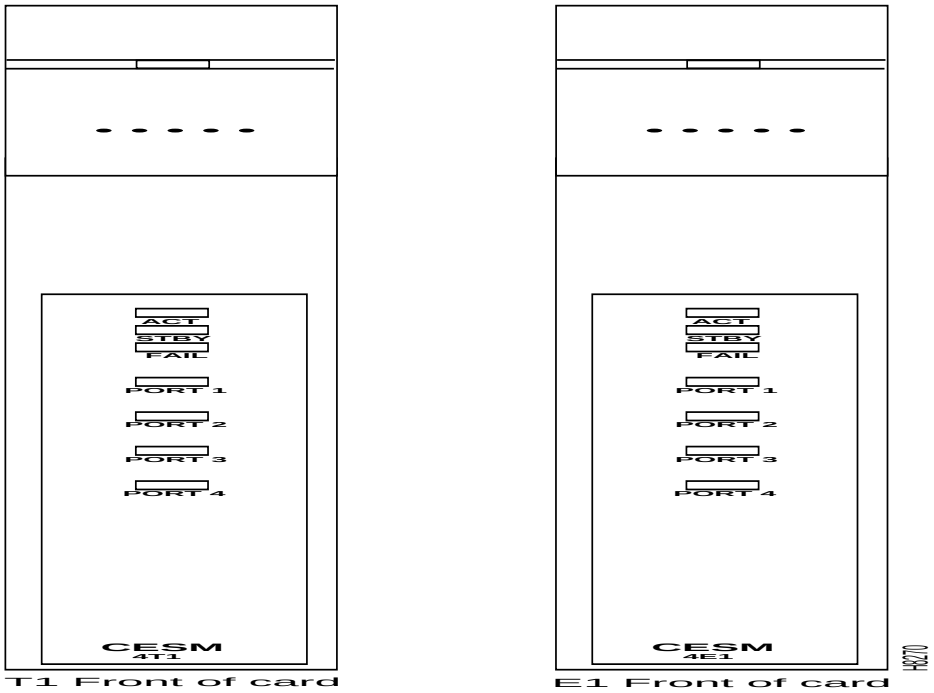
The CESM converts DS1/E1 data streams into CBR AAL1 cells for transport across the ATM network.

The CESM card supports either 4 T1 or 4 E1 ports. Each T1 or E1 port supports a single synchronous unstructured data stream with a data rate of 1.544 Mbps or T1 and 2.048 Mbps for E1. Data rates are not configurable. A single CESM card supports, therefore, up to four connections.

- Timing for the two ends of a CBR connection (termination at AXIS) must be the same Stratum reference.
- Performance monitoring of user applied structure (framing) is not supported.

Illustrations of the CESM card are provided in Figure 4-8.

Figure 4-8 CESM Card



LED Indicators

The CESM has the following LED indicators, all located on the faceplate of the front card.

PORT LED Green, Red or Yellow:

- Green indicates that the port is active.
- Red indicates that there is local alarm on the port.
- Yellow indicates that there is a remote alarm on the port.
- Off indicates that the port has not been activated (upped).

ACTIVE LED Green:

- On indicates that the card set is in active mode.

STANDBY LED Yellow:

- Slow blink without the Active LED indicates that the card is in the boot state.
- Fast blink with the Standby LED indicates that the card is being downloaded.
- Fast blink indicates that the service module is passing BRAM channel information to the ASC.
- Steady yellow indicates that the card is in Standby mode and the firmware is executing ADMIN code.

FAIL LED Red:

- Steady Red with Active and Standby LEDs off indicates either that the card is in the Reset condition, the card had failed, or the card set is not complete (no line module).
- Steady Red with Active LED on indicates that the card was active prior to failing.
- Steady Red with Standby LED on indicates that the card was standby prior to failing

Service Module Back Cards

T1/T3 Backcards

Release 3.0 of AXIS provides back cards for service modules that connect to 4 T1 and 4 E1 lines. The E1 back cards are further categorized by BNC or DB15 connector type. The three possible back cards are:

- DB15-4T1-BC
- DB15-4E1-BC
- BNC-4E1-BC

The back cards provide the physical line connections to either the T1 or E1 lines and communicate with their front cards through the AXIS backplane. A front card/back card set are always installed in the same slot position.

Redundancy Backcards

When the SRM is used to provide 1:N redundancy for T1/E1 service modules, the standby (redundant) card set uses a special redundancy backcard. There are three types of redundancy backcards; R-DB15-4T1, R-DB15-4E1, and R-BNC-4E1 depending upon the line type (T1 or E1) and the E1 connector type (DB-15 or BNC). When 1:N redundance is invoked, the physical lines to failed service module backcard are still used but the signals are routed to and from the redundancy backcard.

Figure 4-9 T1/E1 Backcards