

Alcatel's 3600 MainStreet Multiservice Bandwidth Manager platform offers extensive frame relay services as a key component of the Alcatel multiservice networking solution. With the straightforward and cost-effective addition of a Frame Relay Engine (FRE), Packet Engine (PE) or Frame Relay Switch with Subrate Interface Module (FRS/SRIM) card, a 3600 MainStreet node provides comprehensive frame relay switching capabilities.

MainStreet Frame Relay is a proven service used extensively in public and enterprise networks throughout the world. It can be used effectively in large or small networks deploying frame relay alone or in combination with leased line, X.25 and ATM services. Based on a modular architecture, up to 64 FRE and/or PE cards can be connected across the 100 Mb/s FASTbus to create a high-capacity node capable of switching 120,000 frames per second (fps).



Advanced  
frame relay  
features and  
interworking  
services

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MainStreet Frame Relay services include X.25/frame relay/ATM network and service interworking capabilities, subrate frame relay switching, and value-added service capabilities such as voice over frame relay with quality of service, packet fragmentation and reassembly, and DLCI multiplexing. Figure 1 depicts a frame relay solution architecture.

A 3600 MainStreet system with frame relay interworks seamlessly with the Alcatel 7470 Multiservice Platform (MSP), formerly the 36170 Multiservices Switch\*, to provide an end-to-end frame relay solution, from the customer premises to the ATM-based multiservice backbone. Both systems are fully managed by the industry leading Alcatel 5620 Network Manager (NM), formerly the 46020 Network Manager\*, allowing the service provider to manage the multiservice environment from a single platform and console. New facilities can be added in seconds, rather than weeks, as more subscribers request service.

\* This product belonged to the Newbridge family. Newbridge was acquired by Alcatel in May 2000.

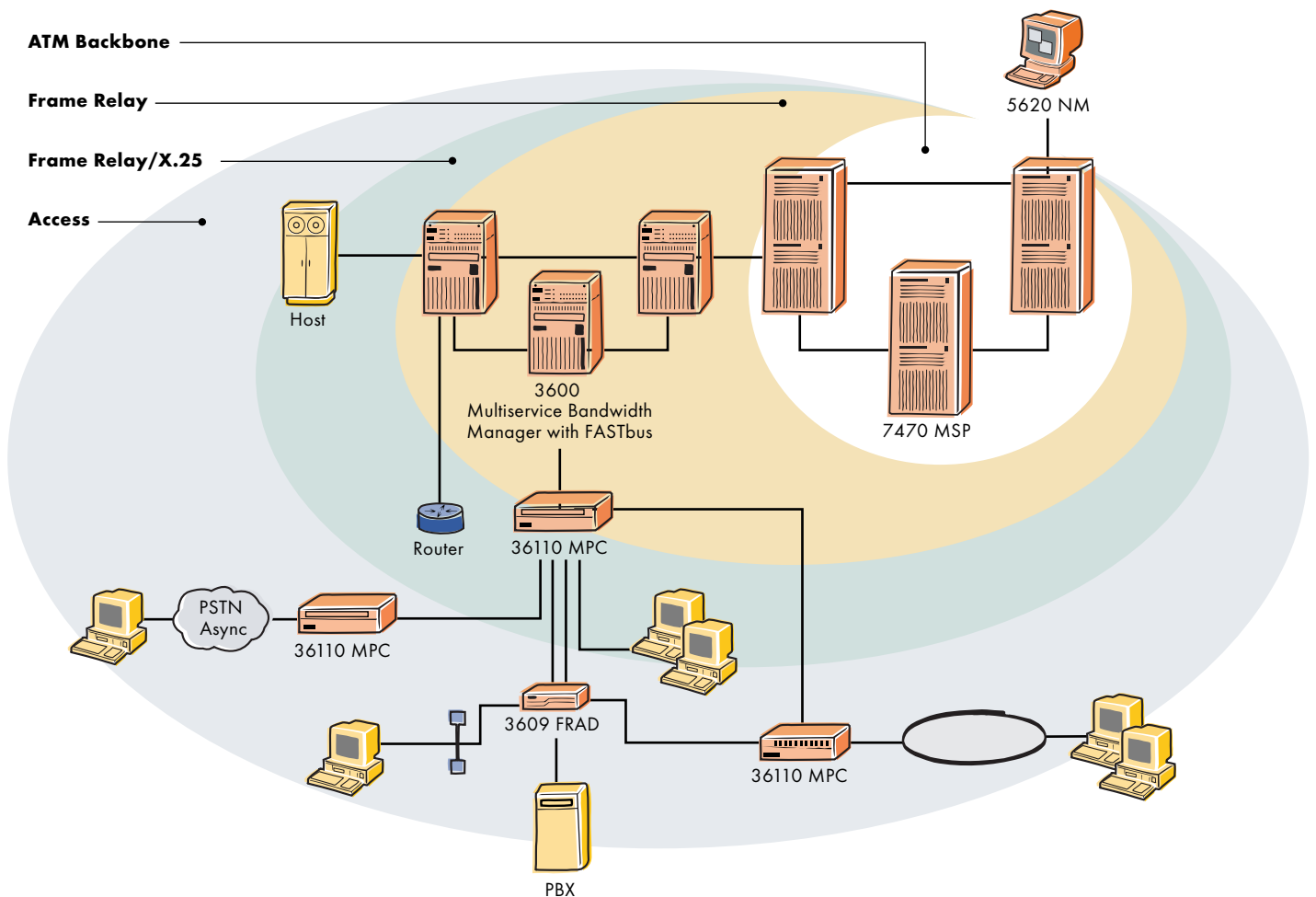
### Scalable frame relay switching platform

The 3600 MainStreet supports multiple services including leased line, ISDN switched services, frame relay and X.25. Adding frame relay services to the 3600 MainStreet platform is as easy as installing an FRE, PE or FRS/SRIM card into any universal card slot (UCS) in a 3600 MainStreet system. For existing systems, this can be done as a field upgrade and, in most cases, does not affect service.

The MainStreet Frame Relay service is based on distributed packet processing architecture. All frame relay switching occurs on the integrated frame relay cards. As interface bandwidth and capacity requirements increase, the system can be economically scaled from a few FRE and/or PE cards to up to 64 cards interconnected across the 100 Mb/s FASTbus.

With the FASTbus option, the 3600 MainStreet system supports an easy migration from frame relay to ATM networking, as well as their coexistence in the same network. The frame relay/ATM interworking solution is provided via an optional rack-mountable MainStreet FRATM Interworking Unit.

▼ Figure 1: Alcatel frame relay solution architecture



### Frame Relay Engine card

The Frame Relay Engine (FRE) card is the full-featured MainStreet Frame Relay switching card. In addition to standard, high-performance frame relay switching, it offers advanced frame relay features such as quality of service (QoS), frame fragmentation/reassembly, DLCI multiplexing, transparent high level data link control (HDLC) encapsulation and frame stream protection switching (link management interface (LMI)-triggered reserved alternate path with immediate diversion (RAPID)).

The FRE card supports up to 62 frame streams with a combined bandwidth of 3.968 Mb/s.

### Packet Engine card

The Packet Engine (PE) card is intended for combined X.25 and frame relay switching applications. The card supports comprehensive X.25 switching capabilities along with high performance frame relay switching. Subscribers can easily migrate from one to the other as both services can be used simultaneously and interchangeably — ports can be reconfigured through software as service needs change.

The PE card supports up to 62 frame streams with a combined bandwidth of 3.968 Mb/s.

### Frame Relay Switch with Subrate Interface Module card

The Frame Relay Switch with Subrate Interface Module (FRS/SRIM) card is used primarily for subrate frame relay or X.25 access to MainStreet networks. The card supports up to 31 frame streams with a combined bandwidth of 1.984 Mb/s.

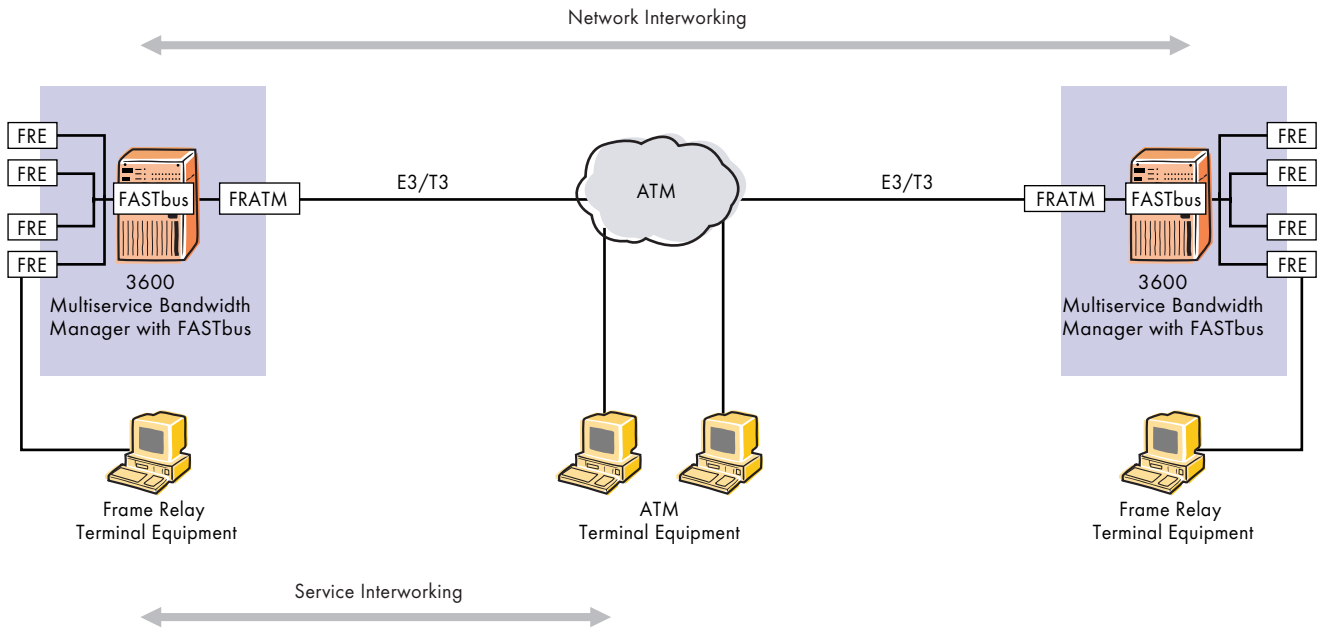
The SRIM provides economical low speed connectivity with high fan-out sub-64 kb/s frame relay switching. This capability is required for the support of existing legacy protocol network devices.

### FASTbus option

The FASTbus option enables the interconnection of up to 64 FRE and/or PE cards and multiple MainStreet FRATM Interworking Units to form a high-capacity frame relay switching node capable of delivering 120,000 fps aggregate switching performance across 256 Mb/s of access bandwidth. A FASTbus Interconnect Panel (FIP) and frame relay resource cards are all that is needed to upgrade a 3600 MainStreet system to accommodate expanding frame relay networking needs.

A 3600 MainStreet system with the FASTbus option accommodates access rates from 1.2 kb/s to full E3/T3, all under the same point-and-click, end-to-end network management system.

▼ Figure 2: Service and network interworking using the FRATM



## FRATM Interworking Unit

The FRATM Interworking Unit provides high performance frame relay-to-ATM interconnectivity using a standard E3 or T3 ATM interface. It connects to the FASTbus ring via the FIP, allowing FRE and PE cards on the 3600 MainStreet system to connect to an Alcatel 7470 MSP or to a standards-based, third-party ATM network. Network and service interworking are illustrated in Figure 2.

For more information, see the *MainStreet FRATM Interworking Unit* data sheet.

## Advanced frame relay functionality

### Voice over frame relay

The FRE card provides an efficient and economical means of switching voice frames and resolving delay and jitter issues. QoS is used to ensure faster delivery of voice frames by prioritizing voice traffic over other frames. Fragmentation is available to reduce the jitter commonly found when voice frames are mixed with long data frames. DLCI multiplexing eliminates the recurring cost of multiple PVCs between remote and central locations.

### Quality of service

In an environment where there is a need for varying frame relay end-to-end, the FRE card offers a comprehensive two-step approach. First, the frame switch specifies a class of service (qualifying) and, second, it specifies tolerable delivery time (quantifying) for the frame. By qualifying and quantifying the frames, an effective QoS platform is established. Conforming to the ITU-T X.146 standard, the QoS, along with tolerable delay times, is selected during commissioning of the frame relay PVC.

### Fragmentation

The FRE card platform supports end-to-end frame fragmentation/reassembly on PVCs based on FRF.12. This feature allows long frames to be fragmented at the ingress FRE card and then reassembled at the egress FRE card.

Typically, fragmentation is used when real-time, delay-sensitive traffic such as voice or video is transmitted on a stream that also carries large data frames. Multiplexing voice traffic using frame relay increases bandwidth efficiency dramatically, but fragmentation measures may be required to prevent the quality of the voice signal at the destination being compromised. This may occur when transmission of long frames on other PVCs using the link causes short voice frames to be excessively delayed.

### DLCI multiplexing

To reduce the costs associated with provisioning multiple PVCs across public frame relay networks to interconnect remote and central sites, the FRE card provides the capability to multiplex many "input" DLCs onto a single "output" DLC that is presented to the public network. The DLCI multiplexing feature conforms to the FRF.11 standard and is fully compatible with Alcatel's 3608 and 3609 MainStreet Frame Relay Access Devices (FRADs) and 3612 MainStreet Narrowband Multiplexer (NBM).

### Voice over frame relay access

Alcatel's 3608 and 3609 MainStreet FRAD products are flexible, expandable frame relay compatible access platforms. They provide customer premises access to toll quality voice, fax and data services, allowing users to take advantage of the cost-effectiveness of multiple services over frame relay.

The 3608 and 3609 MainStreet FRAD products are fully managed as part of an end-to-end solution.

### Unique frame relay features

#### Transparent HDLC-based protocol encapsulation

The feature enables the connection of any HDLC protocol device to the frame relay network and permits point-to-point connections based on frame relay PVCs. It can be used to provide connections between legacy protocol devices based on HDLC such as LAP, LAPB, LAPD, LAPM, SDLC and DSP, as well as proprietary protocols conforming to HDLC, such as Alcatel's TINP (1100 TPX) and Nortel's UTP (DPN-100). The feature also supports CPSS over frame relay.

The FRE, PE and FRS/SRIM cards fully support HDLC-based protocol encapsulation. Subrate HDLC encapsulation is available on the FRS/SRIM card.

#### Asymmetric CIR

Class of service (CoS) parameters are commonly configured to allow symmetric rate enforcing to run in both directions. Asymmetric committed information rate (CIR) allows applications with differing data transfer bandwidth requirements to be provisioned with separate CoS parameters in the transmit and receive directions. Systems network architecture (SNA) sessions between terminals and host are a common application for this feature.

#### Switched access to frame relay

Support for switched access to frame relay allows service providers to bridge their ISDN and Switched 56 networks to a MainStreet Frame Relay network. The MainStreet Frame Relay service provides an interworking function between the frame relay network and central office switches, which support ISDN and Switched 56 access.

### Protection switching

The Alcatel 3600 MainStreet platform provides a number of features to guarantee network availability. All voice, data, aggregate and subrate aggregates can be preconfigured with RAPID (reserved alternate path with immediate diversion) to provide fast rerouting of critical information channels. The FRE card supports frame stream protection switching based on PVC management messages (LMI-triggered RAPID). With this feature, RAPID protection is initiated once the card detects that the stream is out of service.

### Other unique features

Other frame relay features include:

- ▼ Instantaneous congestion and packet discard notification to aid in capacity planning and congestion control
- ▼ X.25-to-frame relay service interworking available on the PE card
- ▼ LMI auto-discovery to simplify configuration and provisioning

### Network and Service Management

The Alcatel 5620 NM provides advanced network management and service provisioning on frame relay and multiservice networks.

The Alcatel 5620 NM offers extensive functionality and ease of use for data traffic on frame relay and ATM links. It configures frame relay switching devices, sets up and manages paths, monitors network operation in real time, displays network synchronization and bandwidth utilization, and performs diagnostics to isolate and manage problems on the network.

Key frame relay management features of the Alcatel 5620 include:

- ▼ Graphical configuration – allows graphical configuration of all frame parameters, such as congestion thresholds and link management protocols.
- ▼ Simple path setup – configuring data link connections (DLCs) to set up PVCs is a simple point-and-click procedure; the operator only has to select valid path endpoints over the configured frame relay links and select the required parameters, including quality of service – the Alcatel 5620 NM system takes care of all the DLCs.
- ▼ Extended path management – frame relay links, paths and DLCs can be listed, allowing any connection to be easily traced through the network; for quick diagnostics, the path tracing feature highlights the path of a PVC and each node it traverses – with a click of the mouse.

Please refer to the *Alcatel 5620 NM* data sheet for more information.

## Technical Summary

### Frame Relay Features

#### Frame relay interface

- ▼ Frame Relay Forum user-to-network interface (UNI) and network-to-network interface (NNI)
- ▼ ITU-T Q.933 Annex A or ANSI T1.617 Annex D: user, network or bidirectional
- ▼ Local management interface (LMI): user, network or network-extended protocols
- ▼ Permanent virtual circuit (PVC) status signaling: per port basis configuration
- ▼ Frame stream integrity monitoring

#### Class of service parameters

- ▼ Committed information rate (CIR), maximum excess burst size (Be), committed burst size (Bc) configurable for each DLC
- ▼ Discard eligibility (DE) bit set when Be + Bc exceeds CIR

#### Congestion management

- ▼ Cards monitor frame stream bandwidth, switch and processor capacity
- ▼ User-configurable congestion threshold monitoring
- ▼ Standards-compliant implementation of FECN, BECN and DE congestion management techniques
- ▼ Green, yellow and red congestion status indicators

#### Statistics

- ▼ Traffic engineering and trouble isolation statistics collected at the card, frame stream and DLC levels
- ▼ Frame throughput statistics collected at the switch, frame stream and DLC levels for:
  - frames and bytes transmitted and received
  - frames discarded due to DE set or not set, congestion, errors, etc.

### Performance and Capacities

#### FRE and PE cards

- ▼ 62 frame streams (64 kb/s) per card
- ▼ Combined bandwidth of 3.968 Mb/s per card
- ▼ Up to 992 PVC/data link connections (DLCs) per frame stream
- ▼ Up to 1,984 PVC/data link connections (DLCs) per card
- ▼ 9,000 fps (64 byte frames) switching capacity per card
- ▼ Up to 4,472 bytes per frame (when LMI enabled); default: 1,600 bytes
- ▼ Up to 4 FRE or 3 PE cards per shelf and 64 cards per FASTbus system

#### FRS/SRIM card

- ▼ 31 frame streams (64 kb/s) per card
- ▼ 31 subrate frame streams with SRIM
- ▼ Combined bandwidth of 1.984 Mb/s per card
- ▼ Up to 992 PVC/data link connections (DLCs) per frame stream
- ▼ Up to 1,024 PVC/data link connections (DLCs) per card
- ▼ 2,000 fps (64 byte frames) per card
- ▼ Up to 4,472 bytes per frame (when LMI enabled); default: 1,600 bytes
- ▼ Up to 6 cards per shelf and 12 cards per node
- ▼ Subrate speeds and protocols
  - AT&T Dataphone Digital Service (DDS) protocol: 2.4, 4.8, 9.6 or 19.2 kb/s for DSOA/DSOB and 56 kb/s for DSOA
  - High capacity multiplexing (HCM) protocol: 1.2, 2.4, 4.8, 9.6, 14.4, 19.6, 38.4, 48 kb/s
  - X.50 protocol: 2.4, 4.8 or 9.6 kb/s for Div. 2/Div. 3, and 19.2 or 48 kb/s for Div. 3

#### FRATM Interworking Unit

- ▼ T3/E3 wire-speed transport on the WAN interface
- ▼ Up to 1,984 frame relay PVCs
- ▼ Up to 1,984 ATM VCCs

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## Standards

### Frame relay forum

- ▼ FRF.1.1, User-Network Interface (UNI) Implementation Agreement
- ▼ FRF.2.1, Frame Relay Network-Network Interface (NNI) Implementation Agreement
- ▼ FRF.3.1, Multiprotocol Encapsulation Implementation Agreement
- ▼ FRF.5, Frame Relay/ATM Network Interworking Implementation Agreement
- ▼ FRF.6, Frame Relay Service Customer Network Management Implementation Agreement (MIB)
- ▼ FRF.8, Frame Relay/ATM Service Interworking Implementation Agreement
- ▼ FRF.11, Voice over Frame Relay Implementation Agreement
- ▼ FRF.12, Frame Relay Fragmentation Implementation Agreement

### ATM forum

- ▼ B-ICI 1.0
- ▼ UNI 3.1

### ITU-T

- ▼ I.122, Framework for Providing Additional Packet Mode Bearer Services
- ▼ I.233.1, Integrated Services Digital Network (ISDN) General Structure and Service Capabilities – Frame Relay Bearer Service
- ▼ I.365.1, Frame Relay Service Specific Convergence Sublayer (FR-SSCS)
- ▼ I.370, Congestion Management for the ISDN Frame Relay Bearer Service

- ▼ I.372, ISDN Overall Network Aspects and Functions – Frame Relay Bearer Service NNI Requirements
- ▼ I.555, Frame Relay Bearer Service Interworking
- ▼ Q.922, ISDN Data Link Layer Specification for Frame Mode Bearer Services
- ▼ Q.933, Digital Subscriber Signaling System No. 1 (DSS1) – Signaling Specification for Frame Mode Bearer Service
- ▼ Q.933 Annex A
- ▼ T1.617 Annex D
- ▼ X.36, Interface between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for public data networks providing frame relay data transmission service by dedicated circuit
- ▼ X.76, NNI between public data networks providing frame relay data transmission
- ▼ X.146, Performance objectives and quality of service classes applicable to frame relay

### ANSI

- ▼ ANSI T1.606, ISDN – Architectural Framework and Service Description for Frame Relay Bearer Service
- ▼ ANSI T1.606 Addendum A, ISDN – Architectural Framework and Service Description for Frame Relay Bearer Service (congestion management and frame size)
- ▼ ANSI T1.606 Addendum B, ISDN – Architectural Framework and Service Description for Frame Relay Bearer Service (NNI requirements)

- ▼ ANSI T1.617, ISDN – Digital Subscriber Signaling System No. 1 (DSS1) – Signaling Specification for Frame Relay Bearer Service
- ▼ ANSI T1.617a Annex F, Multiprotocol Encapsulation over Frame Relay
- ▼ ANSI T1.617a Annex G, Encapsulation of ITU-T X.25/X.75 over Frame Relay
- ▼ ANSI T1.618, ISDN – Core Aspects of Frame Protocol for Use with Frame Relay Bearer

### IETF

- ▼ IETF RFC 1604: Frame Relay Service MIB
- ▼ IETF RFC 1406: Definitions of Managed Objects for the DS1 and E1 Interface Types
- ▼ IETF RFC 1490: Multiprotocol Interconnect over Frame Relay

## Interfaces

### Data interfaces

- ▼ V.24, V.28; TIA/EIA-232-C
- ▼ V.35
- ▼ X.21/V.11
- ▼ TIA/EIA-422 (four full duplex interfaces independently configurable as TIA/EIA-530-A, TIA/EIA-449/V.36, X.21, or V.35)
- ▼ OCU-DP and 4WTO channel units
- ▼ 64 kb/s co-directional (G.703 with AIS detection)
- ▼ 2B1Q Line Card (interface to 275X MainStreet DTUs)

### Aggregate interfaces

- ▼ 44.736 Mb/s DS3 (M13, C-bit parity)
- ▼ 34 Mb/s E3 (G.742/7.51 Asynchronous Positive Justification)
- ▼ 1.544 Mb/s T1 (D4, ESF, 64 kb/s channelized/structured)
- ▼ 2.048 Mb/s E1 (CAS, CCS, 64 kb/s channelized/structured)
- ▼ 56 kb/s or  $n \times 64$  kb/s V.35 PRI
- ▼ 56 kb/s or  $n \times 64$  kb/s X.21 PRI

### ISDN PRI

- ▼ T1/E1 HDSL
- ▼ Fractional T1 module
- ▼ ISDN S/T BRI card
- ▼ ISDN U BRI card
- ▼ Optical Extension E1
- ▼ Optical Extension E3
- ▼ TTC-2M card
- ▼ OC-3 card
- ▼ STM-1 card

### Voice interfaces

- ▼ E&M (Type I, II, III, V), LS/GS Subscriber (LGS), LS/GS Exchange (LGE)
- ▼ T1 D4 and ESF formats
- ▼ E1 CAS and CCS, R2D (E&M)
- ▼ E&M, LGS, LGE, and MRD channel units



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