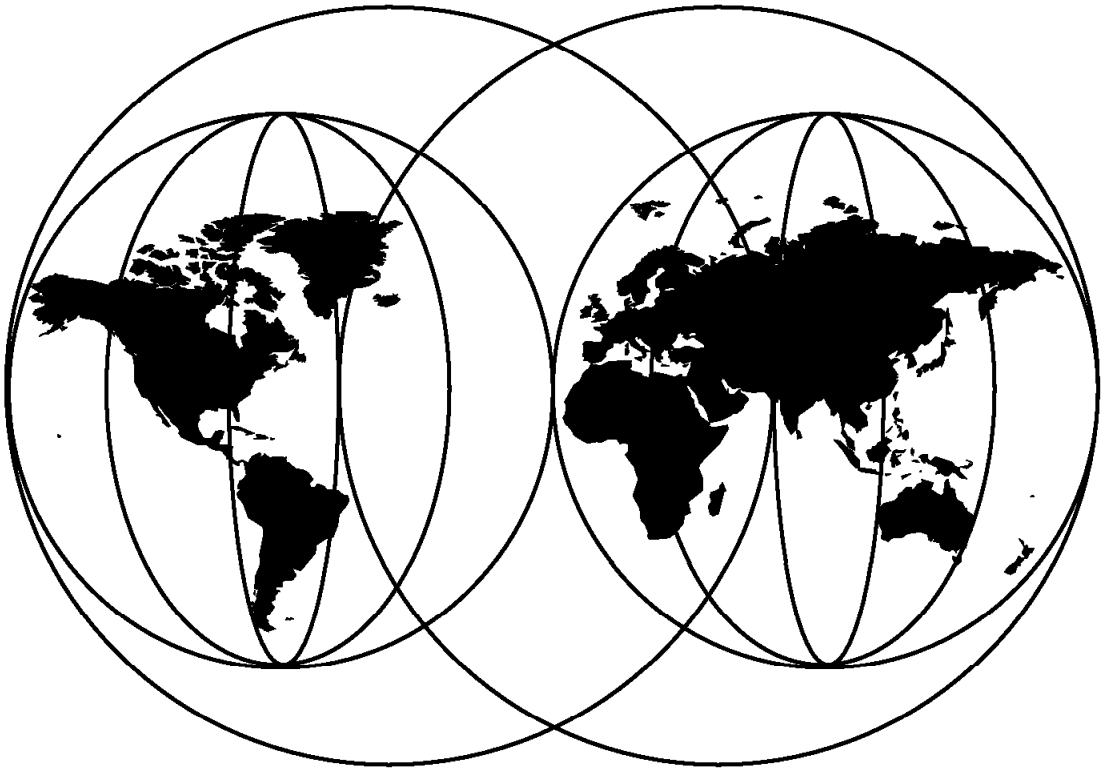
IBM 8265 Nways ATM Campus Switch

Georges Tardy, Kevin Treweek and Farhad G. Sidhwa



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IBM 8265 Nways ATM Campus Switch

March 1998

Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix E, “Special Notices” on page 229.

First Edition (March 1998)

This edition applies to the 8265 Nways ATM Campus Switch at general availability level dated December 1997.

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Contents

Figures

Tables

Preface

This redbook is intended to acquaint the reader with the IBM 8265 ATM Switch. The 8265 is the new platform for next generation high-end ATM backbone networks. The 8265 is the most powerful and the cornerstone of the IBM family of ATM switches. This redbook will assist both technically and marketing minded people in utilizing the superior functionality and operational capabilities of the 8265.

Within this redbook the reader will find:

- Architectural explanations of IBM′s leading edge switching techniques, with explicit reference to IBM′s award winning *Prizma* chip. The strengths of single-stage switching with distributed buffer pools and ATM traffic management will be depicted.
- Descriptions on the various ATM media modules available for the 8265. The backward compatibility of the 8265 with the IBM 8260 Hub. Technical criteria that is required for module operation within an 8265 network environment.
- Software operations of the 8265 Control Point with specific reference to its enhanced PNNI Phase One implementation and ATM Quality of Service (QoS) signalling management. Basic setup of the 8265 and how to retrieve microcode and picocode updates for the 8265.
- Configuration case studies for various 8265 network scenarios. Simple single peer group networks to multiple complex ATM networks will be documented and described.
- The significant simplification of ATM campus management through the use of the Nways Campus Manager suite of software products, which are used in conjunction with NetView for AIX.
- Troubleshooting guidelines for 8265 hardware and software operations. These troubleshooting hints will be able to assist technical personnel in fine-tuning their own specific 8265 networks.
- Vital technological differentiations of the 8265. This information will position the 8265 against competitive products and highlight its exceptional attributes.

The Team That Wrote This Redbook

This redbook was produced by a team of specialists from around the world working at the Systems Management and Networking ITSO Center, Raleigh.

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Chapter 1. 8265 Product Specification

The 8265 is a new ATM hub to address the needs of the next generation of high-end ATM backbone networks. One of the functions is dedicated to integrating advanced functions to minimize network complexity and cost of ownership.

The platform is based on an open architecture that combines high speed, high port density, and high reliability to support the ATM backbone networking requirements.

1.1 Overview

The IBM 8265 Nways ATM Switch is a new addition to the family of IBM Nways ATM switches. It uses IBM′s leading edge switching techniques, supported by the IBM Prizma ASIC chip. The architecture is non-blocking and is able to accept other valuable ATM features such as the MSS module, MPEG-2 Video Distribution module and some 8260 ATM modules. The description of all the pluggable modules in IBM 8265 has been described in Chapter 2, “IBM 8265 Modules” on page 13.

The unique architecture of IBM 8265 combines the strengths of single stage switching with distributed buffer pools and ATM traffic management. In addition to the support of ATM Forum Traffic Management TM 4.0 (CBR, VBR, ABR and UBR), the 8265 provides advanced traffic management functions statistics at the connection level, traffic policing, and port mirroring. The 8265 has one of the most sophisticated Forum-compliant PNNI, UNI and IISP implementation in the industry.

1.2 Chassis

The IBM 8265 Nways chassis comes with the following components:

- 17 slots 25 Gbps ATM backplane
- Three blank power supply bay filler plates
- Three fan units already installed
- Cable management tray to guide cables
- One rubber feet kit, for use when mounting the 8265 on a table
- DCE cable and interposer to connect a local console

1.2.1 Power Subsystem

The 8265 will typically be used as an ATM backbone switch that will support hundreds of users. Recognizing that the 8265 will be used in highly critical areas, a sophisticated power management subsystem is provided by the 8265 to ensure high reliability and robustness.

The 8265 has the ability to house up to four load-sharing power supplies. All power supplies are hot-swappable and are accessible from the front.

These power supplies can be configured in fault tolerant mode so that the 8265 is protected from a power supply failure. If used in fault tolerant mode, the

power supplies keep some of their capacity in reserve so that if a power supply failure does occur, there will be enough capacity left in the remaining power supplies to continue to power the entire hub. This process is nondisruptive, which means that no user will be affected by the failure of a single power supply.

If the available power is not sufficient after a power supply failure (for example, if the 8265 was not in a fault tolerant power supply configuration), then the modules will automatically be powered down in a prioritized and orderly manner. The power down sequence continues until enough modules are shut down to allow the remaining power supplies to cope with the power requirements of the remaining modules and chassis. This function is made possible because each 8265 module is able to have a priority assigned to it, allowing the 8265 to shut down the modules with the lowest priority before having to shut down those with the highest priority. This ensures that if a power supply failure is going to have any impact, it always causes the least possible disruption.

The 8265 uses the concept of power budget. This means that the 8265:

1. Knows how many power supplies are installed and which ones are working
2. Knows how much power is being used by the modules that are already installed
3. Interrogates newly inserted 8265 modules to determine their power requirement

The above features allow the 8265 to determine if there is enough power in the 8265 to power a newly installed module before full power is given to it. If there is, it will be powered up as usual. If not, the 8265 will not power up the module and therefore not impact any of the existing modules.

The existing 415 watt power supplies from the IBM 8260 may be used in the 8265.

1.2.2 Cooling Subsystem

To complement the 8265's intelligent power subsystem, the 8265 also has an intelligent cooling subsystem that is operated from the controller module.

Each 8265 is shipped with three cooling fans. Each of the three fans cools an overlapped area in the hub covering eight slots as shown in Figure 1 on page 3. The slots covered by each fan are:

- Fan 1 is responsible for slots 1-8.
- Fan 2 is responsible for slots 6 -13.
- Fan 3 is responsible for slots 10-17.

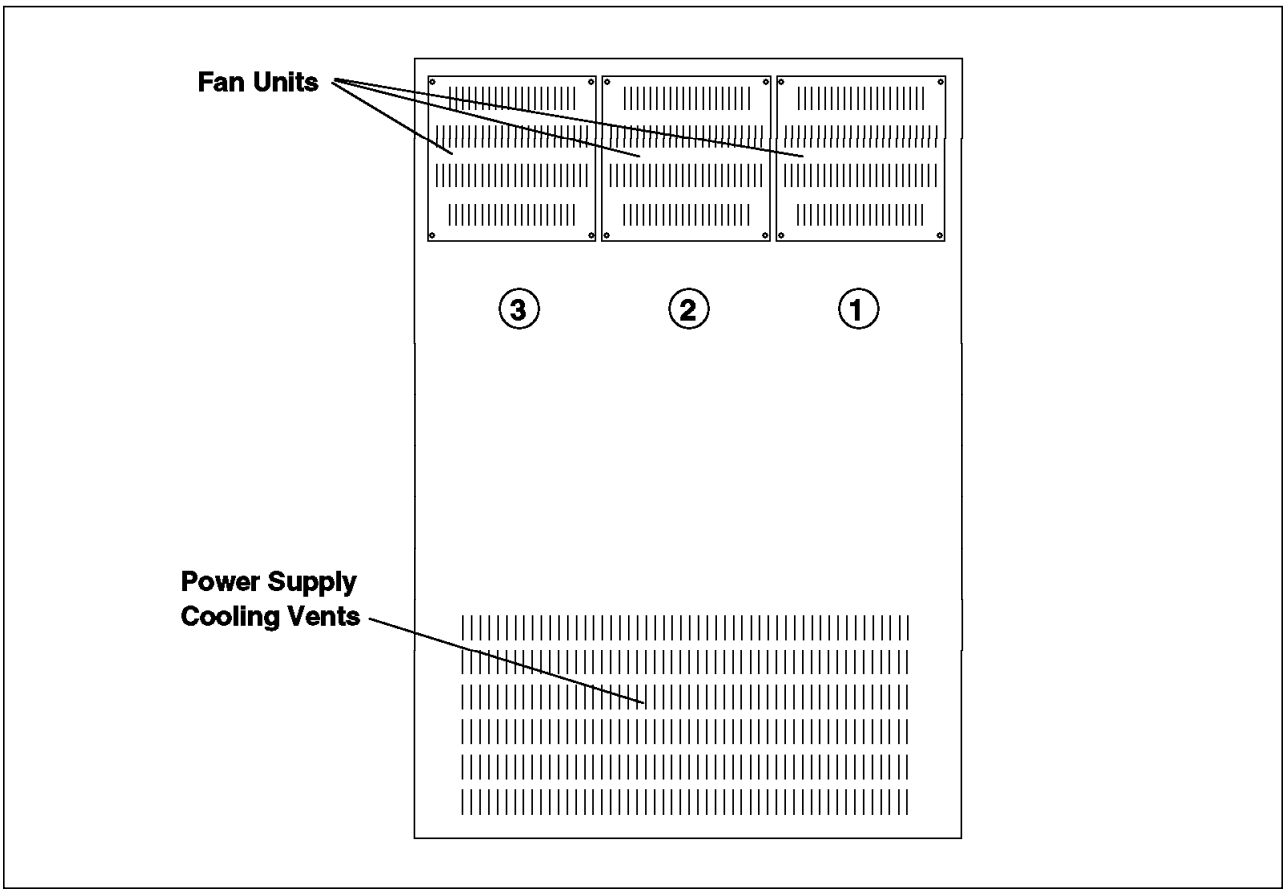


Figure 1. 8265 Fan Units

The controller module continually monitors all the sensors via the management backplane. If a fan unit stops or the temperature in any of the cooling zones rises above 60 C, the controller module can, depending on a user configurable parameter, use the management backplane to power down some of the 8265 modules in the affected cooling zone in order to bring down the temperature to an acceptable level. Note that within the affected area, the modules will be powered down in a prioritized manner as specified by the module priority.

Note: The module priority can be assigned by the user as part of the configuration process.

1.2.3 Certification

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to the FCC rules.

CE European Community marking has been applied to this product and is compliant to the following directives:

- EMC Directive 89/336/EEC and the amendment 92/31/EEC
- Low Voltage Directive 73/23/EEC

This equipment also conforms the 1st Class category standards set by the Japan Voluntary Control Council for Interference by Information Technology Equipment.

For certification of emission standards in other countries, please refer to the *8265 Installation Guide*.

1.2.4 Planning and Site Preparation

The 8265 is designed to be either rack mounted or placed on a table, stand, or shelf. It weighs approximately 57 kg (125 lbs) fully loaded. The table or shelf on which the 8265 rests should support at least 170 kg (375 lbs). The selected table or shelf must be less than 2 m (6 ft) from the nearest AC outlet.

The 8265 is 38.5 cm (15.06 in) in length and 67.3 cm (26.52 in) in height. To ensure proper ventilation, recommended minimum space required in the rear and the front of 8265 is 15 cm (6 in) and 8 cm (3 in), respectively, from the nearest wall or the vertical surface.

The 8265 is to be located in a psychrometric environment of subclass C. A class C environment is generally defined as a building environment that is not air conditioned with normal winter heating and sufficient ventilation.

The 8265 was tested successfully under the following requirements:

Storage:

- Low air temperature .....-40 C (-104 F)
- High air temperature .....+70 C (+ 158 F)
- Relative humidity .....5 to 95 %
- High absolute humidity....31g/m3
- Low absolute humidity....0.5g/m3
- Rate of change of temperature.....0.5 C/min
- Low air pressure....70kPa
- High air pressure....106kPa

Operation:

- Immunity EN-50082-1
- Safety IEC 950
- Climatic:
  - Cold....-5 C/16 hours
  - Dry heat....+55 C/24 hours

To further comply with the environmental and power guidelines, please refer to *IBM 8265 Nways ATM Switch Planning and Site Preparation Guide*.

1.3 Chassis Management and Backplane Topology

The 8265 chassis differs from the 8260 chassis by its ATM backplane.

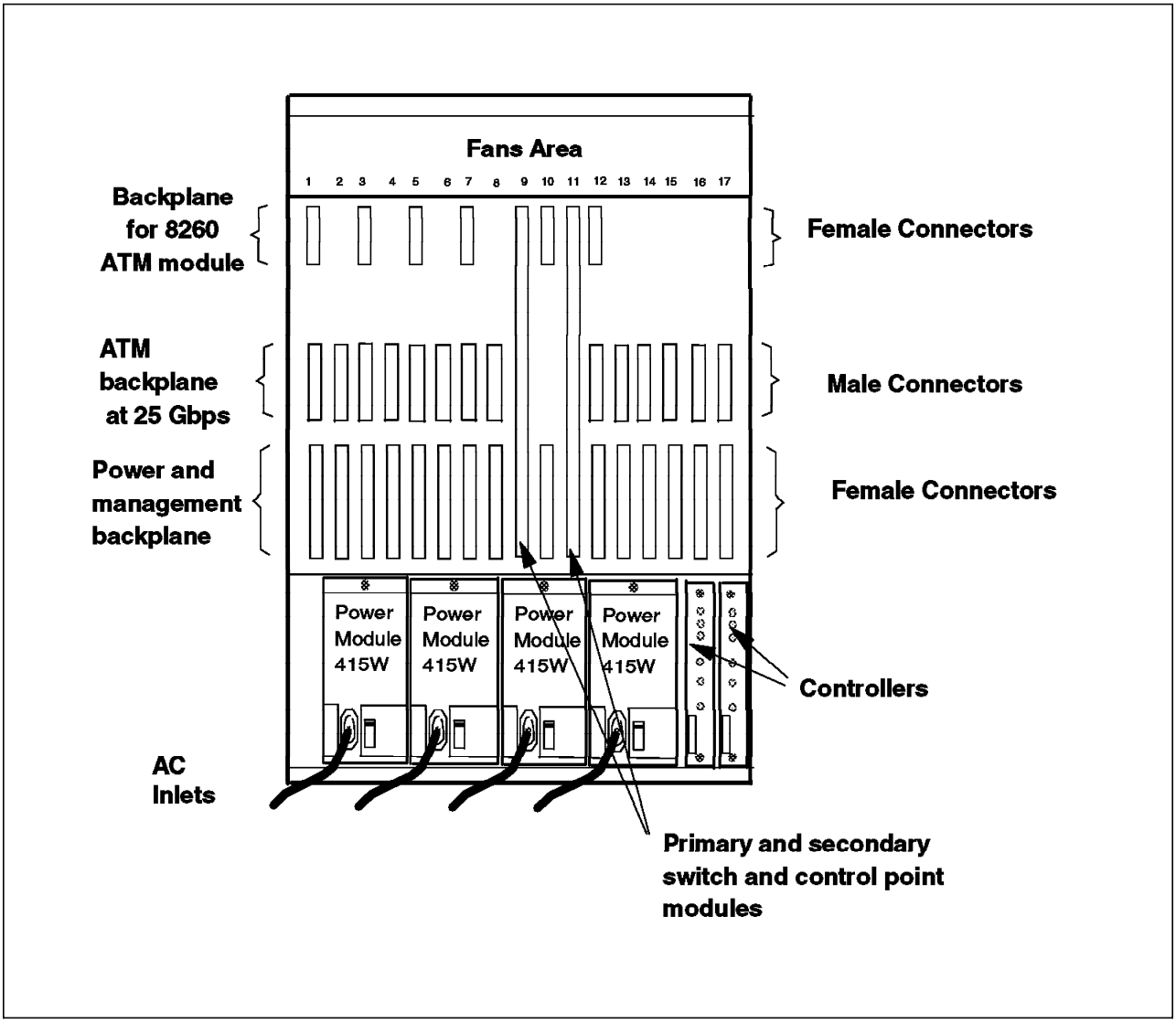


Figure 2. 8265 Backplane

The 8265 backplane (illustrated in Figure 2) is made of one physical board. The backplane board can be broken down into the following components:

- Power and environment management
- The ATM backplane
- The ATM backplane backward compatible with IBM 8260 ATM modules

1.3.1 Power and Environment Management

Through the power and environment management all the 8265 modules draw power and send environment information. This includes power budget, module temperature and vital product data. The information collected is managed by the controller module. See 2.1, “Controller Module” on page 13 for more information.

1.3.2 The ATM Backplane

The ATM media modules are linked to the switching fabric, where the Prizma chip set sits, via the ATM backplane. The Prizma chip set is located on the ATM control point and switch module (A-CPSW) that can be plugged in locations 9/10 or 11/12 on the ATM backplane.

Each media module has a dedicated set of connections to the A-CPSW module. This set of dedicated connections constitutes a star-wiring topology in which the media modules are at the tips of the star and the A-CPSW module at the center. The wiring topology used in the ATM backplane is shown in Figure 3, where each arrow line represents a full-duplex connection.

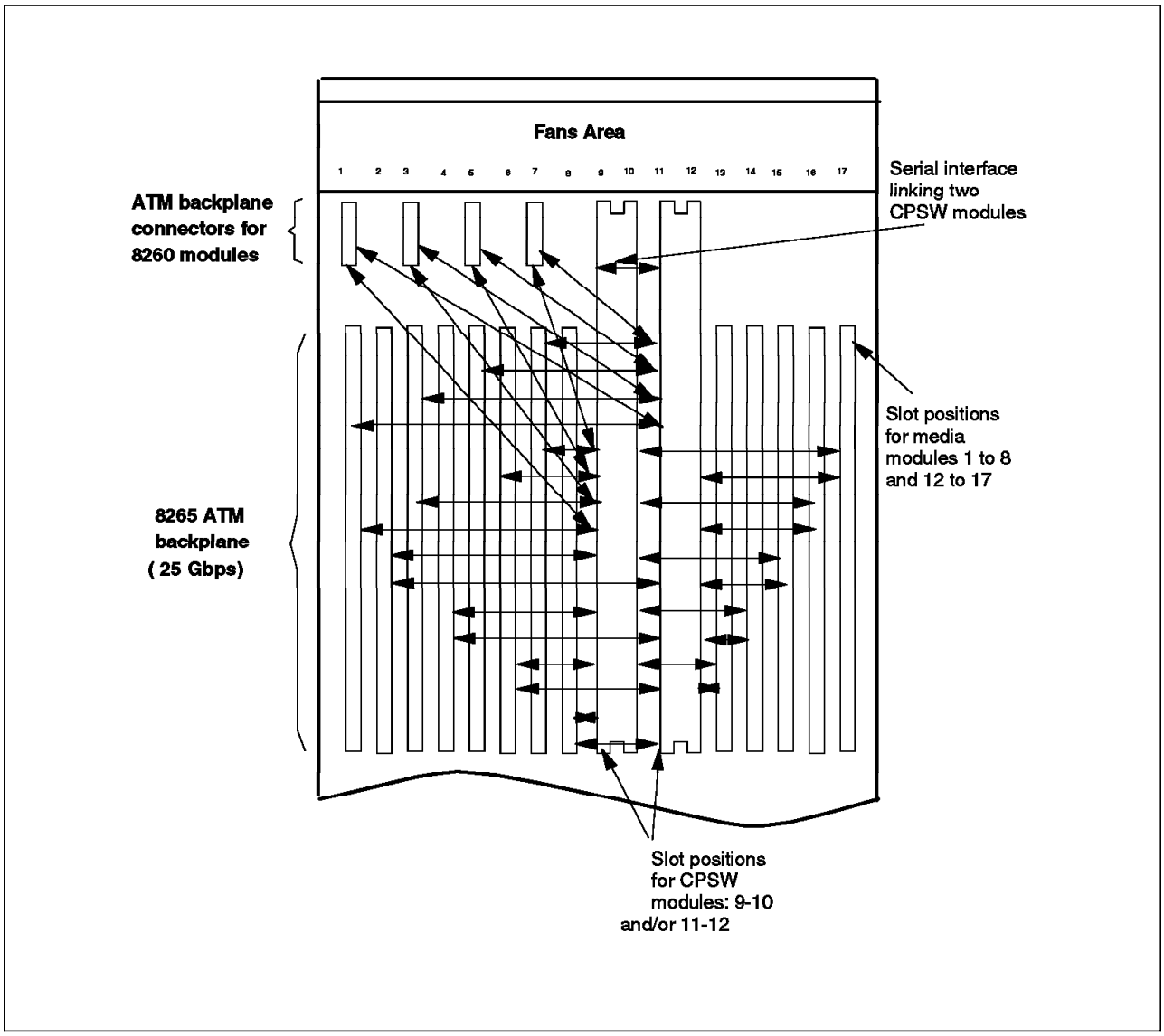


Figure 3. Star-Wiring Topology in ATM Backplane

The main characteristics of the 8265 backplane are as follows:

- The backplane is totally passive and no active components reside on the backplane. This provides high reliability.
- The ATM media modules have full-floating capabilities. This allows all ATM media modules to be inserted into any of the slots 1 to 8 and 12 to 17.

- All ATM modules are hot-swappable. Any module can be removed or inserted without having to power down the hub.
- Each backplane can support up to two A-CPSW modules for reliability and redundancy.
- Certain 8260 ATM media modules can fully coexist with 8265 module.

One can install 8265 media modules in slots 1 to 8 and 12 to 17 of an 8265 equipped with a single A-CPSW module, or in slots 1 to 8 and 13 to 17 of an 8265 equipped with two A-CPSW modules. One can also install a single A-CPSW in slot 11-12, but then only slots 1-8 and 13-17 can be used for media modules, thus losing one slot.

When two A-CPSW modules are installed for redundancy, a serial interface on the 8265 backplane links the two A-CPSWs together (Figure 3 on page 6). This interface is used by the two control points (primary and secondary) to update automatically any configuration changes and to monitor the health of the primary for A-CPSW redundancy. The A-CPSW redundancy method is covered in 2.2, "ATM Control Point and Switch Module (A-CPSW)" on page 14.

A frontal *wrong slot* LED is provided on the modules to indicate incorrect insertion of a module into the chassis.

1.3.2.1 Burnt-In MAC Addresses

The ATM backplane has three burnt-in MAC addresses, for use by the ATM control point. These addresses are used for:

- Token-ring LAN Emulation client
- Ethernet LAN Emulation client
- A-CPSW Ethernet management service port

These burnt-in MAC addresses should simplify the initial setup of 8265 ATM switches. By putting these MAC addresses on the chassis rather than on the A-CPSW module itself, it simplifies maintenance. For example, in the case of swapping A-CPSW modules, the identity of the ATM switch remains unchanged.

1.3.2.2 Pin Description

The power and management backplane is composed of 96 female pin connectors, arranged in a matrix form of 3 rows and 32 columns.

The ATM backplane is composed of 110 male pin connectors, arranged in a matrix form of 5 rows and 22 columns.

In comparison, the backplane for 8260 ATM modules is composed of 120 female pin connectors, arranged in a matrix form of 5 rows and 24 columns.

1.4 Switching Architecture

The 8265 ATM switching architecture, has a central switching fabric with distributed buffer pools and traffic management.

The main hardware components of the switching architecture are shown in Figure 4 on page 8:

- The switch (with the control point)
- The ATM engines (on the media module)

- The ATM backplane

1.4.1 The Switch

The switch architecture is centered around a single stage 16x16 switching fabric composed of two Prizma ASIC chips running in speed expansion mode. This fabric is able to deliver a throughput of 768 Mbps full-duplex per port and an aggregate throughput of 12.3 Gbps full-duplex.

The switching fabric runs in redundancy mode. Fourteen ports of each ASIC chip are used for data, thus providing an aggregate throughput of 10.75 Gbps for each ASIC chip. Out of the remaining two ports of the ASIC chip one port is used for management and the other not used.

By having a central switching fabric, every ATM module uses a dedicated connection to the switching fabric. This allows the fabric to do the switching, which lowers the cost per module and simplifies the backplane design.

The switch card also has an ATM engine like all the ATM media modules. The switch card ATM engine is used to connect the control point to port 0 of the switch.

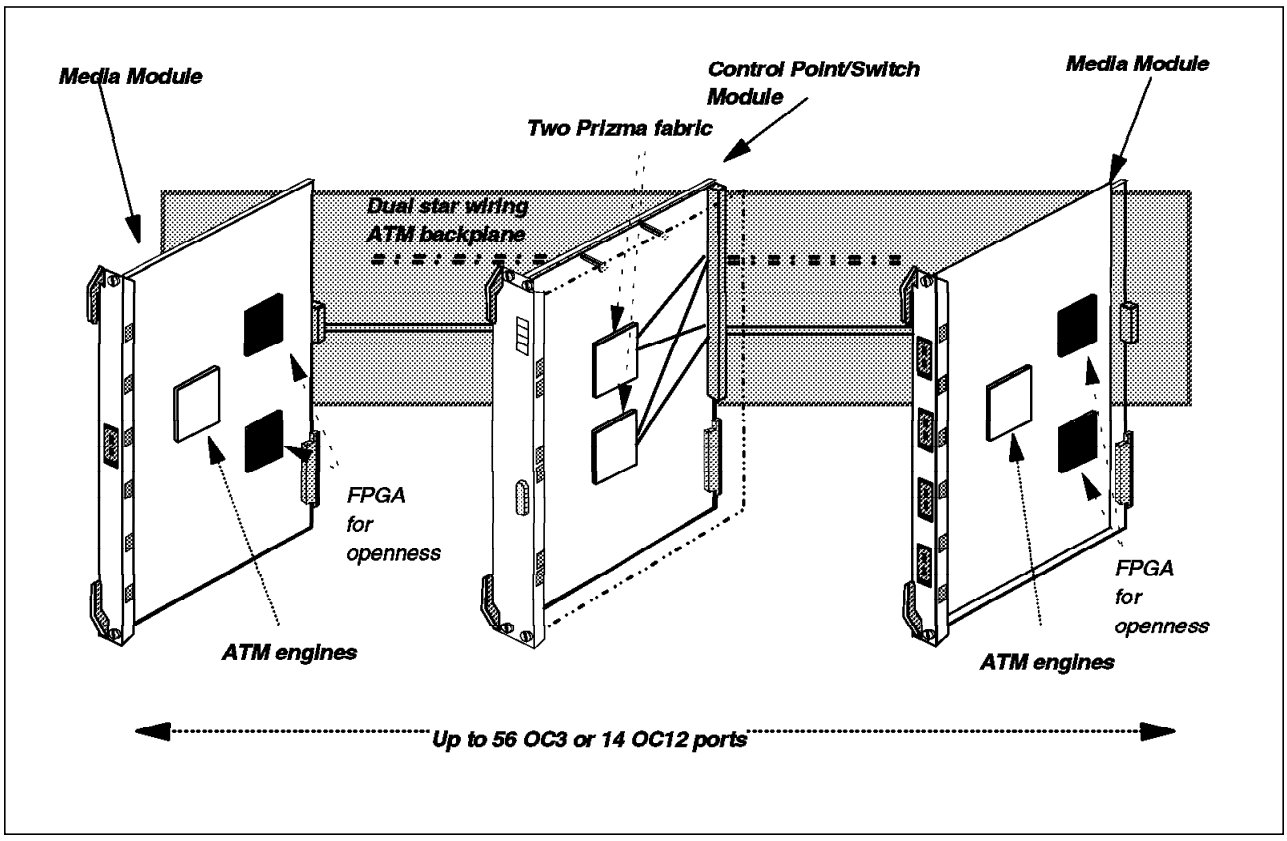


Figure 4. Switching Architecture

1.4.2 The Control Point

The control point processor is based in a PowerPC processor. It has a flash memory from which it loads the bootstrap code and also holds the operational code which runs from DRAM.

The control point function uses a real-time multitasking operating system. The control point card performs all the essential central functions, such as:

- PNNI topology and routing
- Address mapping
- Resource management
- Signalling entities
- Network management
- Setup of all hardware control elements (VP/VC values, shaping parameter values, etc.)

The control point performs management operations on the rest of the ATM subsystem by sending *guided cells*, a patented technique used to control the rest of the 8265 via an internal port connected to the switch (port 0).

1.4.3 The ATM Engines

On each ATM module resides an ATM engine with the cell buffer pools. The ATM engine on an ATM module is a combination of Prizma ASIC and Field Programmable Gate Arrays (FPGAs). This approach is taken to have optimum performance (ASIC) while still maintaining openness (FPGA). The ATM engines perform the following functions:

- Cell routing for point-to-point and point-to-multipoint connections
- Traffic management
- Flow control
- Statistics and counters
- Label swapping
- Multicasting

The ATM traffic management functions are distributed over every module the same way the buffer pools are. As each module comes with its own processing horsepower to perform ATM functions, there is no performance degradation by adding new modules.

1.4.4 The ATM Backplane

As mentioned in 1.3.2, “The ATM Backplane” on page 6 all the ATM media modules are linked to the switching fabric via a passive backplane, where the Prizma chip set sits. This forms a star topology, where the Prizma chip set is in the center of the star with ATM modules at the tips. For redundancy reasons, the backplane is made of two stars, with room for two switching fabrics; thus every ATM media module connects to two stars.

1.4.5, “The Switch” on page 10 describes the control point switch in more detail. Details on the ATM engines can be found in 2.3.1, “The ATM Engines on Media Modules” on page 19.

1.4.5 The Switch

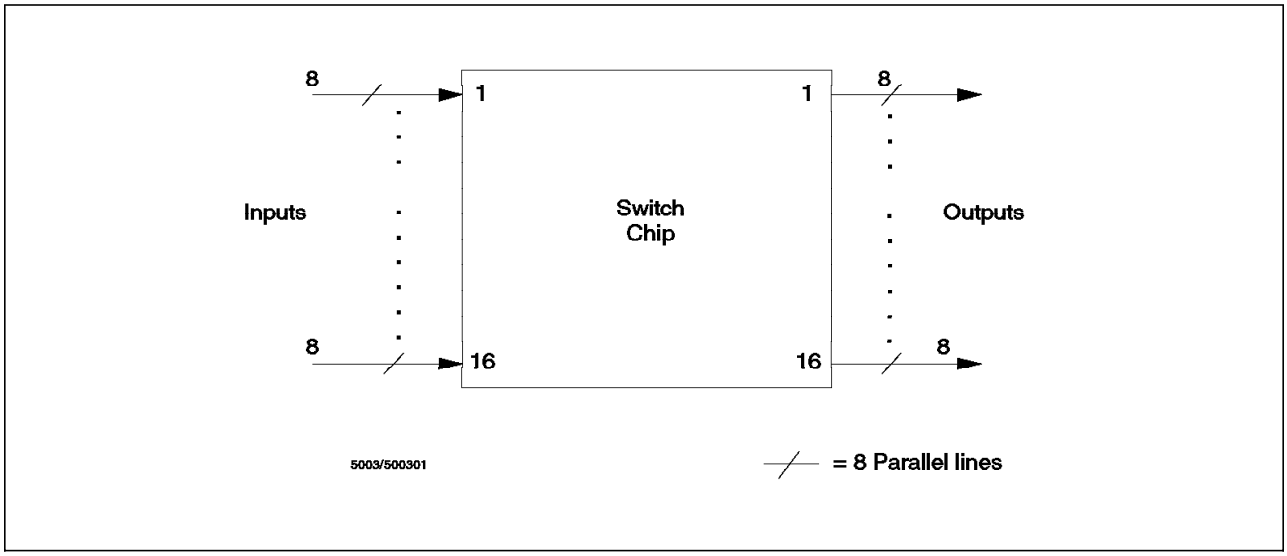


Figure 5. IBM Switch-on-a-Chip

The switch is based on the switch-on-a-chip architecture; the chip pinout diagram is shown in Figure 5. A combination of single chip switching elements can form self-routing single-stage or multistage switching fabrics, which can be modularly constructed. The switch output queues configured as dynamically shared memory, and its built-in flow control delivers high-performance switching without discarding any packets. This shared memory can be expanded by linking multiple switching elements, making the switch scalable. In essence, the switch-on-a-chip design allows for transmission rates of up to 1.6 gigabits per second, per port.

Switch-on-a-chip contains the following features and functions:

- 16 input ports
- 16 output ports
- Single stage
- Transit delay between 5 and 22 microseconds
- 2.4 million transistors on 15 mm chip
- 472 I/O pins
- 256-400 Mbps per port
- Built-in support for modular growth in number of ports
- Built-in support for modular growth in port speed

The design of the IBM switch-on-a-chip allows for the interconnection of multiple chips to increase the number of ports or support higher port throughput than is possible with a single chip.

With switch-on-a-chip, the speed of the switch port can be expanded by using multiple chips in parallel. By expanding two switch-on-a-chips in parallel the switch ports become 16 bits wide, which in effect doubles the port throughput. Therefore the 8265, with a clock rate of 48 MHz, is able to deliver 768 Mbps per port.

The built-in hardware support on switch-on-a-chip gives us *non-blocking architecture* enabling us to increase the modules on the chassis without regarding the performance of the 8265.

Thus with switch-on-a-chip, we get a self-routing, nonblocking, scalable switching fabric. It works well for all kinds of traffic transmission, whether it is voice, video, multimedia or data.

Chapter 2. IBM 8265 Modules

This chapter describes the modules and relevant daughter cards that are available for the IBM 8265 ATM switch. It also shows the backward compatibility of the IBM 8265 ATM switch with certain IBM 8260 ATM modules, highlighting the technical criteria that is required for these modules to operate within the IBM 8265 environment. Indication is given as to where microcode and picocode can be obtained to perform these code updates to the IBM 8260 ATM modules.

2.1 Controller Module

It is mandatory to install a controller module within an IBM 8265 ATM switch. The controller module manages the IBM 8265's power supply and cooling subsystems. It performs the following functions:

- Generates clocks and distributes them across the backplane
- Monitors the installed power supplies
- Provides Intelligent power management
- Environmental control, including monitoring of fan-tray operations and temperature sensing
- Inventory management

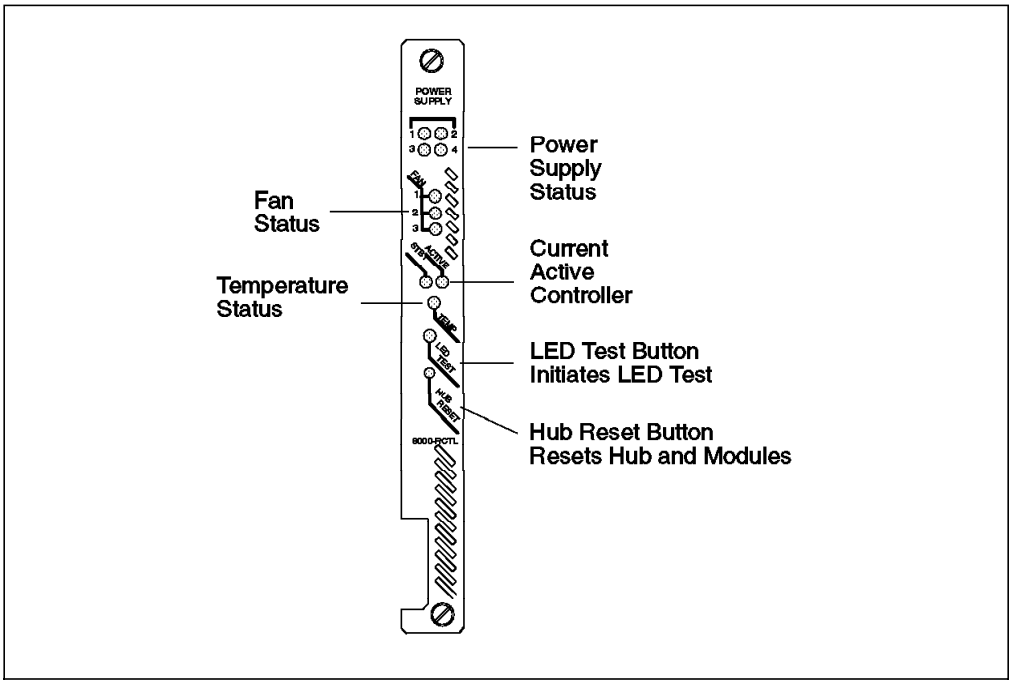


Figure 6. Controller Module

The controller module resides in its own slot in the two slot controller module emplacement, which is located at the bottom right-hand side of the 8265 chassis. These slots can be referred to as slots 18 and 19 of the IBM 8265 ATM switch. This allows all of the 17 ATM media module slots in the 8265 chassis to be utilized by the ATM media modules. As is the case with all modules installed in the 8265, the controller module is hot-swappable and field-replacable.

The second controller module slot is used for redundancy purposes. One controller is required for normal operation of the IBM 8265 ATM switch, however, it is recommended that in order to achieve fault tolerance (that is, if one controller module fails, then the second will automatically take over operation), a second controller module should be installed. Only one controller module is active at a time.

The controller module works in conjunction with the ATM control point and switch module (A-CPSW) to manage power usage in the switch. The A-CPSW provides a user interface for inventory and power management for the controller module.

2.2 ATM Control Point and Switch Module (A-CPSW)

This section briefly describes the features and functionality of the A-CPSW. For detailed software operation and configuration scenarios please see Chapter 3, “ATM Control Point Setup and Operations” on page 47.

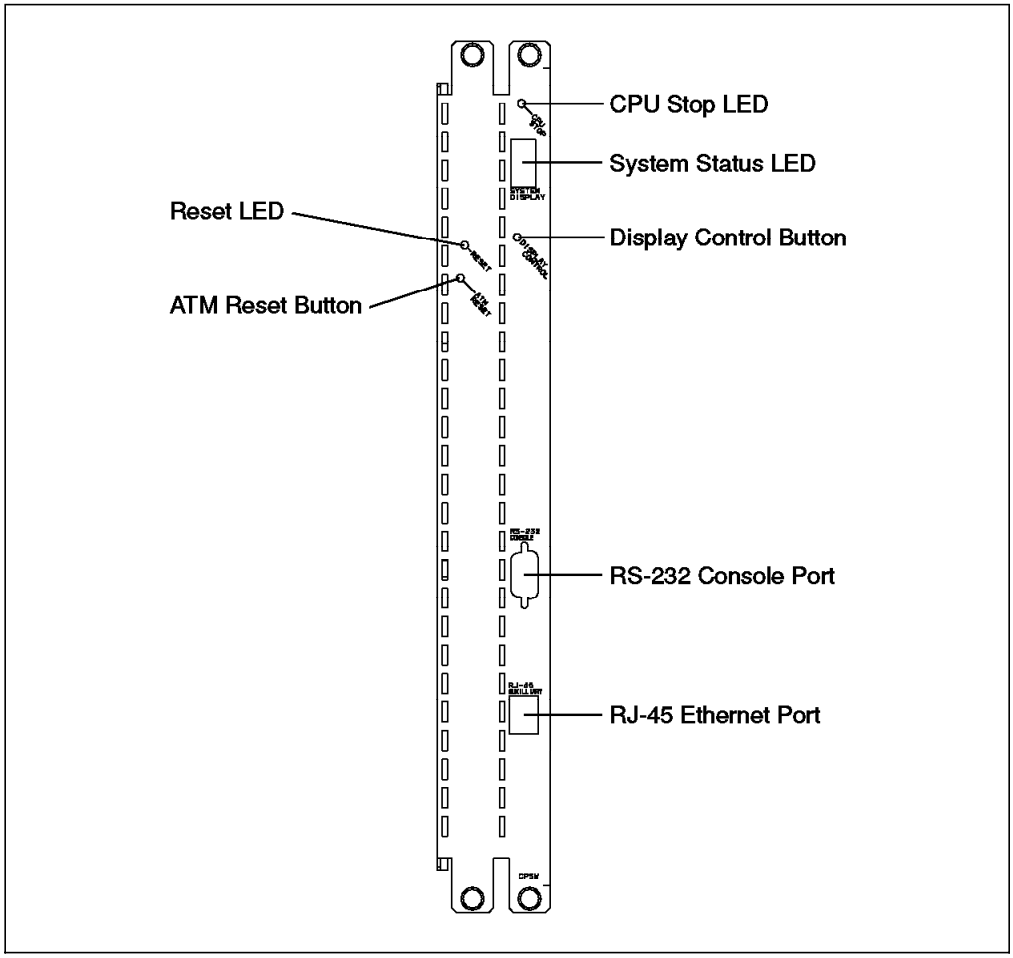


Figure 7. A-CPSW Module

2.2.1 A-CPSW Design Overview

The A-CPSW is the *brain* of the IBM 8265 ATM switch and is present in all ATM configurations.

The control point uses a real-time multitasking operating system to perform all of these functions:

- Address mapping
- Resource management
- Signalling entities
- Network management
- Hardware control element setup
- PNNI topology and routing

The control point performs management operations on all of the ATM subsystem. It does this by means of sending *guided cells* to control the rest of the 8265 through an internal port (port 0) of the switch.

The A-CPSW provides a complete set of functions to control an ATM Campus network and the interconnection of local ATM networks over public ATM WANs. The A-CPSW consists of three cards. Two full size cards and a daughter card packaged into a double slot module. The three cards are as follows

- A base card, which is the ATM switch fabric. This card switches cells from an ATM port on a concentration module to another ATM port on another ATM concentration module or between ports of the same module. ATM cell switching is carried out by the switch integrated circuit. This circuit is two chips acting as a single non-blocking 16X16 16-bit parallel module with an aggregate throughput of 12.8 Gbps full duplex on a 25-Gbps ATM backplane. This card also provides a *gearbox mechanism* for demultiplication of IBM 8260 ATM modules. This is done because 8260 modules can only attach to the 8265′s backplane at 256 Mbps with 8-bit parallel interfaces. The gearbox mechanism is provided by adding a daughter card to the switch base card.

  This adaptation to 8260 connection speeds is called the *speed adaptation layer (SPAL)* and it provides the following functions:

  – Buffering and synchronization from the switch system to the 8260 media modules and vice versa
  – Generation and distribution of clocks for the 8260 media modules
  – Attachment for 8265 ATM modules to the same ports as 8260 modules

  Note

  8260 modules can only be used in slots 1, 3, 5 and 7 (see Figure 3 on page 6).

- A control point card that houses a high-speed PowerPC processor. This card incorporates a PCMCIA card from which the control point is loaded. Future extensions and enhancements to the control point software can be loaded through this PCMCIA card.
- A daughter card that fits onto the base card to provide the logical and physical interface between the control point card and switch fabric.

2.2.1.1 A-CPSW Software Versions

Two versions of the control point software are available. A base version that includes IISP support and a PNNI version. The PNNI version provides:

- Flexibility in the way ATM switches optimize link utilization
- Automatic network selection of the least loaded route
- Administrative weights on ATM links to favor certain links over others
- Improvement in LAN Emulation network reliability
- Simplified LAN Emulation setup

Detailed explanations of the A-CPSW software operations are given in Chapter 3, "ATM Control Point Setup and Operations" on page 47.

For general A-CPSW software information refer to Table 1.

For detailed information refer to the product documentation referenced in Appendix F, "Related Publications" on page 231.

Table 1. A-CPSW Software Versions and Memory Requirements

Description	Feature Number	Part Number
PCMCIA IISP code card Release 1.0	6505	13J8696
PCMCIA PNNI code card Release 1.0 [1]	6506	02L2415
PCMCIA IISP code card Release 2.0 [2]	6525	02L3056
PCMCIA PNNI code card Release 2.0 [1] [2]	6526	02L3057
CP/switch memory upgrade [3]	6516	13J8698

Notes:

[1] Needs additional 16 MB of memory.

[2] Includes support for 0C-12 module, port mirroring, WAN counters and counters per connection.

[3] Additional memory is needed when more connections are required for the base IISP code or when the enhanced PNNI code is run. Please refer to Table 19 on page 185.

2.2.2 A-CPSW Redundancy

A-CPSW modules are installed in slots 9-10 and 11-12 of the 8265 chassis. Two A-CPSW modules can be installed for redundancy purposes. If two A-CPSWs are installed, one will be the *primary* and the other will be the *secondary*. When two A-CPSW modules are installed in an 8265 chassis a serial interface on the backplane of the chassis connects them together. This interface is used by the two control points for the following:

- Update each other automatically with any configuration changes
- For the secondary to monitor the condition of the primary for redundancy purposes

The primary A-CPSW initiates a *mirroring* of its configuration to the secondary A-CPSW across the serial interface. A table is sent from the primary to the secondary with the following information:

- Terminal community names
- Device inventory
- Logical links/static routes or VPC
- Module/port configurations
- PVCs
- End System Identifiers (ESI)
- LECS configurations

The primary A-CPSW polls the secondary A-CPSW every second to determine whether the secondary module is correctly configured, in order for it to take over in the event of a primary A-CPSW failure. The secondary receives the poll from the primary and returns a table correlator to the primary. This correlator is used by the primary to determine the current level of the secondary's table. If the correlator indicates that the information is not current, then the primary will send a copy of the current table to the secondary.

Periodic requests for the secondary to make self-diagnostic tests are issued by the primary. This ensures that the IBM 8265 ATM switch always has an operational backup A-CPSW.

Note

Event though the serial interface connection between the control points is over the backplane, it is not an ATM interface. The 8265 ensures that the mirroring information exchanged between the two control points has a lower priority than ATM cells sent over the ATM backplane. This ensures that ATM signalling is not impacted by A-CPSW traffic mirroring.

Watchdogs are present in the primary A-CPSW. These watchdogs allow for the automatic reboot of the secondary control point in the case of unplanned outages.

2.2.3 Monitoring of ATM Media Modules

The control point module also monitors all other media modules installed in the 8265. The A-CPSW polls the media modules every second to ensure operability. If the A-CPSW is unsuccessful after three polls in obtaining a response from a media module, the unresponding module is reset by the A-CPSW, thereby triggering the module operations to restart.

At the time of resetting all active connections will be released by the backup A-CPSW and switched connections will be reestablished by the adapters of the endstations. Permanent connections will be automatically reestablished by the IBM 8265 primary A-CPSW.

The A-CPSW also performs the function of chassis management for the 8265. Therefore, when configuring an 8265, only a controller module and not the advanced DMM/controller module should be used. The reason for this is that the DMM subset exists within the A-CPSW. This component of the A-CPSW manages and controls the following areas:

- Configuration of modules and port settings
- Out-of-band and in-band downloading of code

- SNMP support
- Telnet support
- Inventory and power management to the controller module
- Code updates for the controller module

2.3 8265 ATM Media Modules

This section describes the new modules that have been specially designed to work within the IBM 8265 ATM switch. Illustration examples are shown of these media modules in IBM 8265 ATM network configurations.

These new ATM media modules can be installed in slots 1-8 and 12-17 of the IBM 8265 ATM switch chassis. However, if a second control point and switch (A-CPSW) module is installed for redundancy purposes, then slot 12 cannot be used.

2.3.1 The ATM Engines on Media Modules

ATM engines reside on each ATM modules. The ATM engine provides the following functionality:

- Cell routing for point-to-point and point-to-multipoint connections
- Traffic management
- Flow control
- Statistics and counters
- Label swapping
- Multicasting

Traffic management and *buffer pools* are distributed over all ATM modules. This ensures that every module has its own processing power to perform ATM functions and its own buffer pool to absorb heavy bursts of data traffic when new ports or modules are added to the 8265 switch. This distributed architecture provides:

- Consistent performance
- System consistency

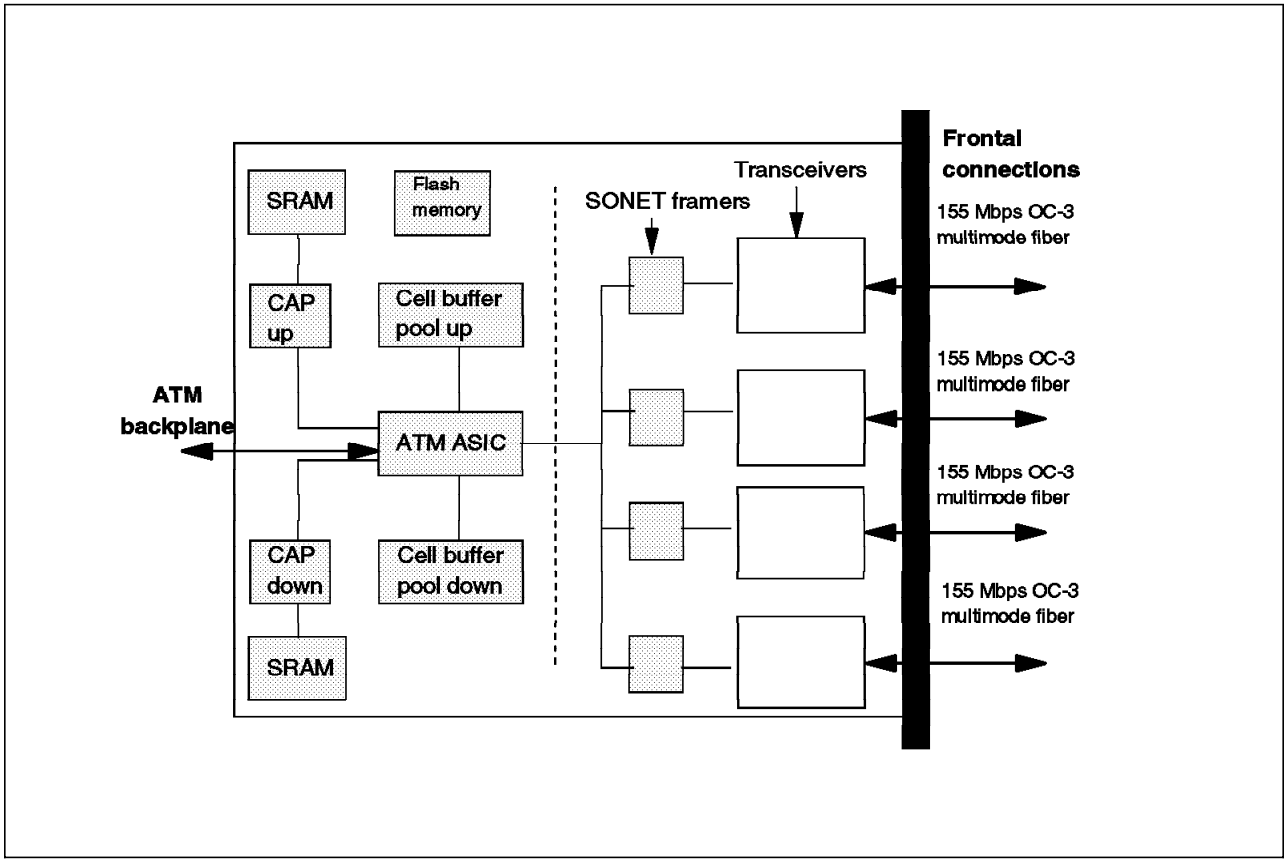


Figure 8. Component View of the Flexible 4-Port 155 Mbps ATM Module

Figure 8 shows the arrangement of the ATM engine functions on a 4-port 155 Mbps ATM module. These functions are applicable to all ATM modules; only the number of ports and physical interfaces will change on other modules.

Each ATM module can de divided into two subsystems:

- The ATM engine
- The media-dependent subsystem

There are two components to the ATM engine. They are:

- The ATM ASIC
- The Common ATM Processor (CAP)

There are two CAPs and two ASICs per ATM media module. One CAP is designated for inbound *(up)* traffic and the other for outbound *(down)* traffic. The CAPs are designed with Field Programmable Gate Arrays (FPGAs), which allow them to be upgraded with the latest versions of firmware. This is the case with the IBM 8260 ATM modules.

The ATM ASIC performs the following functions:

- Handles the ATM front-end multiplexing and demultiplexing
- Dispatches user data ATM cells to the 8265 backplane
- Manages the guided cells between the ATM media modules and the control point

The media-dependent subsystem is specific to the ATM line interface. It depends on the line rate and physical wiring type of the interface (for example, line rates of OC3 and OC12 and wiring types of copper and fiber). Transceivers form part of the media-dependent subsystem. These transceivers can have different optical power ratings and it is possible to have several different transceivers to allow for longer cable distances. For example, it is possible to have different optical strength transceivers for single mode fiber.

The dotted line around Figure 8 on page 20 indicates that this transceiver component is a custom I/O card and not part of the flexible 4-port 155 ATM module.

The media-dependent subsystem uses the UTOPIA interface standard to communicate with the ATM engine subsystem. This UTOPIA interface allows a generic ATM module to be built and operate in the 8265. This module is called the ATM carrier module and is discussed in more detail in 2.4.7, “ATM Carrier Module” on page 38. This generic ATM module then allows third-party applications to interface to the ATM engine subsystem. It is not media-dependent.

2.3.2 622 Mbps Module

This module is a single slot module providing one (1) port of 622 Mbps ATM. The module supports either single-mode fiber (SMF) or multimode fiber (MMF).

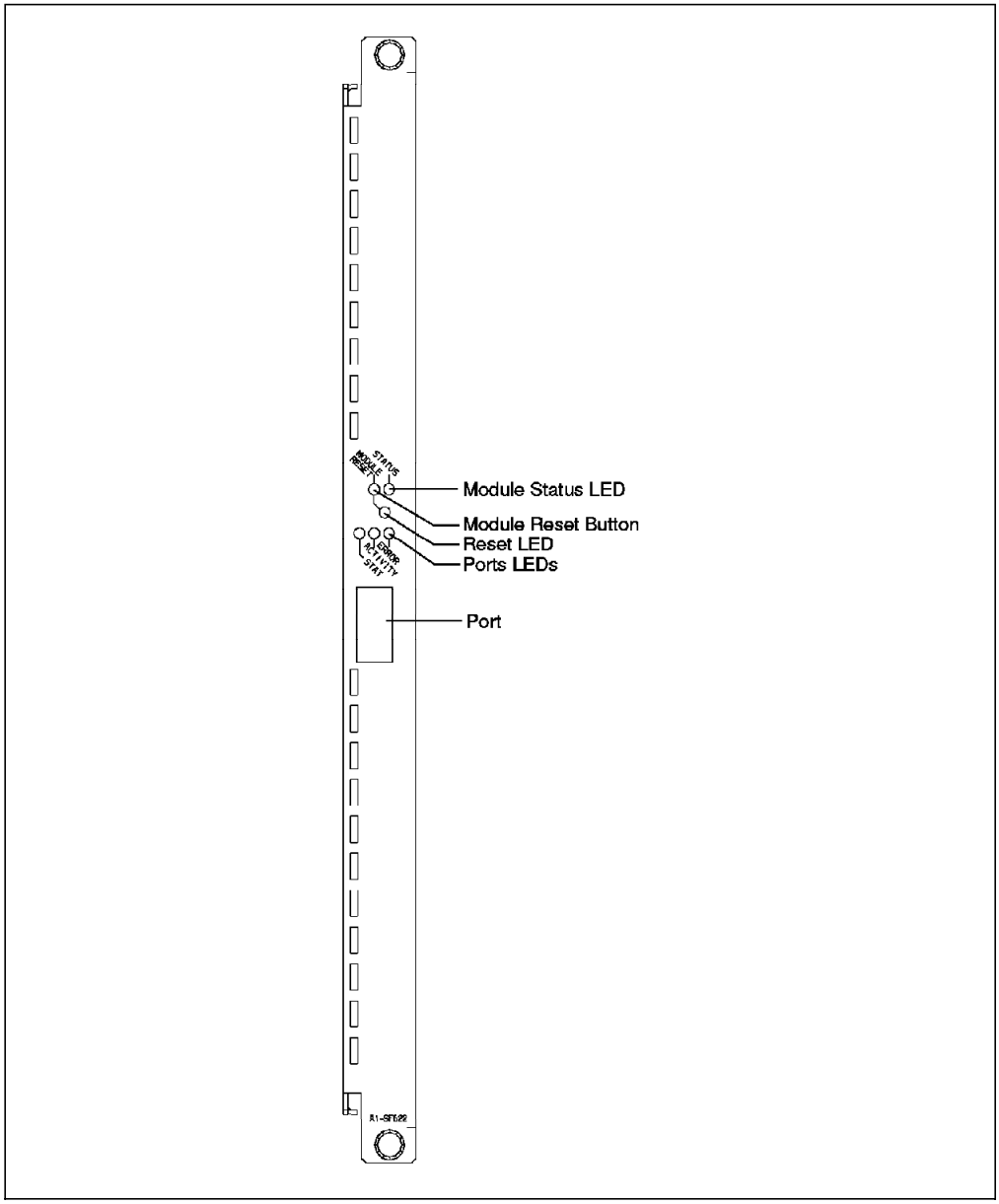


Figure 9. 1-Port 622 Mbps ATM Module

The 622 Mbps ATM module could be used in the following 8265 configurations, which are highlighted in Figure 10 on page 23:

- An ATM backbone link between multiple 8265s across private networks
- High bandwidth links for ATM servers and workstations
- End users requiring high-speed multimedia connections
- A link into the public ATM network

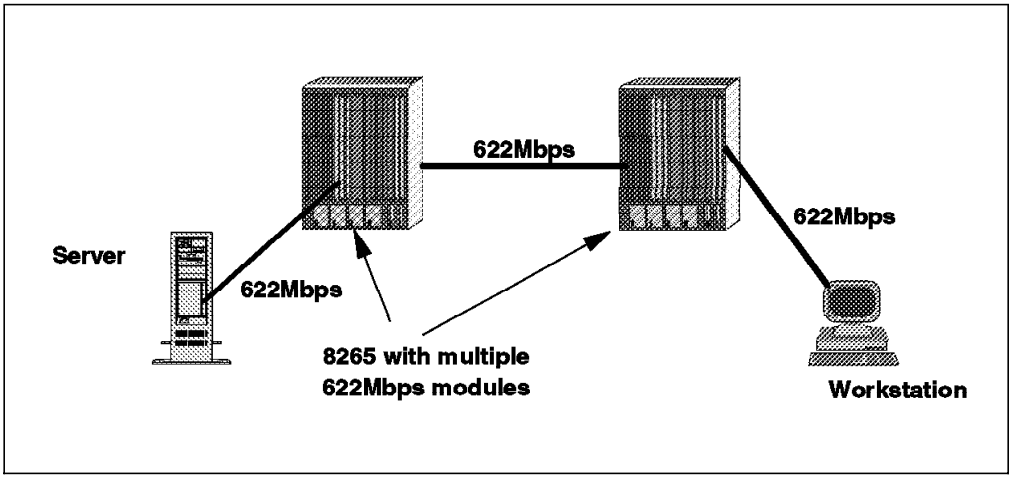


Figure 10. 622 Mbps ATM Modules Used in Various 8265 Network Configurations

The recommended maximum distances that can be achieved by the different fiber connections are:

- Multimode fiber (MMF)
  - 500 meters (m) using 50/125 micron fiber
  - 800 meters (m) using 62.5/125 micron fiber
- Single-mode fiber (SMF)
  - 15 kilometers (km) using single-mode fiber

The 622 Mbps module supports the following ATM Forum public specifications:

- UNI 3.0,3.1 and 4.0
- LAN Emulation over ATM (LANE 1.0)
- PNNI Phase 1
- IISP
- ILMI 4.0
- TM 4.0
- 622.08 Mbps Physical Layer

2.3.3 4-Port 155 Mbps Modules

Two types of 4-port 155 Mbps modules are available for the IBM 8265 ATM switch. These are:

- The fixed configuration single slot multimode fiber module
- A flexible single slot module that lets the user implement I/O daughter cards according to the physical specification of the cabling medium

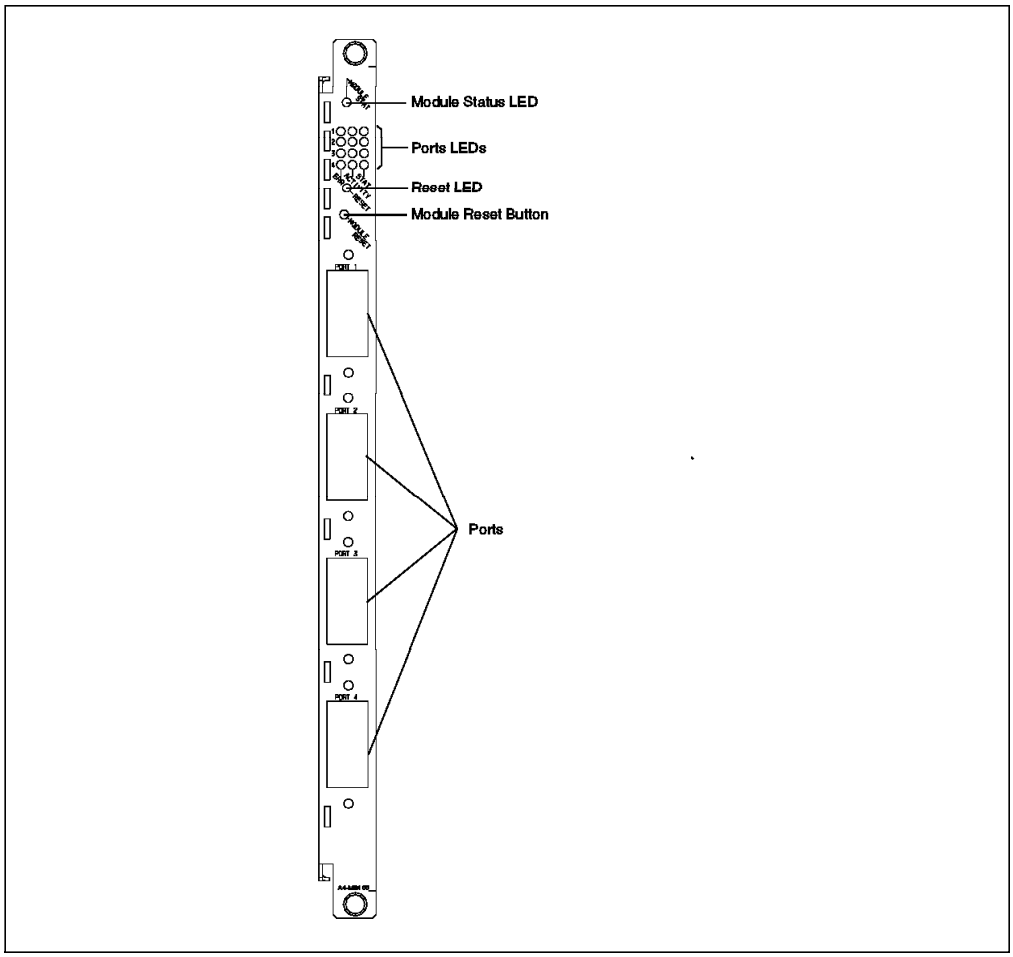


Figure 11. 4-Port 155 Mbps Module

The flexible 4-port 155 Mbps module supports the following I/O daughter cards and cable media with their relevant distances:

- Multimode (MMF) fiber up to 2.2 kilometers
- Single-mode (SMF) fiber at 20 kilometers
- Single-mode fiber (SMF) at 40 kilometers
- Shielded and unshielded twisted pair (UTP and STP) up to 100 meters

As is shown in Figure 12 on page 25, the 4-port 155 Mbps can be used in a multiple of IBM 8265 ATM switch network configurations, such as:

- Multiple 155 Mbps links between 8265s to form one aggregate link
- Uplinks from other ATM connected devices
- ATM servers and workstations that require higher bandwidth

- Interconnect 8265 sites via public Telco services

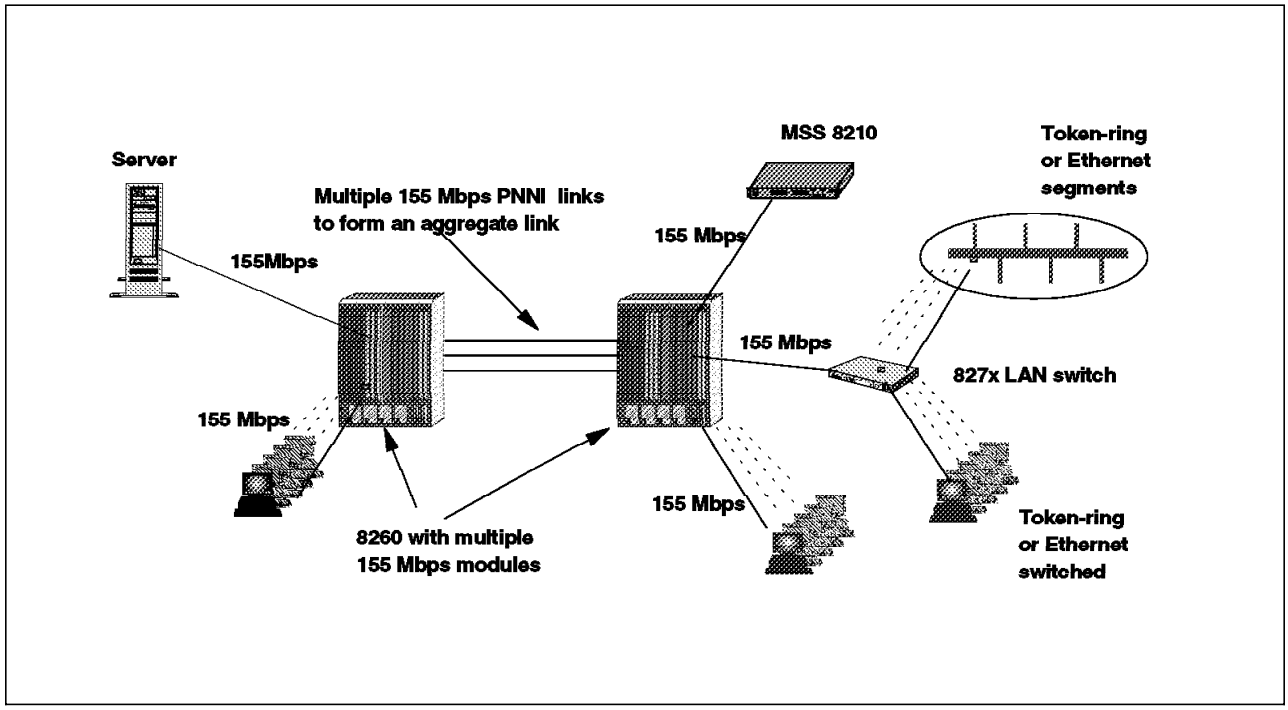


Figure 12. 155 Mbps ATM Modules Used in 8265 Network Configurations

2.3.4 Installing an I/O Daughter Card

In order to install new I/O cards on a flexible 155 Mbps ATM module the following procedures are recommended:

- Do not attempt to install an I/O card on to the motherboard while the motherboard is installed in the chassis of the 8265.
- Remove the 155 Mbps flexible motherboard from the 8265 chassis.
- Hold the I/O card as shown in Figure 13 on page 26 and align its connector and screw holes over the connector and small posts of the motherboard.
- Gently push the I/O card forward so that its port fits into the opening of the motherboard front panel.
- Push down on the I/O card until a click is heard from the motherboard connector.
- Tighten the screws at the front face panel and the small posts on the motherboard.

Using 8260 I/O Daughter Cards

I/O daughter cards from 8260 155 Mbps modules (feature codes 8800, 8801 and 8802) may only be installed in ports 1, 2 and 3 of the IBM 8265 155 Mbps flexible module. These cards do not work in port 4.

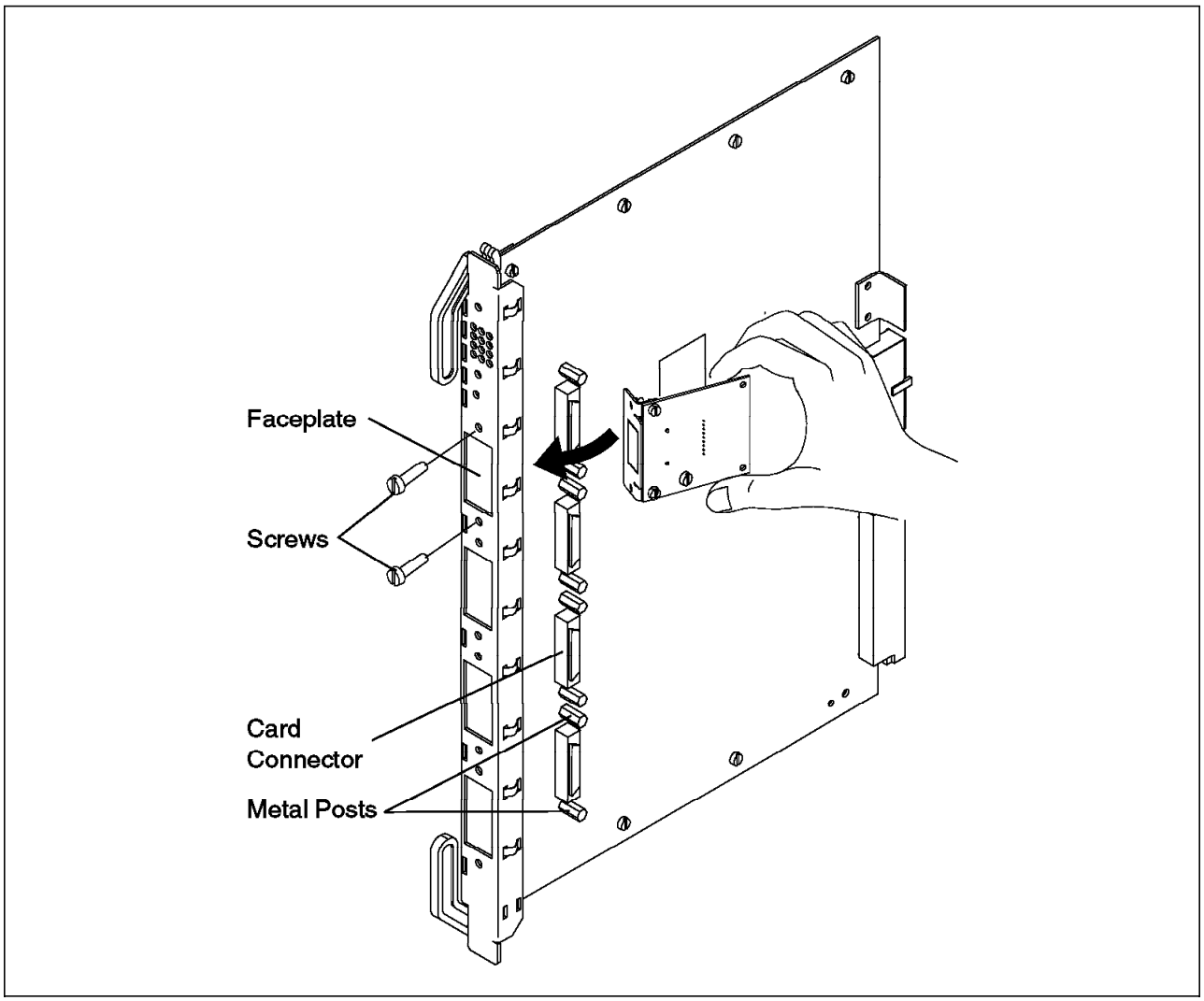


Figure 13. Installing an I/O Daughter Card on the 155 Mbps Flexible Motherboard

Caution

When installing an I/O card on the motherboard, be careful not to touch its components. Always hold the card by the faceplate or by its edges as shown in Figure 13.

An example of an I/0 daughter card is shown Figure 14 on page 27.

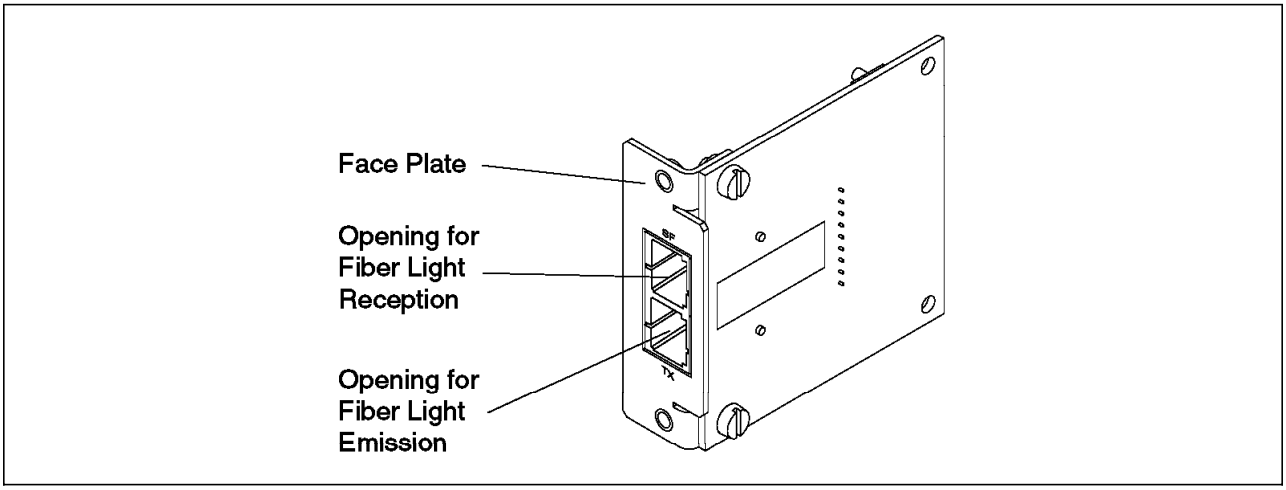


Figure 14. Fiber I/O Daughter Card

2.4 8260 ATM Media Modules

This section deals with the IBM 8260 ATM modules that are compatible with the IBM 8265 ATM switch. It also shows what levels of microcode are needed for these modules in order for them to operate within the IBM 8265 ATM switch environment.

2.4.1 Overview

The IBM 8265 ATM switch is backward compatible with certain 8260 ATM modules. These modules can only be installed in certain slots of the 8265, provided they have the required FPGA level. The slots that 8260 ATM modules can be installed in are slots 1, 3, 5 and 7.

Note

If an A-CPSW is installed in slot 9 of the 8265, then a 3-slot 8260 ATM module (for example an 8271 ATM/LAN Ethernet switch module) *cannot* be installed in slot 7.

2.4.2 8260 Modules and Relevant FPGA Levels

The following table indicates the 8260 ATM modules that can be implemented in the 8265. Indication is given to the relevant levels of FPGA that the modules should be at, in order for them to operate in the 8265. For information on how to download microcode and picocode to upgrade the FPGA on 8260 modules please refer to Chapter 3, “ATM Control Point Setup and Operations” on page 47.

Table 2 (Page 1 of 2). 8260 Modules and Their FPGA Requirements

Module	Faceplate Identification	FPGA Code Level
3-port 155 Mbps Flex Module	A3-MB155	C31
2-port 155 Mbps Flex Module	A2-MB155	B50
4-port 100 Mbps Module	A4-SC100	B50
MSS Server Module	A-MSS	B50

Table 2 (Page 2 of 2). 8260 Modules and Their FPGA Requirements		
Module	**Faceplate Identification**	**FPGA Code Level**
12-port 25 Mbps Module	A12-TP25	C30
8271 LAN Switch Module	A-E12LS2/A-E12LS4	B50
8272 LAN Switch Module	A-TR8LS2/A-TR8LS4	B50
ATM WAN 2 Module	A8-WAN	B50
ATM WAN Module	A2-WAN	B50
Video Distribution Module	A8-MPEG	C32

2.4.3 MultiProtocol Switched Services (MSS) Module

The Multiprotocol Switch Services (MSS) module is the chassis module version of the IBM 8210 Nways MSS Server. There is no ATM uplink on the integrated module because the module attaches directly to the 8265 backplane.

The MSS Server module provides smooth migration from shared media LANs to high-speed ATM networks while providing a multiprotocol networking solution for the ATM environment. The MSS Server module provides LAN Emulation and Classical IP functionality, as well as various bridging and routing features.

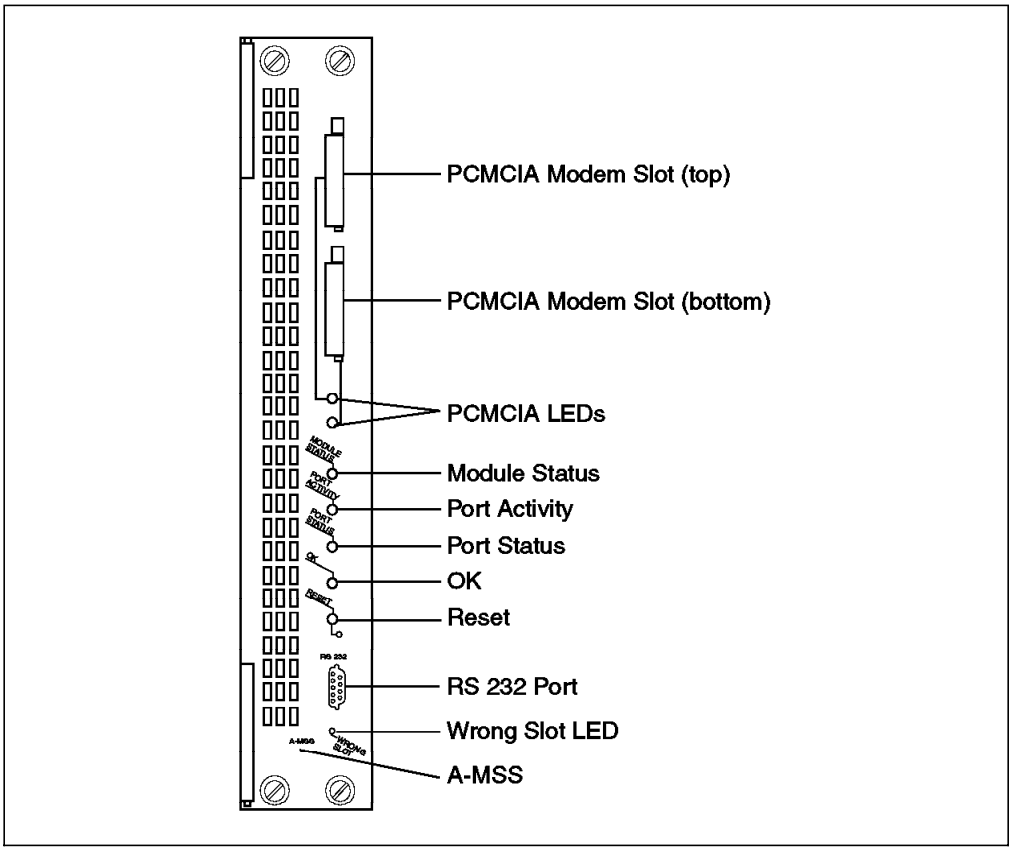


Figure 15. MSS Server Module

The benefits of installing an integrated MSS module in an 8265 are the following:

- Smooth migration path for legacy shared media LANs to ATM.
- Protection of initial and current network hardware investments.
- Simplified installation and configuration of networks.
- Common management to both ATM and legacy networks.
- Network reliability is improved due to the redundancy features of the 8265.
- Enhances network security.

Note

MSS Microcode Version 1.x can be used when the MSS module is from an 8260, but only MSS Microcode Version 2.x can be ordered with an 8265.

The purpose of this section was not to describe in technical detail the operation of the MSS. Please refer to MSS documentation listed in Appendix F, “Related Publications” on page 231 for intricate explanations of the MSS Server.

2.4.4 8271 ATM/Ethernet LAN Switch Module

The 8271 ATM/Ethernet LAN switch module as can be seen in Figure 16 on page 32 is offered in a two slot and three slot version. It provides traditional Ethernet switching but at the same time allows direct ATM backplane connectivity for interconnection of other Ethernet segments or access to ATM connected resources.

Some characteristics of the 8271 module are:

- 12 frontal 10Base-T Ethernet ports with RJ-45 connectors
- Support for up to four UFCs providing additional 10Base-T, 10Base-FL, 100Base-Tx and 100Base-Fx support
- Full-duplex support
- Full compliance with the IEEE 802.3 standard
- EtherPipe support
- Variable switching modes for example, cut-through, store-and-forward and adaptive modes
- Virtual switch capability
- Transparent bridging and filtering

For summary information on the IBM 8271 Nways LAN Switch please refer to A.2.7, “8271 ATM/Ethernet LAN Switch Module” on page 207.

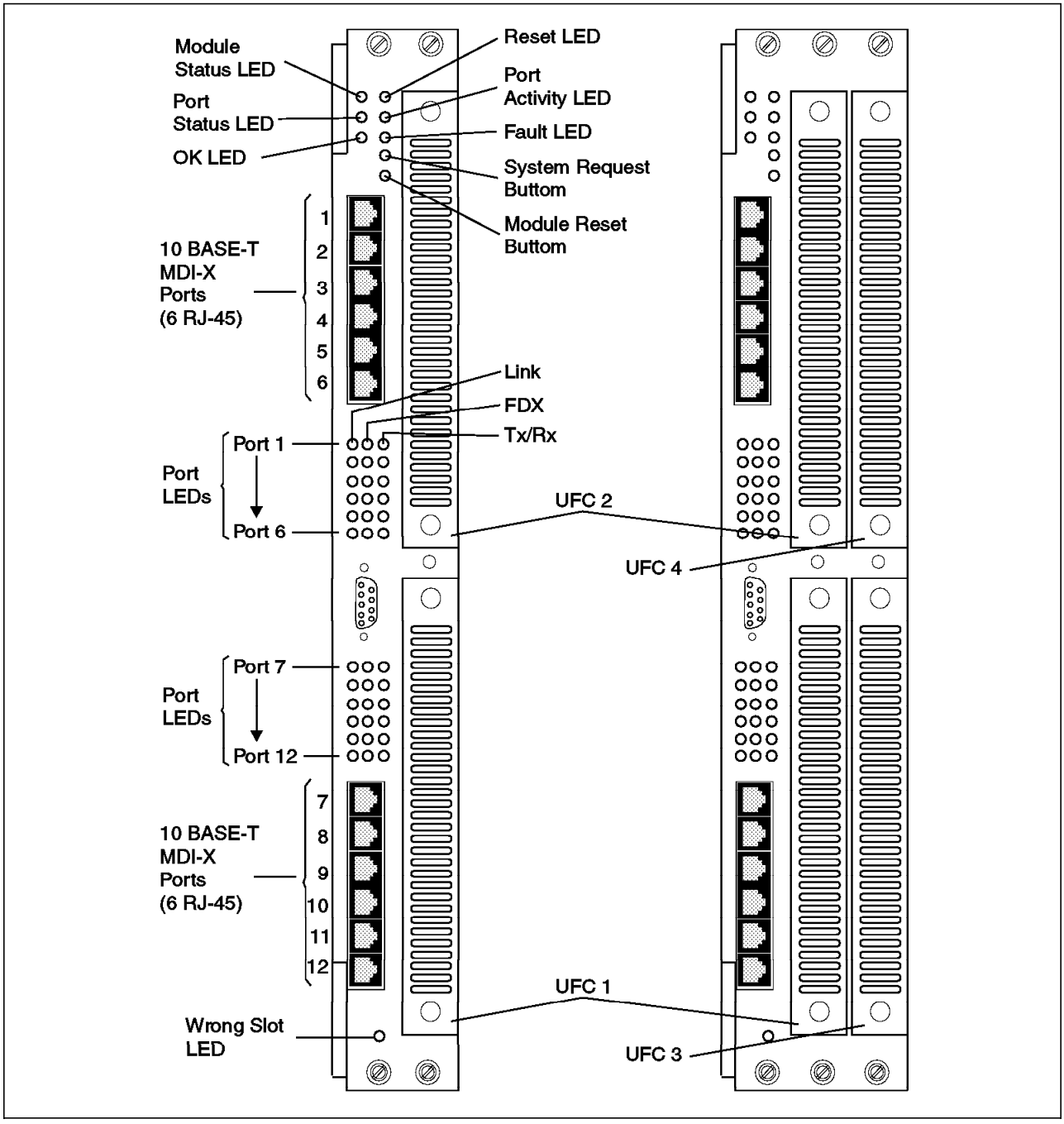


Figure 16. 8271 ATM/Ethernet LAN Switch Module

Figure 17 on page 33 highlights the use of both the 8271 and 8272 ATM/LAN switch module in an 8265 ATM switch network configuration.

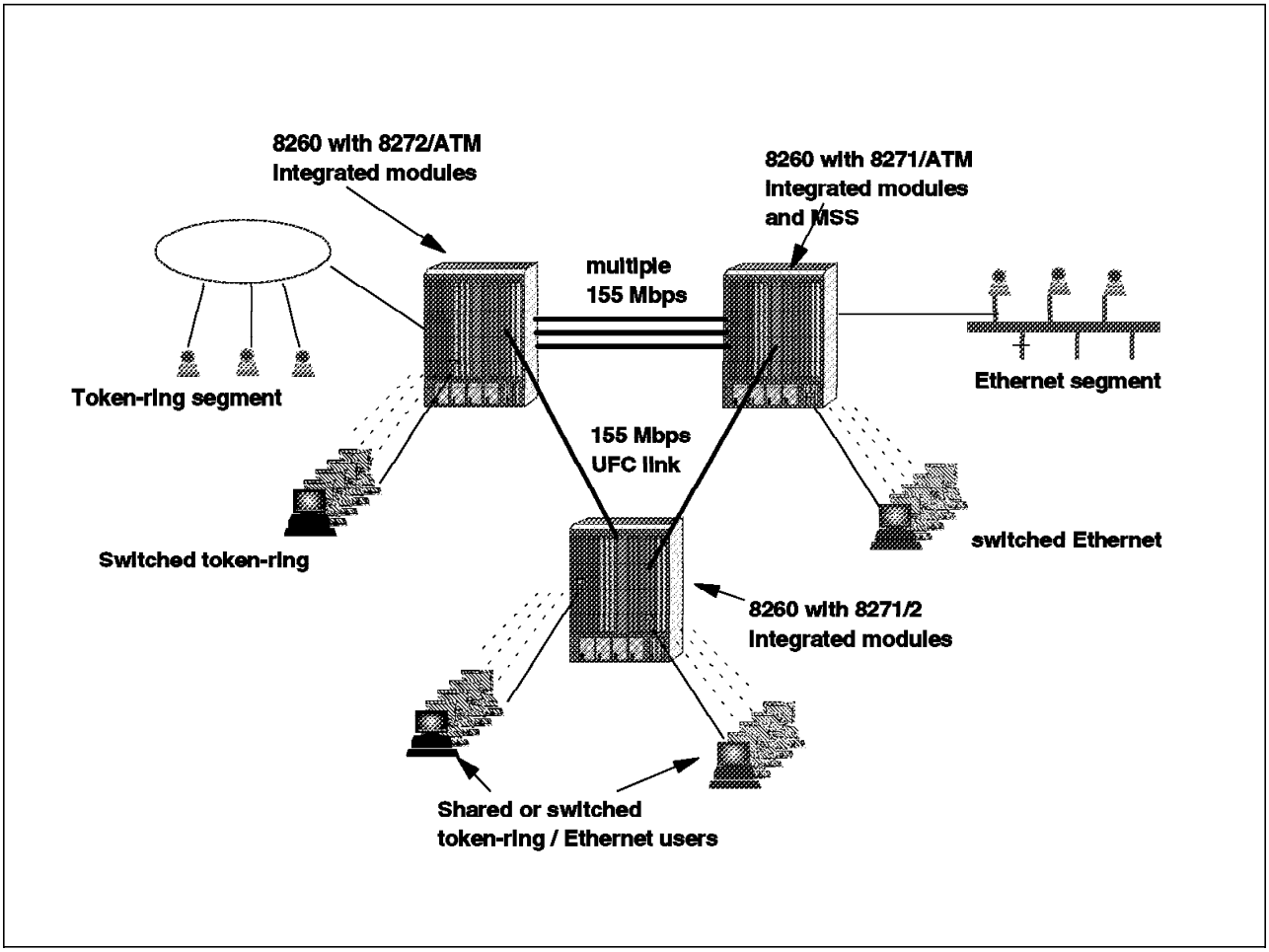


Figure 17. Using 827x ATM/LAN Switch Modules in 8265s

2.4.5 8272 ATM Token-Ring LAN Switch Module

The IBM 8272 ATM/Token-Ring LAN Switch module incorporates all the functionality of its stand-alone counterpart, the IBM 8272 Nways Token-Ring Switch. The module is available in a two slot and three slot version. It provides a high-performance switching solution for both the interconnection of token-ring segments and high-speed ATM access.

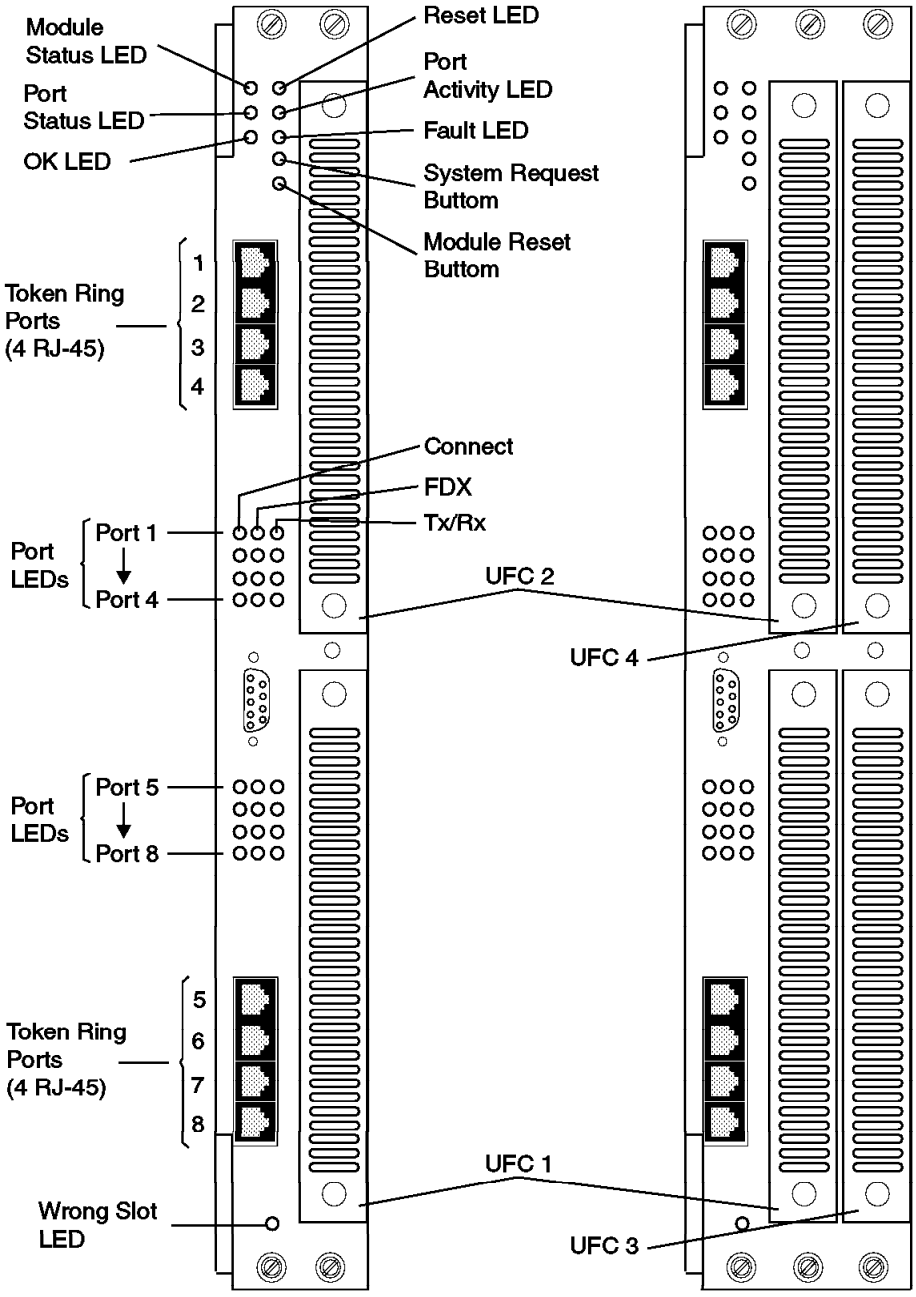


Figure 18. 8272 ATM/Token-Ring LAN Switch Module

Some characteristics of the module are listed below. For a full technical description of the IBM 8272 Nways Token-Ring Switch please refer to Appendix F, “Related Publications” on page 231 for further information.

- Eight frontal token-ring RJ-45 ports
- Support for up to four additional UFCs supporting UTP and fiber ports

- Variable switching modes for example, cut-through, store-and-forward and adaptive modes
- Auto-sense and auto-configure capabilities for 4/16 Mbps token-ring
- Full-duplex operation
- TokenPipe support
- Virtual switch capability
- Transparent bridging and filtering, source route switching and bridging
- Token Probe

An example of 8272 switch modules in an IBM 8265 ATM switch network configuration is shown in Figure 17 on page 33.

2.4.6 Video Distribution Module (VDM)

The Video Distribution Module (VDM) provides eight independent ports to decode MPEG-2 video streams. A video source such as the IBM Media Streamer or the video access node can connect to one or more of the modules ports and transmit MPEG-2 video streams through the ATM network and into the module.

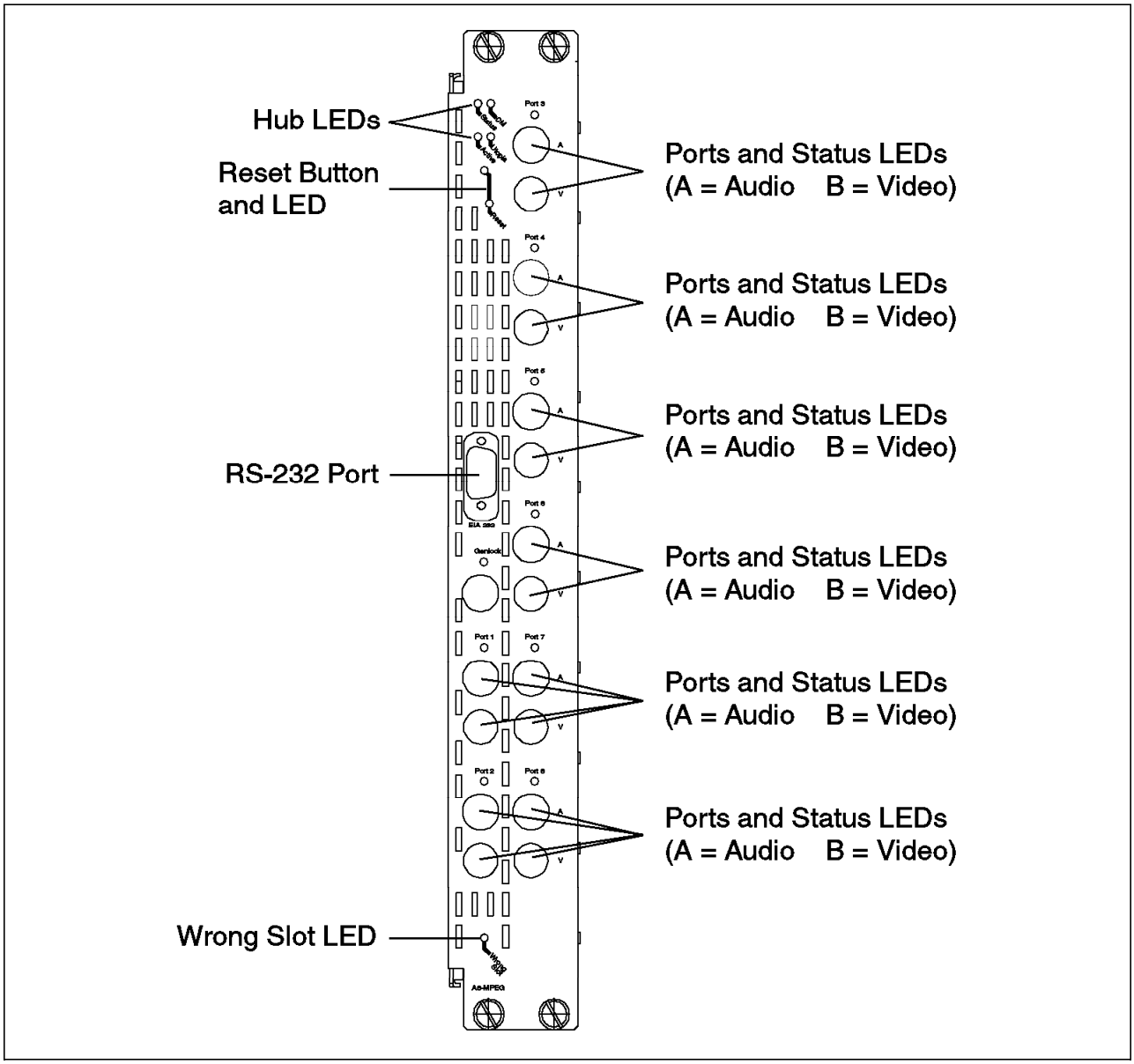


Figure 19. Video Distribution Module

The module receives the cells, reassembles the MPEG-2 video and audio packets, decompresses and decodes the digitized video information and converts it into separate analog and video signals. External ports provide the following standards:

- NTSC video (U.S. standard)
- PAL video (worldwide standard)
- CD-quality audio

The VDM connects to the 8265 ATM backplane through the ATM carrier module (assembled together). The VDM appears as a switched resource of the 8265 and functions as an ATM end node supporting ATM UNI 3.1 signalling.

An example of the VDM in a working 8265 environment can be seen in Figure 20.

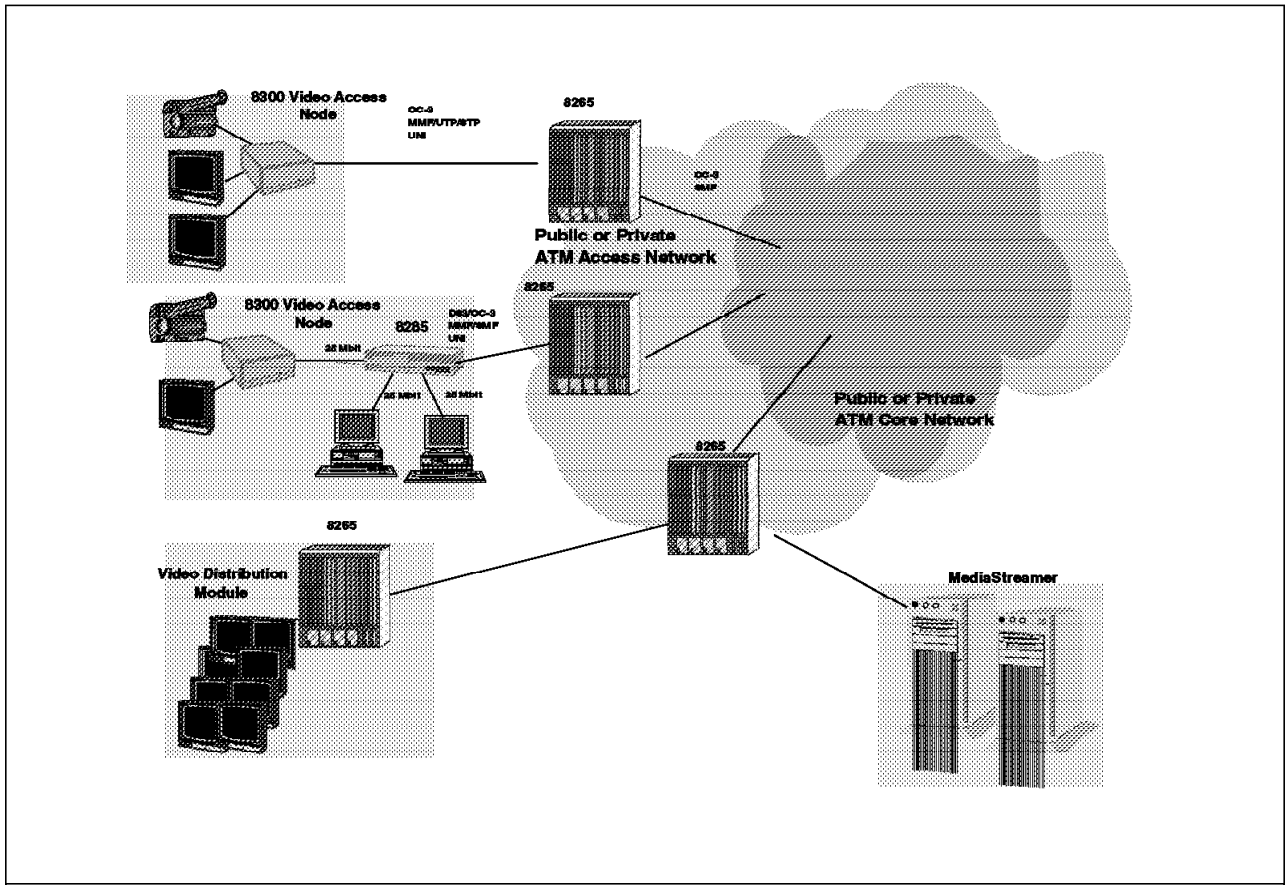


Figure 20. The Video Distribution Module in an 8265 Network

2.4.7 ATM Carrier Module

This section does not deal with the intricate details of the ATM carrier module and the ATM kit development program, but rather gives a brief functional overview of the ATM carrier module. For further details on additional reading material on this subject refer to Appendix F, “Related Publications” on page 231.

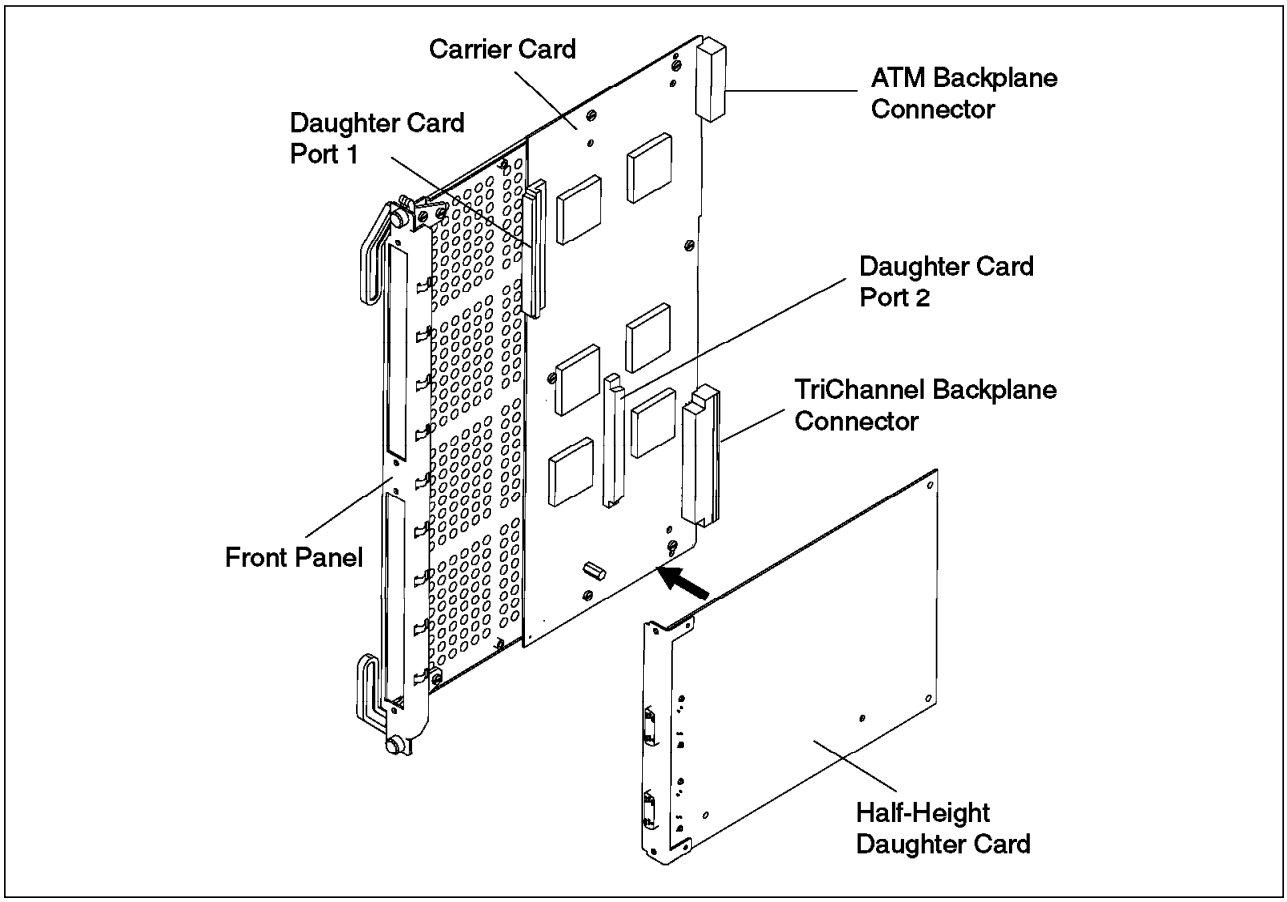


Figure 21. ATM Carrier Module with Daughter Card

The ATM carrier module opens up the IBM 8265 ATM switch platform to third-party companies and developers. It allows them to incorporate their ATM technology into the 8265 environment. It also allows them to build ATM functions and modules for the 8265, as well as develop new ATM applications.

The ATM carrier module uses the UTOPIA standard interface to link the ATM engine and the application together. The UTOPIA interface is the public ATM/PHY-level interface.

The ATM application resides on the daughter card. The daughter card is the link between the physical media and ATM engine of the ATM carrier module. This can be seen in Figure 22 on page 39.

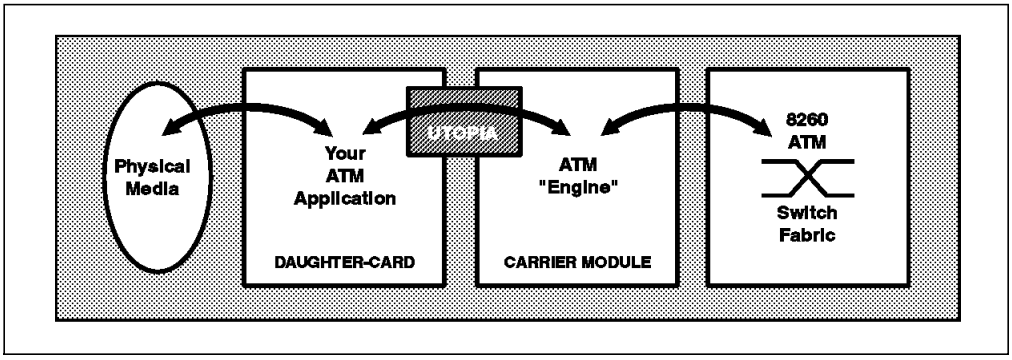


Figure 22. Data Flow in the ATM Carrier Module

2.4.8 FiberCom ATM Circuit Emulation (ACE) Module

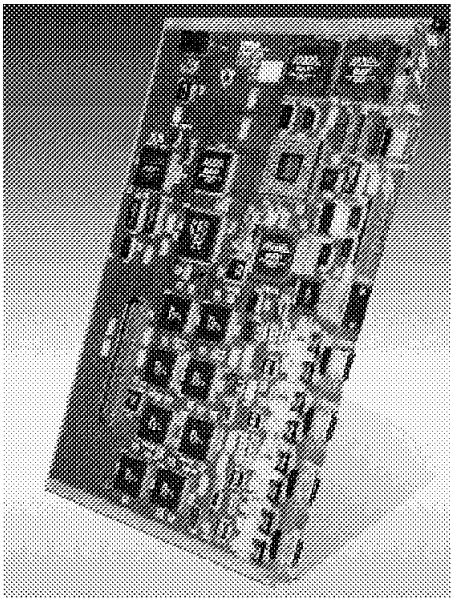


Figure 23. FiberCom ATM Circuit Emulation (ACE) Module

The FiberCom ACE card in *conjunction* with the ATM carrier module provides Circuit Emulation Services over ATM, using ATM Forum specifications for:

- Interconnecting PABXs over the ATM backbone
- Linking structured services such as ISDN and DS1/E1 multiplexors to other fractional services
- Connecting front end processors (FEPs) and routers through an ATM network using the FEPs and router serial interfaces
- Grouping multiple 56 or 64 kbps channels to form one PVC (for example, for video teleconferencing purposes)

The ACE card carries traffic using ATM CBR PVC (AAL1). The PVCs that are used to support the above mentioned configurations by the ACE card are defined on the IBM 8265 ATM switch as *reserved bandwidth* PVCs.

As the 8265 is a non-clocked network, the ACE card obtains its timing from either of the following sources:

- Recovers the clock from the CBR circuit.
- Uses a primary external reference source (Stratum 1 clock) at each node. In this case the ACE card works in synchronous mode with the external clock.

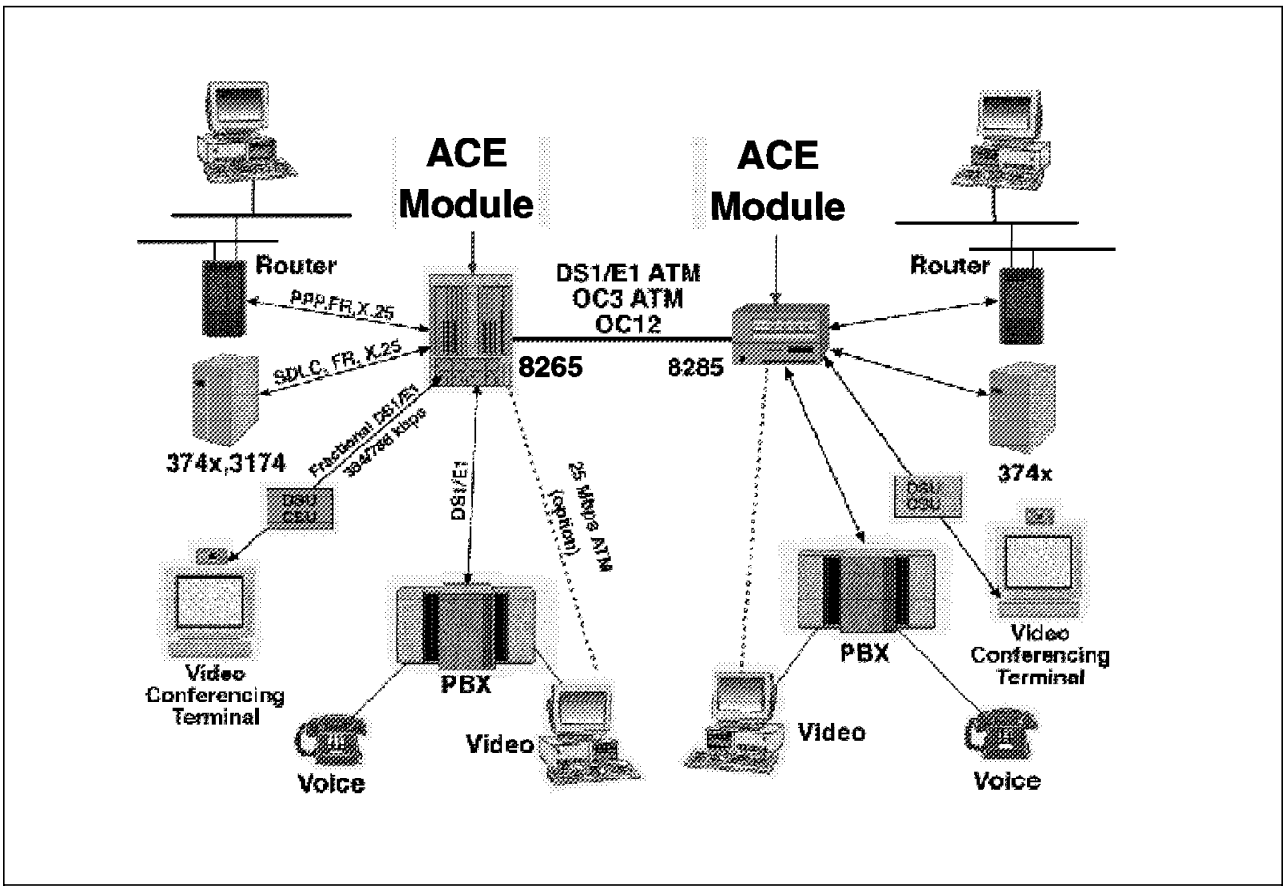


Figure 24. Using a FiberCom Ace Card

Note

The ACE card can be ordered only from FiberCom. When ordering an ACE card an ATM carrier module must be ordered as well. The ACE card *will not* operate without the ATM carrier module. For information on acquiring the FiberCom card please refer to FiberCom's Internet address: http//www.fibercom.com.

2.4.9 ATM WAN 2 Module

The ATM WAN 2 module allows communication between geographically separated IBM 8265 ATM networks over the public ATM network. The ATM WAN 2 module is a single slot module that hosts up to two I/O daughter cards.

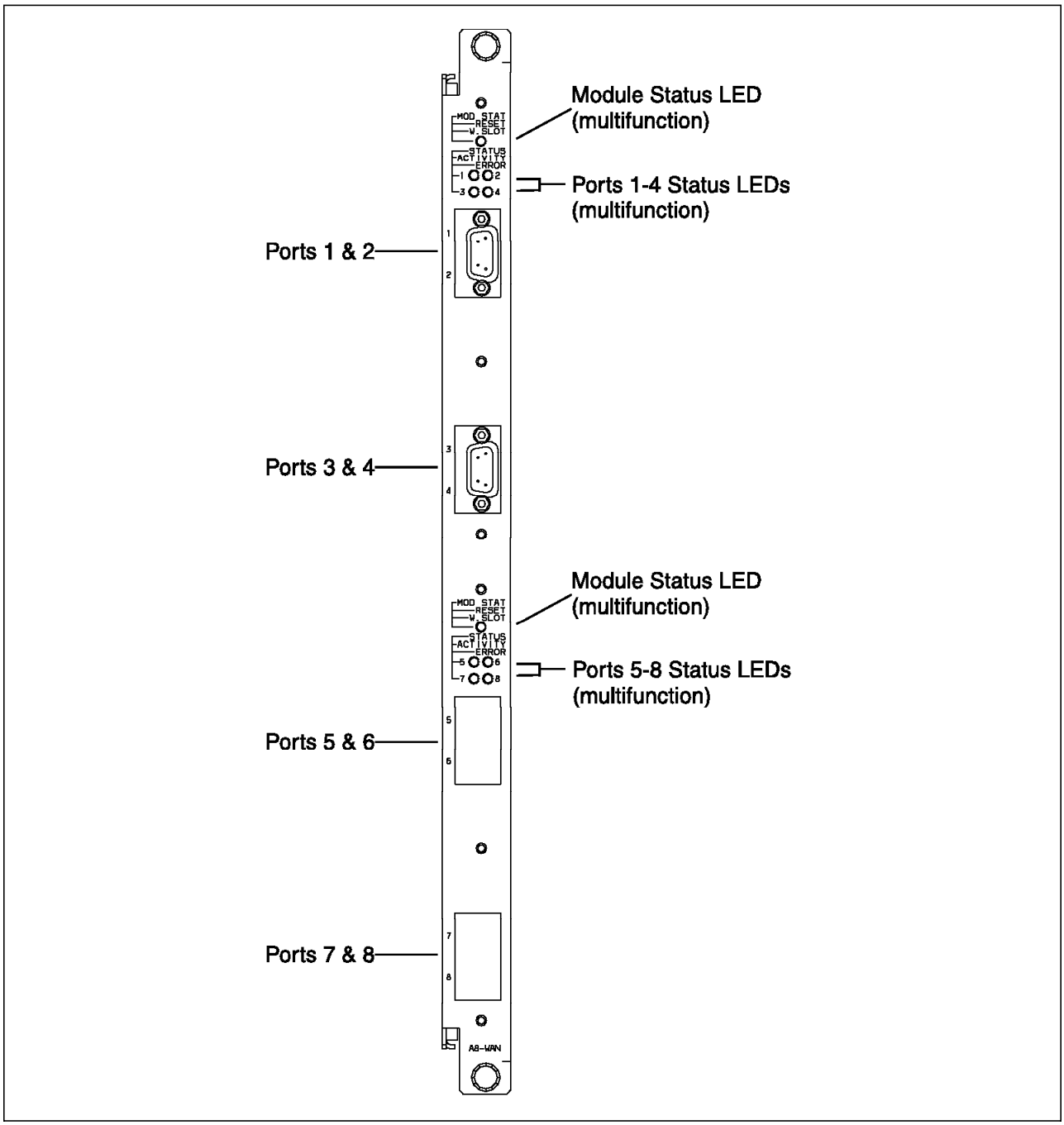


Figure 25. ATM WAN 2 Module

I/O daughter cards can be mixed and matched in any combination. The I/O daughter cards that are available for the module are:

- 4-port T1/E1/J1 card with DB 15 connectors for E1 and RJ48 E1/T1
- 1-port E3 card with BNC connector
- 1-port DS3/T3 card with BNC connector

- 1-port STM-1 MMF card with SC connectors
- 1-port STM-1 SMF card with SC connectors
- 1-port OC3 MMF card with SC connectors
- 1-port OC3 SMF card with SC connectors

The ATM WAN 2 module can be used in the following network scenarios, which are illustrated in Figure 26:

- Interconnect 8265s/8260s over a public ATM network
- Provide WAN connectivity for other devices such as the IBM 8285 ATM switch
- Provide public ATM access for ATM servers and workstations

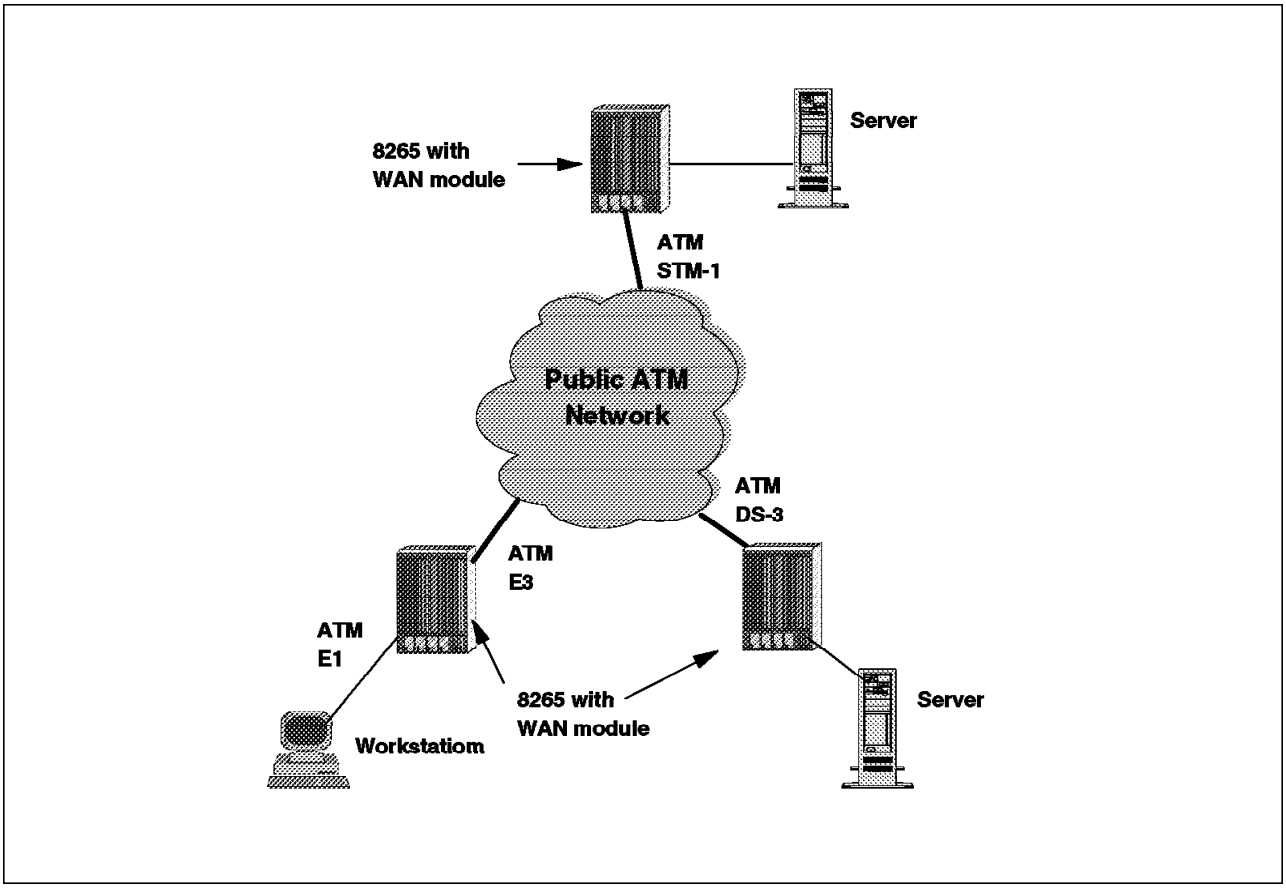


Figure 26. Interconnecting 8265s across a Public ATM Network

2.5 8265 Line Attachment Capacity and Module Power Consumption

The following tables illustrate the attachment and power consumption capacities for 8265 modules. Indication is also given to the slot width of the modules.

Table 3. Specifications: 8265 Line Attachment Capacity

Function	Number
Maximum number of 1.544 Mbps (T1/J1) / 2.048 Mbps (E1) ports	32 (4x8) (A8-WAN module)
Maximum number of 25 Mbps ports	48 (4x12) (A12-TP25 module)
Maximum number of 34.368 Mbps (E3) / 44.726 Mbps (T3) ports	8 (4x2) (A8-WAN module)
Maximum number of 100 Mbps ports	16 (4x4) (A4-SC100 module)
Maximum number of 155 Mbps full SONET/SDH ports	8 (4x2) (A8-WAN module)
Maximum number of 155 Mbps SONET/SDH lite ports	56 (14x4) (A4-MF155 / A4-MB155 module)
Maximum number of 622 Mbps ports	14 (14x1) (A1-MF622 / A1-SF622 module)
Lowest port speed	1.544 Mbps (T1/J1)
Highest port speed	622 Mbps
Maximum usable throughput per module	636 Mbps
Clocking distribution	Not supported. Adaptive clocking only with FiberCom ACE module
Internal and external clocking	Supported for the 155 Mbps and 25 Mbps modules.

Table 4. Power Consumption Requirements for 8265 Modules

Module Type	Slot Width	Power Required (Watts at 5, 2 Volts)
Control Point & Switch	2	80
Controller	1	5
4-port 155 Mbps(MMF)	1	29
4-port 155 Mbps(Flex)	1	20
1-port 622 Mbps(MMF)	1	28
1-port 622 Mbps(SMF)	1	28
4-port 100 Mbps	1	35
12-port 25 Mbps	1	25
ATM WAN2	1	18,4
Video Distribution	2	62,5
MSS Server(8210)	2	42
8271 ATM/LAN Switch	2	58,5
8272 ATM/LAN Switch	2	30
8271 ATM/LAN Switch	3	58,5
8272 ATM/LAN Switch	3	30

2.6 ATM Endstation Adapters

IBM provides cost-effective ATM network connectivity through its TURBOWAYS family of ATM adapters. The adapters are used by ATM end devices in conjunction with IBM's 8265, 8260 and 8285 ATM switches.

TURBOWAYS adapters are high-performance adapters designed to support:

- Micro Channel (MC)
- PCI
- ISA
- S-Bus

While the InterPhase family of adapters supports the following clients:

- EISA
- GIO
- PCI

The following table lists the available ATM adapters.

Table 5. ATM Network Adapters

Make	Bus type	Speed	Cable Medium
TURBOWAYS	ISA	25 Mbps	UTP
TURBOWAYS	MC	25 Mbps	UTP
TURBOWAYS	PCI	25 Mbps	UTP
TURBOWAYS	MC (PS/2)	155 Mbps	UTP/MMF
TURBOWAYS	MC (RS/6000)	155 Mbps	MMF
InterPhase	PCI	155 Mbps	UTP/MMF
InterPhase	EISA	155 Mbps	UTP/MMF
InterPhase	GIO	155 Mbps	UTP

Note

For further information on the availability of IBM's entire range of network adapters for ATM, contact the IBM Web site at: http://www.networking.ibm.com/atmadapters.html.

Chapter 3. ATM Control Point Setup and Operations

This chapter explains the detailed software operation of the A-CPSW. It also describes the setup of the A-CPSW and its command line interface. In the latter sections of this chapter descriptions of ATM Forum-compliant interfaces and network connection types are discussed. Examples of how to configure the A-CPSW module to utilize these interfaces and connection types are depicted in Chapter 4, “Configuring 8265 ATM Networks” on page 91.

3.1 Overview of A-CPSW Characteristics

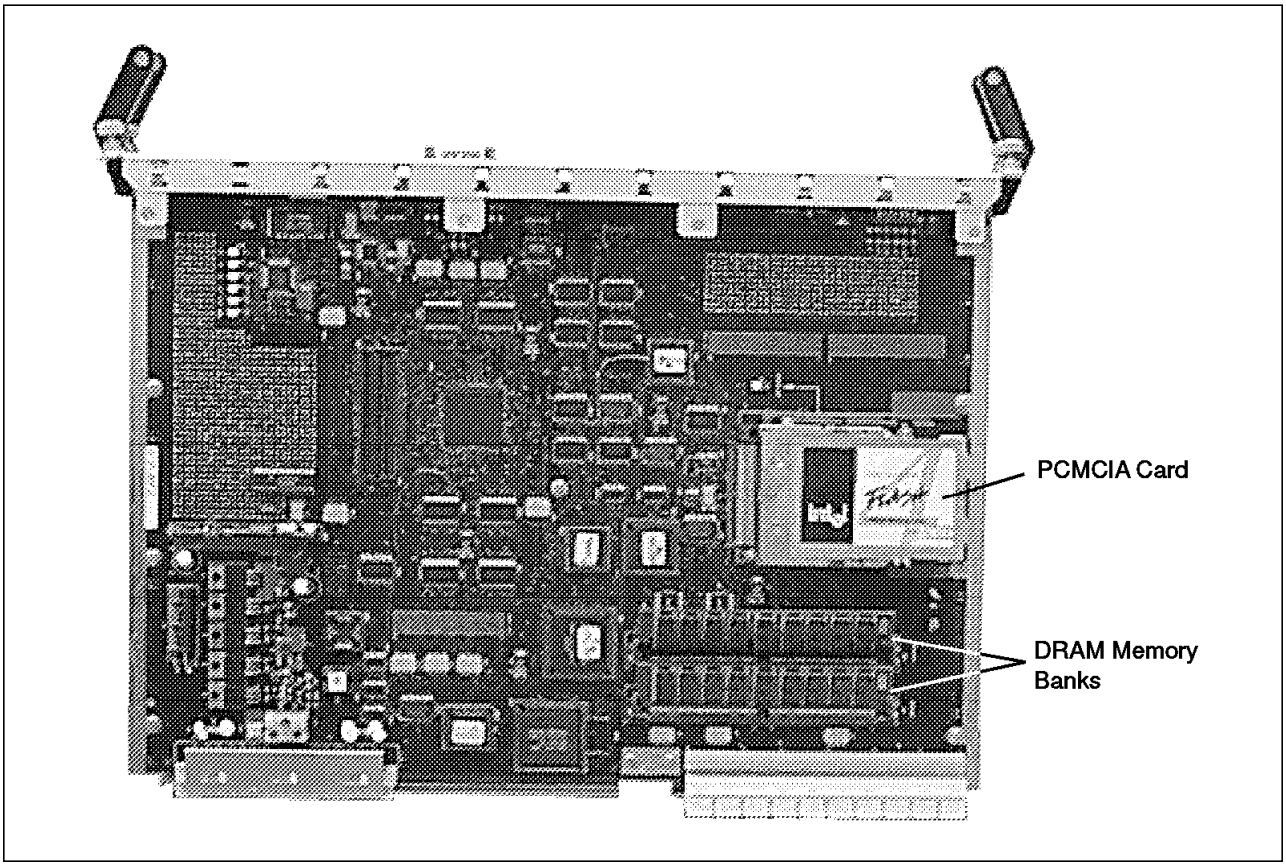


Figure 27. Circuit Board View of an A-CPSW

As was explained in 2.2, “ATM Control Point and Switch Module (A-CPSW)” on page 14 the A-CPSW consists of the following three cards packaged into a two slot module:

- The switch card
- The control point card
- A daughter card

In this section the functions of the control point card are discussed. The control point card houses the *control program*. The control program performs:

- The ATM switching connection establishment

- The ATM circuits management

In Figure 27 on page 47 and Figure 28 the components of the A-CPSW can be seen.

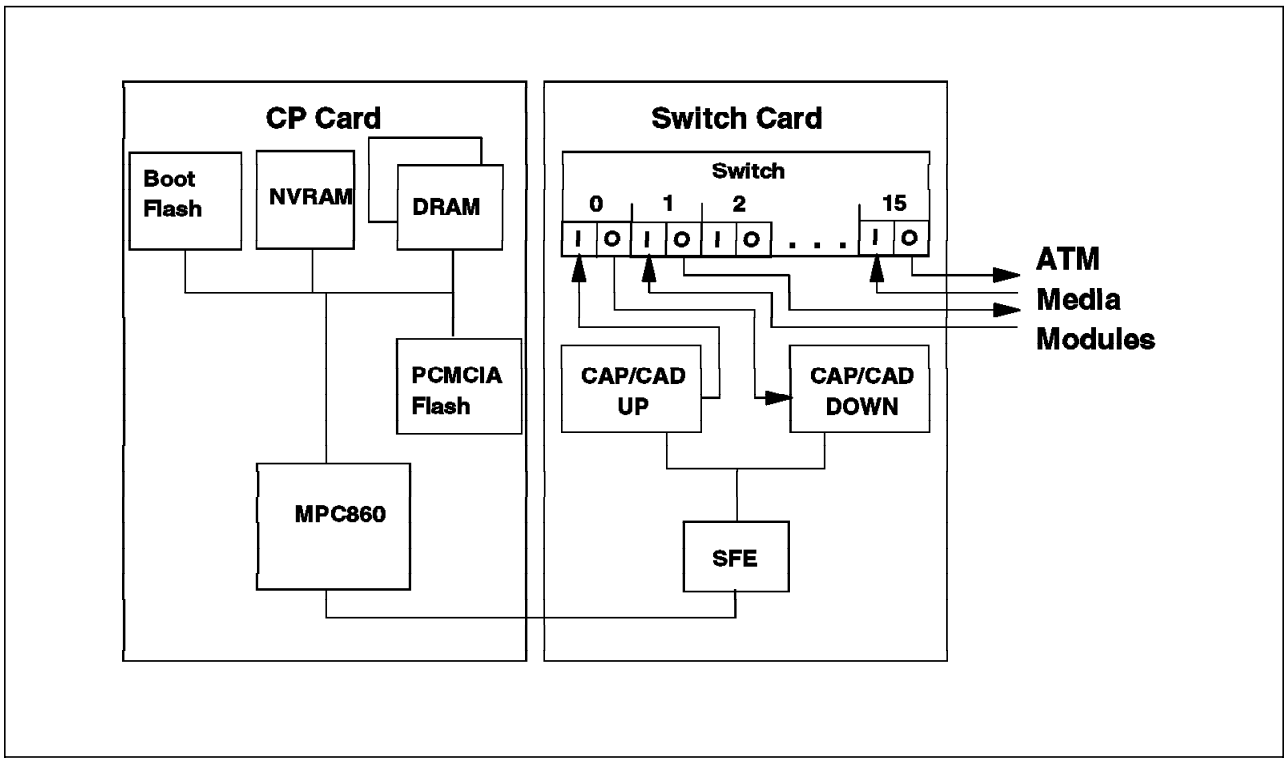


Figure 28. Internal Operation of the Control Point Switch Module

The A-CPSW module has four types of memory installed on its circuitry. These are:

- **Non-volatile RAM (NVRAM)**. All configuration information and error logs are stored here. It is 128 KB in memory size.
- **Dynamic RAM (DRAM)**. DRAM contains the executable operational microcode downloaded from the PCMCIA Flash EEPROM. The memory size can be either 16 MB or 32 MB depending on whether base or enhanced microcode is being run on the A-CPSW.
- **PCMCIA Card**. This card contains the operational base microcode, enhanced microcode and boot microcode modules depending on which PCMCIA card is configured for the A-CPSW. The operational microcode can be replaced using non-disruptive in-band downloads and is swappable via operator command.
- **Boot**. This EEPROM contains the boot flash microcode. It can be replaced by in-band downloads or by copying the boot module residing on the PCMCIA card.

  For further information on microcodes Table 1 on page 16 shows the different releases of microcode and their memory requirements for the A-CPSW.

3.2 Command Line Interface

The command line interface allows the configuration and status display of various components of the IBM 8265 ATM switch. Through the A-CPSW console port a network administrator is able to:

- Configure and manage the A-CPSW
- Configure and manage ATM media modules
- Maintain the various software components of the A-CPSW through microcode downloads
- Have management functionality providing event diagnostics in the ATM switching subsystem

The command line interface can be accessed through a terminal attached locally to the console port of the A-CPSW or via a Hayes Compatible modem attached to the A-CPSW console port. These connection types are discussed in further detail in 3.2.1, “Accessing the Command Line Interface.”

3.2.1 Accessing the Command Line Interface

The command line interface of the A-CPSW can be accessed through the RS-232 console port on the front of the A-CPSW. The console port is a DTE male DB-9 connector. An ASCII terminal (VT100 or compatible) can be used to attach to the console port locally. The cable used to connect the terminal to the console port, should be of the straight through pin-to-pin variety. For the pin assignments of the console cable please refer to Table 6.

The ASCII terminal should be configured to the following factory default settings for the console port:

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit

These settings can be changed once a terminal has successfully connected to A-CPSW. This is done by using the SET TERMINAL command.

Table 6. Console Port Pin Assignments

Pin Number	**Signal Name**
1	Carrier Detect (CD)
2	Receive Data (RX)
3	Transmit Data (TX)
4	Data Terminal Ready (DTR)
5	Signal Ground (GND)
6	Data Set Ready (DSR)
7	Request To Send (RTS)
8	Clear To Send (CTS)
9	Not Used

3.2.2 Administrator and User Access

There are two levels of command line interface access available on the IBM 8265 ATM switch. These are:

- User level
- Administrator level

No user names or IDs are associated with the user or administrator levels. Once connected to the A-CPSW with a console, the following screen appears after you press Enter.

```
ATM switch/control module
(c) Copyright IBM Corp. 1994, 1997. All Rights Reserved.

Password:
```

Figure 29. A-CPSW Initial Console Screen

At the Password prompt either the administrator or user password will be entered. Thus, the password that is entered determines the access level of the person wishing to connect to the A-CPSW.

The factory default passwords for the user level is the Enter key, and for the administrator level it is 8265 followed by the Enter key.

It is recommended, for security purposes, that both passwords be changed as soon as possible on acquiring an IBM 8265 ATM switch. It is also recommended that the network administrator change the passwords on a regular basis, and a secure record of these passwords be kept and documented.

How to change and reset the passwords is explained in 3.2.3, “Resetting and Changing the Passwords” on page 53.

In summary, the two levels of access to the A-CPSW have the following stipulations:

- User Level Access

  Allows access to limited A-CPSW commands. The user is allowed read-only and display access of the 8265 ATM switching subsystem.

- Administrator Level Access

  Allows access to all A-CPSW commands. The administrator is allowed read-write access to the A-CPSW and can modify the ATM switching subsystem of the 8265.

3.2.2.1 Reference Guide to A-CPSW Commands

This section only provides the reader with a quick reference guide in table format to the various commands that can be used in both user and administrator mode. For more information on command line interface commands please refer to *IBM's 8265 ATM Switch Command and User Guides*.

The command line interface has the following characteristics:

- The commands are not case-sensitive. The system interprets XYZ the same as xyz.
- Abbreviated command input is accepted. This allows the minimum required number of unique command characters to be typed. Pressing the Spacebar after this automatically fills in the rest of the command string.
- System prompts if mandatory commands are not entered.
- Typing ? provides help and displays the system's next available options. Abnormal termination of the entered command can be achieved by entering Ctrl and C simultaneously.

Table 7 (Page 1 of 2). User Level Commands

Command	Action
?	Provides help and displays next options
LOGOUT	Ends a user terminal session
SHOW ALERT	Displays the alert settings for the A-CPSW
SHOW CLOCK	Displays current date and time
SHOW COMMUNITY	Shows the associated community names for specified management stations
SHOW DEVICE	Shows configuration information about the ATM control point
SHOW ERRORS	Displays all errors since last download
SHOW FLASH	Shows information on the current microcode stored in the flash EEPROM
SHOW FUTURE_PNNI CONFIGURATION STATE	Displays any uncommitted changes to the future PNNI configuration
SHOW FUTURE_PNNI NODE_0	Shows the current Node 0 settings in the future PNNI configuration
SHOW FUTURE_PNNI PATH_SELECTION	Displays the ABR and UBR path selection in the future PNNI configuration
SHOW FUTURE_PNNI SUMMARY_ADDRESS	Shows a summary list of addresses in the future PNNI configuration
SHOW HOST	Shows the current list of host names assigned IP addresses
SHOW HUB	Shows information about the 8265 switch environment
SHOW INVENTORY	Lists all modules, daughter cards, controller module and software
SHOW LAN_EMUL CONFIGURATION_SERVER	Displays the entries in the LECS address table
SHOW MODULE	Shows configuration information displayed on connected modules
SHOW PNNI CONFIGURATION_STATE	Shows any uncommitted changes pending in the future PNNI configuration
SHOW PNNI NEIGHBOR	Lists the neighbor node IDs connected to one or more ports of the 8265
SHOW PNNI NODE_0	Shows the current Node 0 settings in the active PNNI configuration
SHOW PNNI PATH_SELECTION	Displays the current active path selection for ABR and UBR calls

Table 7 (Page 2 of 2). User Level Commands	
Command	**Action**
SHOW PNNI PEER_GROUP_MEMBERS	Lists the current node IDs of members of the ATM peer group
SHOW PORT	Displays configuration information on a single port or all ports
SHOW POWER	Displays power modes and classes
SHOW PVC	Displays the definitions of selected or all PVCs
SHOW RAM	Lists the amount of Random Access Memory (RAM) installed
SHOW REACHABLE ADDRESS	Displays all reachable addresses defined in the local switch
SHOW ROLE	Displays the primary or secondary status of A-CPSWs
SHOW SECURITY	Displays security access control settings and violations for the 8265
SHOW SIGNALLING ATM_INTERFACE	Displays signalling interface settings for a port or VPC
SHOW SIGNALLING CROSS_CONNECTIONS	Shows current defined cross connections for ports or VPC
SHOW SIGNALLING CONTROL	Displays the global state of the signalling entity in the switch
SHOW TERMINAL	Displays the A-CPSW console port settings for terminal and SLIP connections
SHOW TFTP	Displays the parameters for inband download and upload operations
SHOW TRACE	Displays the status of all available trace types
SHOW VPC_LINK	Displays all or selected VPC links
TELNET	Logs on to and manages any A-CPSW in the network

In administrator mode *all* commands are available to the user. The following table represents only a fraction of the available commands in administrator mode. The tables purpose is to serve only as a quick reference guide to the initial setup of an 8265 ATM switch. For more detailed information and examples of administrator mode commands please refer to Chapter 4, “Configuring 8265 ATM Networks” on page 91.

Table 8 (Page 1 of 2). Reference Guide to Configuring an A-CPSW from Administrator Mode	
A-CPSW Command	**Action Performed**
SET DEVICE PASSWORD	Configures either user or administrator passwords

Table 8 (Page 2 of 2). Reference Guide to Configuring an A-CPSW from Administrator Mode

A-CPSW Command	Action Performed
SET TERMINAL BAUD SET TERMINAL DATABITS SET TERMINAL PARITY SET TERMINAL STOPBITS SET TERMINAL PROMPT SET TERMINAL TIMEOUT SET TERMINAL HANGUP SET TERMINAL CONSOLE_PORT_PROTOCOL	Configures the A-CPSW's console port settings
SET CLOCK SET DEVICE NAME SET DEVICE LOCATION SET DEVICE CONTACT	Changes the factory default settings for the A-CPSW
SET PNNI NODE_0 ATM ADDRESS	Configures a user-defined ATM address for the A-CPSW
SET MODULE ENABLE SET MODULE ISOLATED SET PORT	Configures ATM media modules and ports
SET TERMINAL BAUD SET TERMINAL SLIP_ADDRESS SET TERMINAL CONSOLE_PORT_PROTOCOL	Configures SLIP parameters
SET DEVICE IP_ADDRESS SET DEVICE DEFAULT_GATEWAY SET DEVICE ARP_SERVER SET DEVICE COMMUNITY SET ALERT	Configures Classical IP parameters
SET DEVICE LAN_EMULATION_CLIENT SET DEVICE DEFAULT GATEWAY SET COMMUNITY SET ALERT	Configures LANE parameters
SET PVC	Configures PVCs for both VCCs and VPCs
SET TFTP	Configures TFTP parameters for code download/upload
SET TRACE	Configures trace and dump facilities

3.2.3 Resetting and Changing the Passwords

If the administrator password for the A-CPSW for any reason needs to be reset, the following procedure must be followed:

- Enter Force at the Password prompt.
- Press the ATM Reset button on the A-CPSW.

This procedure will reset the password back to its original factory default setting of 8265.

3.2.3.1 Changing the Administrator and User Passwords

As stated in 3.2.2, “Administrator and User Access” on page 50 from time to time it is necessary to change the administrator and user passwords. The following consecutive screen displays show how this is accomplished.

Note

A-CPSW passwords are case-sensitive and passwords that are entered are not displayed on the screen console.

Type the following command to initiate the administrator password change, and then press the Enter key.

```
8265ATM> set device password administrator

Enter current administrator password:(old password)
New password:                        (new password)
Re-enter password:                   (new password)

Password changed.

8265ATM>save device
```

Figure 30. Changing the Administrator Password

The SAVE DEVICE command was used to save the new password.

```
8265ATM> set device password user

Enter current administrator password:(old password)
New password:                        (new password)
Re-enter password:                   (new password)

Password changed.

8265ATM>save device
```

Figure 31. Changing the User Password

3.2.4 Configuring Default Settings for the A-CPSW

The A-CPSW is pre-configured with default settings that may need to be changed before the switch can be utilized. The following console screen shows how to change the basic parameters in order to customize the IBM 8265 ATM switch to the user’s own requirements.

```
8265ATM>set clock 10:00 1997/10/29 1

8265ATM>set device name 2

Enter device name:ATMG_09

8265ATM>set device location 3

Enter device location:LA GAUDE LAB

8265ATM>set device contact 4

Enter device contact:Kevin Treweek or Farhad Sidhwa

8265ATM>set terminal prompt ATMG9> 5

ATMG9>set terminal timeout 10 6

ATMG9>save device 7


ATMG9>set pnni node_0 atm address: 39.99.99.99.99.99.99.00.00.99.
99.01.01.99.99.99.99.99.99.01 8

ATMG9>commit pnni 8a
COMMIT successfully executed.
To save new configuration issue SAVE.

ATMG9>save all
```

Figure 32. Configuring Customized Settings for the A-CPSW

Notes:

1 The A-CPSW node clock has its own battery and functions even when the CPSW fails to operate.

2 A unique name is assigned to the A-CPSW in order to simplify command parameters when performing ATM tasks. This unique name is used instead of the IP address to identify the A-CPSW.

3 **4** This is mainly for service information. In the event of failure on the 8265 ATM subsystem, service personnel to be contacted are listed.

5 In 8265 multi-switch networks it will be easier to recognize the A-CPSW that work is being performed on if the console prompt is changed to a name similar to the device name entered in **2**.

6 The console timeout is a safety precaution that enables the administrator to specify the length of time a terminal session can be inactive before the user is automatically logged off the A-CPSW. The default value for SET TERMINAL TIMEOUT is 0. This means that no timeout period is set. Time is always specified in minutes with this command.

7 The SAVE DEVICE command is used to save all the settings that have been changed. This must be done before steps **8** and **8a**, because

changing the ATM address of the A-CPSW will reset the switch, and changes made will be lost if not saved.

8 **8a** When an 8265 is powered on for the first time it automatically loads a default ATM address. If there is only one 8265 in the configuration, there is no need to change the ATM address.

In a multiple switch network configuration, the default ATM address must be reconfigured so that each switch has a unique ATM address. Issuing the COMMIT PNNI command activates the new configuration.

3.2.4.1 ATM Addressing Formats

The 8265 ATM subsystem supports the addressing scheme defined by the ATM Forum for addressing endpoints in private ATM networks. The scheme is modelled after the format of the OSI Network Service Access Point (NSAP) as specified in ISO-8348 (CCITT X.213).

As shown in Figure 33 on page 57 the 8265 control point supports the three Initial Domain Identifier (IDI) formats specified by the ATM Forum. These are:

- Data Country Code (DCC)
- E.164 (Specific Integrated Service Digital Network Number)
- International Code Designator (ICD)

Each of the three ATM address formats is 20 bytes long and consists of two main parts:

- Network prefix (13 bytes)
- End system part (7 bytes)

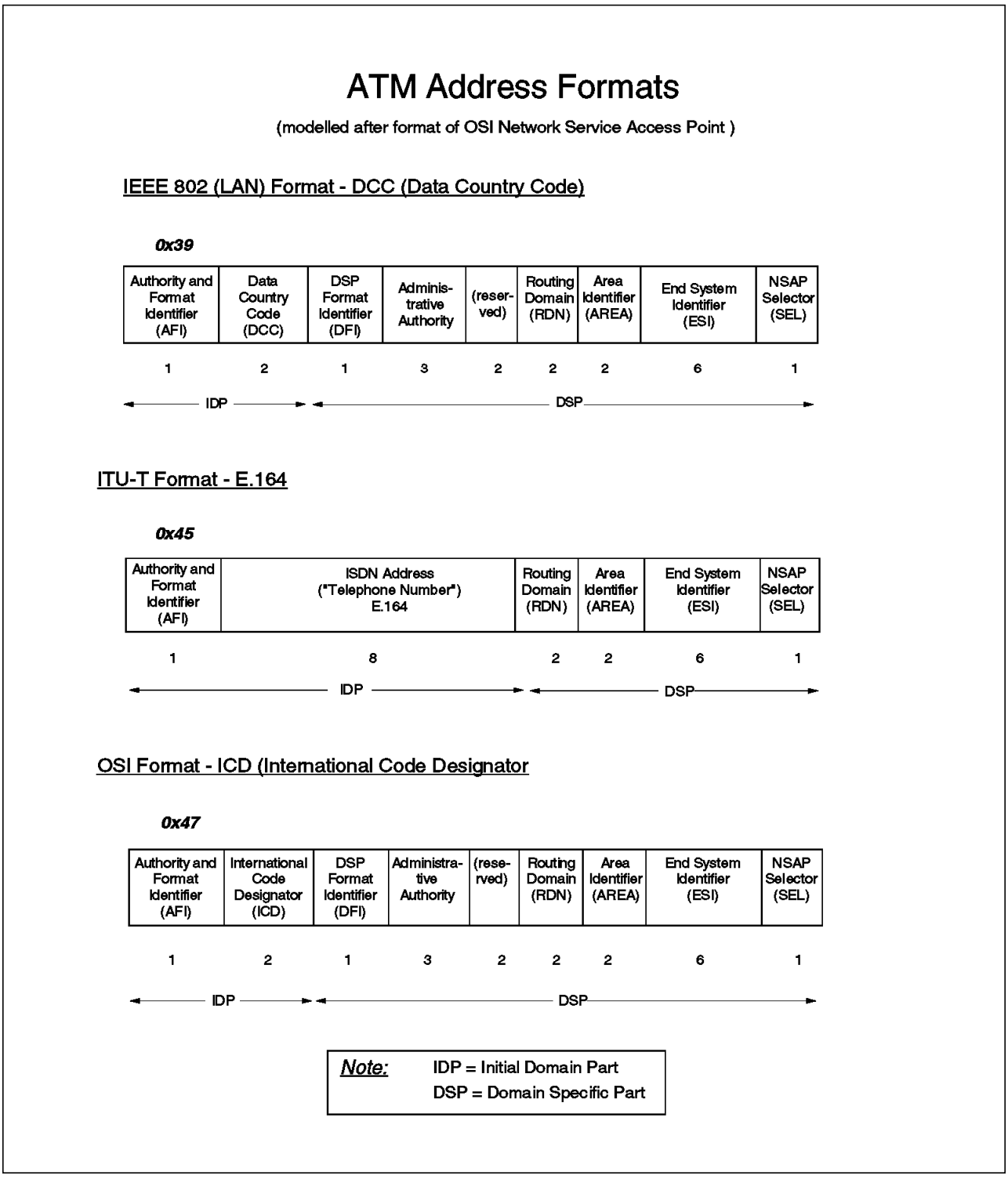


Figure 33. NSAP Address Formats Supported in the 8265 ATM Subsystem

With reference to Figure 33 the following abbreviations are defined:

- Authority and Format Identifier (AFI)
- Data Country Code (DCC)
- Domain-Specific Format Identifier (DFI)
- Administrative Authority (AA)

- B-ISDN addressing format (E-164)
- International Code Designator (ICD)
- Routing Domain Number (RDN)
- End System Identifier (ESI)
- Selector (SEL)

3.2.5 Configuring an IP Address for the A-CPSW

Two Internet Protocol (IP) addresses and subnetwork masks must be configured on the A-CPSWs for two reasons:

1. To use the Ethernet port for:
   - Remote TELNET sessions
   - SLIP terminal console sessions
2. For management of the ATM subsystem from an SNMP workstation on either a Classical IP network or a LAN Emulation network

When in administrator mode the IP and subnet mask can be configured in one command. Examples of configuring IP addresses and subnet masks for both the Ethernet port and SNMP management are given in the following console displays.

```
ATMG9>set device ip_address eth 9.100.94.51 ff.ff.ff.00

ATMG9>set device ip_address atm 9.100.94.54 ff.ff.ff.00
```

Figure 34. Configuring IP Addresses for the Ethernet Port and SNMP

3.2.5.1 IP Addressing Scheme

IP uses *IP addresses* to specify source and target hosts on the Internet. The network address of the IP address is unique and is assigned by a central authority, the Network Information Center (NIC), on request by a company or network administrator. IP addresses are 32-bit addresses represented in dotted decimal format, for example, 9.100.94.51 as shown in Figure 34. This was the unique IP address given to the Ethernet port of the A-CPSW in this specific example.

The *subnet mask* ff.ff.ff.00 in Figure 34 is a 32-bit number containing binary ones at bit positions corresponding to subnet bits in the IP address. The subnet mask is often written in the same format as the IP address. For example, 255.255.255.0 is the same as ff.ff.ff.00.

3.2.6 Maintenance Mode

Some operations such as the downloading of microcode and FPGA picocode (as explained in 3.3, “Downloading Microcode and FPGA Picocode” on page 60) can only be performed when the IBM 8265 ATM switch is in maintenance mode.

Access is gained to maintenance mode through the administrator level access by entering the command MAINTAIN.

Note

The MAINTAIN command can *only* be used from a local ASCII (VT100 or equivalent) terminal connected locally to the console port of the A-CPSW.

It is recommended that the following points are adhered to before maintenance mode is used:

- Any changes to the ATM subsystem made while in administrator mode should be saved, if required, before the MAINTAIN command is issued to the system.
- All traffic should be stopped to and from the ATM subsystem.

Entering maintenance mode interrupts ATM traffic and resets the A-CPSW. In maintenance mode the command prompt appears as >> and the System Status LCD on the A-CPSW displays the MAINTENANCE MODE ENTERED UPON USER REQUEST message.

```
8265ATM>maintain

You are about to reset the ATM subsystem for maintenance.
Are you sure ? (Y/N):Y


>>
```

Figure 35. Using the Maintain Command in Maintenance Mode

The following table represents a summary and description of the maintenance mode commands.

Table 9 (Page 1 of 2). Maintenance Mode Commands

Command	Description
BOOT	Activates the new software stored in the flash EEPROM, ends maintenance mode and starts a new A-CPSW session.
CLEAR ALL	Deletes all stored information such as configuration, error log and restarts the counters.
CLEAR CONFIGURATION	Erases the ATM subsystem configuration in an A-CPSW.
DOWNLOAD OUT_OF_BAND	Downloads new A-CPSW software.
SET DEFAULT GATEWAY	Assigns the IP address of the router used to receive and forward IP packets to stations not attached to the 8265.
SET IP_ADDRESS	Assigns an IP address to the Ethernet port on the A-CPSW.
SET MAC_ADDRESS	Assigns a MAC address to the Ethernet port on the A-CPSW.
SET ROLE	Selects which A-CPSW is primary and secondary in a redundant A-CPSW configuration.
SET SUBNET_MASK	Assigns a subnetwork mask to the Ethernet port on the A-CPSW.
SHOW ERRORS	Displays the errors recorded during the last execution of the DOWNLOAD_OUT_OF_BAND command.
SHOW FLASH	Displays a summary of the microcode stored in the flash memory.

Table 9 (Page 2 of 2). Maintenance Mode Commands	
Command	**Description**
SHOW RAM	Displays the amount of Random Access Memory (RAM) installed.
SHOW ROLE	Displays the primary or secondary role of the A-CPSW.
SWAP ACTIVE	Activates the backup flash EEPROM without resetting the A-CPSW.
USE BAUD	Changes the baud rate of the console terminal connection while in maintenance mode.

To exit maintenance mode enter the BOOT command. The MAINTENANCE MODE display on the A-CPSW System Status LCD will switch off and the console command prompt will return to 8265ATM.

3.3 Downloading Microcode and FPGA Picocode

It may become necessary to update the microcode and FPGA levels of the A-CPSW and ATM media modules for the following reasons:

- Replacement of the PCMCIA flash EEPROM with enhanced code
- Upgrades to existing picocode FPGA levels of the 8260/8265 ATM media modules
- Upgrades to the A-CPSW microcode

Attention

If the 8260 module is not at the preferred FPGA level as shown in Table 2 on page 27, then this module has to be field upgraded to the required level *before* it can physically be installed in an 8265 chassis. Therefore, 8260 modules not at the required level must be upgraded in an 8260 chassis first, before installation in an 8265.

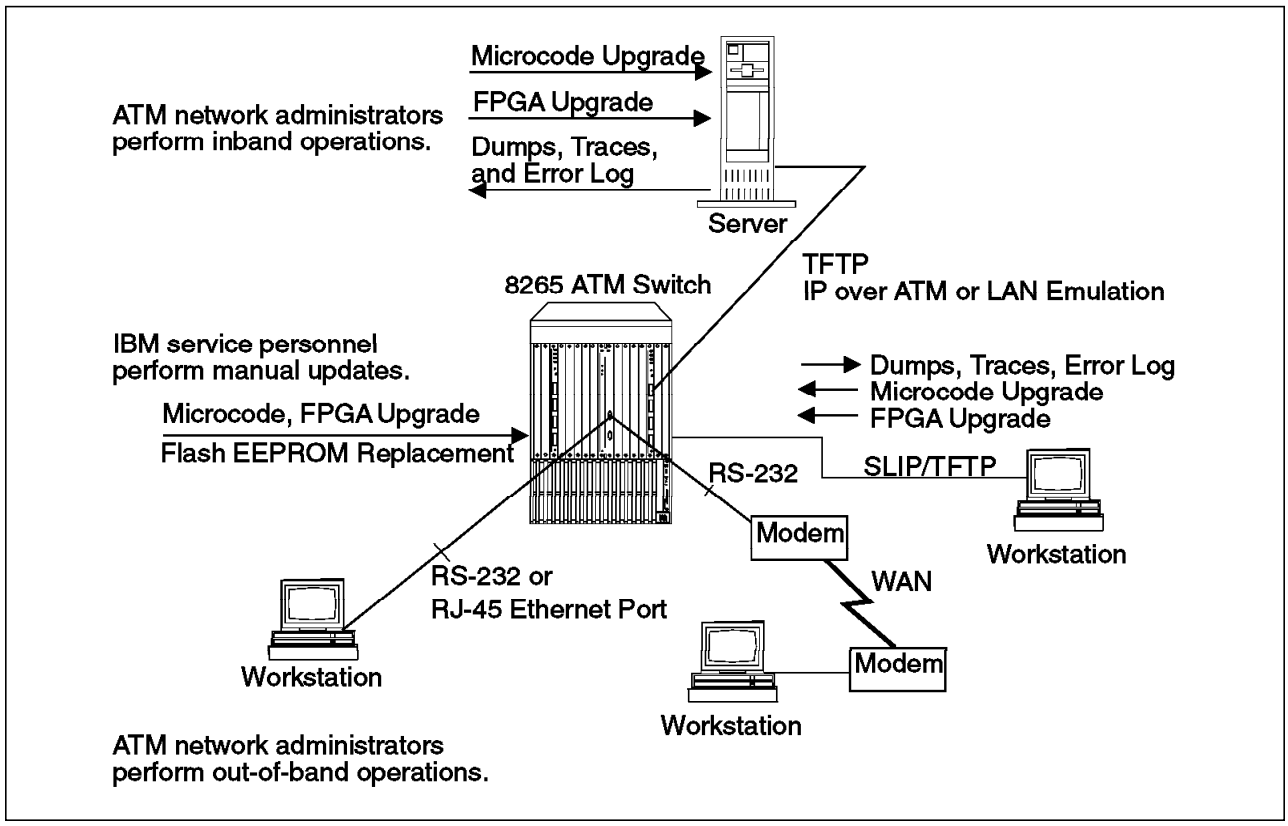


Figure 36. Options for Upgrading Microcode and FPGA Picocode

To update microcode and picocode the user can use one of the following methods:

- In-band using TFTP file transfer from a network management station or any other station capable of TFTP service
- Out-of-band using an RS-232 locally or remotely attached terminal using the X/YMODEM protocol
- Out-of-band using the SLIP protocol

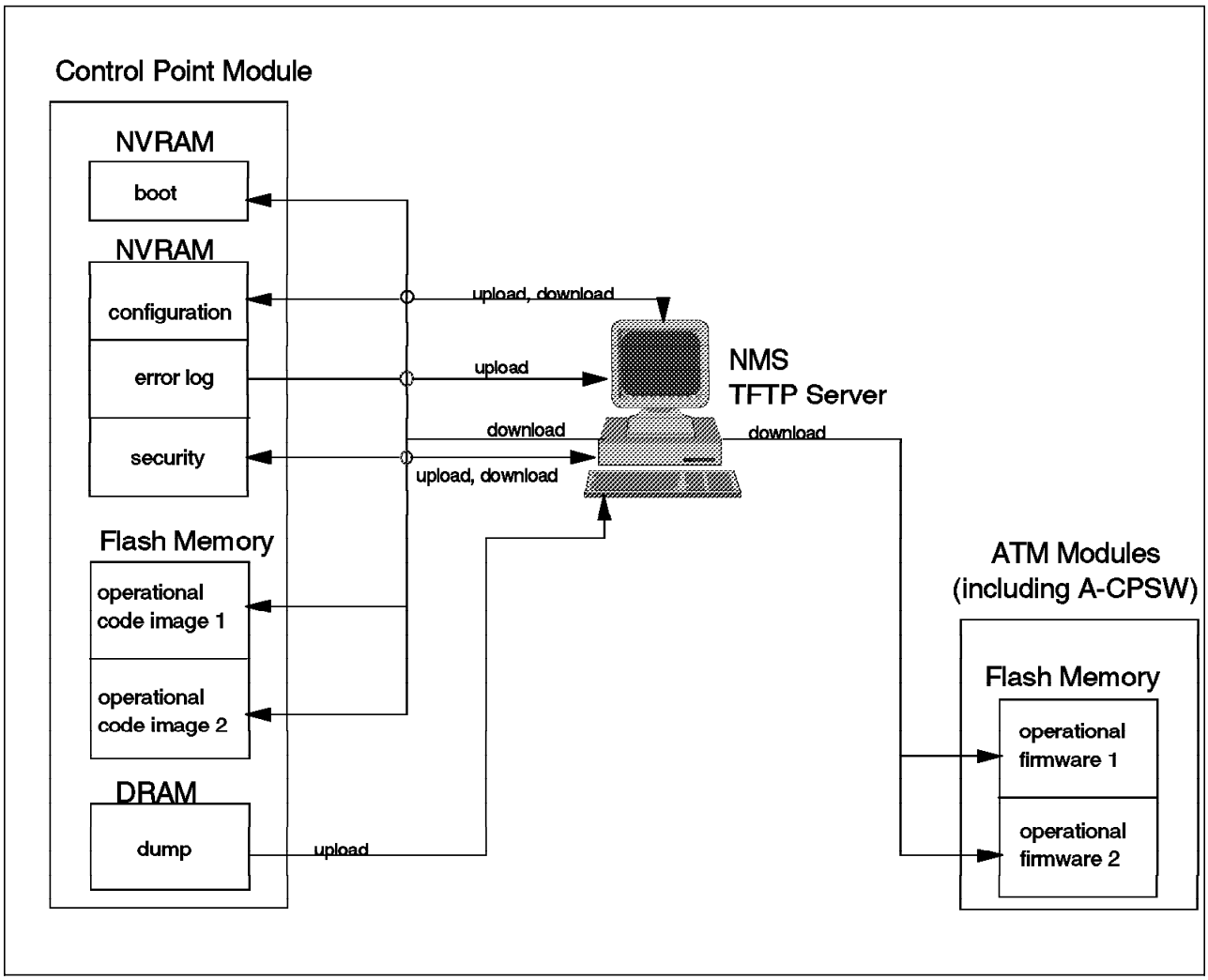


Figure 37. Memory Structure and Code Operations

There are three types of code for the A-CPSW:

- Boot Code

  This code resides in dedicated flash memory on the A-CPSW module and is the first code that executes after a power-on or reset of the switch. It contains initialization, diagnostic and download out-of-band commands.

- Operational Code

  This code is executed once the boot code procedure has finished. There are two copies of the code stored in the PCMCIA flash memory. One is the current operational code loaded into DRAM during the initialization process and the second code allows new operational code to be loaded into flash memory while the control point is running. This second copy can be swapped with the running copy of code at any time. Having two copies of operational code simplifies maintenance on the 8265, for example, enhancements to the operational code.

- Firmware

  This code configures the FPGAs on both the A-CPSW and ATM media modules ATM engines. Two copies of code are stored in the PCMCIA flash memory. The first is loaded into the FPGAs at initialization and the second

can be used to swap with the first for maintenance reasons, for example, updates to firmware.

Notice

New versions of microcode and FPGA picocode for 8265/8260 modules can be obtained via the Internet at the following URL: http://www.networking.ibm.com/8265/8265fix.html.

If the user of an 8265 would like to receive automatic notification of when microcode updates are available, the user can register their e-mail address at the following URL: http://www.networking.ibm.com/8265/8265reg.html.

3.4 Managing the Power Supply to an 8265

As was explained in 1.2.1, “Power Subsystem” on page 1 the 8265 has two operational power states or modes that it can operate in. These are power *fault tolerant* mode or power *non-fault tolerant* mode.

Fault tolerant power mode is when there is sufficient power modules physically configured in the 8265 to enable a network administrator to allocate *one* power supply solely to replace power lost if and when a single power supply fails.

To display which of the two modes is currently in effect on the 8265 the user must enter the SHOW POWER MODE command. An example of this command is in Figure 38.

```
ATMG9>show power mode

                      Power Management Information
                      ----------------------------
Hub Power Modes:

       Fault-Tolerant Mode:        FAULT_TOLERANT
       Fault-Tolerant Status:      FAULT_TOLERANT
       Overheat Power Down Mode:   DISABLE

ATMG9>
```

Figure 38. A 8265 in Fault Tolerant Power Mode

If the user requires changing the 8265 power mode, then the SET POWER MODE command is used as seen in Figure 39.

The controller module in the 8265 will determine if there is sufficient unallocated power budget available to set the switch to fault tolerant power mode. If there is insufficient power, then the controller module will ensure that the 8265 remains in non-fault tolerant mode.

```
ATMG9>set power mode non_fault_tolerant

     Power mode set to NON_FAULT_TOLERANT

ATMG9>
```

Figure 39. Changing the Power Status on an 8265

The network administrator can also assign different power class settings for individual ATM media modules. Power class settings for individual modules allows for preference of one module over another at power up or power down. This could occur when power deficit or overheating conditions are prevalent within the 8265.

Power class settings for individual modules are definable in single values ranging from 1 - 10, with 1 being the lowest and 10 the highest possible setting.

```
ATMG9>set power slot 1 class
Enter Class: 9

Slot 01 power class is set to 09.

ATMG9>show power slot 1

                Power Management Information
                ----------------------------
Slot Power Information:

Slot     Class            Admin Status        Operating Status
----     -----            ------------        ----------------
1        9                ENABLE              ENABLED

ATMG9>
```

Figure 40. Assigning Power Classes to Individual Modules

If a power supply fails in the 8265 and there is insufficient power to keep all the 8265 modules operational, the controller module will power down the 8265 in the following sequence:

- Modules powered down from slot 17 to slot 1, starting with modules that have the lowest power class setting.
- If two or more modules have the same class, then they will power down from slot 17 to slot 1.
- Modules will continue to power down until power consumption is below the required budget of the remaining operational power supplies.
- During a power deficit modules with a class 10 rating do not power down unless manually requested to by the administrator.

The SHOW POWER BUDGET command will show the distributed and available power among all the installed power supplies.

```
ATMG9>show power budget


                      Power Management Information
                      ----------------------------
8265 Power Budget :

Voltage Type Voltage Level Watts Capacity Watts Available Watts Consumed
------------ ------------- -------------- --------------- --------------
+5V             5.094         366.00          225.00           141.00
-5V            -5.058          25.50           22.25             3.25

ATMG9>
```

Figure 41. Power Budget of Installed Power Supply Modules

3.5 Enabling and Disabling ATM Media Modules

When an IBM 8265 ATM switch is powered on for the first time the installed ATM media modules do not start up with the ATM subsystem, A-CPSW and controller modules.

The factory default settings for ATM media modules and ports are Isolated and Disabled. The ATM media module and port must first be enabled before it can be configured as part of the ATM subsystem. An example of how to enable and isolate a module in the 8265 is in the following console display.

```
ATMG9>set module 12 connected enable

Module set

ATMG9>set module 12 isolated

ATMG9>set port 12.1 enable pnni
```

Figure 42. Enabling and Isolating ATM Media Modules and Ports

Note

Before removing a module from the 8265 always isolate it from the network by using the SET MODULE slot ISOLATED command.

3.6 Displaying 8265 Module Settings

Basic information for modules installed in specified slots or all modules installed in the 8265 is displayed in the following console screens.

```
ATMG9>show module 18

Slot  Module         Version    network        General Information
----  -------------- -------    -------------- -------------------
18.01 8000-RTCL      1.XX       N/A            Active controller module

ATMG9>
```

Figure 43. Displaying Basic Information for a Controller Module

```
ATMG9>show module all

Slot  Install  Connect  Operation  General Information
----  -------  -------  ---------  --------------------------
 1        n        n         n     -
 2        n        n         n     -
 3        n        n         n     -
 4        n        n         n     -
 5        n        n         n     -
 6        n        n         n     -
 7        n        n         n     -
 8        n        n         n     -
 9        Y        Y         Y     8265 control point and switch
10        Y        n         n     <extension>
11        n        n         n     -
12        Y        Y         Y     8265 ATM 155Mbps Module
13        n        n         n     -
14        n        n         n     -
15        n        n         n     -
16        Y        Y         Y     8265 ATM 155Mbps Module
17        n        n         n     -
18        Y        n         n     Active controller module
19        n        n         n     -

ATMG9>
```

Figure 44. Basic Information on All Installed Modules

```
ATMG9>show module 1 verbose

Slot  Install  Connect  Operation  General Information
----  -------  -------  ---------  --------------------------
 1        Y        Y         Y     8265 ATM 1-Port 622Mbps Module

status: connected / hardware OK
        enable / normal

P/N: 58G9878  EC level: D55931 Manufacture: VIME
Operational FPGA version : 6
     Backup FPGA version : 6


     Type  Mode      Status
----------------------------------------------------------------
1.01: PNNI enabled    UP

ATMG9>
```

Figure 45. Detailed Display of an 1-Port 622 Mbps Module

3.6.1 Security

Access security to the 8265 is provided for all types of ATM applications regardless of whether the ATM device is running LAN Emulation, Classical IP or native ATM. The purpose of access security is to validate physical access to the ATM network.

When an ATM station connects to the 8265 it registers its ATM address through ILMI to the connecting 8265′s A-CPSW. When network security is ENABLED the ATM address is validated to determine if network access is granted to the attaching device. The ATM address validation is based on the ILMI protocol using either the End System Identifier (ESI) or the full ATM address of the device.

Security can be implemented either globally on all detected ports or only on an individual port basis. Examples of different security commands is shown in Figure 46 on page 69.

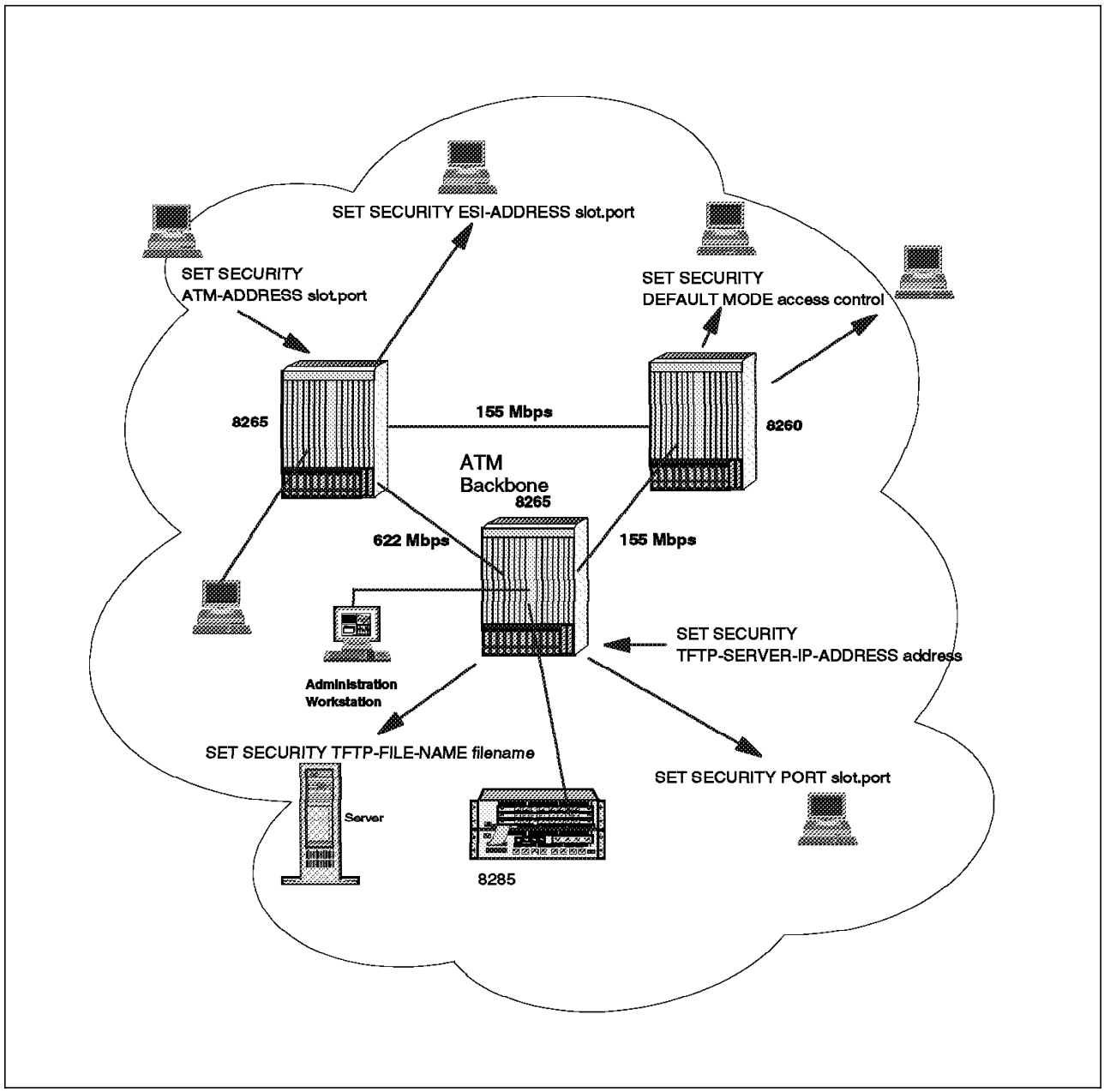


Figure 46. Security Options Available on the 8265

The network access security system in the A-CPSW maintains a table of ATM addresses that are allowed network access. If the registering address is not in the table, the A-CPSW will disable the port and report an SNMP trap.

The security settings for the A-CPSW are accessible through the A-CPSW's console port and are performed in administrator mode.

In addition to maintaining address tables the A-CPSW performs the following security functions:

- Autolearn
- Violation trappings
- Violation loggings

The Autolearn function allows the 8265 to automatically learn the addresses that register through ILMI and stores them in the access control address table.

Factory default settings for all security functions on all ports is DISABLED. These facilities have to first be enabled from the A-CPSW console before they become active and can be utilized.

Examples of security settings are in the following console screens.

```
8265ATM>set security autolearn enable
```

Figure 47. Enabling the Autolearn Function on the A-CPSW

```
8265ATM>set security port 3.1 enable
```

Figure 48. Security Is Enabled on Port 1 Slot 3 of a Module in an 8265

3.7 Control Point Software Operations

The ATM control point establishes and disconnects ATM connections. It achieves this by routing and signalling.

- Routing

  Routing locates the destination endstation and selects the best path possible to reach it. This function is similar to RIP and OSPF in IP networks but includes two additional features, *QoS* and *scalability*. QoS routing supports traditional data applications and real-time applications such as video conferencing on the same physical infrastructure. Scalability provides the support necessary for small networks to intricate worldwide networks.

- Signalling

  ATM is a *connection-oriented* technology and thus requires signalling. Setting up and tearing down ATM connections requires ATM switches to allocate and de-allocate vital network resource requirements (QoS). This can only be achieved by signalling.

Private Network-to-Network Interface (PNNI) Phase 1 protocol provides full dynamic routing and the deployment of multi-vendor networks in a single level peer group. The PNNI control point allows for the inclusion of Interim Inter-Switch Signalling Protocol (IISP) redundant links between peer groups. This provides for fault tolerant and redundant networks.

The PNNI functionality of the 8265 is described in detail in the following sections of this chapter.

3.8 Connections

The 8265 control point supports an extensive set of connections including:

- Permanent VPs and VCs
- Switched VPs and VCs
- Point-to-point
- Point-to-multipoint
- Reserved Bandwidth (CBR,VBR-rt, VBR-nrt)
- Best Effort (ABR, UBR)

ATM connection types are listed in the following table:

Table 10. Supported ATM Connections

Type of Virtual Connection	Connection Type	Connection Class	Connection Mode
Virtual Path Connection (VP)	Switched	Reserved Bandwidth and Best Effort	Point-to-point and point-to-multipoint
Virtual Path Connection (VP)	Permanent	Reserved Bandwidth and Best Effort	Point-to-point and point-to-multipoint
Virtual Channel Connection (VC)	Switched	Reserved Bandwidth and Best Effort	Point-to-point and point-to-multipoint
Virtual Channel Connection	Permanent	Reserved Bandwidth and Best Effort	Point-to-point and point-to-multipoint

Switched virtual circuits (SVCs) and permanent virtual circuits (PVCs) are supported on the same port of an 8265 ATM media module. A list of supported virtual circuit types is shown in Table 11.

Table 11. Supported Virtual Circuits

Type	Support
Unidirectional Point-to-Point	Yes, backward bandwidth=0
Bidirectional Point-to-Point (symmetric bandwidth)	Yes
Bidirectional Point-to-Point (asymmetric bandwidth)	Yes
Unidirectional Point-to-multipoint	Yes
Bidirectional Point-to-multipoint	No
Unidirectional Multipoint-to-point	No
Multipoint-to-Multipoint	No

3.8.1 Switched Connections (SVP/SVC)

The control point supports numerous switched connections. The number of connections varies depending on whether the accounting connection state is ON or OFF. For a full list of connection capacities please refer to Table 19 on page 185.

3.8.1.1 Point-to-Point Connections

SVCs between two endstations consist of two half connections. These half connections are from endstation to switch and from switch to endstation. The following resources are taken up by an SVC within a control point and the ATM media module:

- One connection control block on the media module
- One connection control block from the pool on the A-CPSW

An example of this process is shown in Figure 49.

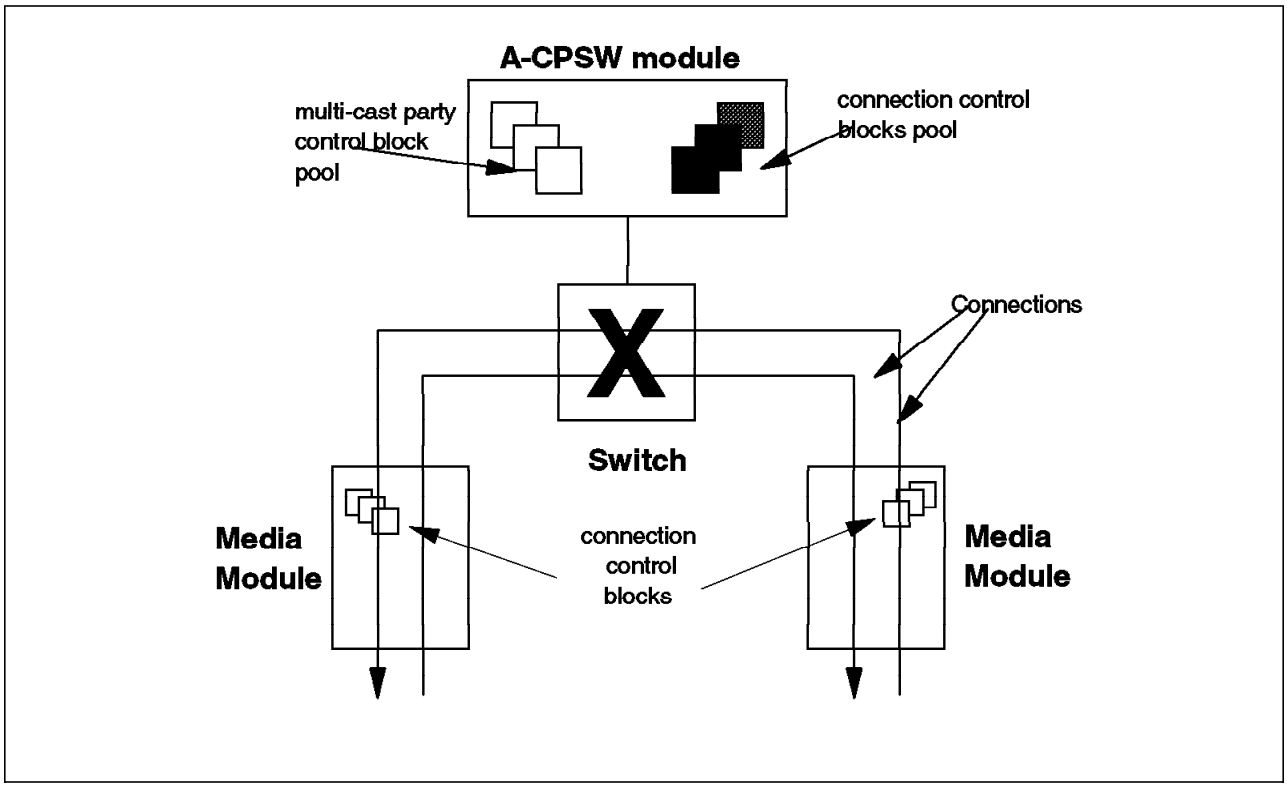


Figure 49. Connection Control Blocks on an A-CPSW

Note

If two endstations are connected to the same media module, then two control blocks are required from this media module.

3.8.1.2 Point-to-Multipoint

Multicasting is supported by the control point. One cell that is destined for multiple output ports takes up *only* one cell location in the shared switch memory. This cell contains a bit map of the target output queues and these output queues point to that one cell location.

As the multicast cell arrives at the top of the output queue it is sent to the output module. If the point-to-multipoint connection spans over multiple ports, then the multicast cell is not replicated but instead the pointer to the buffer containing the cell to multicast is passed from port to port for multicasting.

The control point identifies when the last output port has transmitted the multicast cell and then releases the memory in the control point for this connection. This memory releasing technique minimizes the amount of memory space required for multicast messages and reduces multicast latency.

The control point keeps a record of all downstream UNI endstations that are part of a point-to-multipoint tree that spans its own particular switch. As a result of this record it requires resources to support these point-to-multipoint connections. These resources are the following and are displayed in Figure 50:

- One connection control block on the A-CPSW for the root in the switch attaching to the root endstation
- One connection control block per connection branch to another switch and per endstation attached to this switch
- Two multicast control blocks on the A-CPSW for every endstation attached to this switch and the connection to all downstream switches
- One control block on the media module through which the connection passes

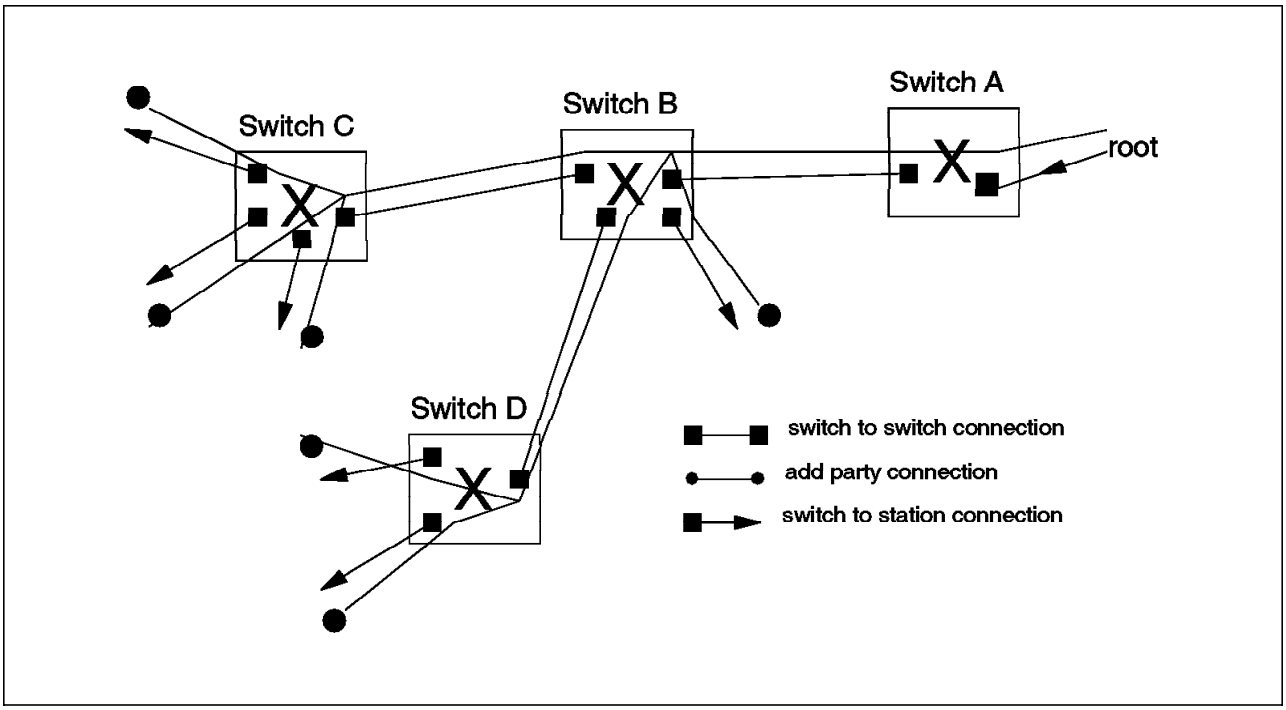


Figure 50. Point-to-Multipoint Connection

In Figure 50 the distribution of resources is as follows:

- **Switch A**

  Two connection control blocks and 12 multicast connection control blocks
- **Switch B**

  Four connection control blocks and 12 multicast connection control blocks
- **Switch C**

  Four connection control blocks and six multicast connection control blocks
- **Switch D**

  Three connection control blocks and four multicast connection control blocks

3.8.2 Permanent Connections (PVP/PVC)

The control point supports *smart* PVPs and PVCs. Smart PVPs and PVCs are internally mapped onto SVPs and SVCs to allow them to automatically reestablish connection paths on an alternate link in the event of original path failure.

Smart PVPs/PVCs configurations are stored in the NVRAM of the originating A-CPSW, which allows for automatic re-establishment of connections after a power on or reset of the control point.

The two endpoints of a PVP/PVC may or may not be on the same switch. Creation of PCP/PVC connections is performed from either the console of the A-CPSW or a network management station. PVP/PVC connections are typically created in independent segments rather than the complete connection at once. The PNNI Phase 1 protocol normally selects the best effort and resources for PVP/PVC links.

Permanent connections are automatically saved by the A-CPSW after they have been activated successfully. This is done for redundancy purposes in the event of A-CPSW failure or reset.

3.9 Path Selection and Load Balancing

The load balancing and selection of paths performed by the control point depends on the type of connection request. These connection requests can be:

- Constant Bit Rate (CBR)
- Variable Bit Rate real time (VBR-rt)
- Variable Bit Rate non-real time (VBR-nrt)
- Unspecified Bit Rate (UBR)
- Available Bit Rate (ABR)

These connection requests are also known as Quality of Service (QoS) and are explained in detail in 3.15.2, “Quality of Service Classes (QoS)” on page 84.

3.10 Signalling

The control point supports all the signalling standards that are currently defined by the ATM Forum. These standards are:

- ATM Forum UNI 3.0
- ATM Forum UNI 3.1
- ATM Forum UNI 4.0
- ATM Forum IISP for NNI connections
- ATM Forum PNNI 1.0 for NNI connections

The control point supports the following public network interfaces:

- Public UNI
- VOID

Figure 51 on page 75 depicts all the supported signalling standards and interfaces that the 8265 control point supports.

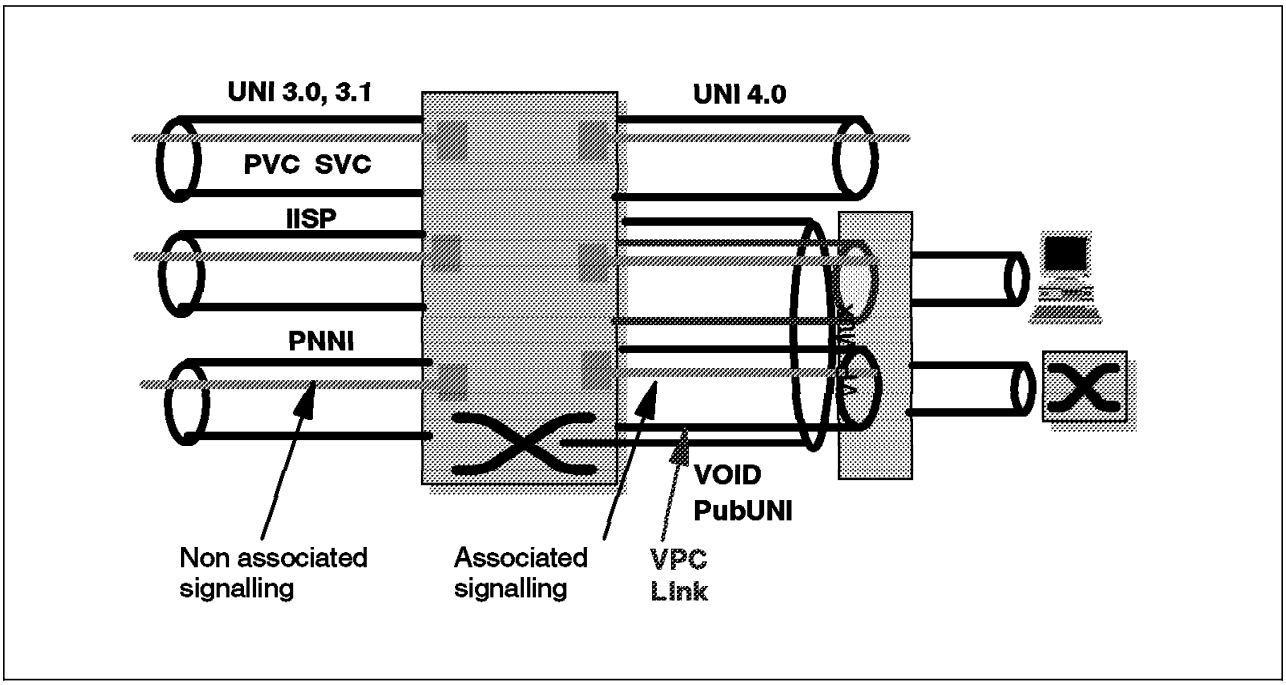


Figure 51. Supported ATM Forum Standards and Interfaces

Different types of signalling interfaces can be defined on the same physical interface of an 8265 ATM media module. In addition to this the control point can also concurrently support different signalling versions on different physical interfaces and also different VPC links of the same 8265 switch.

Signalling versions can either be configured manually or dynamically learned by the control point. In dynamic mode the control point automatically discovers the signalling version of the attaching device.

The control point provides the interconnection for the concurrent signalling versions in the 8265 switch. The control point provides the connection establishment between the various signalling versions, for example, UNI 3.0,3.1 and 4.0 stations. This connection establishment is known as *signalling version translation*. Signalling translation is down on a *best effort* basis as all UNI versions are not fully compatible with each other.

The control point also supports *associated signalling*. This is the ability to control signalling only on the VPC that the signalling channel is defined.

3.10.1.1 VPC Links and VP Tunneling

VP tunneling is a key factor for connecting to public ATM networks and ATM WANs. It is important to be able to carry signalling protocols transparently over the WAN (tunnel) to enable SVC technologies such as LAN Emulation to be deployed across WANs.

The WAN provides permanent virtual paths called virtual path connections (VPCs). The 8265 can have several VP tunnels on each unique physical interface. Each VPC can be of IISP, PNNI or UNI type.

This means that:

- PNNI peer groups can be deployed across a WAN using PNNI VPCs.
- Remote endstations or LAN switches can be attached using UNI VPCs.
- ILMI signalling and routing may be provided per VPC.

As illustrated by Figure 52 VPCs of any type can be mixed on the same interface allowing the number of physical attachments to the WAN to be minimized. For a typical configuration case study and example please refer to 4.4, “Peer Group Configuration Across a WAN (Case Study 3)” on page 123.

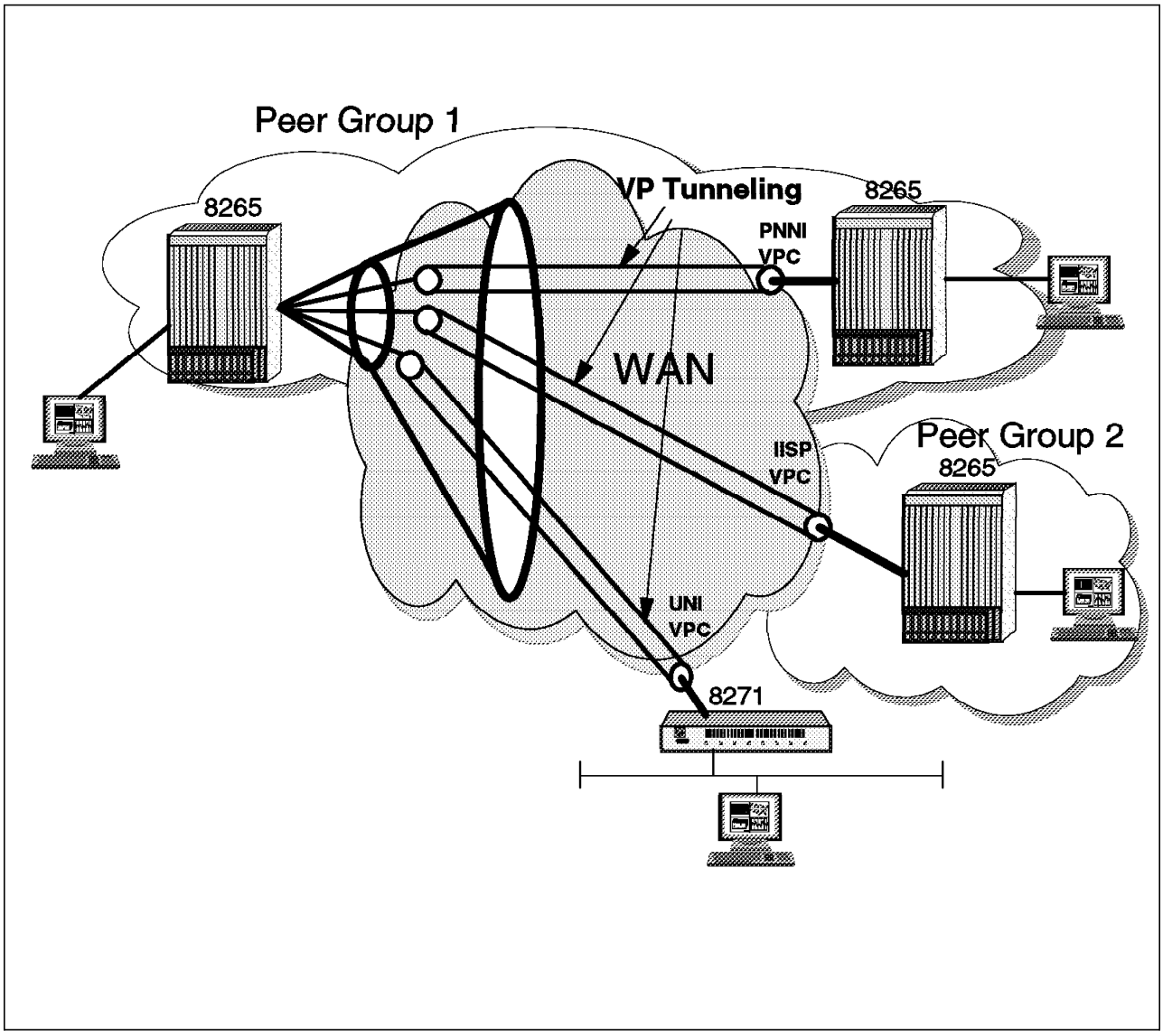


Figure 52. VP Tunneling

VPCs can be defined on a port as being public UNI or VOID, both definitions indicate that the logical interface type (UNI, IISP and PNNI) is defined at the VPC level. The control point does not impose any restrictions on the VPI values at the WAN interface. These VPI values can be different at both ends of the tunnel.

3.10.1.2 Signalling on and between ATM Media Modules

Figure 53 on page 78 is a diagram of how the ATM engine signalling functions on and between two 4-port 155 Mbps MMF media modules are arranged. Although the diagram describes these particular modules it is applicable in theory to all other media modules.

The media-dependent subsystem, in this case the 155 Mbps (OC3) MMF, is specific to the ATM line interface. The SONET Framer is responsible for building the SONET envelope during the transmission of ATM cells and removing this envelope during reception of ATM cells. The media-dependent subsystem uses the UTOPIA interface to communicate with the ATM ASIC. The UTOPIA interface communicates at speeds up to 800 Mbps with the ATM ASIC.

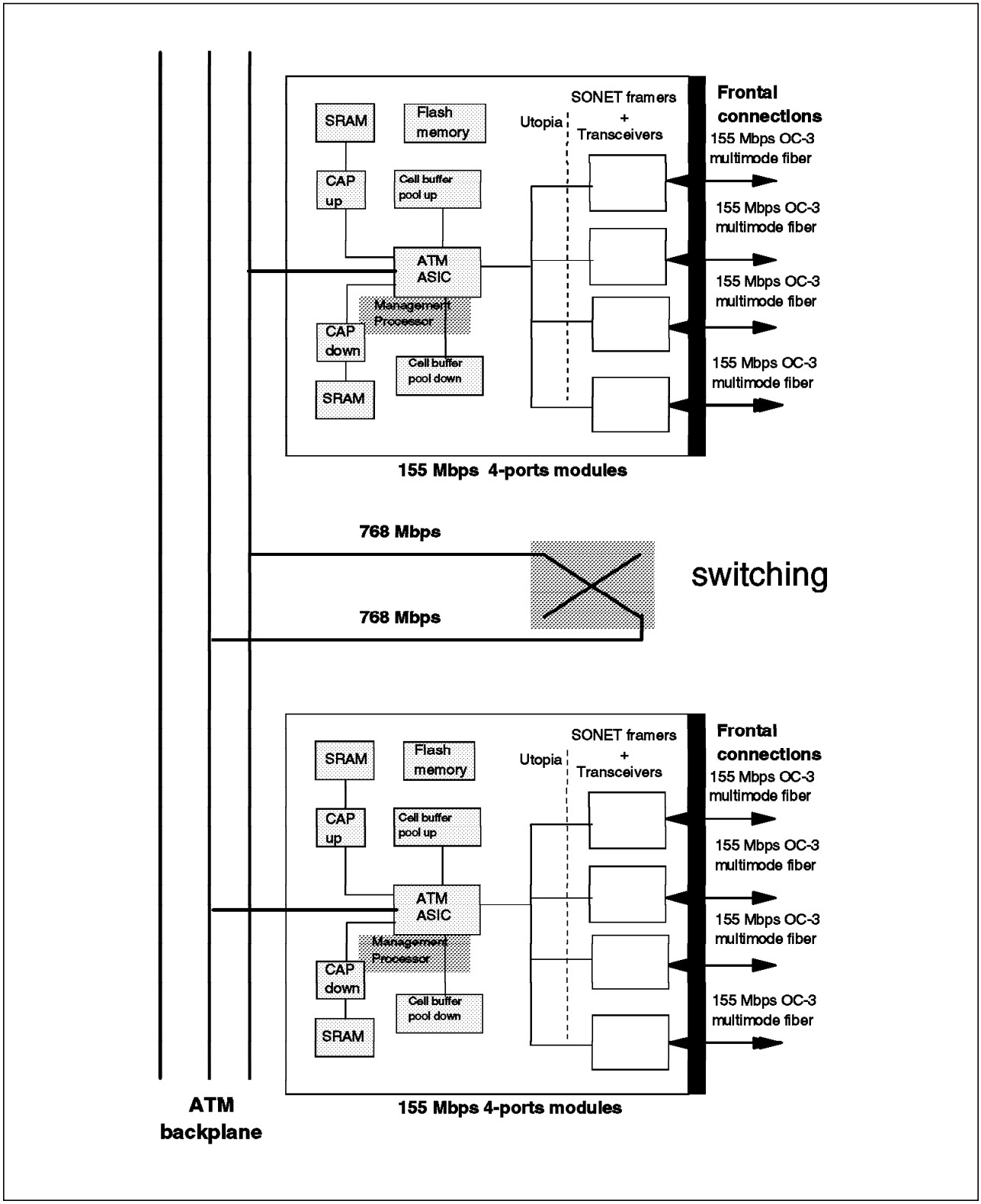


Figure 53. Signalling between Two 4-Port 155 Mbps MMF ATM Modules

The ATM ASIC working at speeds of 768 Mbps handles the ATM front end multiplexing/demultiplexing and data movement of ATM and management *guided* cells between ports and switch. The ATM ASIC builds the internal cell in its SRAM according to instructions given to it by its associated CAPs. The ATM

ASIC communicates with the switching fabric on one of the ports (1 to 15) of the switch. This is achieved via the 8265 backplane.

The Common ATM Processor (CAP) handles the cell routing, queuing, scheduling, traffic management and guided cell process. It decides the routing header for internal cells and passes this information onto the ATM ASIC. In terms of scheduling the CAP-Up provides policing for Reserved Bandwidth (RB). The CAP-Down provides ingres reshaping for RB traffic and egress shaping per VP connection.

3.10.2 User-to-Network Interface (UNI) 4.0 Support

The 8265 A-CPSW supports the user-to-network interface (UNI) 4.0 functions listed in Table 12.

Table 12. UNI 4.0 Supported Features in the 8265

Capability	Standard	Support
Point-to-point calls	Mandatory	Yes
Point-to-multipoint calls	Mandatory	Yes
Signalling of individual QoS parameters	Mandatory	Yes
Leaf initiated join	Optional	No
ATM Anycast	Mandatory	Yes
ABR signalling for point-to-point calls	Optional	Yes
Generic Identifier Transport	Optional	Yes
Virtual UNIs	Optional	Yes
Switched Virtual Path (VP) service	Optional	Yes
Proxy Signalling	Optional	No
Frame Discard	Optional	Yes
Traffic Parameter Negotiation	Optional	Yes
Supplementary Services	Optional	No

3.11 Crankback

If network resources and connectivity are not available to a requesting endstation, then the originating call is sent back to the endstation requesting the call setup. This is known as *crankback*.

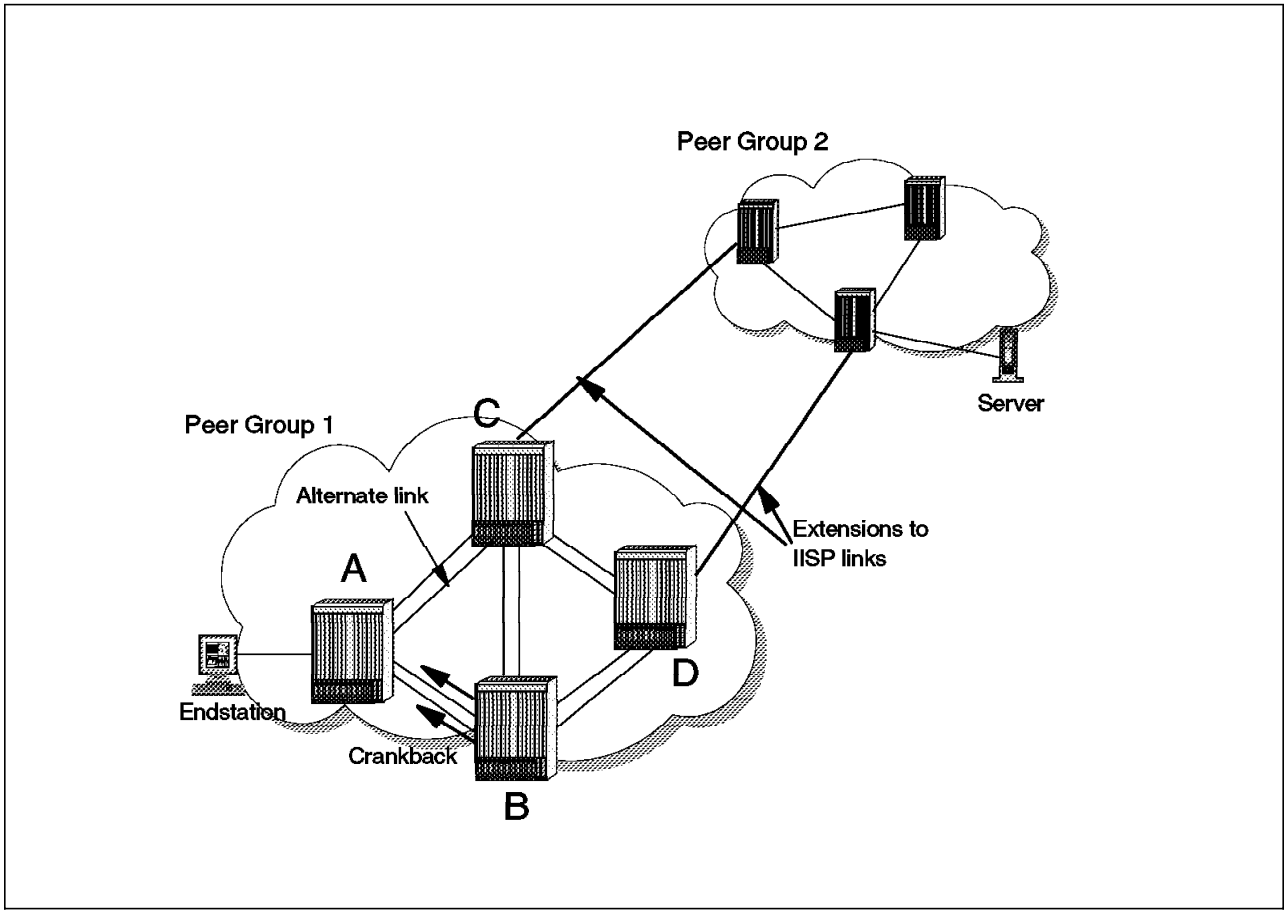


Figure 54. Crankback of Calls in an 8265 Network

With reference to Figure 54 a call that originates from the endstation connected to switch A is cranked back by switch B due to lack of network resources for call setup. However, the crankback is not returned from switch B before all parallel and alternate paths have been tried. This is known as *alternate link* searching.

Crankback control places additional processing overheads on the control point which in turn impacts call setup performance; therefore crankback on 8265s is an option that can be disabled by a network administrator.

Crankback support has been extended to include IISP links as well.

3.12 Simplified 8265 Installation

Sometimes setting up and configuring even the simplest of ATM networks might not be possible for Information Technology (IT) staff due to lack of technical knowledge or expertise. Therefore the 8265 control point uses a process called *plug and play*, which allows for easy and simplified network setups but at the same time allows for intricate ATM configurations by experienced network designers.

Using the Interim Local Management Interface (ILMI) 4.0 implementation the control point only needs the ATM address of the 8265 to be configured to have the ATM subsystem up and functional.

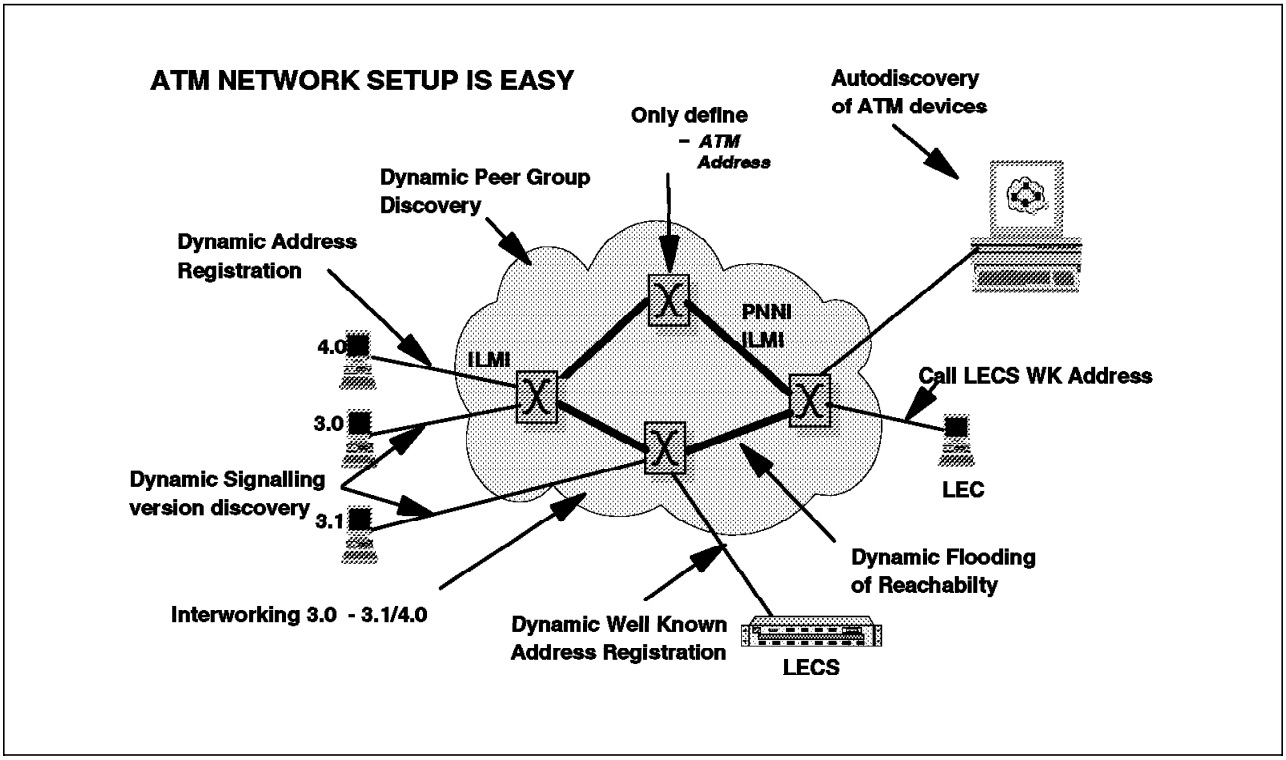


Figure 55. Simplified ATM Networks Setup

The main features of plug and play are:

- Burnt-in MAC addresses on the 8265 backplane for 8265 identification to remain the same even in the case of A-CPSW replacement
- Automatic detection and configuration of interface types for attaching endstations or switches
- LAN Emulation well-known and anycast address support
- SNMP automatic network topology discovery
- Non-Volatile (NVRAM) storage of ATM configuration parameters
- Automatic Intrusion Detection through the secure line feature
- Support for endstations that do not support ILMI protocol

3.13 8265 Redundancy and Availability

Being able to provide redundancy at the switch hardware level and network configuration level is paramount in today's business-oriented world. The 8265 provides two levels of high availability. These levels are at the:

1. **Box Level**

   A-CPSW redundancy is catered for on the 8265. ATM configuration parameters on the primary A-CPSW are mirrored on the secondary A-CPSW.

2. **Network Level:**

   - Distributed ATM network control
   - Link redundancy
   - Path redundancy
   - Endstation dual homing

- Soft permanent connections
- LECS redundancy

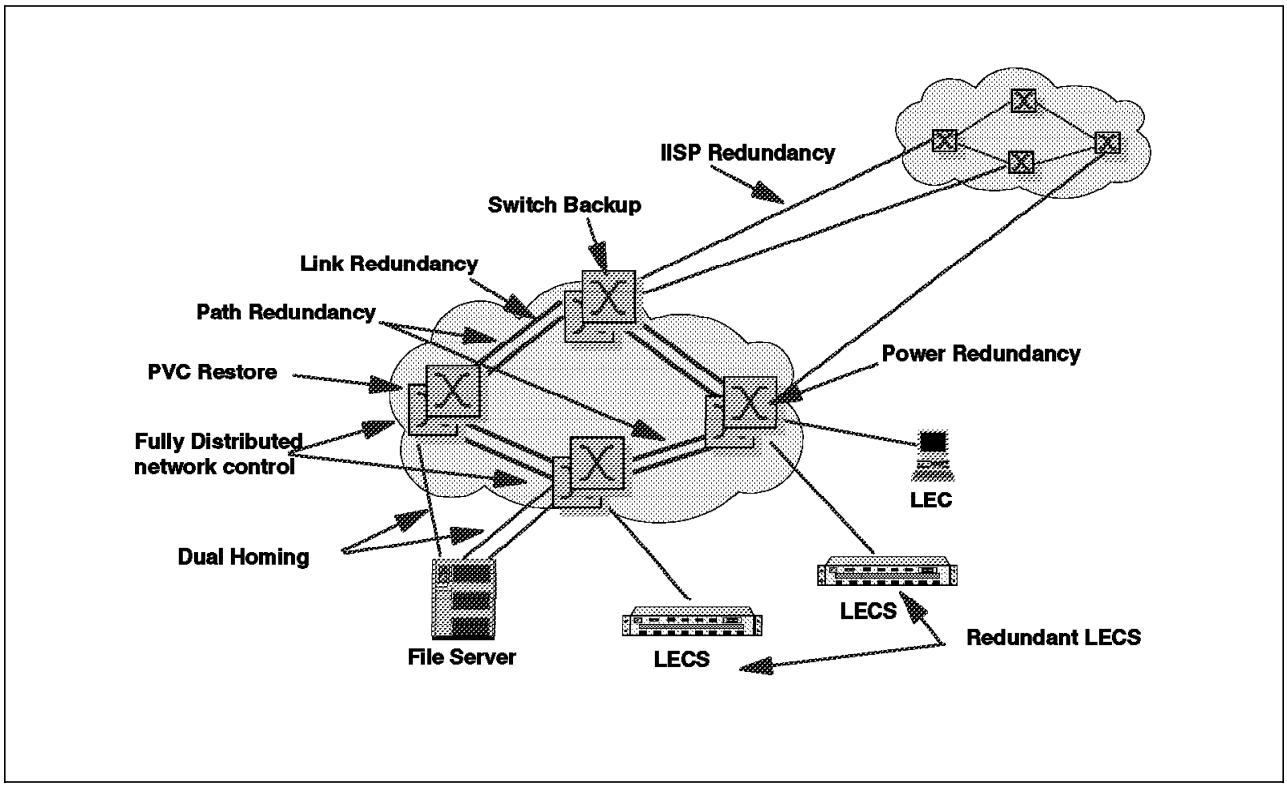


Figure 56. High Availability on the 8265

3.14 Signalling Tuning

Signalling tuning is perhaps more prevalent to larger more complex networks; however, the 8265 provides signalling tuning to all networks in the following areas:

- Clearing of large number of connections on failed trunks
- Clearing of point-to-multipoint connections
- No limitation on concurrent call setups
- Avoidance of layer 2 signalling congestion

Examples of this signalling tuning performed by the 8265 control point appear in Figure 57 on page 83.

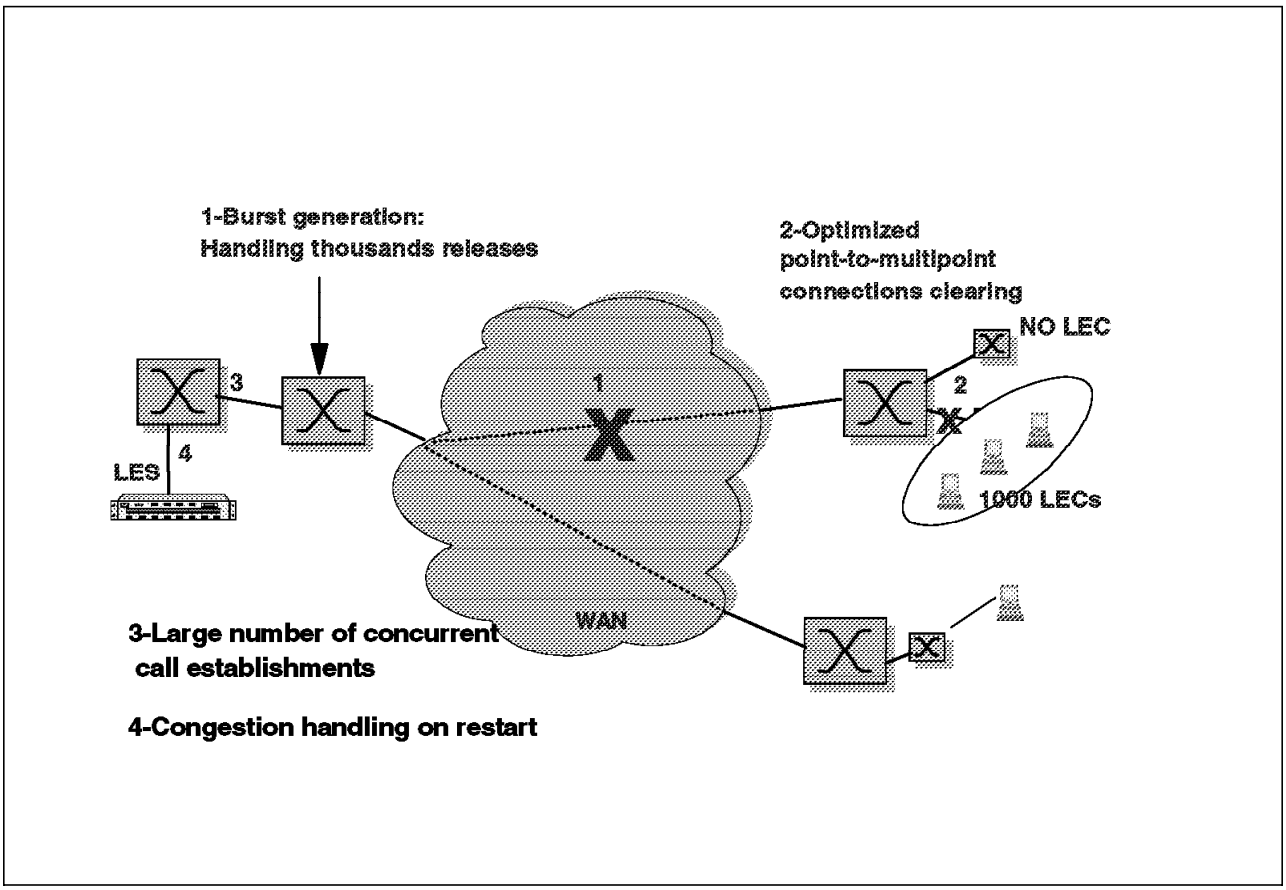


Figure 57. Signalling Tuning Performed by the Control Point

3.15 Traffic Management

This section covers the various traffic management features and functions of the IBM 8265 ATM switch.

3.15.1 8265 Queueing Architecture

The IBM 8265 ATM switch uses both *input* and *output* queueing.

Each ATM module is equipped with its own output and input queues. Output queues are assigned one per QoS and per physical or logical port (VP). Input queues are assigned per QoS and per destination module. Queueing provides the following:

- Traffic shaping at port or VP level via the output queues
- Buffering of heavy traffic by the input queues

3.15.2 Quality of Service Classes (QoS)

The 8265 supports the following Classes of Service:

- Circuit Emulation (CE)- Class A
- Connection-Oriented Data (COD)- Class C
- Connection Less Data (CLD)- Class D
- Constant Bit Rate (CBR)
- Variable Bit Rate - real time (VBR-rt) - supported as CBR
- Variable Bit Rate - non-real time (VBR- nrt) - supported as CBR
- Unspecified Bit Rate (UBR)
- Available Bit Rate (ABR)

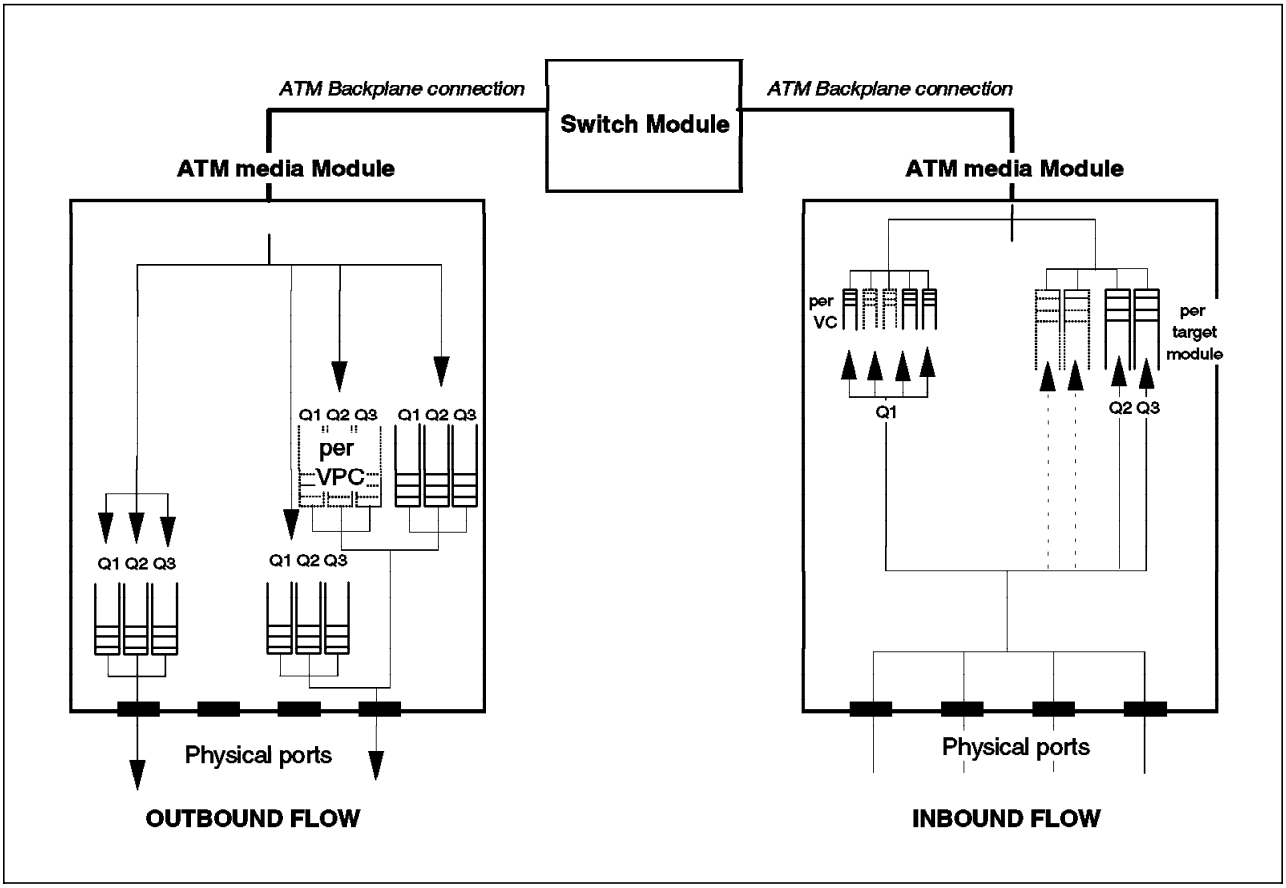


Figure 58. ATM Queues and Quality of Service

Figure 58 shows the various queues that are present on every ATM module. It also depicts the flow of traffic in the ATM media module. The following is an explanation of the queues:

Queues:

Q1 CBR/VBR service

Q2 ABR service

Q3 UBR service

1. The inbound traffic flow is split by QoS into different queues:
   - There is one queue per VC for CBR/VBR traffic **Q1**. This performs the leaky bucket function to police the connection peak cell rate.
   - There is one queue per destination module and per QoS either ABR or UBR **Q2** **Q3**. This allows for the buffering of incoming traffic in case of traffic congestion.
2. The outbound flow of traffic can be split by physical port, logical port, VPC and QoS.

The 8265 has the ability to create several *logical* ports on one physical port with each port acting as a separate entity. For example, different VPCs can be defined as PNNI and UNI on the same physical port and have different QoS parameters set up for them.

The CBR/VBR and ABR queues are provided with a guaranteed number of cell buffers which ensures that traffic never gets blocked or delayed due to buffer depletion. This ensures that system latency remains stable, within the limits of cell delay variation, even under heavy traffic loads.

3.15.3 Constant Bit Rate Service (CBR)

CBR is a reserved bandwidth service where connections get constant and permanent bandwidth. CBR is characterized by the Peak Cell Rate (PCR) value of the aggregate traffic signaled by the user at call setup time.

Connection Admission Control (CAC) within the control point manages CBR connections. Bandwidth is allocated to the requested CBR connection at 85% of the selected route's maximum bandwidth. The remaining 15% is left for management control purposes, for example, SNMP, signaling and PNNI topology updates. If no route is found for the CBR connection, the call is rejected.

CBR service can be used for uncompressed video or voice traffic.

3.15.4 Unspecified Bit Rate Service (UBR)

UBR is a non-reserved bandwidth service. The 8265 control point provides bandwidth to UBR services at a default peak rate equal to the link's physical rate. However, in reality no bandwidth is permanently allocated to UBR connections.

UBR traffic is queued in a First In First Out (FIFO) fashion. UBR queues are scheduled on a round-robin basis. In the event of traffic congestion UBR traffic is affected by two congestion threshold mechanisms. These are:

- Early Packet Discard (EPD)
- Partial Packet Discard (PPD)

These mechanisms help the network recover from congested states and protects CBR services from bursty network traffic that typically causes network congestion. UBR services are normally configured for legacy LAN type applications where traffic is traditionally bursty.

3.15.5 Variable Bit Rate Service (VBR)

VBR is a reserved bandwidth service similar to CBR. Network resources are allocated at call setup according to signaled traffic parameters. A sustainable cell rate (SCR) and a maximum burst size (MBS) are also configured for this service. The SCR is the upper limit of the average cell rate and the MBS limits the duration of cell transmission at peak rate.

VBR can be defined into the following:

- Non-real time (VBR-nrt) suitable for video playback and multimedia
- Real time (VBR-rt) suitable for synchronous traffic, for example, live video transmissions

3.15.6 Available Bit Rate Service (ABR)

ABR is a combination of reserved bandwidth and non-reserved bandwidth connections. The ABR connections periodically *poll* the network and adapt their transmission rates according to the feedback they ascertain. ABR services are also configured with a minimum cell rate (MCR) which ensures that an ABR link never receives less transmission bandwidth than this MCR threshold.

Polling is performed by the source station which transmits resource management (RM) cells. These cells are looped back to the source from various switches along the requested route and contain information on which to make ABR service decisions. This information is either implicit or explicit and tells the source about available transmission rates (explicit) and network congestion indications (implicit).

ABR connections are also subject to CAC. An ABR call is only excepted if its MCR does not exceed 85% of the capacities of the links. If the MCR is more than 85%, then the ABR call is rejected. ABR is only supported on point-to-point connections.

ABR services is generally configured for asynchronous traffic such as X.25 and frame relay over ATM.

3.15.7 QoS Table

The QoS bit rate services described in the previous sections can best be summarized in the following table:

Table 13. Quality of ATM Service

Service Class	Congestion Feedback	Bandwidth Guarantee	Throughput Guarantee
CBR	No	Yes	Yes
VBR	No	Yes	Yes
UBR	No	No	No
ABR	Yes	No	Yes

3.16 8265 Traffic Services

The 8265 provides numerous traffic management functions, which are discussed in the following sections.

3.16.1 Traffic Shaping

In the case of many WAN connections between ATM networks the bandwidth that is subscribed to with the Public Telco's is not necessarily the actual bandwidth specification of the physical interface of the ATM module. A physical interface could be 155 Mbps (OC-3) on a module but the bandwidth attained from the Telco is only 30 Mbps.

It therefore becomes necessary to ensure that the connecting module avoids exceeding the Telco's subscribed rate.

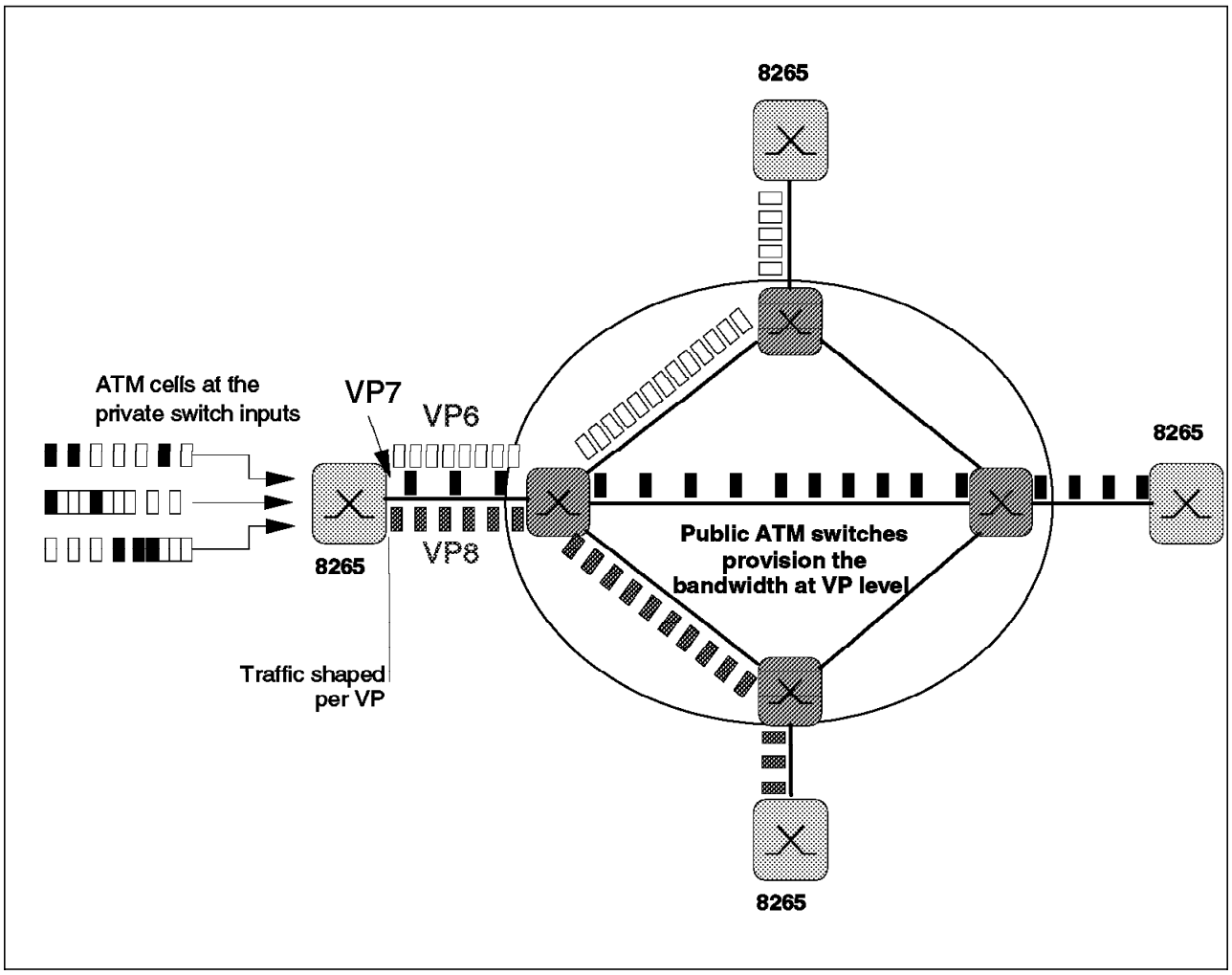


Figure 59. Traffic Shaping on the 8265

The way that the 8265 ensures that the subscribed Telco bandwidth rate is not exceeded is by using a technique called *pacing* or *traffic shaping*. Pacing is a leaky bucket function that sends the end user ATM cells at the maximum rate defined by the user. Pacing spaces the arriving cells at the output port of the module to ensure that the peak cell rate will never exceed the subscribed Telco rate. Traffic shaping is available on the following ATM modules:

- The 8265 1-port 622 Mbps module
- The 8265 4-port 155 Mbps module
- The 8260 WAN 2 module

  Note: Traffic shaping is only on one VP per port.

3.16.2 Port Mirroring

The 8265 provides a port mirroring function, which allows the mirroring of input traffic to any output port of the 8265. Several ports can be mirrored simultaneously on different ports of different modules.

Port mirroring provides the following:

- Fault localization
- Event diagnostics

- Problem determination

Port mirroring is *non-disruptive* to normal ATM traffic, therefore an ATM network analyzer can be implemented into a network for diagnostic purposes without interference to the network traffic flow.

All cells including *bad* cells are mirrored by the 8265. This function provides a true reflection of what is happening on the network to the analyzer, as if the analyzer was actually physically inserted into the link.

3.16.3 Traffic Statistics and Management Functions

Information on traffic statistics is accumulated:

- Per connection

  Detailed tracking of traffic patterns. Upstream/downstream cells of received and transmitted cells are monitored. Discarded cells due to traffic congestion problems are also monitored.

- Per module

  Analysis of module load with upstream and downstream statistics.

- Per port

  Analysis of port load with upstream and downstream statistics.

The following table highlights the traffic management functions of the 8265.

Table 14. Traffic Management Functions

Function	**Support**
Call Admission Control (CAC)	Yes
Usage Parameter Control (UPC)	Yes
Generic Cell Rate Algorithm (GCRA)	Yes, single leaky bucket
Network Parameter Control (NPC)	No
Cell Loss Priority (CLP)	No
Leaky Bucket	Yes
Selective Cell Discarding	No
Traffic Shaping Mechanism	Yes
Network Resource Management (NRM)	Yes
ABR Flow Control Relative Rate	Yes
ABR Flow Control Explicit Rate (ER values)	No, but ER field set to 0 when highest threshold met
Feed Back Control Mechanism	Yes
Explicit Forward Congestion Indication (EFCI)	No
Per VC Queuing	Yes, for CBR/VBR
Full Packet Level Discard	Yes
Explicit Frame Discard Signalling	Yes
Dynamic Discard Thresholds	Yes, but not user-specified
OAM F4/F5	No

Chapter 4. Configuring 8265 ATM Networks

This chapter provides guidelines for configuring 8265s in various ATM campus network case studies. The intent is to illustrate to the reader, through documented steps, the process of setting up 8265s.

4.1 ATM Network Overview

An ATM network provides a connection between ATM devices. These devices are the two endpoints of an ATM connection.

8265s can be interconnected to construct local, privately owned and administered ATM campus networks.

4.1.1 Network Components

Some terms used to describe the components of an ATM campus network are defined here:

- ATM Campus Network

  One or more interconnected ATM peer groups. These peer groups are controlled by one administrative domain and a single private owner using one network access protocol (UNI).

- ATM Peer Group

  One or more ATM switches interconnected by PNNI interfaces, and sharing the same peer group identifier.

- ATM User Device

  An end system that encapsulates data into ATM cells and forwards them to the ATM subsystem across a UNI interface.

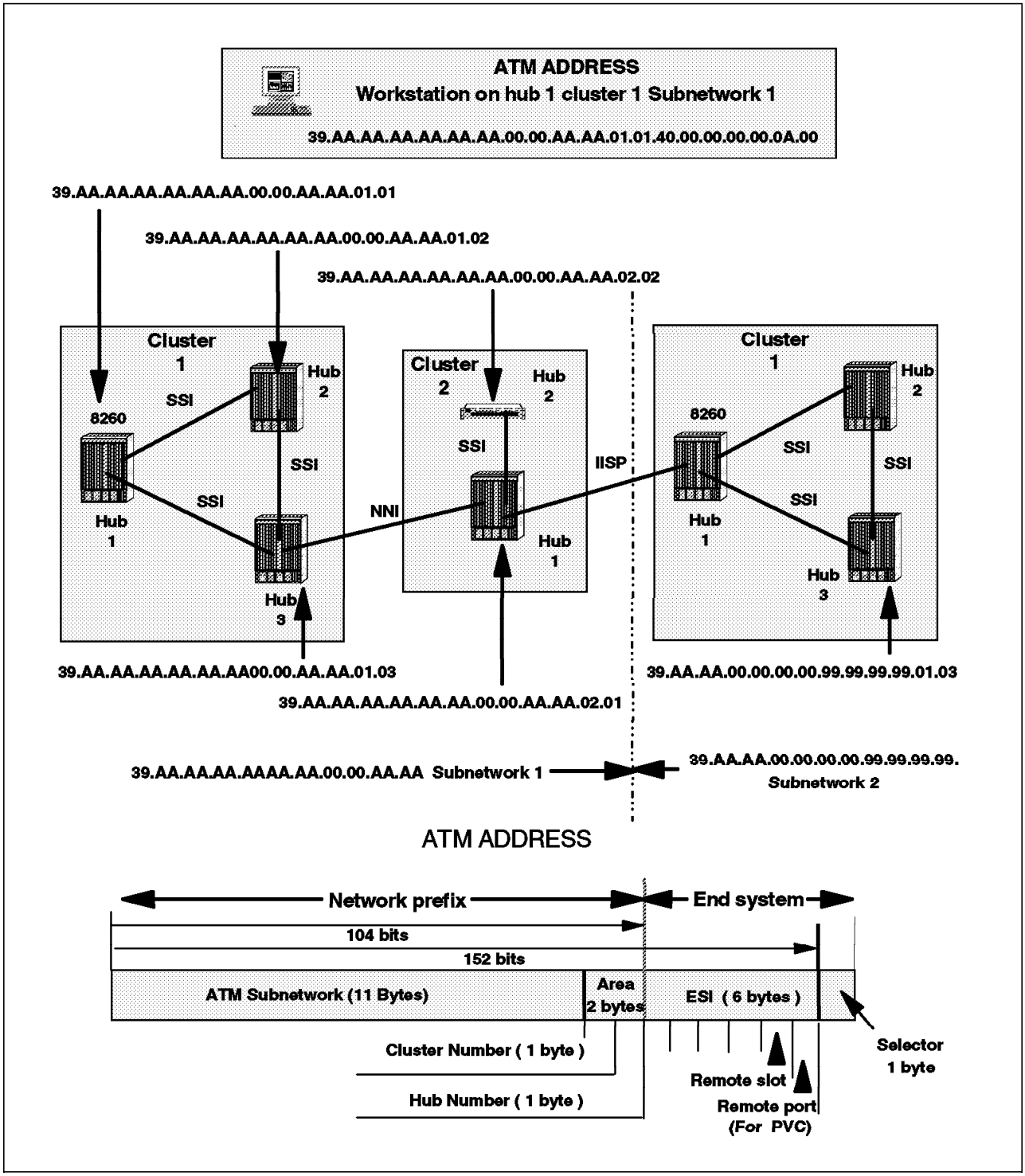


Figure 60. ATM Address Assignment in Campus Network

Figure 60 shows how ATM addresses must be set in peer groups or clusters to provide unique identification for the ATM resource to the ATM campus network.

4.1.2 Network Interfaces

The following protocols are defined in ATM standards for use across the interfaces connecting the components of an ATM campus network:

- UNI

  Defines the interface between an ATM user device (such as a terminal, router, bridge, server, workstation, or concentrator equipped with an ATM adapter) and the ATM network. The ATM subsystem supports the private UNI defined by the ATM Forum UNI Specifications V3.0, V3.1 and V4.0.

- IISP

  Defines the interface between two ATM switches belonging to different ATM routing domains. In the current release, IISP switches are used to interconnect PNNI peer groups. Operator intervention is required in order to define the addresses reachable over IISP links. You can define multiple IISP connections between two different peer groups.

- PNNI

  Defines the interface between ATM switches in the same peer group. The PNNI interface supports networking functions without the need of operator intervention, such as routing, node failure and node recovery, backup, and topology management. You can define multiple PNNI connections between two ATM switches.

- Public UNI

  ILMI is not supported.

  VP tunnels can be defined on such a port, and signalling can be supported through the VP.

- VOID

  ILMI is not supported.

  VP tunnels can be defined on such a port, and signalling can be supported through the VP.

- AUTO

  The interface is automatically set according to that of the incoming signal, as detected by ILMI.

4.2 Simple Peer Group Configuration (Case Study 1)

The intent of this section is to document configuration setup guidelines for an 8265 in a single peer group environment.

In the first case study we use the following IBM equipment:

- IBM 8265 (Hub_0)
  - A-CPSW
  - 4-port 155 Mbps (quantity 3)
- IBM 8260 (Hub_1)
  - CPSW
  - 4-port 155 Mbps (quantity 2)
- IBM 8285 (Hub_2)

- Expansion unit

- RS/6000 (ARP server)
  - ATM adapter card
- RS/6000 (Station S1)
  - ATM adapter card

4.2.1 Network Environment

The case study environment used is shown in Figure 61. The 8265, 8260 and 8285 are in one peer group. Here we describe how to configure the 8265 (Hub_0) in a peer group using PNNI and UNI interfaces. For reference purposes the steps to configure the 8260 (Hub_1) and 8285 (Hub_2) are listed to assist in configuration for this case study.

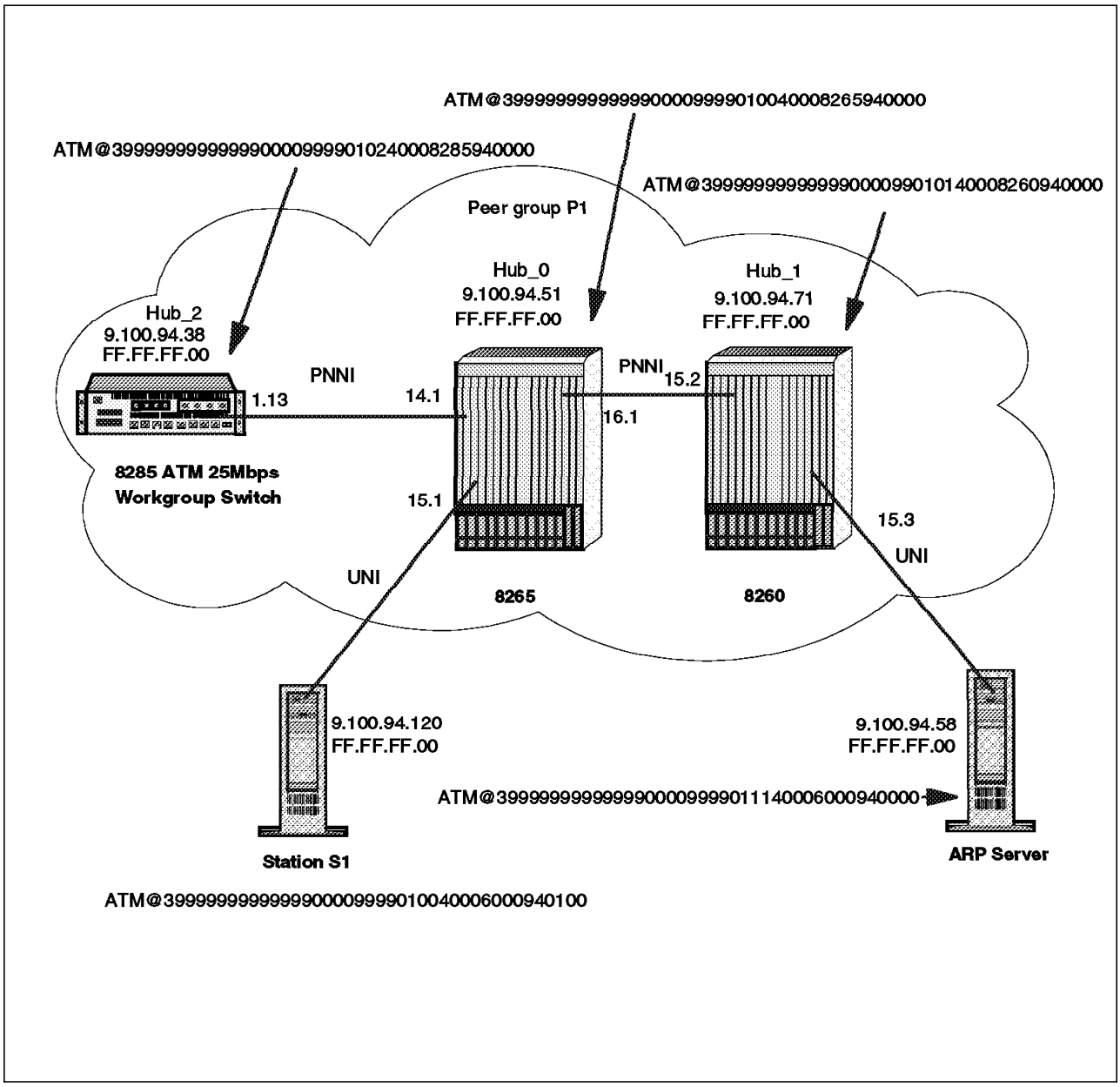


Figure 61. Peer Group Example for Case Study 1

It is assumed that the previous chapter describing the basic configuration of the A-CPSW and module setup has been read. So we start with the configuration of the ATM ports and interfaces:

1. Configuring ATM ports and interfaces

   At this step it is assumed that the module is connected to the backplane using the SET MODULE CONNECT command, as already discussed in 3.5, “Enabling and Disabling ATM Media Modules” on page 66.

   As the ports of the modules may have been used before, we need to know the status of the ports we intend to use. Issue the SHOW PORT ALL command to know the status of the ATM interface of the ports.

```
8265>show port all

      Type Mode     Status
-------------------------------------------------------------------------------
14.01: PNNI enabled  UP
15.01: UNI  enabled  UP
16.01: PNNI enabled  UP
```

   The ports may show any status. Now looking at the type of ATM interfaces, disable all the ports by issuing the SET PORT DISABLE command.

```
8265>set port 14.1 disable PNNI
8265>set port 15.1 disable UNI
8265>set port 16.1 disable PNNI
```

   You can also apply the default values to the port at the time the port is disabled with the ATM interface set to UNI. So let us start by applying the default parameter values to port 1 of the modules in slots 14, 15 and 16 in the 8265 (Hub_0).

   This enables the default parameters to be set for the ports mentioned. As we use the SET PORT command with the port and module number, you will see on the console screen information similar to the following:

```
8265>set port 14.1 apply_default
14.01: Port set
8265>set port 15.1 apply_default
15.01: Port set
8265>set port 16.1 apply_default
16.01: Port set
```

   At this time the ports 14.1, 15.1 and 16.1 are disabled and the ATM interface is set at UNI.

   Before you can use the devices attached to the media ports, you must enable each port and configure the type of interface used by the port to receive and transmit ATM data.

   You can set a port to any of the ATM interfaces:

   - User-to-Network (UNI)
   - Public User-to-Network (public_UNI)
   - Interim Inter-Switch Signalling Protocol (IISP)
   - Private Network-to-Network (PNNI)

- VOID
- AUTO

To enable port 1 of the module in slot 14 of Hub_0 as a PNNI port issue the following command:

```
8265>set port 14.1 enable pnni
14.01: Port set
```

You can also specify multiple ports on the same module within the same command. For example SET PORT 1.2 3 4 ENABLE UNI would enable ports 2, 3 and 4 of module 1.

Now enable port 1 of the module in slot 16 as PNNI and enable port 1 of the module in slot 15 as UNI in Hub_0. As we use the SET PORT command with the port and module number, you will see on the console screen information similar to the following:

```
8265>set port 16.1 enable pnni
16.01: Port set
8265>set port 15.1 enable uni
15.01: Port set
```

Now let's use the SHOW PORT command to display configuration information for the ATM media module ports in the 8265 switch. Port information is displayed only for connected modules. Information about ports on isolated modules is not made available.

As we use the SHOW PORT command with the port and module number, using the VERBOSE extension option parameter, the following console screen information is displayed:

```
8265>show port 14.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
14.01: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

```
8265>show port 16.1 Verbose


      Type Mode     Status
-------------------------------------------------------------------------------
16.01: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 0.16383 (0.14 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

```
8265>show port 15.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
15.01: UNI enabled  UP

Signalling Version   : Auto
> Oper Sig. Version  : 3.0
ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : on
Signalling vci       : 0.5
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

If the value for Status in the console display indicates that an ATM port is DOWN or not operational, please refer to Chapter 6, “Troubleshooting 8265 Networks” on page 163.

2. Configuring the ATM switch address

   Configuring the ATM switch address will cause a *reset* of the ATM system. If you have made any other configuration changes, and not saved them, save them now or they will be lost.

   When an 8265 is powered on for the first time, it automatically loads a default configuration, including a default ATM address. As we have multiple switches in the network, the default ATM address must be reconfigured so that each switch has a unique address. This reconfiguration is achieved by

issuing the SET PNNI NODE_0 ATM_ADDRESS command, followed by the desired ATM address. The following example sets the ATM address to:

39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00

As we use the SET PNNI NODE_0 ATM_ADDRESS command with the ATM address, you will see on the console screen information similar to the following:

```
8265>set pnni node_0 atm_address:39.99.99.99.99.99.99.00.00.99.99.
01.00.40.00.82.65.94.00.00
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
```

Once you have entered the ATM address, you can do any of the following:

- Issue the COMMIT PNNI command. This saves the ATM address entered and resets the ATM control point.

  ```
  8265>commit pnni
  Non-pnni configuration updates will be lost when COMMIT issued.
  Suggestion: issue SAVE ALL before issuing COMMIT..
  Are you sure ? (Y/N) Y

  Press Enter
  Trap Message received on: 11:42:20 Fri 7 Nov 1997
  ```

- Issue the SAVE PNNI command. This saves the ATM address entered. The ATM address will be applied at the next reset.
- Issue the NOCOMMIT PNNI command. This removes the ATM address that you have entered (the previous ATM address remains).
- Issue the SHOW FUTURE_PNNI NODE_0 to display the ATM address that you have just entered. This command is issued if the user thinks an error was made when entering the address. Reissue the SET PNNI NODE_0 ATM_ADDRESS command to change the ATM address again.

  To display the node_0 parameters for the future configuration, enter the following command:

  ```
  8265>show future_pnni node_0
  ---------------------- Node  0 ----------------------
    ATM addr : 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
    Level Identifier :  96 (24 half-bytes and 0 bits)
    PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.01
    Node Id  : 60.39.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
    Unrestricted Transit.
  ```

  Here the peer group ID is the current value and is discussed later in this chapter.

- To display the current ATM address, enter the SHOW PNNI NODE_0 command for the active configuration.

```
8265>show pnni node_0
-------------------- Node  0 ---------------------
  ATM addr : 39.99.82.65.09.99.99.00.00.87.87.01.09.50.00.00.00.94.51.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.99.00.00.88.88.01
  Node Id  : 60.A0.39.99.82.65.09.99.99.00.00.87.87.01.09.50.00.00.00.94.51.00
  Unrestricted Transit.
```

Here again the peer group ID is the current value and it is discussed later in this chapter.

3. Configuring the ARP server ATM address

   One of the RS/6000s has been configured as an ARP server. We assign ARP IP addresses to the 8265 and the other devices. This enables us to have a Classical IP over ATM network. As the target devices are reachable via a Classical IP over ATM subnetwork, the 8265 switch must be configured with the ATM address of the ARP server by using the SET DEVICE ARP_SERVER command. The ARP server is used in a Classical IP over ATM network to map IP addresses to ATM addresses.

   Issue the SET DEVICE ARP_SERVER command and you will see the console screen information similar to the following:

```
8265>set device arp_server 39.99.99.99.99.99.99.00.00.99.99.
01.11.40.00.60.00.94.00.00

Device arp_server changed
```

   We see the ARP server IP address when we issue the SHOW DEVICE command.

4. Configuring peer group identifiers

   Peer group identifiers are private ATM address prefixes that define the set of switches that together form one peer group.

   All switches that are to form a peer group must have the same peer group identifier. (Both length and content must be the same.)

   The length, in bits, of the peer group identifier is called the *level identifier*, and governs the length of the address that must be matched. The level identifier can be set to any length from 0 bits through to 104 bits, although normally less than 104 bits is used.

   We will explicitly define the peer group identifier using the SET PNNI NODE_0 LEVEL_INDENTIFIER command. You will see on the console screen information similar to the following:

```
8265>set pnni node_0 level_identifier:96
Will alter content & length of peer group id.
To cancel issue UNCOMMIT.
```

5. Entering a peer group ID

   To define a peer group ID, you must specify both the length and content.

   We define the peer group using the SET PNNI NODE_0 PEER_GROUP_ID command. The following example sets the peer group ID to:

   39.99.99.99.99.99.99.00.00.99.99.01

```
8265>set pnni node_0 peer_group_id:96
39.99.99.99.99.99.99.00.00.99.99.01
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
```

By using COMMIT PNNI the node_0 takes the peer group ID from the first 96 bits of the entered string:

39.99.99.99.99.99.99.00.00.99.99.01

Where 96 is the new level ID.

This action results in the peer group ID being different from the switch's 96-bit ATM address.

Note

The entered peer group ID value must conform to the prefix of the private ATM address. PNNI applies address checking to entered peer group IDs.

This operation removes the restraint that the address of every switch in a peer group has to have a common prefix of level ID length. One peer group ID, *common* to the network, can be entered at each switch, thereby making the network operation independent of whether the switch addresses have a common prefix or not.

Once you have explicitly defined a peer group ID, you cannot modify the length of it by entering the SET PNNI NODE_0 LEVEL_IDENTIFIER command. This will cause the peer group ID to be determined from the switch's ATM address. To change the length of an explicitly defined peer group ID, you must re-enter the SET PNNI NODE_0 PEER_GROUP_ID command.

6. Configuring summary addresses

   In PNNI, *reachability* is the advertising of end system addresses throughout a peer group for the purpose of setting up connections between end systems. Reachability in PNNI routing is simplified by the capability of having groups of addresses with a common prefix to be represented by that prefix. Such a prefix is called a *summary address*.

   PNNI generates a default summary address to provide reachability to all end systems attached to the switch whose addresses share the switch's 13 byte ATM address prefix. These addresses are generated by the ILMI address notification protocol. Additional non-default summary addresses can be configured to provide reachability for address groups that do not share their switch's 13 byte ATM address prefix. For example, entering the following command will cause all end systems directly attached to the switch via UNI, whose addresses begin with the first 104 bits of the string 39.99.99.99.99.99.99.00.00.99.99.01.00 to be represented in the peer group by the just entered summary address. PNNI stores a summary address if no end system address prefixes match that address.

```
8265>set pnni node_0 summary_addr internal:
104 39.99.99.99.99.99.99.00.00.99.
99.01.00
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
```

   PNNI uses a longest matching prefix criterion, so no two summary addresses within a PNNI network should have the same value, unless they represent the same set of addresses. Furthermore, summary addresses should be

configured as long as possible to enhance the longest matching prefix selection.

Now let us look at the related summary address commands.

Issuing the SHOW FUTURE PNNI SUMMARY ADDRESS command will show the user the future summary address on the console screen before the COMMIT command is issued.

```
8265>show future_pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.99.99.99.99.99.00.00.99.99.01.00
```

Issuing the SHOW PNNI SUMMARY ADDRESS command will show you the current summary address on the console screen.

```
8265>show pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.82.65.09.99.99.00.00.87.87.01.09.  .  .  .  .  .  .
```

Issuing CLEAR PNNI SUMMARY ADDRESS will clear the numbered entry of the summary address.

```
8265>clear pnni summary_address 1
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
8265>commit pnni
COMMIT successfully executed.
To save new configuration issue SAVE.
8265>save pnni
```

7. Configuring PNNI path selection

   IBM's PNNI Phase 1 implementation supports all the types of classes of traffic (QoS):

   - Constant Bit Rate and Variable Bit Rate

     Routing is done on-demand, corresponding to the demand appearing when processing a call from the network. (This is automatic and requires no configuration action from the ATM console.)

     – Calls not satisfying the Generic Call Admission Control (GCAC) are pruned.

     – A shortest path is computed based on the administrative weight.

     – Widest path is the default value.

   - Available Bit Rate

     IBM's PNNI Path Selection supports Available Bit Rate (ABR) calls in two ways, pre-computed and on-demand:

     – Paths are pre-computed and a specific route is obtained via table lookups, resulting in fast connection setup.

     – Paths are computed on-demand, resulting in slower connection setups, but with more optimization for the individual routes.

     The default setting for ABR is for paths to be pre-computed, but this can be changed to on-demand by entering the following command:

```
8265>set pnni path_selection abr: on_demand_path
```

The setting can be changed back to pre-computed by entering the following command:

```
8265>set pnni path_selection abr: precomputed_path
```

Unspecified Bit Rate

IBM′s PNNI Path Selection supports Unspecified Bit Rate (UBR) in two ways, shortest path and widest path:

- The *shortest path* approach follows a two step algorithm. In step one, paths with minimal hop count to the destination are selected. In the second step, the widest path approach is applied to the previously selected group of shortest paths to select the final route. This approach is favored when the network contains critical restraints such as links (VCIs, VPIs) and/or switches that tend to become traffic bottlenecks. The drawback of the shortest path approach, is its reduced load balancing capability.
- The *widest path* approach finds the least loaded path in terms of bandwidth regardless of the number of hops required to reach the destination. This approach balances the load on the paths through a network in the absence of critical constraints within that network. The default configured setting is the widest path approach, and this can be changed to shortest path by entering the following command:

```
8265>set pnni path_selection ubr: shortest_path
```

The setting can be changed back to widest path by entering the following command:

```
8265>set pnni path_selection ubr: widest_path
```

To display the current route modes, enter the following command:

```
8265>show pnni path_selection
Unspecified bit rate : shortest path.
  Available bit rate : pre-computed path.
```

We used UBR shortest path, as it selects the path with the fewest number of hops. For ABR we selected pre-computed path as this results in faster connection setup time, using the pre-computed path and taking routing information from predefined lookup tables.

Note

Reserved Bandwidth (VBR, CBR) and point-to-multipoint calls are processed as on-demand and shortest path calls.

8. Using the crankback function

   The crankback function enables the PNNI control point to automatically establish an alternate link to a target device when a failure occurs on the current route. To enable or disable the crankback function, you enter the SET

PNNI CRANKBACK ON or SET PNNI CRANKBACK OFF commands. The following example shows how to enable the crankback function.

```
8265>set pnni crankback: on
To activate issue COMMIT after your last 'set pnni...' entry.
To cancel all changes since previous COMMIT, issue UNCOMMIT.
```

Issue the SHOW PNNI CRANKBACK command to see the current status of crankback.

```
8265>show pnni crankback
Crankback : off.
```

Issue the COMMIT PNNI command, to activate the last SET PNNI entry.

```
8265>commit pnni
Non-pnni configuration updates will be lost when COMMIT issued.
Suggestion: issue SAVE ALL before issuing COMMIT..
Are you sure ? (Y/N) Y

Press Enter
```

9. Displaying PNNI information

   Here we show how to display information about the PNNI system.

   There are two types of information that can be displayed:

   - Information relating to the active and future configurations:
     - Node_0 information (ATM address, level identifier, and peer group ID)
     - Path selection settings
     - Summary addresses
   - Information relating to the PNNI system itself:
     - Configuration status
     - Peer group member neighbors
     - PTSEs

10. Displaying Node_0 Information

    The following parameters can be displayed for Node_0:

    - ATM address
    - Level identifier
    - Peer group ID

    To display the Node_0 parameters for the Active configuration, enter the following command:

```
8265>show pnni node_0
--------------------- Node  0 ---------------------
  ATM addr : 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.01
  Node Id  : 60.39.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
  Unrestricted Transit.
```

    a. Path selection settings

To display whether paths are set to be pre-computed or set up on demand, enter one of the following commands. For the active configuration, enter the following command:

```
8265>show pnni path_selection
Unspecified bit rate : widest path.
  Available bit rate : precomputed path.
```

For the future configuration, enter the following command:

```
8265>show future_pnni path_selection
Unspecified bit rate : shortest path.
  Available bit rate : precomputed path.
```

b. Peer group members

To display all node IDs included in the currently active peer group, enter the following command:

```
8265>show pnni peer_group_members
------ Peer Group of Node 0------
  60.A0.39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00 connected
  60.A0.39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00 connected
  60.A0.39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00 connected

3 Members.
```

c. Neighbor node IDs

To display a list of neighbor node IDs, enter the following command:

```
8265>show pnni neighbor
------ Neighbors of Node 0------
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00: Full
    Port 16.01 vpi=0
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00: Full
    Port 14.01 vpi=0
```

Node IDs are 22-byte identifiers that characterize a PNNI node. Neighbor nodes are nodes directly connected via one or more links to the node being referenced.

d. Summary addresses

To display the summary addresses already in effect (in the active system), enter the following command:

```
8265>show pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.99.99.99.99.99.00.00.99.99.01.00   .  .  .  .  .  .
```

To display the summary addresses set in the future configuration, enter the following command:

```
8265>show future_pnni summary_address
```

The resulting display also includes an index number for each summary address set. This index number can be used to delete a summary address when used in the following command:

```
8265>clear pnni summary_addr <n>
```

Where <n> is the index number of the address to be deleted.

e. Configuration state

To display the PNNI configuration state, enter the following command:

```
8265>show pnni configuration_state
```

This displays whether the active configuration is saved or not, and whether there is a pending COMMIT.

f. PTSEs

Key entities in PNNI are PNNI Topology State Elements (PTSEs). A PTSE is a collection of PNNI information that is flooded to all logical nodes within a peer group. Each Node_0 creates its own PTSEs called *self originated* PTSEs, of which there are six types:

1) Nodal State Parameter (NSP)
2) Nodal Information Group (NIG)
3) Internal Reachability (IR)
4) External Reachability (ER)
5) Horizontal Link (HL)
6) Up Link (UL).

Summary information about these PTSEs can be obtained by issuing the following command:

```
8265>show pnni ptse self_originated all
```

This lists the number of existing PTSEs of each type. If the summary shows the presence of, for example, three HL PTSEs, you can use a positive integer, smaller or equal to 3, to retrieve detailed information about the respectively indexed HL PTSE. For example, say you wish to inspect the second PTSE, then you would enter the following command:

```
8265>show pnni ptse self_originated horizontal_link 2
```

The general structure of the command applies to all other PTSE types, you simply replace HORIZONTAL_LINK with NODAL_INFORMATION_GROUP, INTERNAL_REACHABILITY, EXTERNAL REACHABILITY, NODAL_STATE_PARAMETERS, or UP_LINK. Additionally, you can also display the PTSE′s Resource Availability Information Groups (RAIGS) by including the parameter WITH_RAIGS. For example:

```
8265>show pnni ptse self_originated horizontal_link 2 with_raigs
```

You can also limit the PTSE summary information displayed to only one type of self-originated PTSE. For example, entering the following command will display summary information about HL PTSEs only.

```
8265>show pnni ptse self_originated horizontal_link
```

Self-originated PTSEs are flooded to all other switches in the ATM PNNI network so that the database of any one switch contains copies of PTSEs issued by all other switches. These PTSEs can also be displayed. By entering SHOW PNNI PEER_GROUP_MEMBERS, you can obtain the index entry identifying the node ID (which identifies the switch) whose PTSEs you want to display. For example, if the index entry is 3, you would enter the following command to obtain summary information about all PTSE types issued by the respective node.

```
8265>show pnni ptse 3
```

Then you could display that node's second HL PTSE (assuming it exists), by entering the following command:

```
8265>show pnni ptse 3 horizontal_link 2
```

You can also limit the displayed PTSE summary information to one PTSE type. For example, entering the following command will limit the summary to HL PTSEs issued by the switch whose node ID corresponds to index 3. Remember, that you obtain the node ID to index mapping by entering the SHOW PNNI PEER_GROUP_MEMBERS command.

```
8265>show pnni ptse 3 horizontal_link
```

g. Show device

The SHOW DEVICE command is used to display the configuration information about the ATM control point.

Issuing the SHOW DEVICE command displays detailed information on the console screen. The ATM subsystem can be interpreted as being operational and healthy by observing the Subnet atm: Up response highlighted in the following console display. For further details please refer to the *IBM Nways 8265 ATM Command Reference Guide*.

```
8265>show device
8265>ATM Control Point and Switch Module
Name : ATMG_09
Location :
La Gaude LAB

For assistance contact :
Kevin Treweek
Farhad Sidhwa
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.3.2.0
Flash EEPROM version: v.3.2.0
Flash EEPROM backup version: v.3.2.0
Last Restart : 11:42:19 Fri 7 Nov 1997 (Restart Count: 33)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Up
 IP address: 9.100.94.51. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: FFF9D688FFF3
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 00062977000C
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.92.33

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
Accounting is disabled.
```

11. Configuring Hub_1 and Hub_2

    Repeat the previously explained steps 1 to 8 for both Hub_1 and Hub_2.

    The SHOW DEVICE command will illustrate the configuration information about the ATM control point of Hub_1 and Hub_2. Your setup for Hub_1 and Hub_2 should provide similar values for the configuration.

a. Hub_2 SHOW DEVICE command

```
8285>show device
8285 Nways ATM Workgroup Switch
Name : 8285
Location :


For assistance contact :
 27 Oct 97

Manufacture id: RTP
Part Number: 4412SW8 EC Level: 09181C
Serial Number: LAG
Boot EEPROM version: v.3.1.7
Flash EEPROM version: v.3.1.7
Flash EEPROM backup version: d.3.1.7
Last Restart : 16:27:42 Thu 6 Nov 97 (Restart Count: 19)

A-8285
--------------------------------------------------------------------------------
 > Subnet atm: Up
 IP address: 9.100.94.38. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Dynamic RAM size is 12 MB. Migration: off. Diagnostics: disabled.
Duplicate ATM addresses are not allowed.
8285>
```

b. Hub_1 SHOW DEVICE command

```
8260>show device
8260 ATM Control Point and Switch Module
Name : QA Partner demo - ATM
Location :
Mon Jul  1 14:10:23 DFT 1996 QA Partner demo - T6X test floor

For assistance contact :
 6 Oct 97

Manufacture id: VIME
Part Number: 47H2331 EC Level: E28028
Boot EEPROM version: v.3.1.7
Flash EEPROM version: d.3.1.7
Flash EEPROM backup version: v.3.1.7
Last Restart : 13:42:26 Thu 30 Oct 97 (Restart Count: 135)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Up
 IP address: 9.100.94.71. Subnet mask: FF.FF.FF.80

 > Subnet lan emulation ethernet/DIX
   Up
   Config ELAN Name :""
   Actual ELAN Name :"Eth_BB"
   MAC Address: 40FC82602222
   IP address : 9.100.93.161. Subnet mask: FF.FF.FF.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 16 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
```

Next we display the port configuration of Hub_1 and Hub_2. Similar port configurations will be observed after repeating steps 1 through 8 of the configuration process for these hubs.

c. Hub_2 SHOW PORT command

```
8285>show port 1.13 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
1.13: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 0.16383 (0.14 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

d. Hub_1 SHOW PORT command

```
8260>show port 15.3 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
15.03: UNI enabled  UP

Signalling Version   : Auto
> Oper Sig. Version  : 3.0
ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : on
Signalling vci       : 0.5
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

```
8260>show port 15.2 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
15.2: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 0.16383 (0.14 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

e. PING

This command is used to verify if the IP device is active and reachable. The target devices are reachable via a Classical IP over ATM network.

The 8265> switch is configured with the ATM address of of the ARP server by using the SET DEVICE ARP_SERVER command, as discussed in Step 3:Configuring an ARP Server ATM Address. We also saw the ARP server IP address when we issued the SHOW DEVICE command. The ping command sends packets to the device to be *pinged* and requests the devices to send back the same packets. PING loops continuously until the CTRL+C keys are pressed. The confirmation of the packets received indicates positively the connectivity of our peer group network.

Examples of the ping test from Hub_0 to Hub_1, Hub_2, Station S1 and the ARP server using their respective IP addresses are shown in the following screen:

```
8265>ping 9.100.94.38
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.38: 1 packets sent, 1 received
Ping 9.100.94.38: 2 packets sent, 2 received
Ping 9.100.94.38: 3 packets sent, 3 received
Ping 9.100.94.38: 4 packets sent, 4 received

8265>ping 9.100.94.120
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.120: 1 packets sent, 1 received
Ping 9.100.94.120: 2 packets sent, 2 received
Ping 9.100.94.120: 3 packets sent, 3 received

8265>ping 9.100.94.71
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.71: 1 packets sent, 1 received
Ping 9.100.94.71: 2 packets sent, 2 received
Ping 9.100.94.71: 3 packets sent, 3 received
Ping 9.100.94.71: 4 packets sent, 4 received
Ping 9.100.94.71: 5 packets sent, 5 received

8265>ping 9.100.94.58
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.58: 1 packets sent, 1 received
Ping 9.100.94.58: 2 packets sent, 2 received
Ping 9.100.94.58: 3 packets sent, 3 received
Ping 9.100.94.58: 4 packets sent, 4 received
Ping 9.100.94.58: 5 packets sent, 5 received
```

As we are able to ping all the IP devices in the network it is assumed that the network is up and running.

However, other problems maybe encountered. These could be related to LAN emulation, bridging or routing at layer 3. Please refer to Chapter 6, “Troubleshooting 8265 Networks” on page 163 for fault isolation procedures.

4.3 Multiple Peer Groups Configuration (Case Study 2)

The intent of this section is to illustrate the configuration guidelines for an 8265 using the IISP interface. The IBM equipment used in this two peer group configuration setup was:

- IBM 8265 (Hub_0, Peer Group P2)
  - A-CPSW
  - 4-port 155 Mbps (quantity 3)
- IBM 8285 (Hub_1, Peer Group P2)
  - Expansion unit
- IBM 8260 (Hub_0, Peer Group P1)
  - CPSW
  - 4-port 155 Mbps (quantity 2)
- RS/6000 (ARP server)
  - ATM adapter card
- RS/6000 (Station S1)
  - ATM adapter card

4.3.1 Network Environment

The case study environment used is shown in Figure 62. The 8265 (Hub_0) and 8285 (Hub_1) are in peer group P2. The 8260 (Hub_0) is in peer group P1. In this example we define two peer groups P1 and P2 and we describe how to configure the 8265 (Hub_0) in peer group P2 using the IISP interface protocol. We also show the steps to configure the 8260 (Hub_0) for your reference purposes.

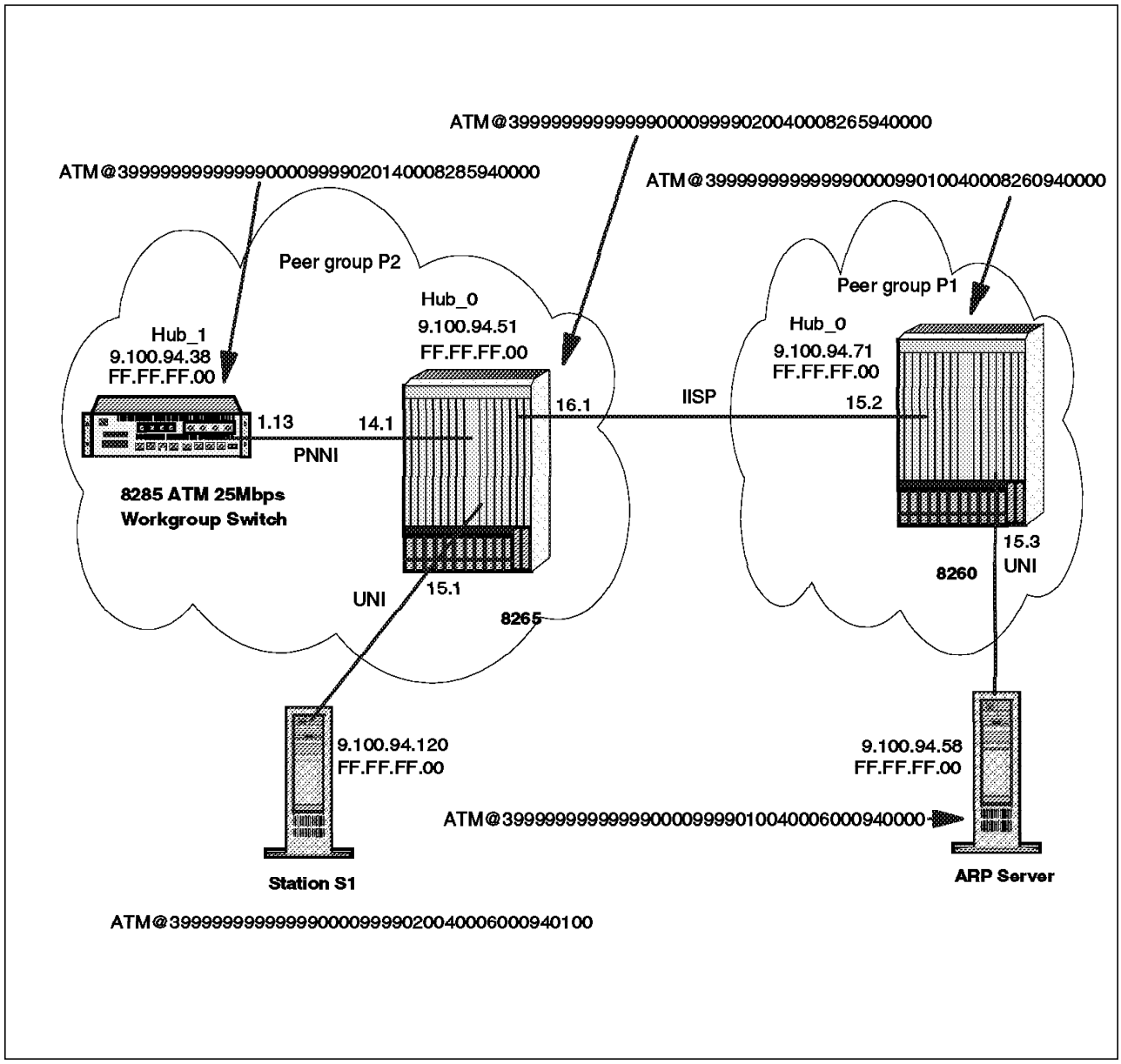


Figure 62. Two Peer Groups Connected by IISP Interface

Here we define two peer groups P1 and P2. The 8260 (Hub_0) is in peer group P1 and the 8265 (Hub_0) and 8285 (Hub_1) are in peer group P2.

It is assumed that Hub_0 and Hub_1 of peer group P2 have been configured as in the previous case study 4.2.1, “Network Environment” on page 94.

Now we display the status of the devices and ports using the SHOW DEVICE and SHOW PORT commands.

- Hub_1 of peer group P2 configuration

```
8285>show device
8285 Nways ATM Workgroup Switch
Name : 8285
Location :


For assistance contact :
 27 Oct 97

Manufacture id: RTP
Part Number: 4412SW8 EC Level: 09181C
Serial Number: LAG
Boot EEPROM version: v.3.1.7
Flash EEPROM version: v.3.1.7
Flash EEPROM backup version: d.3.1.7
Last Restart : 16:27:42 Thu 6 Nov 97 (Restart Count: 19)

A-8285
------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.38. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.01.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.01.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.60.00.94.00.00

Dynamic RAM size is 12 MB. Migration: off. Diagnostics: disabled.
Duplicate ATM addresses are not allowed.
8285>
```

Note: The ATM address subnetwork has been changed to reflect peer group P2. Please note the Subnet atm: Down as we are reconfiguring the Hub_0, as described in the next step.

```
8285>show port 1.13 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
1.13: PNNI enabled   Up

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 0.16383 (0.14 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

- 8265 (peer group P2 Hub_0) information and setting

  The SHOW DEVICE command is used to display the configuration information about the ATM control point of Hub_0 of peer group P2.

```
8265>show device
8265>ATM Control Point and Switch Module
Name : ATMG_09
Location :
La Gaude LAB

For assistance contact :
Farhad Sidhwa
Kevin Treweek
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.3.2.0
Flash EEPROM version: v.3.2.0
Flash EEPROM backup version: v.3.2.0
Last Restart : 11:42:19 Fri 7 Nov 1997 (Restart Count: 33)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.51. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: FFF9D688FFF3
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 00062977000C
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.92.33

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
Accounting is disabled.
```

Note: The ATM address subnetwork has been changed to reflect peer group P2. The display screen shows Subnet atm: Down, as we are reconfiguring the Hub_0 parameters. This means that the ATM link between the peer groups is not active.

The Hub_0 ports 14.1 and 15.1 are configured for PNNI and UNI ATM interfaces respectively. This was already done in Case Study 1, so there is no need to reconfigure these ports.

If you issue the SHOW PORT command on the ports 14.1 and 15.1, you will see on the console screen information similar to the following:

```
8265>show port 14.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
14.01: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

```
8265>show port 15.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
15.01: UNI enabled  UP

Signalling Version   : Auto
> Oper Sig. Version  : 3.0
ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : on
Signalling vci       : 0.5
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

1. Displaying SHOW PNNI node_0 parameters

```
8265>show pnni node_0
--------------------- Node  0 ---------------------
  ATM addr : 39.99.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.02
  Node Id  : 60.39.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
  Unrestricted Transit.
```

We got the peer group ID of peer group P2.

2. Displaying the SHOW PNNI summary_address command

```
8265>show pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.99.99.99.99.99.00.00.99.99.02.00
```

We got the summary address of the node

We now start with the configuration of the 8265 (Hub_0) from peer group P2.

3. Configuring ATM ports and interfaces

As described in the previous section, 4.2.1, “Network Environment” on page 94 on how to set the ports to different ATM interfaces, set the port 16.1 to IISP interface.

```
8265>set port 16.1 enable IISP network
```

At this point if the port is set correctly, you should display the port status by issuing the SHOW PORT command. The information on the screen should be similar to the following:

```
8265>show port 16.1


      Type Mode     Status
--------------------------------------------------------------------------------
16.01: IISP enabled  UP
```

4. Configuring reachable addresses

When IISP is defined to connect the switches together, you also need to specify the address of the switch that is to be reached. To do this, you enter the SET REACHABLE_ADDRESS command. This command specifies the prefix of the addresses reachable through the specified port.

```
8265>set reachable_address 16.1 96 39.99.99.99.99.99.99.00.00.99.99.01
```

Use the SHOW REACHABLE_ADDRESS command to display the reachable address list.

```
8265>show reachable_address all
Port   Len   Address                                  Active  Idx   VPI
-------------------------------------------------------------------------
16.1   96    39.99.99.99.99.99.99.00.00.99.99.01    Y      1      0
```

- 8260 (peer group P1 Hub_0) information and setting

```
8260>show device
8260 ATM Control Point and Switch Module
Name : QA Partner demo - ATM
Location :
Mon Jul  1 14:10:23 DFT 1996 QA Partner demo - T6X test floor

For assistance contact :
 6 Oct 97

Manufacture id: VIME
Part Number: 47H2331 EC Level: E28028
Boot EEPROM version: v.3.1.7
Flash EEPROM version: d.3.1.7
Flash EEPROM backup version: v.3.1.7
Last Restart : 13:42:26 Thu 30 Oct 97 (Restart Count: 135)

A-CPSW
-------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.71. Subnet mask: FF.FF.FF.80

 > Subnet lan emulation ethernet/DIX
   Up
   Config ELAN Name :""
   Actual ELAN Name :"Eth_BB"
   MAC Address: 40FC82602222
   IP address : 9.100.93.161. Subnet mask: FF.FF.FF.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
-------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
-------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.60.00.94.00.00

Dynamic RAM size is 16 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
```

Note

The ATM address subnetwork has been been changed to reflect the device as Hub_0 in peer group P1. The Subnet atm: Down indicates that the network is still down.

The peer group ID and the summary address remains the same as of peer group P1 of Case Study 1. So we have the display information as shown below:

```
8260>show pnni node_0
-------------------- Node  0 --------------------
  ATM addr : 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.60.94.00.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.99.00.00.99.99.01
  Node Id  : 60.39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.60.94.00.00
  Unrestricted Transit.
```

```
8260>show pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.99.99.99.99.99.00.00.99.99.01.00
```

Now repeat the following steps on the 8260 (Hub_0) of peer group P1:

1. Configuring the ATM ports and interfaces

   As described in the previous section, 4.2.1, “Network Environment” on page 94 on how to set the ports to different ATM interfaces, set the port 15.2 to IISP interface using the USER option as shown below. For two peer groups connected by IISP, one port should be set to NETWORK and the other to USER.

   ```
   8260>set port 15.2 enable IISP user
   ```

   At this point, if the port is set correctly, you should display the port status by issuing the SHOW PORT command. The information on the screen should be similar to the following:

   ```
   8260>show port 15.2

         Type Mode     Status
   ------------------------------------------------------------------------------
   15.02: IISP enabled  UP
   ```

   Next we set the reachable address to the prefix of addresses reachable through the specified port.

2. Configuring reachable addresses

   ```
   8260>set reachable_address 15.2 96 39.99.99.99.99.99.99.00.00.99.99.02
   ```

   Use the SHOW REACHABLE_ADDRESS command to display the reachable address list.

```
8260>show reachable_address all
Port   Len   Address                                 Active  Idx   VPI
-------------------------------------------------------------------
15.2   96    39.99.99.99.99.99.99.00.00.99.99.02    Y       1      0
```

3. Show device display

   The SHOW DEVICE command is used to display the configuration information about the ATM control point of 8265 (Hub_0) of peer group P2.

   Issue the SHOW DEVICE command on Hub_0 of peer group P2. Detailed information is displayed on the console screen. The screen may be interpreted by looking at Subnet atm: Up. This indicates a healthy network, as all the devices are configured correctly.

```
8265>show device
8265>ATM Control Point and Switch Module
Name : ATMG_09
Location :
La Gaude LAB

For assistance contact :
Kevin Treweek
Farhad Sidhwa
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.3.2.0
Flash EEPROM version: v.3.2.0
Flash EEPROM backup version: v.3.2.0
Last Restart : 11:42:19 Fri 7 Nov 1997 (Restart Count: 33)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Up
 IP address: 9.100.94.51. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: FFF9D688FFF3
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 00062977000C
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.02.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.92.33

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
Accounting is disabled.
```

4. PING

   Issue this command to verify if the IP device is active and reachable. The target devices are reachable via the Classical IP over ATM network.

   We ping from Hub_0 of peer group P2 to the Hub_1 of peer group P2, Hub_0 of peer group P1, Station S1 and the ARP server using their respective IP addresses.

```
8265>ping 9.100.94.38
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.38: 1 packets sent, 1 received
Ping 9.100.94.38: 2 packets sent, 2 received
Ping 9.100.94.38: 3 packets sent, 3 received
Ping 9.100.94.38: 4 packets sent, 4 received

8265>ping 9.100.94.120
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.120: 1 packets sent, 1 received
Ping 9.100.94.120: 2 packets sent, 2 received
Ping 9.100.94.120: 3 packets sent, 3 received

8265>ping 9.100.94.71
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.71: 1 packets sent, 1 received
Ping 9.100.94.71: 2 packets sent, 2 received
Ping 9.100.94.71: 3 packets sent, 3 received
Ping 9.100.94.71: 4 packets sent, 4 received
Ping 9.100.94.71: 5 packets sent, 5 received

8265>ping 9.100.94.58
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.58: 1 packets sent, 1 received
Ping 9.100.94.58: 2 packets sent, 2 received
Ping 9.100.94.58: 3 packets sent, 3 received
Ping 9.100.94.58: 4 packets sent, 4 received
Ping 9.100.94.58: 5 packets sent, 5 received
```

Similarly ping from Hub_0 of peer group P1 to all the devices of peer group P2. All the pinged devices should send the same packets back similar to the above.

As we are able to ping all the IP devices, the network is deemed to be up and running.

If other problems are encountered it could be related to LAN emulation, bridging or routing at layer 3. Troubleshooting hints are available in Chapter 6, “Troubleshooting 8265 Networks” on page 163.

4.4 Peer Group Configuration Across a WAN (Case Study 3)

The intent of this section is to demonstrate configuration guidelines for an 8265 by using the VOID interface. The following IBM equipment was used in the creation of a single peer group:

- IBM 8265 (Hub_0, Peer Group P1 at Location A)
  - A-CPSW
  - 4-port 155 Mbps (quantity 3)
- IBM 8285 (Hub_2, Peer Group P1 at Location A)
  - Expansion unit
- IBM 8260 (Hub_1, Peer Group P1 at Location B)
  - CPSW
  - 4-port 155 Mbps (quantity 2)
- RS/6000 (ARP server)
  - ATM adapter card
- RS/6000 (Station S1)

– ATM adapter card

4.4.1 Network Environment

The case study environment used is shown in Figure 63 on page 125. This case study involves a single peer group located at two different geographic sites and connected through a WAN using VOID ports.

When an 8265 is physically attached to a WAN, and VP tunnelling is provided, the attached device at the other side of the WAN appears as an adjacent device for the local switch.

Creating VPCs allows us to extend the connectivity of the 8265, and have several VP tunnels on a unique physical interface.

The 8265 (Hub_0) and 8285 (Hub_2) are in peer group P1 at Location A. The 8260 (Hub_1) is in the same peer group P1 but at Location B. Here we describe how to configure the 8265 (Hub_0) by using the VOID interface. We also show the steps to configure 8260 (Hub_1), for your reference purposes.

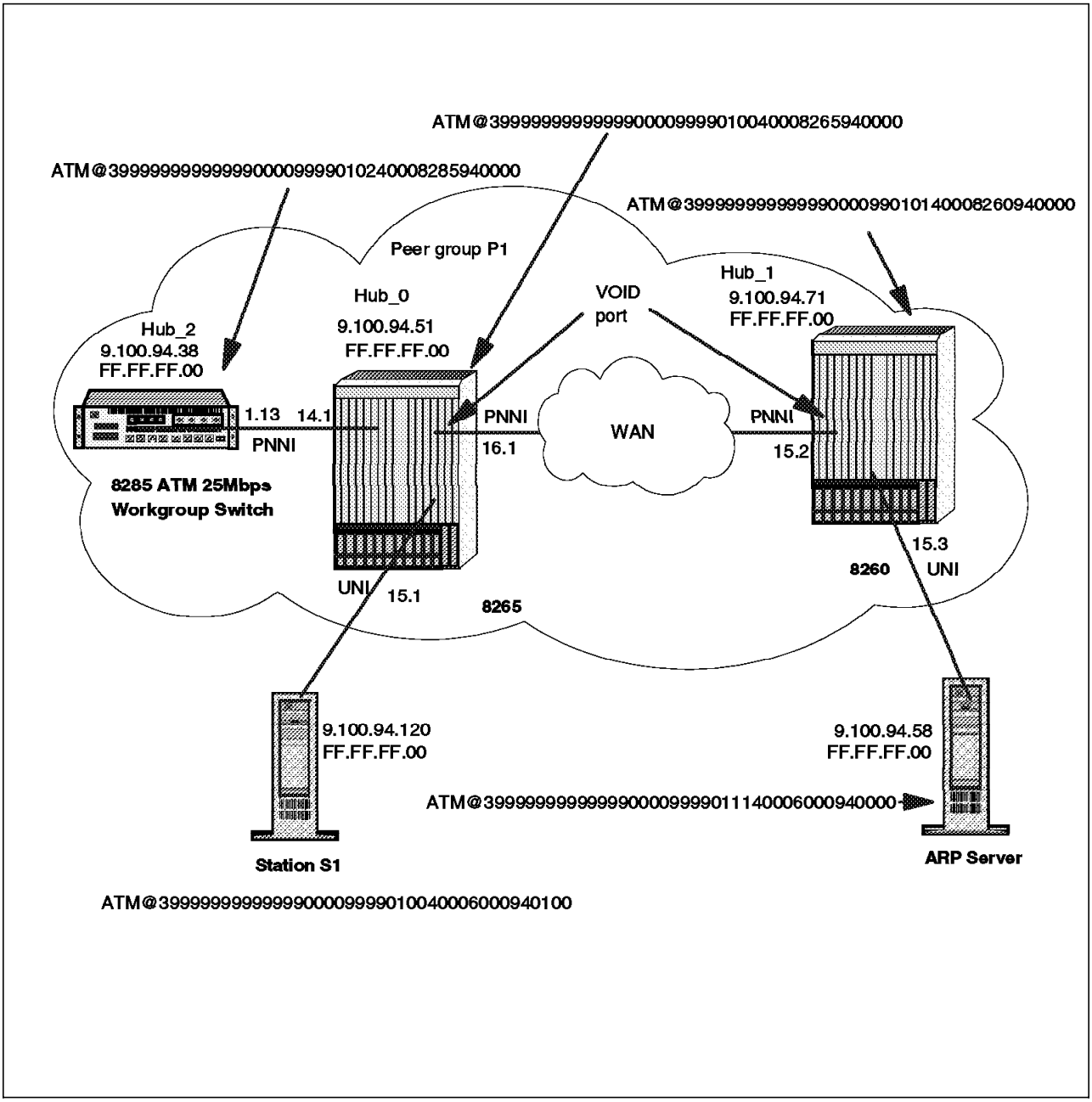


Figure 63. A Single Peer Group Connected by the VOID Interface

It is assumed that Hub_0, Hub_1 and Hub_2 of peer group P1 have been configured as in Case Study 1, with the peer group IDs identical.

We display the status of the devices and ports using the SHOW DEVICE and SHOW PORT command.

- Hub_2 information

```
8285>show device
8285 Nways ATM Workgroup Switch
Name : 8285
Location :


For assistance contact :
 27 Oct 97

Manufacture id: RTP
Part Number: 4412SW8 EC Level: 09181C
Serial Number: LAG
Boot EEPROM version: v.3.1.7
Flash EEPROM version: v.3.1.7
Flash EEPROM backup version: d.3.1.7
Last Restart : 16:27:42 Thu 6 Nov 97 (Restart Count: 19)

A-8285
------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.38. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Dynamic RAM size is 12 MB. Migration: off. Diagnostics: disabled.
Duplicate ATM addresses are not allowed.
8285>
```

Note: Please note Subnet atm: Down as an indication that we are reconfiguring the Hub_0, as described below. This means that the WAN link between the peer group members is not active.

```
8285>show port 1.13 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
1.13: PNNI enabled   Up

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 0.16383 (0.14 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

The SHOW DEVICE command is used to display the configuration information about the ATM control point of Hub_0.

- Hub_0 information and port setting

```
8265>show device
8265>ATM Control Point and Switch Module
Name : ATMG_09
Location :
La Gaude LAB

For assistance contact :
Kevin Treweek
Farhad Sidhwa
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.3.2.0
Flash EEPROM version: v.3.2.0
Flash EEPROM backup version: v.3.2.0
Last Restart : 11:42:19 Fri 7 Nov 1997 (Restart Count: 33)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.51. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: FFF9D688FFF3
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 00062977000C
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.92.33

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
Accounting is disabled.
```

Note: Subnet atm: Down indicates that the WAN link between the two locations is not active.

The Hub_0 ports 14.1 and 15.1 are already configured for PNNI and UNI ATM interfaces respectively, so there is no need to reconfigure these ports.

If you issue the SHOW PORT command on ports 14.1 and 15.1, you will see on the console screen information similar to the following:

```
8265>show port 14.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
14.01: PNNI enabled  UP

ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : off
Signalling vci       : 0.5
Routing vci          : 0.18
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

```
8265>show port 15.1 verbose


      Type Mode     Status
-------------------------------------------------------------------------------
15.01: UNI enabled  UP

Signalling Version   : Auto
> Oper Sig. Version  : 3.0
ILMI status          : UP
ILMI vci             : 0.16
RB Bandwidth         : unlimited
Police               : on
Signalling vci       : 0.5
RB Admin weight      : 5040
NRB Admin weight     : 5040
VPI.VCI range        : 15.1023 (4.10 bits)
Connector            : SC DUPLEX
Media                : multimode fiber
Port speed           : 155000 kbps
Remote device is active

Frame format    : SONET STS-3c
Scrambling mode : frame and cell
Clock mode      : internal
```

Now display the PNNI Node_0 parameters for Hub_0.

```
8265>show pnni node_0
-------------------- Node  0 ---------------------
  ATM addr : 39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.99.00.00.99.99.01
  Node Id  : 60.39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
  Unrestricted Transit.
```

The summary address of Hub_0 is shown below:

```
8265>show pnni summary_address
------ Internal Summary Addresses of Node 0------
  Entry 1: Prefix Length=104, default, advertised:
    39.99.99.99.99.99.99.00.00.99.99.01.00
```

Next we start with the configuration of the 8265 (Hub_0).

1. Configuring ATM ports and interfaces

   As described in the previous section, 4.2.1, “Network Environment” on page 94 on how to set the ports to different ATM interfaces, set port 16.1 to the VOID interface.

   ```
   8265>set port 16.1 enable void
   ```

   At this point if the port is set correctly, you should display the port status by issuing the SHOW PORT command. The information on the screen should be similar to the following:

   ```
   8265>show port 16.1

         Type Mode     Status
   ----------------------------------------------------------------------------
   16.01: VOID enabled  DOWN
   ```

   Note: The display screen shows Status: DOWN, as we are reconfiguring the Hub_0 parameters. This means that the ATM link between the two locations is not active.

2. Setting up virtual path channels (VPCs)

   VPC links can be defined for the VOID interface. In our case study we are connecting the switches within the same peer group via a WAN. This is done by using the SET VPC command to configure VPCs with PNNI interface. Please refer to the *IBM 8265 ATM Switch Command Reference Guide* for the command details and also read 3.10.1.1, “VPC Links and VP Tunneling” on page 75.

   ```
   8265>set vpc_link 16.1 1 enable pnni bandwidth:155000
   ```

   Here we have used VPI=1. This value is used because when a link crosses a WAN the service provider will not allow the use of VPI=0, as this value is used for internal WAN traffic. Consequently, the private organization must use another VPI other than the default.

   Use the SHOW VPC_LINK command to see the status of the VPC link.

```
8265>show vpc_link all

      VPI: Type Mode   Status
-------------------------------------------------------------
16.1    1: PNNI enable Down
8265>
```

Note:

The screen display shows us Status: Down. This is because we are configuring the Hub_0 parameters. This means that the ATM link between the two locations is not active.

3. Allowing duplicate ATM addresses

   Depending on network configuration and requirements, you can configure the ATM control point to allow or disallow the acceptance of duplicate ATM addresses registered from ILMI.

   Disallowing duplicate addresses may, for example, be useful for backup servers.

   Allowing duplicate addresses may be useful for load balancing between switches.

   To specify whether duplicate addresses are allowed or disallowed, you enter the following command:

```
8265>set device duplicate_atm_addresses disallowed
```

   In our case we have disallowed duplicate ATM addresses as we have Station S1 and the ARP server with separate ATM addresses.

- Hub_1 information and setting

```
8260>show device
8260 ATM Control Point and Switch Module
Name : QA Partner demo - ATM
Location :
Mon Jul  1 14:10:23 DFT 1996 QA Partner demo - T6X test floor

For assistance contact :
 6 Oct 97

Manufacture id: VIME
Part Number: 47H2331 EC Level: E28028
Boot EEPROM version: v.3.1.7
Flash EEPROM version: d.3.1.7
Flash EEPROM backup version: v.3.1.7
Last Restart : 13:42:26 Thu 30 Oct 97 (Restart Count: 135)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Down
 IP address: 9.100.94.71. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/DIX
   Up
   Config ELAN Name :""
   Actual ELAN Name :"Eth_BB"
   MAC Address: 40FC82602222
   IP address : 9.100.93.161. Subnet mask: FF.FF.FF.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.94.65

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Dynamic RAM size is 16 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
```

Note

The display screen shows Subnet atm: Down as we are configuring the Hub_1 parameters.

The peer group ID and the summary address remain the same as that of peer group P1 of Case Study 1. So we display the information as shown below:

```
8260>show pnni node_0
-------------------- Node  0 --------------------
  ATM addr : 39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
  Level Identifier :  96 (24 half-bytes and 0 bits)
  PGroup Id: 60.39.99.99.99.99.99.00.00.99.99.01
  Node Id  : 60.39.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00
  Unrestricted Transit.
```

Now repeat the following steps for the 8260 (Hub_1):

1. Configuring the ATM ports and interfaces

   As described in the previous section, 4.2.1, “Network Environment” on page 94 on how to set the ports to different ATM interfaces, set the port 15.2 to the VOID interface.

   ```
   8260>set port 15.2 enable void
   ```

   At this point if the port is set correctly, you should display the port status by issuing the SHOW PORT command. The information on the screen should be similar to the following:

   ```
   8260>show port 15.2

         Type Mode     Status
   -------------------------------------------------------------------------------
   15.02: VOID enabled Down
   ```

   Note: The Status: DOWN indicates we are reconfiguring the Hub_1 parameters. This means that the ATM link between the two locations is not active.

2. Setting up virtual path channels (VPCs)

   Here again we define VPC links for VOID interface. In our case study we are connecting the switches within the same peer group via a WAN.

   Use the SET VPC command to configure VPCs with the PNNI interface and use VPI=1 as the identifier.

   ```
   8260>set vpc_link 15.2 1 enable pnni bandwidth:155000
   ```

   Now use the SHOW VPC_LINK command to see the status:

   ```
   8260>show vpc_link all

         VPI: Type Mode   Status
   ------------------------------------------------------
   15.2    1: PNNI enable Up
   8260>
   ```

   Now at this point the ATM subnetwork should be working.

4.4.2 Network setting verification

Perform the following commands to display the whole configuration setting.

1. Show device

   The SHOW DEVICE command is used to display the configuration information about the ATM control point of the 8265 (Hub_0).

   Issue the SHOW DEVICE command on Hub_0 and detailed information is displayed on the console screen. The screen displays Subnet atm: Up, an indication of a healthy network.

```
8265>show device
8265>ATM Control Point and Switch Module
Name : ATMG_09
Location :
La Gaude LAB

For assistance contact :
Farhad Sidhwa
Kevin Treweek
Manufacture id: 930
Part Number: 02L3099 EC Level: F12445
Boot EEPROM version: v.3.2.0
Flash EEPROM version: v.3.2.0
Flash EEPROM backup version: v.3.2.0
Last Restart : 11:42:19 Fri 7 Nov 1997 (Restart Count: 33)

A-CPSW
--------------------------------------------------------------------------------
 > Subnet atm: Up
 IP address: 9.100.94.51. Subnet mask: FF.FF.FF.00

 > Subnet lan emulation ethernet/802.3
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: FFF9D688FFF3
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0
 > Subnet lan emulation token ring
   Not Started
   Config ELAN Name :""
   Actual ELAN Name :""
   MAC Address: 00062977000C
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00
   Config LES addr: none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add: none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway : OK
--------------------------------------------------------------------------------
 IP address: 9.100.92.33

ARP Server:
--------------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.11.40.00.60.00.94.00.00

Device configured for PNNI port capability.
Dynamic RAM size is 32 MB. Migration: off. Diagnostics: disabled.
Device defined as primary.
Accounting is disabled.
```

2. Peer group members

   To display all node IDs included in the currently active peer group, enter the following command:

```
8265>show pnni peer_group_members
------ Peer Group of Node 0------
  60.A0.39.99.99.99.99.99.00.00.99.99.01.00.40.00.82.65.94.00.00 connected
  60.A0.39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00 connected
  60.A0.39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00 connected

3 Members.
```

3. Neighbor node IDs

   To display a list of neighbor node IDs, enter the following command:

```
8265>show pnni neighbor
------ Neighbors of Node 0------
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.01.40.00.82.60.94.00.00: Full
    Port 16.01 vpi=1
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.02.40.00.82.85.94.00.00: Full
    Port 14.01 vpi=0
```

   Node IDs are 22-byte identifiers that characterize a PNNI node. Neighbor nodes are nodes directly connected via one or more links to the node being referenced.

4. PING

   Issue this command to verify if the IP device is active and reachable. The target devices are reachable via the Classical IP over ATM network.

   We ping from Hub_0 to Hub_1, Hub_2, Station S1 and the ARP server using their respective IP addresses.

```
8265>ping 9.100.94.38
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.38: 1 packets sent, 1 received
Ping 9.100.94.38: 2 packets sent, 2 received
Ping 9.100.94.38: 3 packets sent, 3 received
Ping 9.100.94.38: 4 packets sent, 4 received

8265>ping 9.100.94.120
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.120: 1 packets sent, 1 received
Ping 9.100.94.120: 2 packets sent, 2 received
Ping 9.100.94.120: 3 packets sent, 3 received

8265>ping 9.100.94.71
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.71: 1 packets sent, 1 received
Ping 9.100.94.71: 2 packets sent, 2 received
Ping 9.100.94.71: 3 packets sent, 3 received
Ping 9.100.94.71: 4 packets sent, 4 received
Ping 9.100.94.71: 5 packets sent, 5 received

8265>ping 9.100.94.58
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.94.58: 1 packets sent, 1 received
Ping 9.100.94.58: 2 packets sent, 2 received
Ping 9.100.94.58: 3 packets sent, 3 received
Ping 9.100.94.58: 4 packets sent, 4 received
Ping 9.100.94.58: 5 packets sent, 5 received
```

   Similarly ping from Hub_1 to all the devices of the peer group. All the pinged devices should send the same packets back similar to seen above.

   As we are able to ping all the IP devices the network is up and running.

If other problems are encountered, they could be related to LAN emulation, bridging or routing at layer 3. Refer to Chapter 6, “Troubleshooting 8265 Networks” on page 163 for further troubleshooting details.

Chapter 5. Nways Campus ATM Manager

This chapter describes the management functions that are available for the IBM 8265 ATM switch. It provides a description of the Management Information Bases (MIBs) that are available for the 8265. It briefly overviews the functions of IBM's Nways Campus Manager (NCM) and explains how Nways Campus Manager functions are useful in the management of an 8265 ATM network.

5.1 8265 Supported Management Information Bases (MIBs)

The A-CPSW provides full SNMP support with the use of the following standard SNMP commands:

- get
- getnext
- set
- traps

Below is a list of all the MIBs an 8265 ATM network supports. Any SNMP-based management system can utilize these MIBs.

- MIB-II Version 1.1 and 1.2

  The 8265 ATM subsystem fully supports this MIB. For the purposes of the system group, ATM is treated as a data link protocol. The interface group describes the ATM cell layer interface. This group only concerns itself with the ATM cell layer as a whole and not the individual connections. The amount of traffic that was transmitted and received can be found in this MIB. Also the number of cells dropped due to an incorrect HEC and invalid ATM cell header will also be found.

- MIB II Evolution (RFC 1573)

  Defined to model network interface.

- IETF AToMMIB

  This MIB is described in RFC 1695. It describes objects used for managing ATM-based:

  – Interfaces

  – Devices

  – Networks

  – Services

  The following are descriptions of the various groups supported in the IETF MIB:

  – The ATM Interface Configuration Group

    This group describes the type of ATM traffic on a particular interface. It contains ATM interface configuration parameters such as the status of the interface, maximum number of VPCs and VCCs supported on an interface, the number of configured VPCs and VCCs, the number of active VPI and VCI bits, VPI/VCI of ILMI (if at all) and the ATM address type.

  – The DS3 PLCP Group

This group has configuration and state information for those ATM interfaces that use DS3 for carrying ATM cells.

- The ATM Traffic Descriptor Parameter Group

  This group has information relating to the ATM traffic parameters including the QoS class.

- ATM Virtual Path Link (VPL) Group

  This group contains configuration and state information for bidirectional VPLs. Here VPs can be created, deleted or modified.

- ATM Virtual Channel Link (VCL) Group

  This group contains configuration and state information for bidirectional VCLs. Here VCs can be created, deleted or modified. Information can be found on the AAL that is in use on a VC and specific information on AAL5, for example, the type of data encapsulation used.

- The Virtual Path (VP) Cross Connect Group

  This group contains configuration and state information of all point-to-point and point-to-multipoint VP cross connections. It provides information on the VP swapping table. Within this group VP cross-connections can be established and removed.

- The Virtual Connection (VC) Cross Connect Group

  This group performs the same functions as in the VP cross connect group except for VCs.

- The AAL5 Virtual Channel Connection Performance Statistics Group

  This group contains the AAL5 performance statistics for VCCs.

- ATM Supplemental MIB (Draft-IETF-AToMMIB-ATM2)

  This is an extension to the AToMIB and covers mainly SVC management.

- PNNI MIB

  Full support of the PNNI MIB replaces the previous OSPF MIB that has been dropped.

- PNNI MIB Extension

  This MIB extension allows for the creation, deletion and management of soft PVCs in relation to the AToMMIB tables.

- ILMI MIB

  This MIB is defined by the ATM Forum in V3.0 of the UNI specification. Following is a brief description of the groups defined in these MIBs:

  - System Group

    This group provides system information on the interfaces that are running the ILMI protocol.

  - Physical Port Group

    This group provides information on a particular port such as the status, transmission types (for example, 4B/5B encoding at 100 Mbps or SONET STS-3c at 155.52 Mbps) and cable type.

  - ATM Layer Group

This group indicates the maximum number of supported VPs and VCs on the UNI, the number of VPs and VCs configured on the UNI and the number of active VP and VC bits on the interface.

- ATM Statistics Group

  Indication to the number of cells received, dropped and transmitted on the UNI interface will be displayed by this MIB.

- Virtual Path Group

  This group gives information on the VPs on the UNI. This includes status, traffic shaper parameters, policing parameters and QoS.

- Virtual Channel Group

  This group performs the same functions as the virtual path group but for VCs.

- Network Prefix Group

  This group contains the information on the network prefix in use on the user side of the UNI and its validity.

- Address Group

  This group has information on the ATM address in use on the user side of the UNI and its validity.

- Service Registry Group

  This group provides a general purpose service registry for locating ATM network services for example LECS.

- IBM Hub-Specific MIB Extensions:
  - Traps Control Group

    This group allows for the configuration of traps that are sent and received.

  - Switch Control Group

    This group determines which slots are controlled by the switch.

  - ATM Modules Group

    This group gives details on the modules such as the maximum number of supported VPs and VCs, the number of VPs and VCs in use and the type of module.

  - ATM Port Group

    Information is supplied on the number of ports on a module, cable type, status and what interface support is provided, for example, private UNI, private NNI or public UNI.

  - The ATM Interfaces Group

    This group maps each ATM port to the MIB-II interface index and to the physical slot/port numbers.

  - Cross Connect Group

    Information on the label swapping tables for VPs and VCs is stored in this group.

  - Neighbor Devices Group

Information can be found in this group on the ATM devices connected to specific ports, for example, the IP address and description of attached devices.

  - TFTP Group

    This group controls the parameters for TFTP download functions.

  - Statistics Group

    Statistics for individual VP and VC connections are found in this group.

  - Optional Feature Group

    A list of optional ATM features installed on the ATM subsystem are provided by this group, for example, the 155 Mbps uplink on the A12-TP25 module.

  - Extended Interface Group

    This group defines additional configuration parameters.

  - Service Group

    This group provides the user with dumps, traces and switch configurations.

- IBM Signalling Extensions

  This IBM MIB extension defines ATM signalling support on the 8265. Below is a brief list of the information that can be accessed via this MIB:

  - Number of supported signalling channels
  - Range of reserved VPs and VCs
  - VPI/VCI used for the signalling channel on a port
  - The state of the Q93B and Q2931 interface
  - Q93B/Q2931 statistics such as the number of call attempts and rejections
  - Information about Q93B/Q2931 calls in progress such as calling and called party
  - Details of cleared calls including the ATM interface involved, called party and calling party, date and time, cause of clearing, QoS requested and the bandwidth requested
  - Details and statistics on the Signalling ATM Adaptation Layer (SAAL)

- IBM PVC Management MIB Extensions
- IBM Security Group

  This group contains information about authorized ATM addresses.

- IBM ATM Statistics MIB Extensions
- ATM Forum LAN Emulation Client MIB
- WAN MIBS:
  - E1/TI (RFC 1406)
  - E3/DS3 (RFC 1407)
  - SONET (RFC 1595)

5.1.1 Supported Counters

The 8265 supports the following counters for real-time statistics and monitoring:

- Logged calls with internal index, interface number, calling number, creation time, clear time and clear cause.
- Interface traffic with counters for received cells, received cells in error, unknown received cells and transmitted cells. Traffic is measured per-connection in terms of cells per second, bytes per second or bits per second.
- Interface bandwidth broken down into maximum available bandwidth and currently used bandwidth.
- Current number of calls in progress, both incoming and outgoing.
- Call statistics, which includes number of successful and unsuccessful calls.
- SAAL errors, unexpected SAAL PDU and failed SAAL establishments.
- Traffic control including policy violations per-connection.
- CPU and buffer utilization.
- Traffic congestion monitoring.
- Throughput monitoring at the switch or module level.
- Control traffic or policy violations on a per-connection basis.
- Congestion detection.

These counters are extracted from the A-CPSW using a standard SNMP interface. History logs are maintained by the control point and can be utilized by a network management station at any time.

Billing and accounting activities can be performed by the 8265; however, a billing/accounting application has to be developed to process raw data provided by the control point.

5.2 IBM Nways Campus Manager ATM Overview

Nways Campus Manager ATM (NCMA) is a program module of Nways Campus Manager that runs under IBM′s NetView for AIX. Although NCMA is not mandatory to configure and set up an 8265 ATM network, it is highly recommended, because the information and functions that it provides will significantly simplify the management and configuration of an 8265 ATM network.

NCMA should be used in conjunction with IBM Nways Campus Manger LAN (NCML). This will provide the user with full comprehensive 8265 box management. NCML will provide management facilities to the legacy LAN environment attached to the 8265 network and NCMA manages the technical requirements of the ATM system within the 8265 network.

NCMA consists of:

- ATM Manager
- LAN Emulation Manager
- FaultBuster

NCMA is a graphical user-interface tool for:

- Managing
- Monitoring
- Fault diagnosing

ATM resources and LAN Emulation components in:

- ATM switches
- ATM bridges
- ATM concentrators
- MSS servers
- Non-IBM and IBM ATM devices supporting the PNNI protocol

To manage an 8265 network from NetView for AIX, correct versions and levels of application and operating software must be used. These versions are listed in Table 15.

Table 15. Software Version Levels for 8265 Support

Name	**Version**
AIX	4.1.5 4.2 4.2.1 4.3
Nways Campus Manager	1.2
Nways Campus Manager ATM (NCMA)	2.3
Nways Campus Manager LAN (NCML)	3.3

Note

Nways Campus Manager for AIX is operated from an IBM RISC System 6000 POWERstation or POWERserver workstation.

NCMA facilitates the management of ATM networks within an enterprise, namely on a site or a campus. It allows network administrators to manage ATM environments from a single operator console on a NetView for AIX workstation.

5.3 ATM Manager Topological Support

NCMA provides the following topological support for an ATM network:

- Automatic discovery of ATM devices and physical links between elements.

  ATM devices are automatically discovered, placed in a submap and monitored. When the network changes, the discovery capability of NCMA indicates the changes and automatically updates the network map.

- Dynamic display of the topology hierarchy of ATM nodes and interfaces on the following:
  - ATM Campus submap
  - ATM Device submap
  - ATM Meta-connection submap

- ATM View panel
- PNNI Peer Group Topology panel

The graphical topology display uses *color coding* to represent the status of resources. The colors used to display the status of an ATM device are detailed in Table 16.

Table 16. Color Display Status of ATM Objects

Status	**Color**
Critical	Red
Marginal	Yellow
Normal	Green
Unmanaged	Brown
Unknown	Blue
Disabled	Light Grey
Powered Off	Dark Grey

If a device becomes inactive or its operation becomes impaired, the information is updated to reflect the change in status for the device by changing the color of the device in the topology display.

If connection is lost with an ATM device, the status of the interface remains the same color but the status of the attached ATM device turns to *critical* (red).

5.4 ATM Manager Resource Configuration

Configuration and monitoring of the following resources is possible from NCMA:

- ATM physical resources
- Permanent Virtual Circuit (PVC) management including creation and deletion of PVCs; however this is for IBM devices only.
- Switched Virtual Circuit management including tracking and forced clearing; however this is for IBM devices only.
- Virtual Path (VP) and Virtual Channel link management.

Context menus provide access to functions applicable to all objects displayed in the topological submaps as well as online context-sensitive help information.

5.4.1 ATM Manager Fault Management

Enhanced system reliability is provided by cooperative management between NCMA and NetView for AIX. The two systems interact to provide recognition of network management information from different sources including:

- Display of traps
- Color coding of status information
- Logging of call failures

NCMA also provides these important fault management features:

- Change management through inband code downloads for simplified problem fixes
- Key performance counters and statistics for enhanced network tuning
- End-to-end connection tracking

5.5 LAN Emulation Manager

LAN Emulation Manager facilitates the management of LAN Emulation components in an 8265 network. It provides dynamic displays of topological hierarchy for LAN Emulation controlled devices via LAN Emulation Manager control panels on NCMA.

LAN Emulation Manager controls the:

- LAN Emulation domains
- Emulated LANs (ELANs)
- LAN Emulation Configuration Servers (LECSs)
- LAN Emulation Servers (LESs)
- Broadcast and Unknown Servers (BUSs)

Context menus provide access to functions applicable to objects displayed on the end-user interface panels. Online context-sensitive information help is also available.

Tool bars with icons are provided for ease of use and guide the user through complex LAN Emulation configurations.

Detection, analysis and problem correction caused by the failure of the following LAN Emulation components is provided for by LAN Emulation Manager:

- LECSs
- LESs
- BUSs

5.6 FaultBuster

FaultBuster is an intelligent tool that provides the network administrator with:

- Graphical representation of network-related problems
- Reasons for the changed status of the selected ATM resource
- The ability to investigate problems by:
  - Recursively recalling FaultBuster on one subcomponent of the selected ATM resource
  - Displaying additional information on the ATM resource, for example, received events
  - Running explicit tests such as sanity checks, ping and trace tests
- Customization of the fault diagnostic database, which allows the user to specify unique lists of troubleshooting functions.
- Integrated scenario for LAN Emulation path tracing.

FaultBuster diagnoses problems in:

- PNNI peer groups
- ATM clusters
- ATM devices
- ATM interfaces
- LAN Emulation resources such as:
  - Domains
  - ELANs
  - LECs
  - LES/BUSs
  - LECSs

Problems between:

- Two ATM interfaces
- Two LAN Emulation resources

5.7 Using Nways Campus Manager ATM (NCMA)

This section describes how NCMA is used to manage 8265 ATM-based subsystems.

5.7.1 NCMA Manager Views

When navigating through NCMA in NetView for AIX, the following submaps appear in a hierarchical level:

- Root submap
- NCMA Campus submap
- NCMA Device submap
- NCMA Connection submap

5.7.1.1 The NetView for AIX Root Submap

The NetView for AIX Root submap shown in Figure 64 on page 148 is the access point to using the management facilities of NCMA. From the root submap you can:

- Manage the ATM Campus

  When the ATM campus is managed, each node of the ATM campus will be polled according to the *polling interval* configured for that node.

- Unmanage the ATM Campus

  An unmanaged ATM campus is not managed by NCMA. This means that none of the nodes in this campus will be polled by NCMA; therefore, no information or diagnostics can be obtained from this ATM campus network.

- Explode the ATM Campus icon

  This gives the network administrator the ability to display the ATM cluster-level view in the ATM Campus submap.

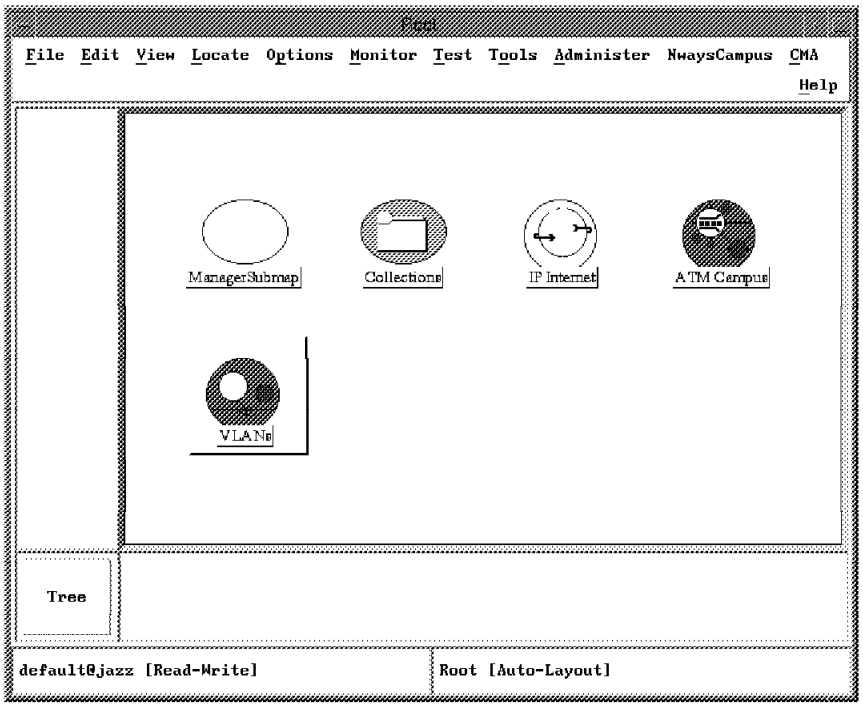


Figure 64. NetView for AIX Root Submap

5.7.1.2 NCMA Campus Submap

The NCMA Campus submap as shown in Figure 65 displays all the ATM clusters and peer groups in an ATM campus. It displays both IBM and non-IBM devices that both support and do not support the PNNI protocol.

From this submap an ATM cluster can be selected to be managed or unmanaged by NCMA. When an ATM cluster is managed it can be exploded to display the ATM node-level in the ATM Cluster submap.

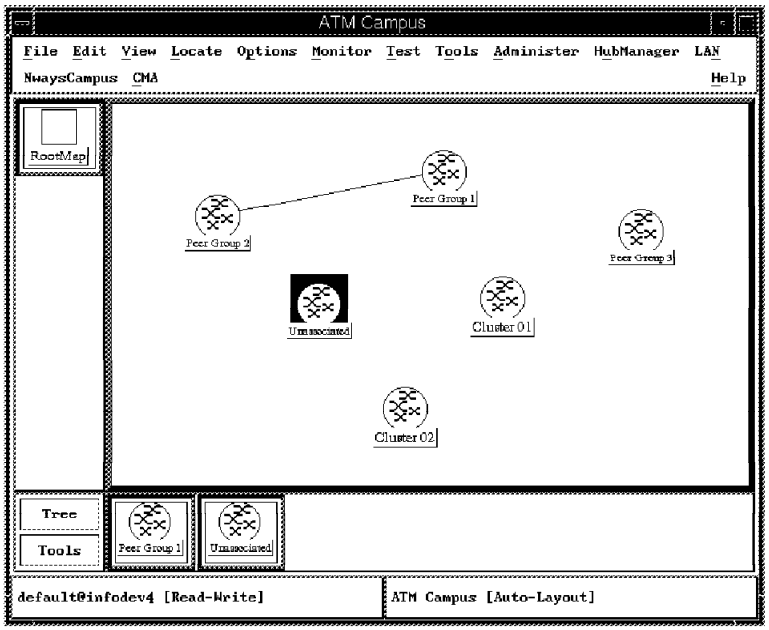


Figure 65. NCMA Campus Submap

5.7.1.3 NCMA Device Submap

The NCMA Device submap shown in Figure 66 displays the node-level view and contains the icons representing the 8265 ATM nodes and the ATM physical links between them.

From this submap ATM nodes can be managed or unmanaged. From the NCMA menu the following can be selected for each node:

- Profile
- Configuration
- Fault
- Performance
- Device

If a node is managed, it can be exploded to display the interface-level view in the ATM Node submap.

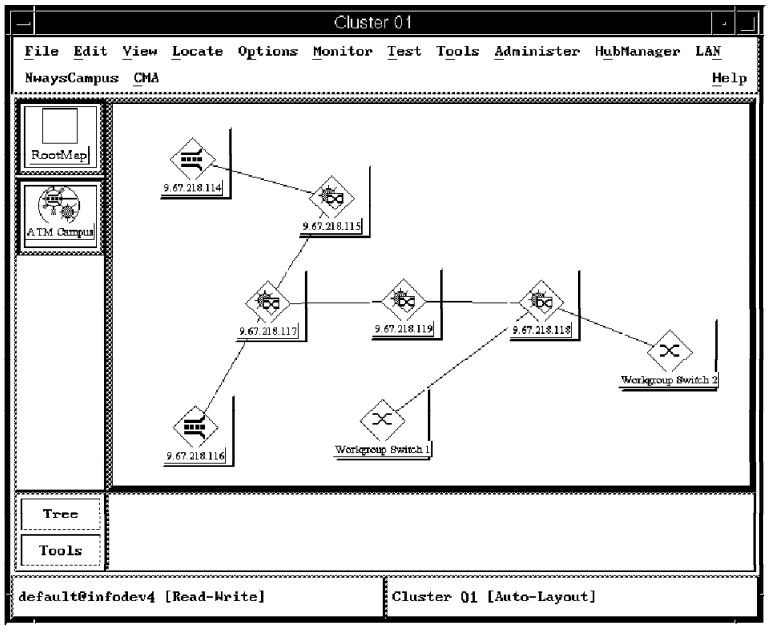


Figure 66. NCMA Device Submap

5.7.1.4 NCMA Connection Submap

The NCMA Connection submap shown in Figure 67 on page 150 displays the interface-level view and contains icons representing the physical ATM ports of the 8265 and the ATM node internal interface. The interface number shown for each port is the slot/port that the physical interface is located within the 8265.

From this submap specific interfaces or all interfaces can be managed or unmanaged. Selection of the following items from the NCMA menu for each interface can also be performed:

- Profile
- Configuration
- Fault

- Performance

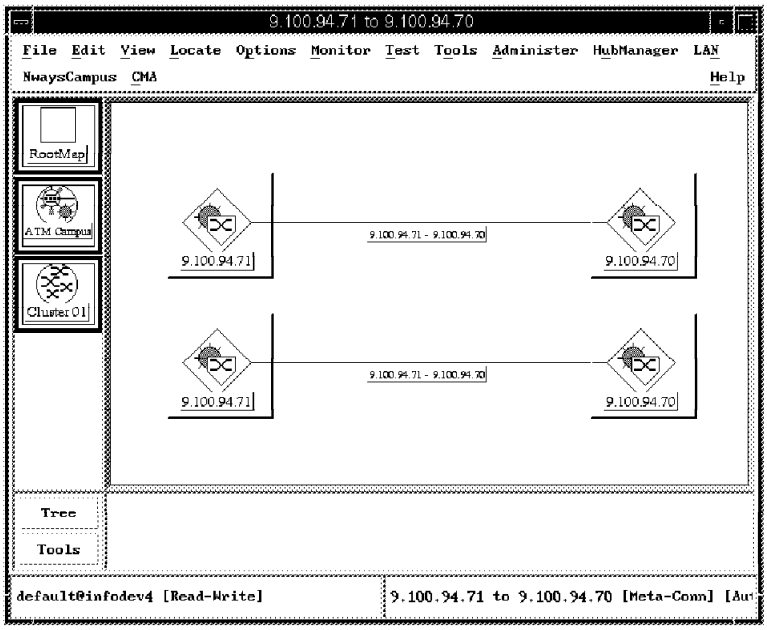


Figure 67. NCMA Connection Submap

5.8 ATM View Panel

The ATM View panel displays icons representing the logical and physical ATM ports of a selected ATM device. The numbers shown under each ATM interface icon are in the form of interface index.

Figure 68 on page 151 shows a sample of the ATM View panel.

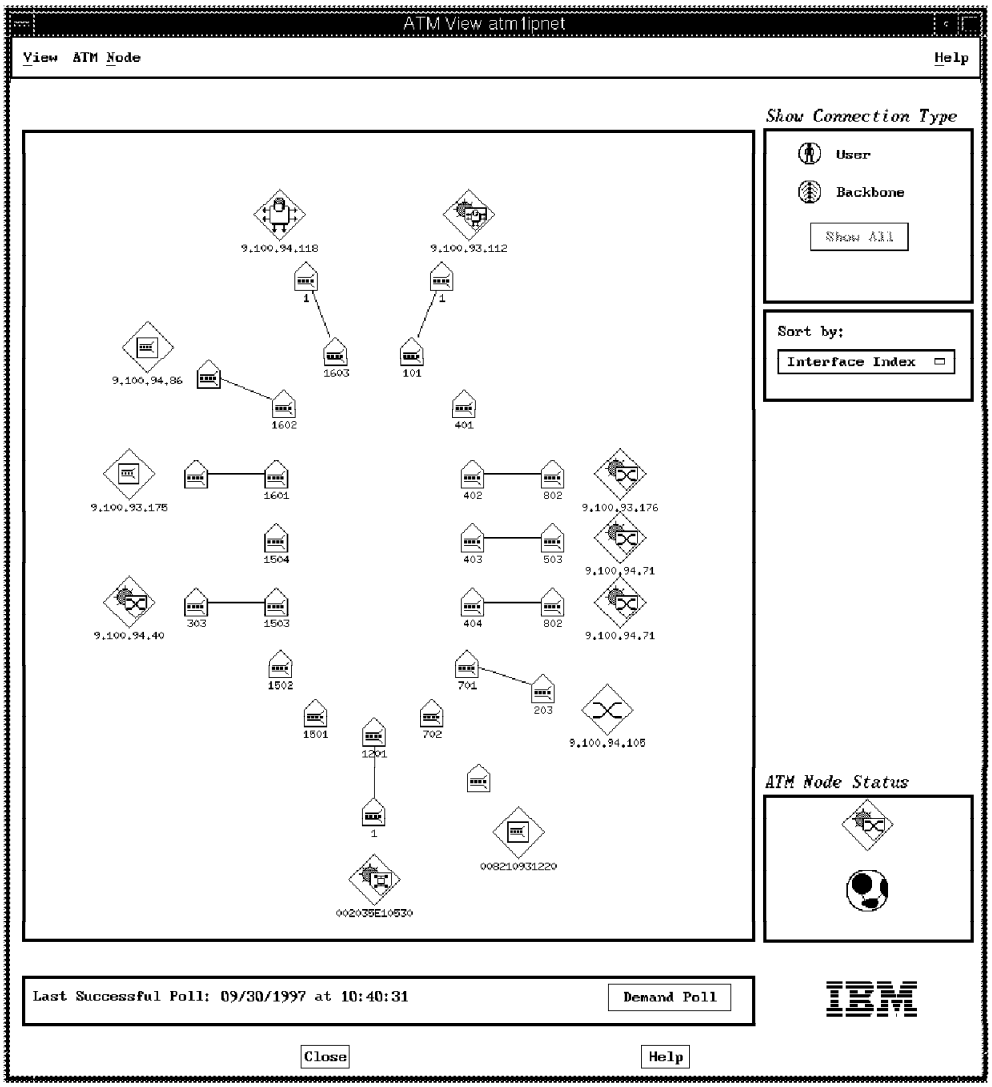


Figure 68. ATM View Panel

An ATM View panel is attained by double-clicking on an icon of an ATM switch shown in the ATM Device submap. This is displayed in Figure 66 on page 149.

From an ATM View panel the user can perform the following operations:

- Highlight user, backbone or all connections
- Sort the display by:
  - Interface index
  - Connection type
  - Remote ATM connection type
- ATM Device configurations
- LAN Emulation configurations if LANE components are available on the ATM device selected

Three different ATM views can be selected. These are:

- Row/Column

- Star
- Tabular

5.8.1 Front Panel Display of an 8265

The front panel chassis display of an 8265 as displayed in Figure 69 on page 153 is available via the ATM Device submap.

Double-click the left-hand mouse button twice on a selected 8265 ATM device as seen in Figure 66 on page 149. The chassis front panel of the selected 8265 will be displayed and from this screen the user can obtain:

- A-CPSW configuration information
- Module information
- Port and interface information
- Power configurations
- Fan and temperature information

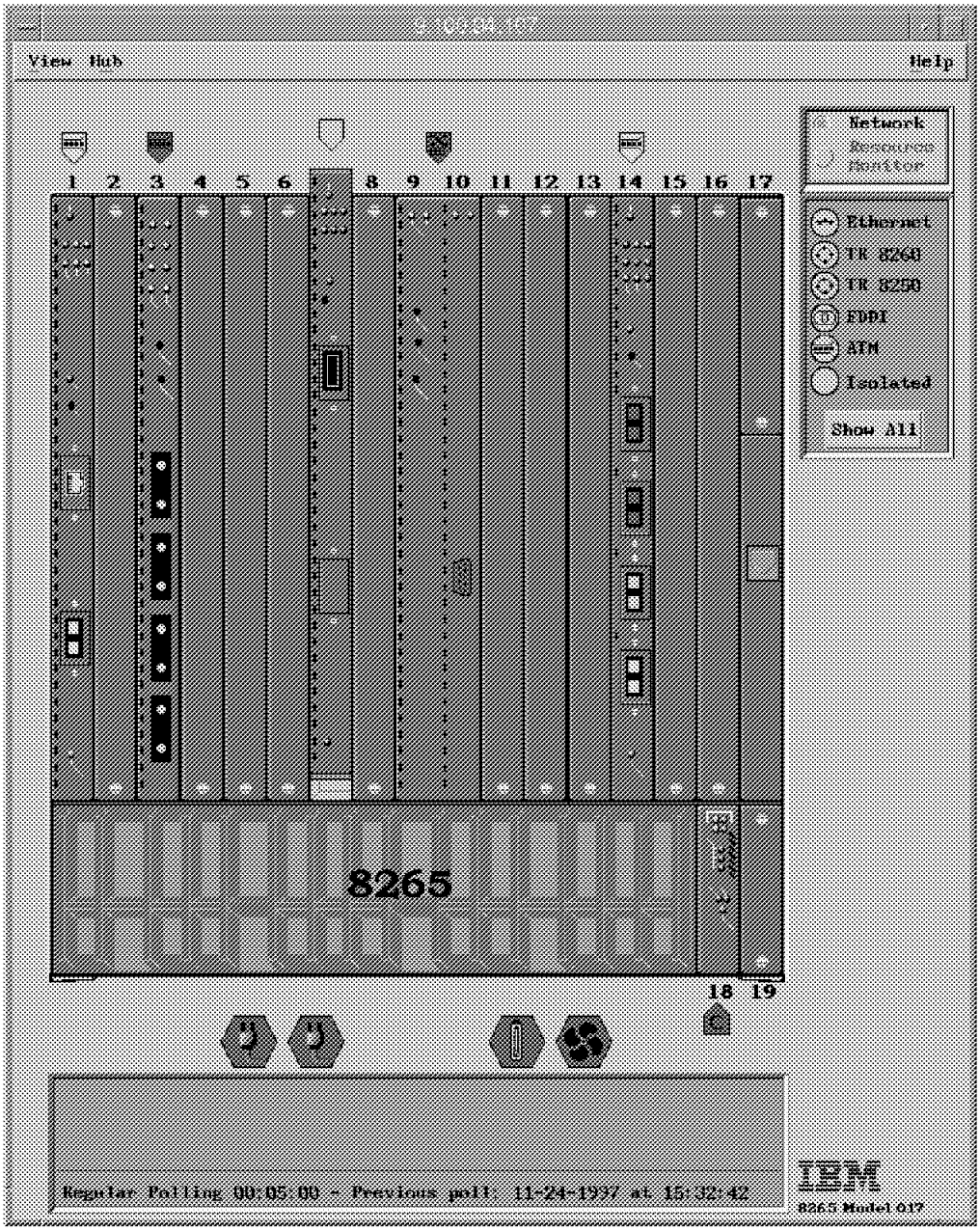


Figure 69. 8265 Chassis Front Panel Display Window

Configuration information on individual modules installed in the 8265 can be obtained by clicking the left-hand mouse button twice on the tag symbols that appear in Figure 69 above the modules.

Specification settings and operational details are available for:

- Power
- Fans
- Temperature

These details are available by clicking the left-hand mouse button twice on the fan and power icons that appear below the main chassis panel displayed in Figure 69.

5.8.2 PNNI View

Various displays of PNNI connections are available to the user. These include:

- PNNI peer groups
- PNNI topological views
- PNNI nodal views
- PNNI spanning tree views

An example of a PNNI node view is shown in Figure 70.

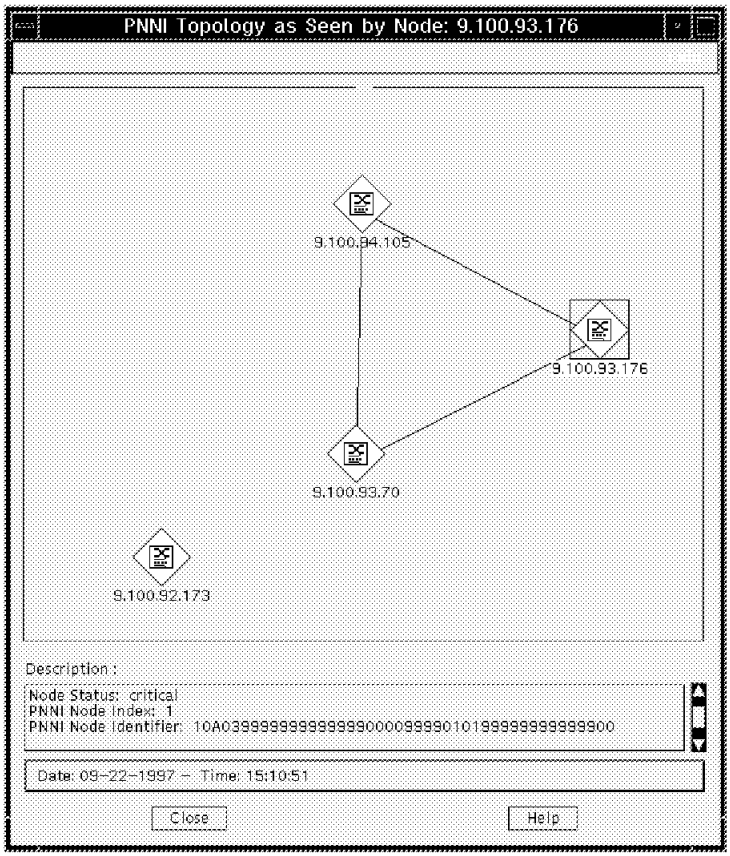


Figure 70. PNNI Node View

Each PNNI device builds its own reachable spanning tree log. This represents all the routes to other PNNI devices that the local PNNI device is aware of. The spanning tree PNNI routes are displayed in Figure 70 and are represented by the solid lines interlinking the PNNI nodes.

The local PNNI device is at the root of the spanning tree and its spanning tree can be used to debug ATM call failures such as:

- No route to destination
- Insufficient resources

5.9 Using LAN Emulation

To use LAN Emulation Manager double-click the left mouse button on the VLAN icon in the NetView for AIX Root submap as shown in Figure 64 on page 148. This displays the VLAN Broadcast Domain View as shown in Figure 71.

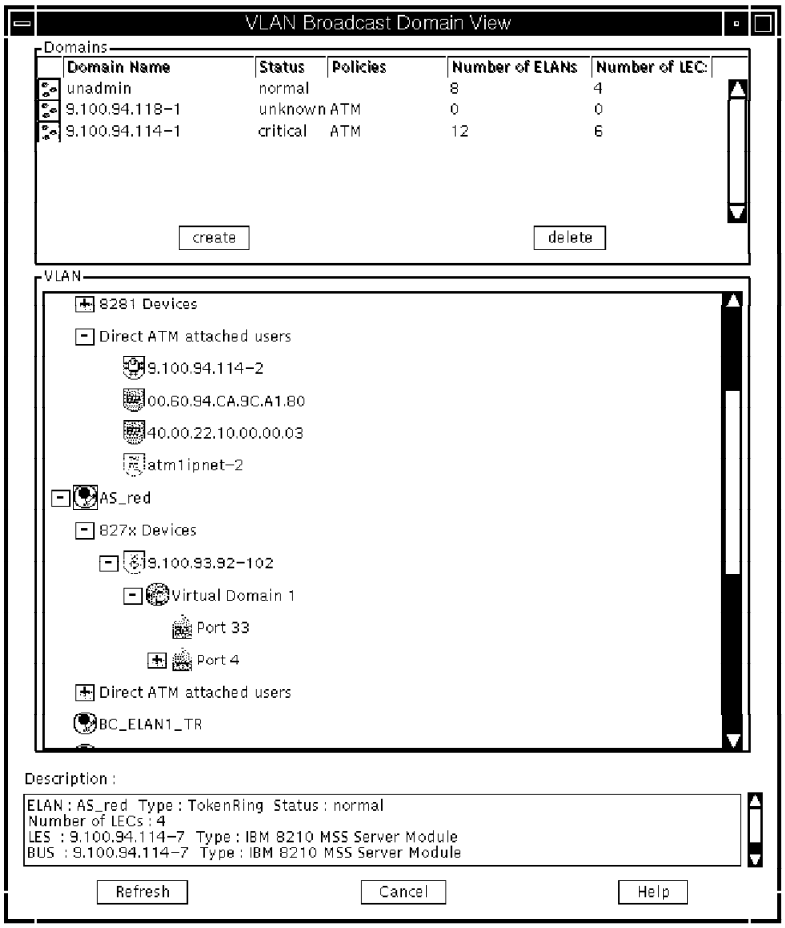


Figure 71. VLAN Broadcast Domain View

This panel allows the user to:

- Create new and delete existing LAN Emulation domains. The default domain *unadmin* always exists and cannot be deleted.
- Expand the tree view of the ELAN selected; however, only if a *plus* sign exists next to the ELAN icon.
- Explode the view of the LAN Emulation domain selected as shown in Figure 72 on page 156. To explode the view of an Emulated LAN the user must double-click the left mouse button on the desired ELAN.

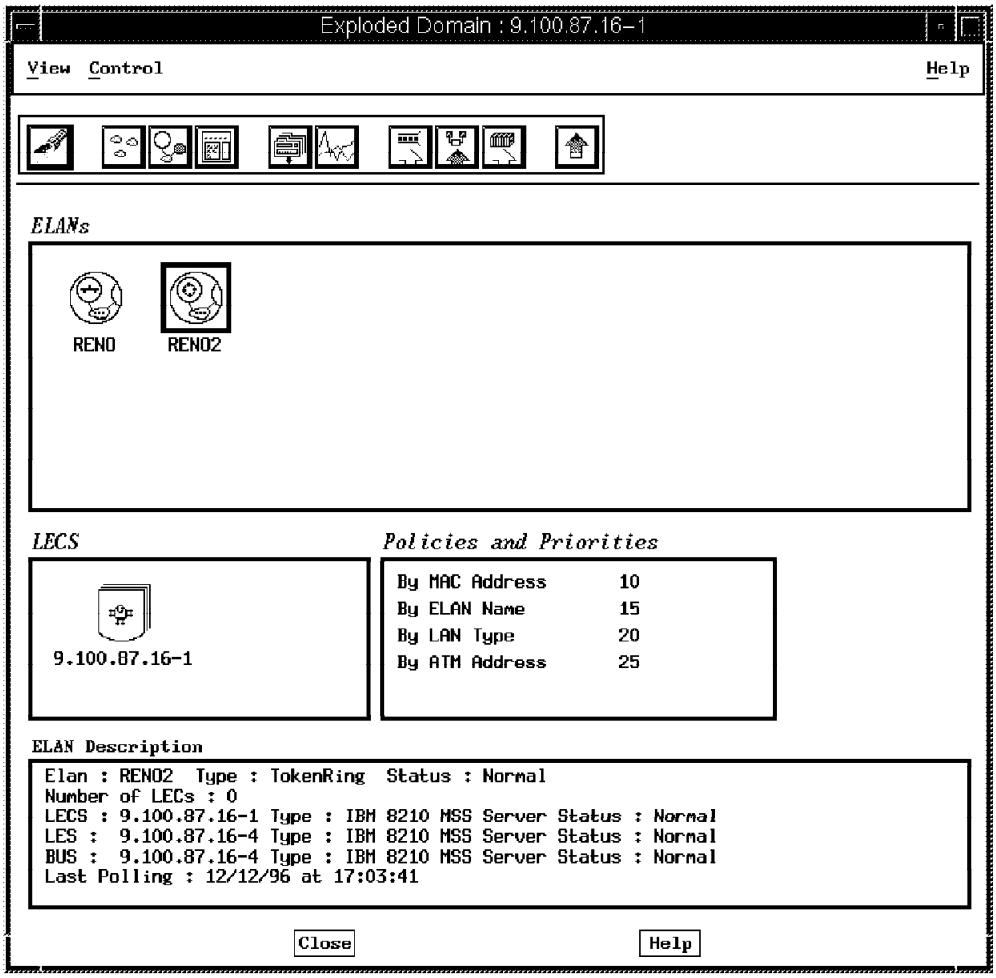


Figure 72. Exploded Domain Panel View

The characteristics of the selected ELAN are displayed in the Exploded Domain view panel as shown in Figure 72.

The characteristics consist of:

- LAN Emulation Clients (LECs) connected to the ELAN
- LAN Emulation Configuration Server (LECS) managing the ELAN
- LAN Emulation Servers (LESs) defined in the ELAN
- Broadcast and Unknown Server (BUS) defined in the ELAN
- Polling information about the ELAN for example frequency, time stamp and policy polling information

5.10 Using FaultBuster

The FaultBuster Selection panel allows for the diagnosing of problems on selected resources.

As shown in Figure 73 on page 157 the FaultBuster Selection panel allows the selection of type and identity, for example IP address or name, of a resource for which the abnormal state is desired to be diagnosed and analyzed.

To utilize the FaultBuster facility on NCMA the following steps must be followed:

- Select the FaultBuster option from anyone of the following menu bars:
  - Campus Manager ATM submap
  - LAN Emulation submap
  - ATM Manager end-user interface panel
- Enter the resource information of the device, for example, IP address or device name, that is to be diagnosed and click on the **OK** button of the FaultBuster Selection panel as shown in Figure 73.
- After clicking OK the main FaultBuster panel similar to Figure 74 on page 158 will appear.

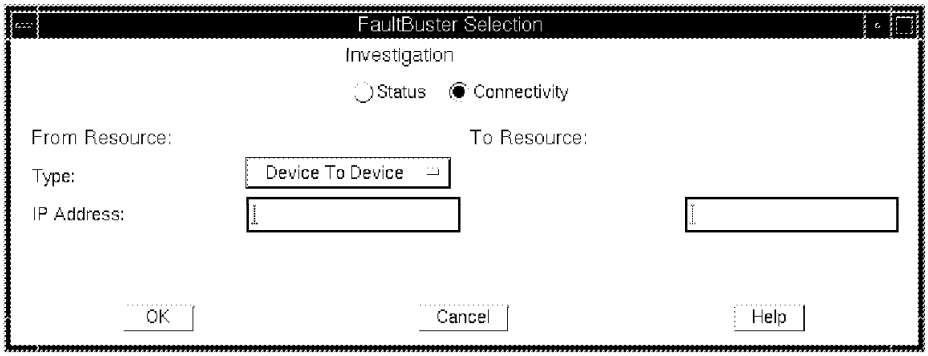


Figure 73. The FaultBuster Selection Panel for Connectivity Problems

From the Main FaultBuster panel any number of different options are available to the user. Reasons for the conditional state of the resource will be listed as well as descriptions of the problems occurring on the selected device.

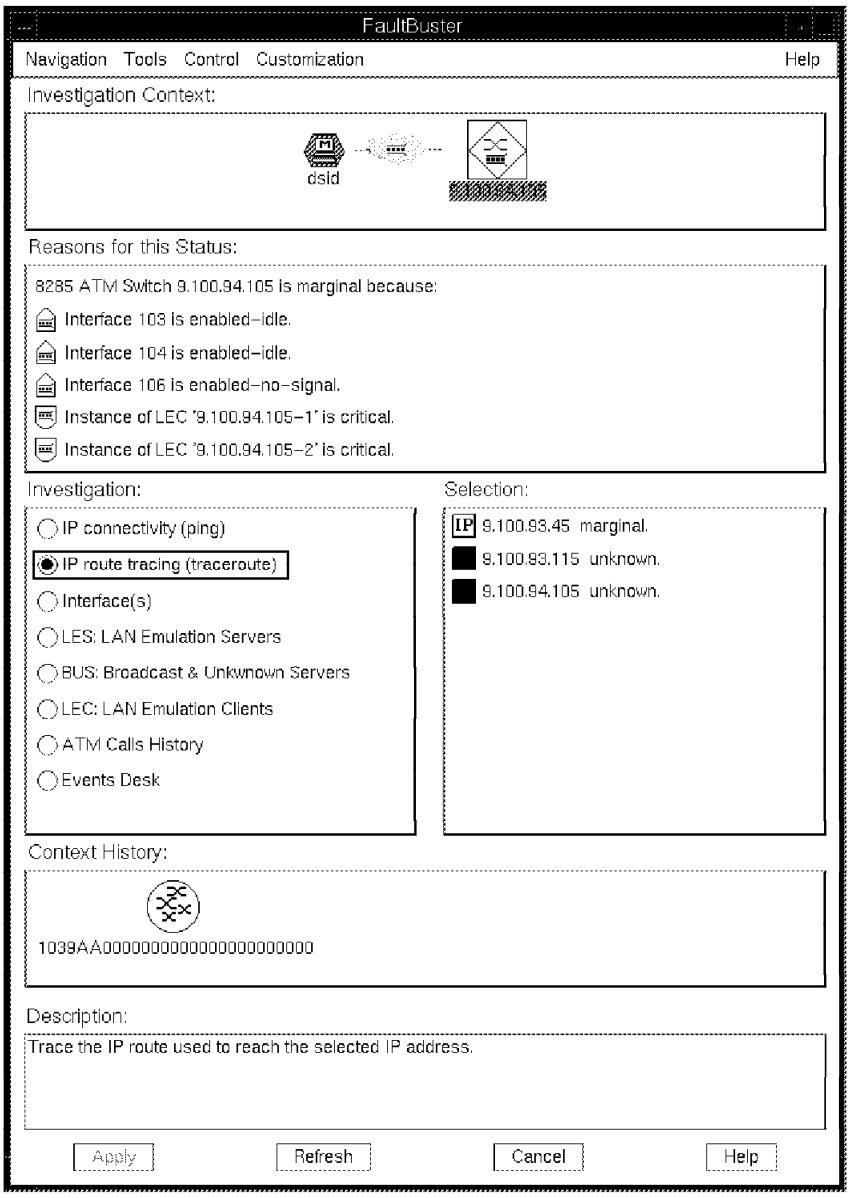


Figure 74. The Main FaultBuster Panel

5.11 Statistical Displays

Using the statistical gathering facilities of Campus Manager ATM it is possible to:

- Collect statistical data about *critical* ATM devices
- Graphically display the statistical data

The Statistics Selection panel as shown in Figure 75 on page 159 can be selected from one of the following panels:

- Interface Configuration panel
- ATM View panel
- LAN Emulation panel

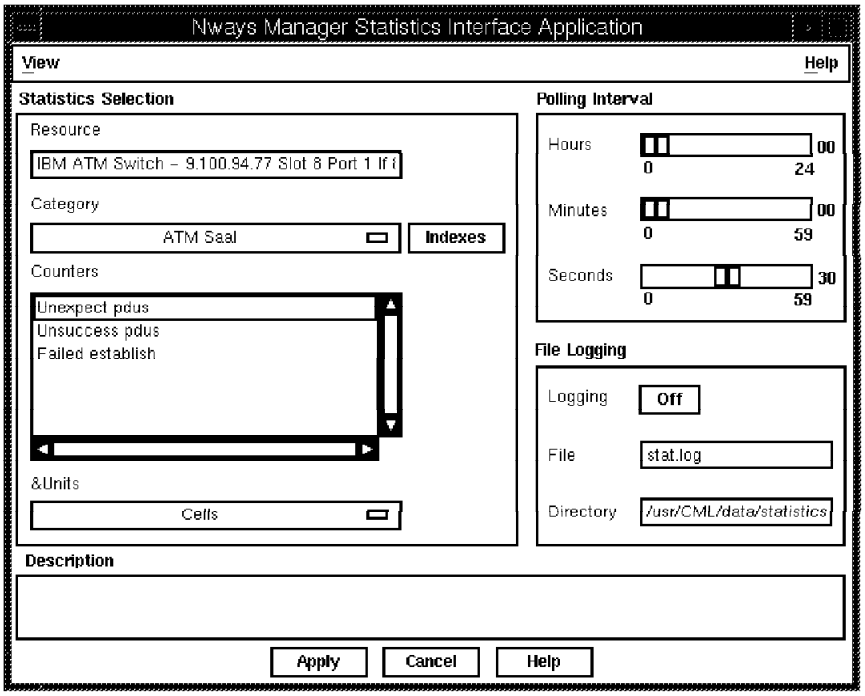


Figure 75. Statistics Selection Panel

From the Statistics Selection panel a user can:

- Select one of the categories in the Category option menu.
- Select counters available for the category selected.
- Change statistical units for example cells, bytes or bits.
- Change polling intervals of ATM devices.
- Specify directory and file name of log files.
- Log results to files.
- Index access requirements to category counters.

After all the above parameters have been entered in the Statistics panel click on the **Apply** button as shown in Figure 75 and the Statistics Display panel shown in Figure 76 on page 160 will be displayed.

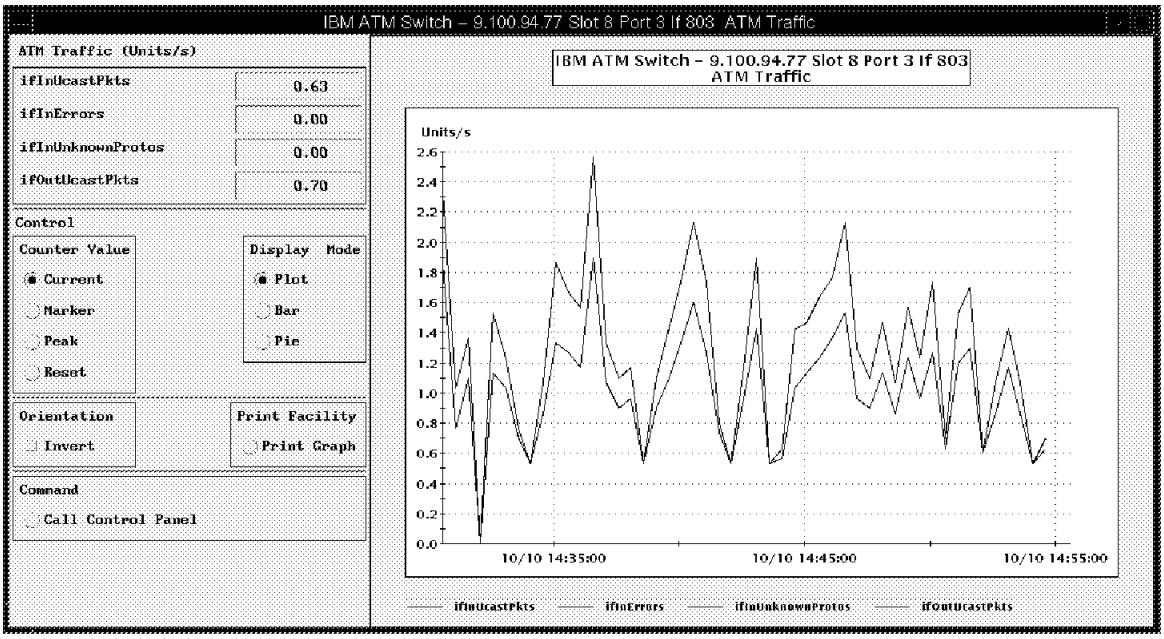


Figure 76. Statistics Display Panel

The Statistics Display panel allows for:

- Value selection of statistics for example current and peak values. It also allows for the marking and resetting of these values.
- Graphical display selection, for example, plot charts, bar charts and pie graphs.
- Printing of the selected panel display.
- Inversion of the display for plot or bar display.
- Callup of the Statistics Control panel as shown in Figure 77 on page 161.

The Statistics Control panel lists all the selected statistics that have been started and requested by the user. Multiple requests for statistics can be initiated on different ATM resources. These different requests will be displayed in separate panels for each resource.

Note

Multiple requests for the same resource and category will result in any existing panel being brought to the front.

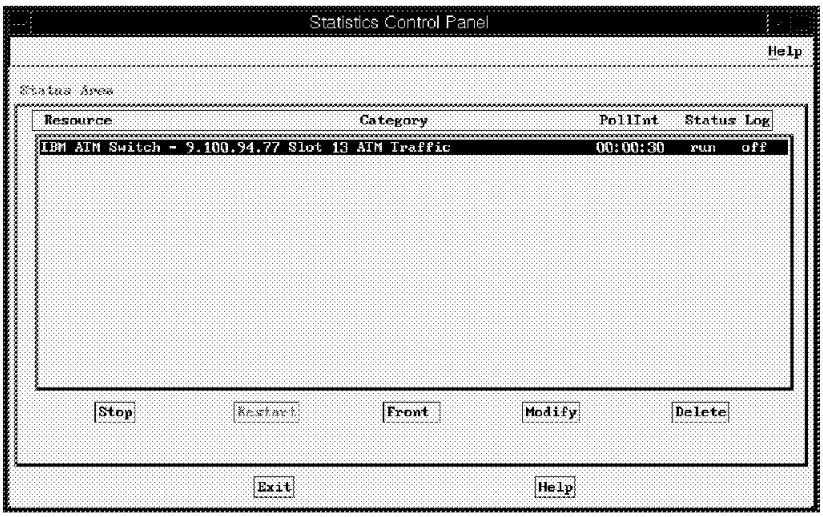


Figure 77. Statistics Control Panel

Chapter 6. Troubleshooting 8265 Networks

This chapter details how to proceed with troubleshooting 8265 ATM campus networks. We discuss problems that occur after all the ATM devices are successfully attached to ATM media ports and the ATM traffic is started in the network.

6.1 Problem Source Isolation in a Networking Environment

When faced with multiple problems, generally you would want to correct the one with the greatest impact on the network first. Exceptions are when a less critical problem can be quickly and easily resolved.

6.2 Before You Begin

Effective network problem determination requires the knowledge of the network topology involved. In that regard, the more information the troubleshooter can get, the better. Having the following information available will save much time and effort for the network troubleshooter:

- Create network layout diagrams

  These drawings should document the logical and physical connections throughout the network in question. The physical diagrams should include detailed connectivity information for media runs from devices (workstations, servers, routers, etc.) to wall plates, patch panels and hub ports. These will be especially useful for connectivity problems since many connection problems are still the result of bad or loose media cable connections, or as is often the case with hubs, the result of disabled or misconfigured port settings.

- Collect user manuals for each component (installation, customization, and problem determination manuals).

Plan your troubleshooting strategy. If the network is not totally usable, you should plan how to attack the problem when maintenance becomes available so as to make the most productive use of your time.

6.3 Define the Problem

Quick troubleshooting requires that the problem be defined as accurately as possible. Certain basic questions need to be asked and answered to help narrow the problem search area:

- What changed?

  The biggest cause of network problems is changing something. It is a good idea to keep a control change log book to enable any inadvertent changes.

- Has it ever worked correctly?

- What is wrong?

  Define what you cannot do. Put it in writing if you can, then you can stare at it and contemplate solutions.

- What is the scope of the problem?

For example, you discovered that a device cannot connect to a server. Is it confined to one device not being able to connect to a server or is it that no devices can connect to the server? Can the device connect to any server? Is the problem confined to one segment or does it span multiple segments?

- Is the problem related to a specific protocol or application?
- Is the problem intermittent?
- Is it more prevalent at a particular time of day or under load?
- Can the problem be duplicated?

6.4 Problem Determination Tools and Procedures

Tools to gather data are varied depending on the problem, but generally will include the following:

1. Interrogation of affected users
2. Visual aids (LEDs, power indications, etc.)
3. Console commands from the affected devices

   Initial problem isolation activity will likely start with the ATM switch. The SHOW commands are very useful in diagnosing the problem. The network administrator can quickly and easily target potential problem areas using the following commands:

   - SHOW DEVICE
   - SHOW HUB
   - SHOW LAN_EMUL CONFIGURATION_SERVER
   - SHOW MODULE ALL VERBOSE
   - SHOW PORT ALL
   - SHOW PNNI
   - SHOW PVC
   - SHOW REACHABLE_ADDRESSES
   - SHOW SECURITY
   - SHOW VPC_LINK
4. Protocol commands such as IP PING, traceroute or IPX PING
5. ATM Forum UNI Cause Codes
6. ATM Forum LANE Status Codes
7. Internal traces
8. Protocol analyzers

   Protocol analyzers are expensive and it is not always possible to use protocol analyzers. Using protocol analyzers requires special skills and they are only used if the problem cannot be solved in other ways.

6.5 Problem Determination Flowchart

A flow chart for problem isolation is presented to isolate the problem area.

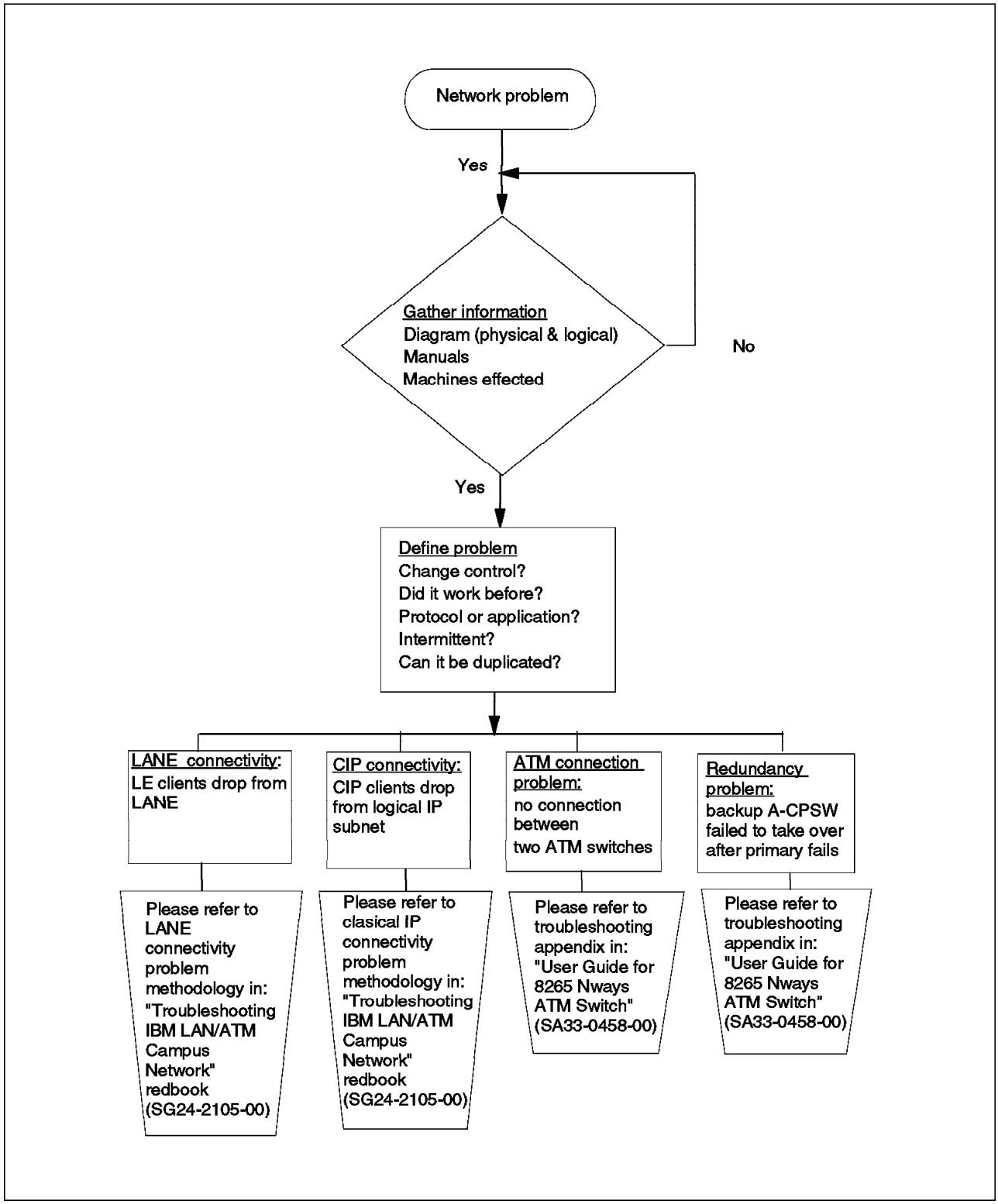


Figure 78. Problem Determination Methodology

Here we summarize the steps to help you in determining network problems:

1. Gather information.

   As mentioned in 6.2, “Before You Begin” on page 163, the key to effective problem determination is to gather as much information as possible regarding the problem. This includes:

   - Physical and logical diagram.
   - Manuals.
   - Network environment you are working, whether it is an emulated LAN or Classical IP network.
   - Machines that are having problems.

     Note the ATM, MAC and the network addresses (IP/SNA/NetBIOS/IPX) of the key network components. These includes hubs, bridges, routers, switches, LECS, LES, BUS and ATM ARP servers.
   - Cause code error. Please refer to 6.2, “Before You Begin” on page 163.

2. Define the problem.

   Most of the times problems occur when some changes have been made to your network. Effective control change and management of changes through a control change logbook minimize the impact of your problem by identifying the changes quickly.

   Sometimes one should also know if the specific network issue was operable, as it may become a setting or configuration issue.

   We should have an understanding if it is the protocol or the application that is giving the problem. Usually if commands such as PING, TELNET or log on to server works, it is not a protocol problem and one may have to look at the application a little bit closer.

   Sometimes the problem occurs intermittently. When this problem occurs document the time, number of users logged in, applications running on the network, print jobs or utilities using the system resources, etc. to determine the cause of the problem. See if the problem can be duplicated to narrow down the cause of the problem.

3. Interrogate the network based on the problem symptoms.

   If the change causing the problem cannot be identified or is unknown, you must interrogate the network to discover the problem. The key information you need to discover depends on the problem you are experiencing. We classified the most common problems that may occur into four main types:

   - Emulated LAN connectivity problems

     Emulated LAN connectivity problems include all cases where a number of devices on a LANE cannot communicate with each other because one or more of them are no longer members of the LANE. This may be because they failed to join or have been dropped from it after a period of time. Please refer to the *Troubleshooting IBM LAN/ATM Campus Network* redbook for further details on how to troubleshoot the problem.
   - Classical IP connectivity problems

     Classical IP connectivity problems include all cases where a number of devices on a logical IP subnet can not communicate with each other because one or more of them are no longer members of the logical IP.

This may be because they failed to join or have been dropped from it after a period of time. Please refer to the *Troubleshooting IBM LAN/ATM Campus Network* redbook for further details on how to troubleshoot the problem.

- No connection between two ATM switches

  The IBM Nways Campus Manager, which is discussed in this chapter, determines which ATM devices are interconnected. Our base line logical and physical connectivity diagram could be used to determine which of the devices are not connected and is a source of the problem. Please refer to the *IBM 8265 Nways User's Guide* for more details on the problem of switch connections.

- A-CPSW takes over problem

  In a network we may even see the whole network not functioning because of A-CPSW problems. In redundant mode the backup A-CPSW should take over the faulty A-CPSW. If this has not occurred, there is a procedure in the 8265 user's guide to correct this problem.

The methodology used to diagnose and fix problems, for the different types of problems listed above, may often vary. The different methodologies we used in this redbook are considered in the sections below. Resolve the problem or investigate a different symptom.

By following the problem methodologies described below, you will usually resolve the problem. In some cases you may identify that the problem is actually related to a different problem area, in which case you may need to repeat the entire problem determination process to investigate this new area to resolve the problem.

6.6 Gathering Information by Using 8265 SHOW Commands

Table 17 refers to the SHOW commands that are typically used to gather information about the 8265 network environment. These SHOW commands can significantly help you in gathering the information you require to diagnose and locate your problem.

Table 17 (Page 1 of 2). SHOW Commands

Command	Description	Useful for finding
SHOW DEVICE	Configuration information about the ATM control point. Network subnet status for: • ATM • LANE-Token-Ring • LANE-Ethernet	• Name of device • Location of device • Boot EEPROM VERSION • Flash EEPROM VERSION • Subnet ATM status • LANE network status • IP address • Subnet mask • MAC address • CIP status • ATM address • LES ATM address • BUS ATM address • LECS ATM address • Default gateway IP • ARP server ATM address
SHOW HUB	Information about the 8265 switch environment	• Backplane type • Power supply status • Temperature • Fan status
SHOW LAN_EMUL CONFIGURATION_SERVER	Displays the entries in the LECS address table	• Displays substitute LECS address in place of WKA
SHOW MODULE	Configuration information on connected modules **Valid:** for either media modules or A-CPSW	• CPSW connection status. Possible values: connected, not connected or pending. • Hardware status of CPSW or ATM module. Possible values: OK (functioning properly) or KO. (A hardware problem has been detected.) • Ports Mode. Possible value: enable or disable • Error condition status
SHOW PNNI	Shows any PNNI configuration	• Configuration state • Neighbor node IDs • Node_0 settings • Path selection • Peer group members • Summary address

Table 17 (Page 2 of 2). SHOW Commands

Command	Description	Useful for finding
SHOW PORT	Displays configuration information on a single port or all ports	• Port status • Type of ATM interface (PNNI,UNI,IISP,ILMI) • Port type (VOID) • Slot number of modules
SHOW PVC	Displays the definitions of selected or all PVCs	• PVC information for ATM modules **Attention:** Port information given in hexadecimal.
SHOW REACHABLE ADDRESS	Displays all reachable addresses defined in the local switch	• Reachable address explicitly defined in the reachable address table. • Reachable address dynamically created by ILMI.
SHOW SECURITY	Displays security access control settings and violations for the 8265	• ATM addresses that have been granted access • Information regarding the security violations • Current access security log setting
SHOW VPC_LINK	Displays all or selected VPC links	VPC link information for the ATM media modules

Note: For detailed information on SHOW commands, please refer to *8265 Command Reference Guide*, SA33-0458.

6.7 Gathering Information by Using IBM Nways Campus Manager

The IBM Nways Campus Manager is a very useful tool for gathering information about your network environment. It shows the physical and logical connectivity, and also ATM LAN emulation addresses and Classical IP addresses used in your network. This can significantly help in gathering the information you require to diagnose and locate your network problem.

In the following diagram you can see which ATM devices are connected to the 8265, and the status of each slot/port on the hub. You can get this screen by double-clicking on the following objects: **NetView for AIX Root Map -> ATM Campus -> Cluster Number -> Hub Symbol**

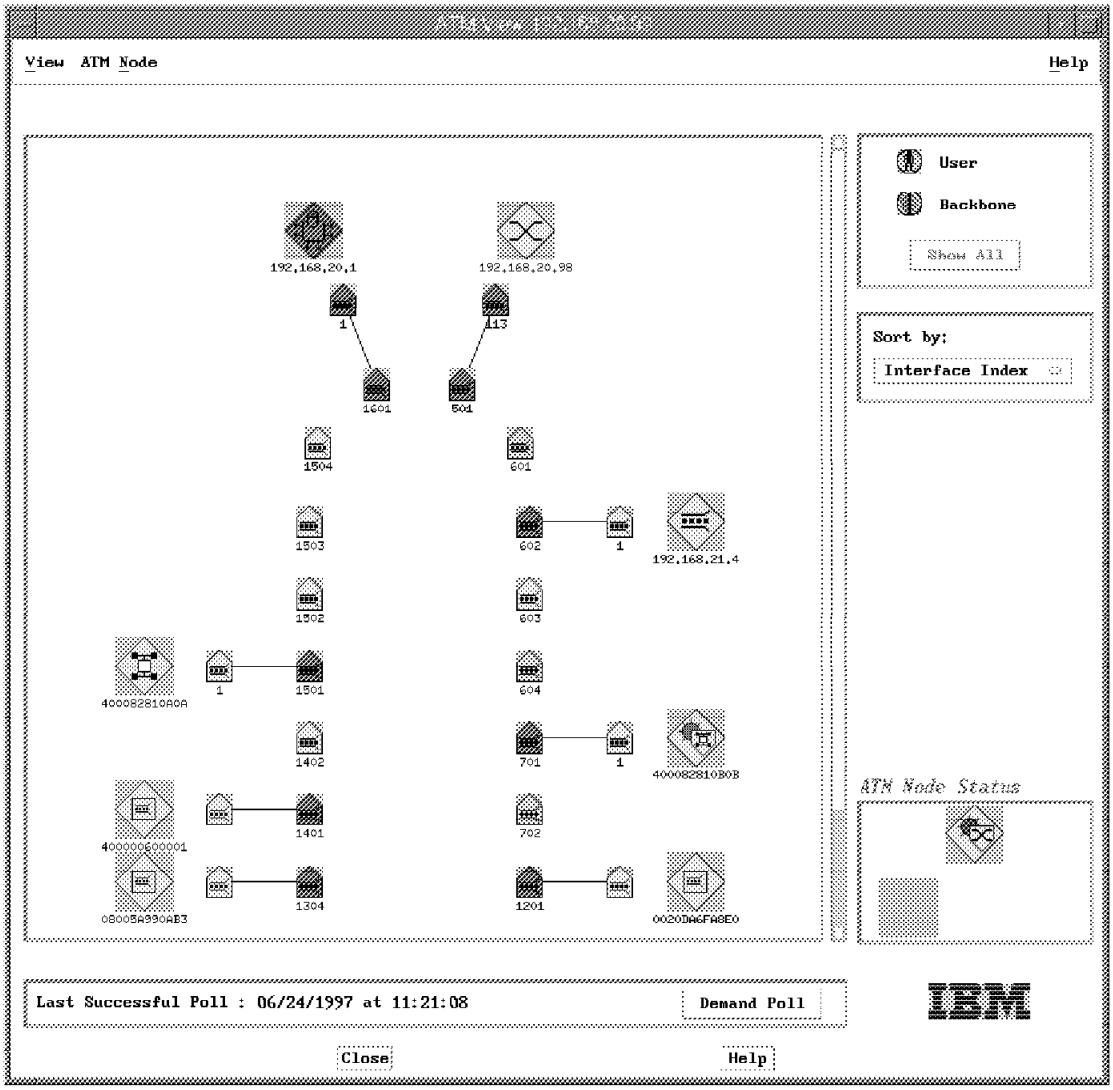


Figure 79. ATM Interface Submap in IBM Nways Campus Manager

You can see the status of LAN emulation components visually. It's easy to get the configuration of these. You can get the following screen by double-clicking as follows: **NetView for AIX Root Map -> LAN Emulation -> Domain -> ELAN**.

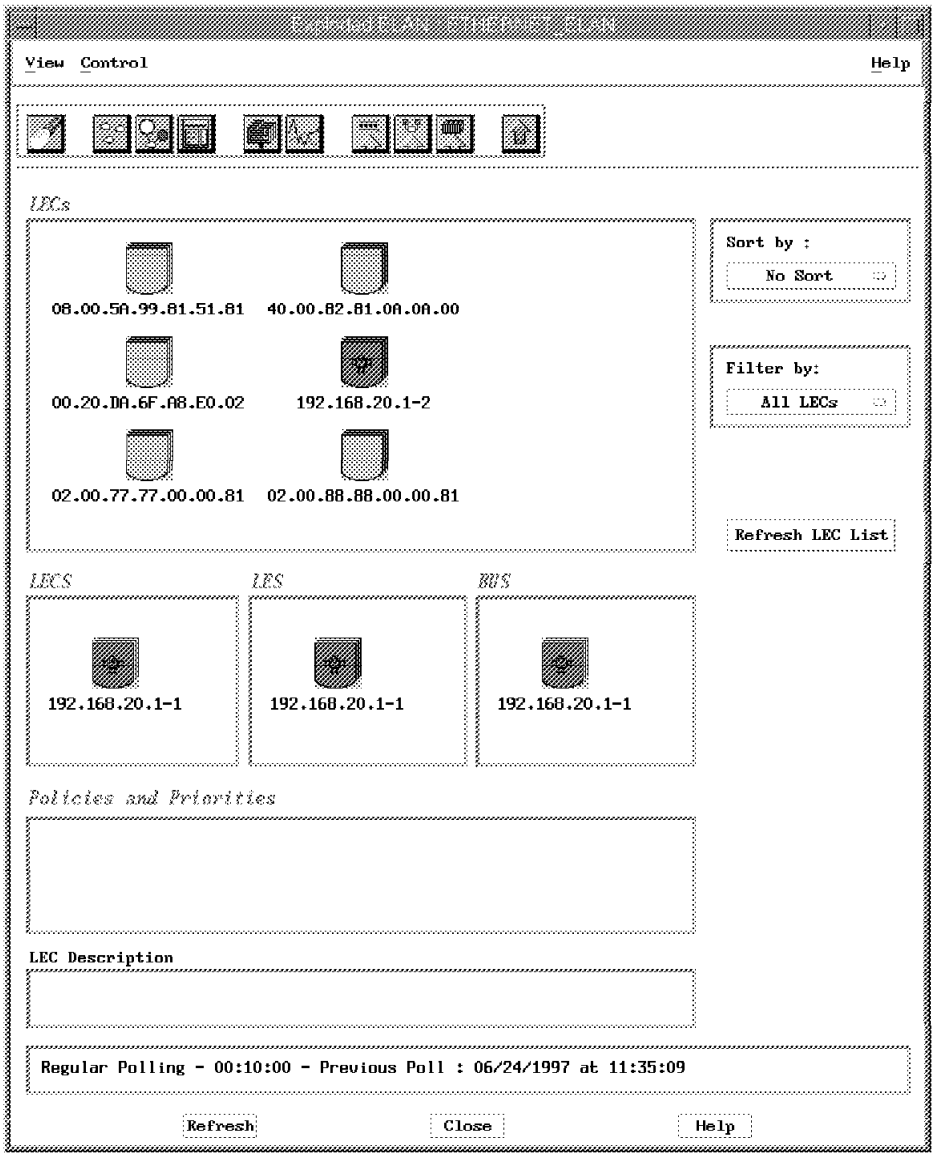


Figure 80. Exploded ELAN by IBM Nways Campus Manager

Chapter 7. Summarizing 8265 ATM Campus Switch Attributes

In this chapter the unique features and architecture of the 8265 is documented and described. This chapter assists IBM marketing and sales personnel, field engineers and business partners to best leverage the benefits of implementing an 8265 within the customer's network environment. It will provides a quick reference guide to vital technical information in table format. Network performances of the 8265 are also discussed during the course of this chapter.

7.1 Overview

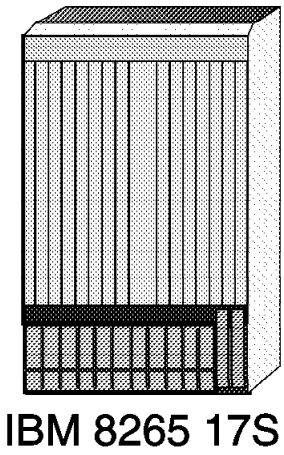
The IBM 8265 ATM Switch introduces a new platform for next generation high-end ATM backbone networks.

It is the most powerful and cornerstone of IBM's family of ATM switches and has an *open* architecture that addresses ATM backbone requirements for:

- High switching capability
- High port density
- High reliability

The 8265 is the choice for a network with switched backbones which requires:

- OC3 and OC12 ATM switching
- Concentrating campus LANs
- Wide area ATM connections
- Native attachment of high-speed servers
- Smooth transition to ATM connectivity for legacy Ethernet and token-ring networks



8265 Open Architecture provides:
- High switching capability
- High port density
- High reliability

8265 supports
- OC3 and OC12 ATM switching
- WAN ATM connections
- High-speed server connections
- Legacy LAN connectivity

Figure 81. IBM 8265 S17 Capabilities

7.2 Switching Architecture

The IBM 8265 ATM switching architecture combines the strengths of:

- A central switching fabric
- Distributed buffer pools
- Traffic management

The architecture is centered around IBM's Switch-on-a-Chip architecture. The two award-winning design Prizma ASIC single stage chips provide a substantial increase in bandwidth and are capable of providing up to four times the cell switching capacity of current IBM 8260 models.

The chip sets running in speed expansion mode deliver:

- 800 Mbps full-duplex per port
- Aggregate throughput of 12.8 Gbps full-duplex

Single stage (16x16) switching provides superior performance over multiple stage switching because it does not suffer from:

- Cell delay variation
- Signal jitter

The switching fabric links to the ATM media modules via a *passive* backplane in the form of a *star*. The Prizma chip sets form the center of this star. For redundancy and backup purposes the backplane is actually made up of two stars

with room for two switching fabrics. Every media module therefore connects to the two stars.

The 8265, by having a central switching fabric with each ATM module having a dedicated connection to the switching fabric, allows for:

- Simplification of the backplane design
- Scalability to higher throughputs, for example, 64 Gbps and more
- Lower price cost for each module

7.3 Common Hardware and Operating System

The 8265 offers a convenient and scalable migration path for the already installed 8260 network base. The 8260 and 8265 have many common components that offer initial network hardware investment protection to customers wishing to upgrade their networks to an 8265 platform.

The 8265 backplane has the capability to cater to up to four 8260 ATM modules. 1-, 2- and 3-slot 8260 ATM modules can be used within an 8265. Due to its backward compatibility with the 8260 almost all 8260 ATM modules can be implemented in the 8265 with only slight alterations to the 8260 ATM modules Field Programmable Gate Arrays (FPGAs). The 8260 modules that can be used in an 8265 include:

- Multiprotocol Switched Services (MSS)
- 8271 Ethernet LAN Switch modules
- 8272 Token-Ring LAN Switch modules
- Video Distribution Module
- Circuit Emulation Module
- WAN ATM-2 modules
- ATM Kit developed modules
- 25 and 155 Mbps modules

Power supplies and controller modules are interchangeable between the 8265 and 8260. This excludes the Advanced DMM/Controller module.

The 8265 also uses tried and tested attributes of the current 8260 models, these being:

- Passive components for reliability purposes
- Female connectors for protection against poor module insertions
- Dual control point/switch and controller module slots for redundancy purposes
- Multiple power supplies

The 8265 integrates its own advanced functions with those of the 8260 to minimize network complexity and lower overall cost of ownership.

The 8265 uses the same ATM operating subsystem as the 8260 and 8285 workgroup switch. The common operating system offers users:

- No additional training costs on operating system

- Familiar ease of use
- Robustness
- Feature-rich operations

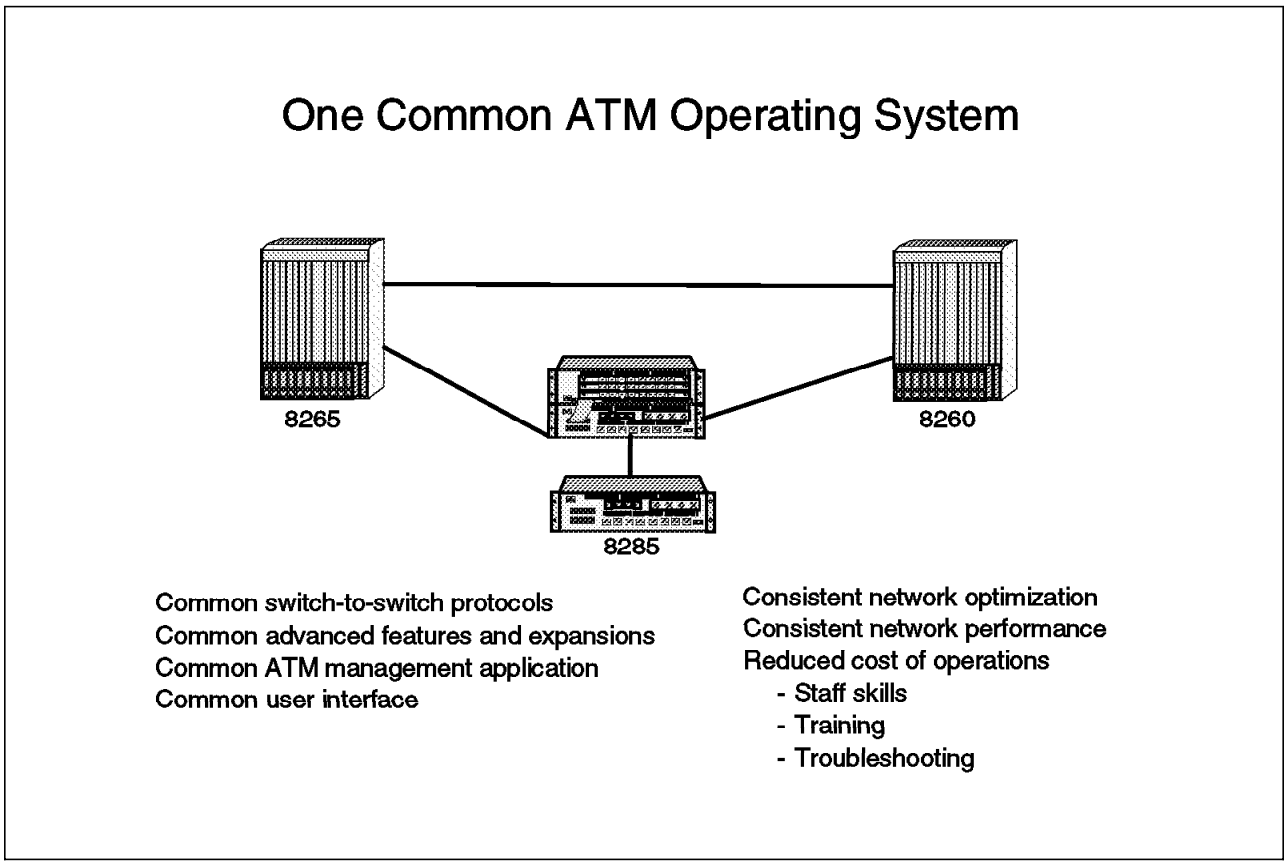


Figure 82. Common Operating System

Some of the major features of the operating system are:

- ATM Forum UNI 3.0,3.1 and 4.0
- Auto-detect and inter-networking between UNI 3.0,3.1 and 4.0
- Anycast addressing
- PNNI Phase 1
- IISP
- Widest and shortest path computation
- Load balancing for all QoS traffic
- Pre-computed and on-demand routing
- Parallel link aggregation
- VP tunnelling for UNI and NNI
- Call setup screening and access control
- Link sharing

7.4 Network Security

Access to the ATM network and control of the connection establishments provides enhanced security features to an already secure ATM network provided by the 8265.

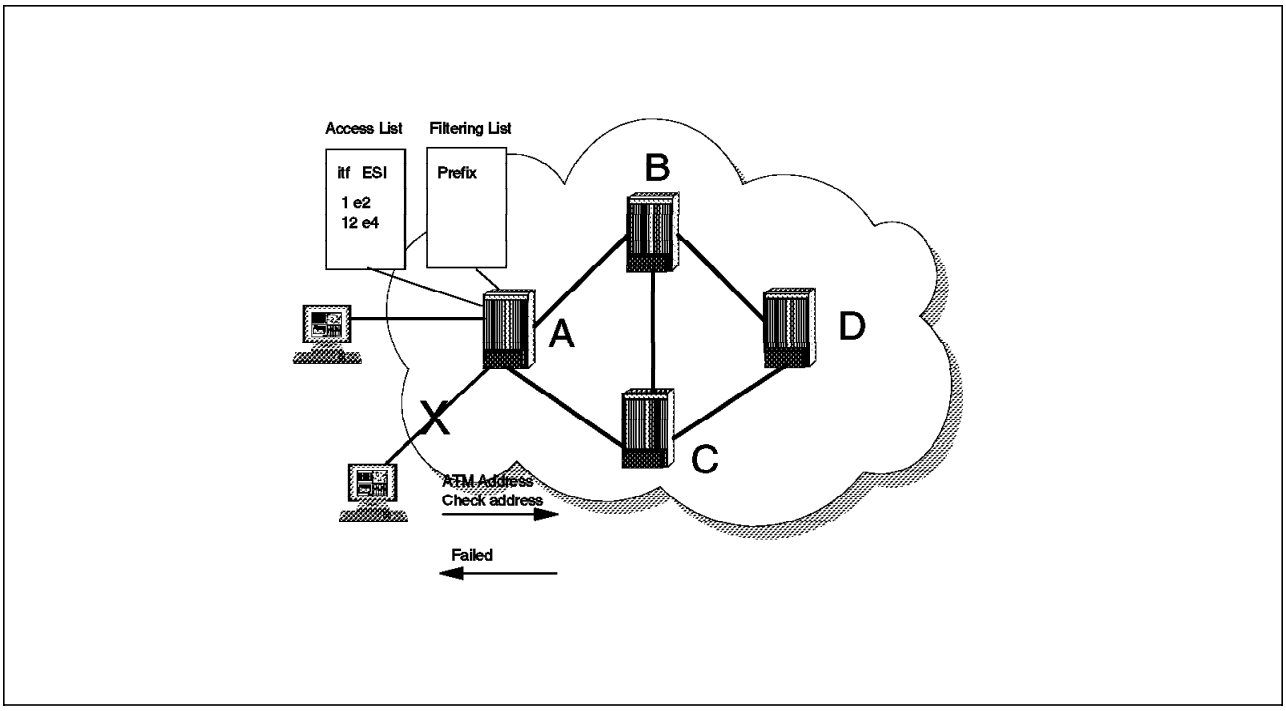


Figure 83. Access Control to an 8265 Network

Included in these functions are:

- Access Control

  This validates the physical access to the ATM network. Access control is based on the Interim Local Management Interface (ILMI) protocol which validates addresses registered by attaching endstations against a predefined *access list*. These lists are known as access control tables.

- Call Screening

  Call screening or filtering performs a *firewall* function for the 8265 A-CPSW. Information for call screening is obtained from the Q.2932 signalling messages in ATM. Filtering can be done on a call direction, QoS, called party number and calling party number basis.

- Closed User Groups

  The purpose of closed user groups is to determine who can call whom and only allow calls between members of the same group.

7.5 Network Redundancy

High availability is one of the most important features of today's networks. The 8265 is designed and built with high availability in mind. It has features for high availability at the box and network level.

7.5.1 Hardware Redundancy

The 8265 hardware redundancy at the box level is provided by:

- Primary and secondary control points
- Dual environment controller modules
- Multiple power supplies
- Multiple cooling fans

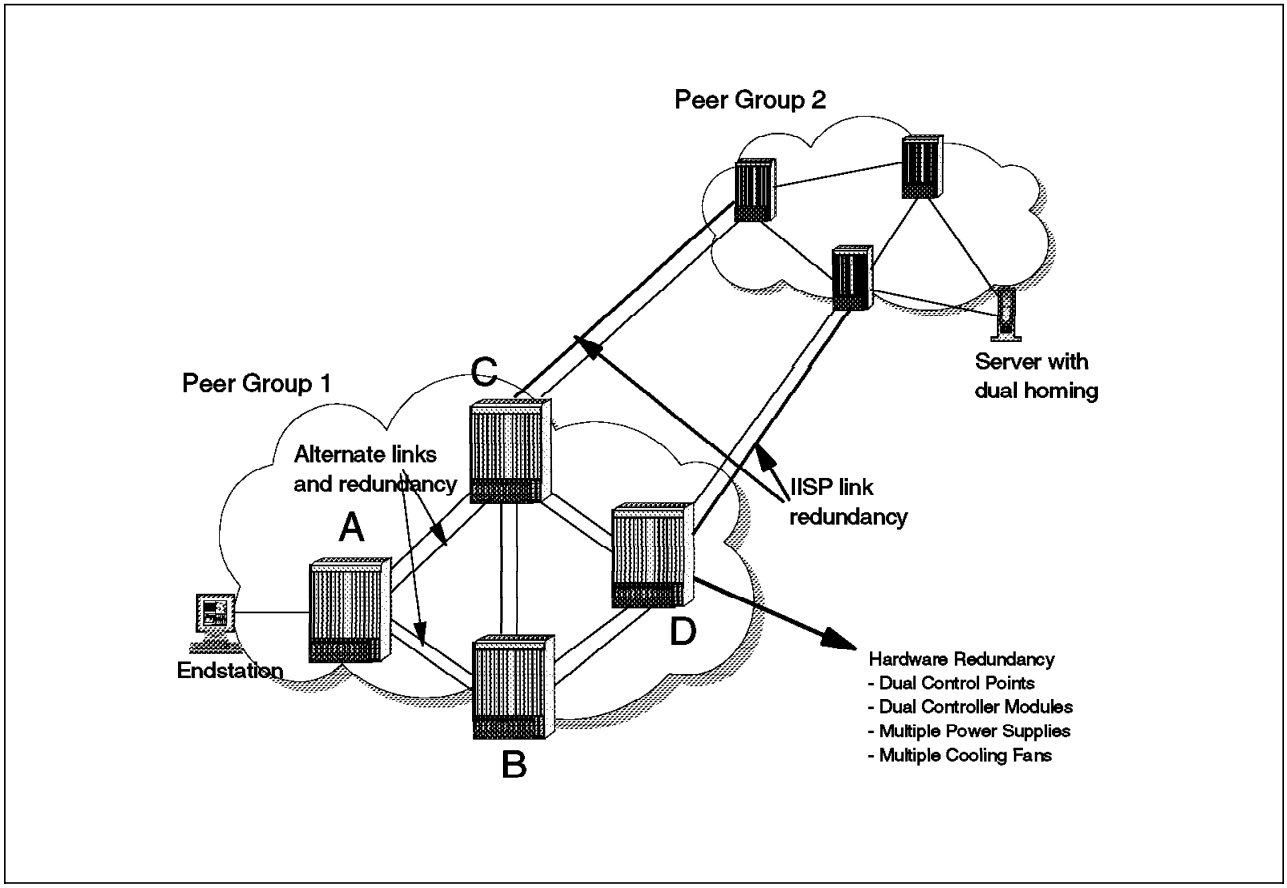


Figure 84. The 8265 Provides Box and Network Level Redundancy

7.5.2 Network Redundancy

The following features are exploited to provide high availability at the network level:

- Distributed implementation
- Link redundancy
- Path redundancy
- Dual homing
- Soft permanent connections
- LECs redundancy

7.6 Link Sharing and Aggregation

Link aggregation groups the links between two adjacent nodes into a single aggregated link on which various call load balancing policies can be applied.

Link sharing limits the amount of bandwidth that can be allocated by CBR, VBR-rt, VBR-nrt and ABR connections. Link sharing is used in the following cases:

- To prevent some applications (for example, circuit emulation) from using all the bandwidth of a link leading to service starvation for other applications.
- To partition the network into trunks supporting only reserved bandwidth connections and trunks supporting only best effort connections.

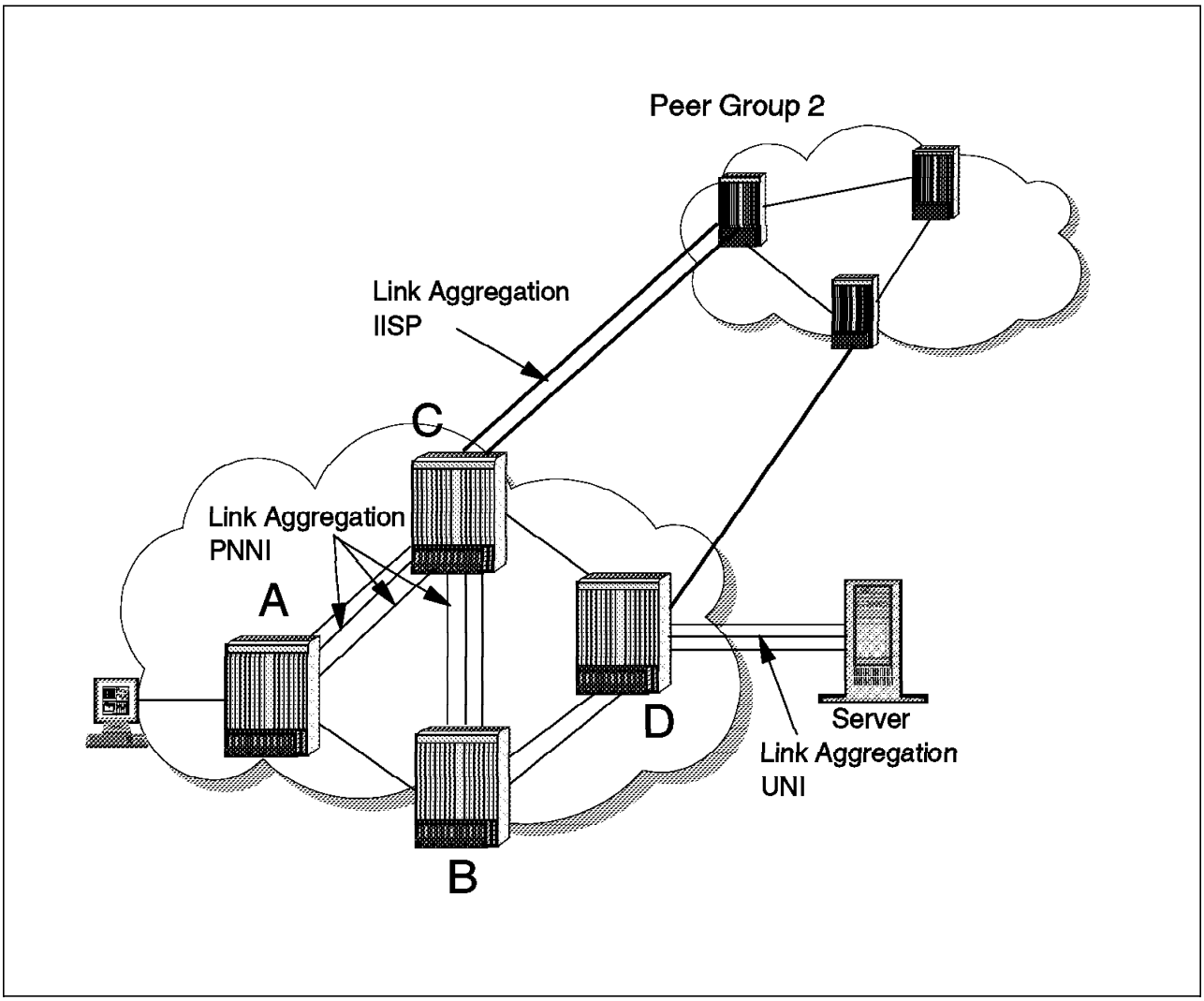


Figure 85. Link Aggregation and Sharing

These features apply to:

- PNNI links
- UNI connections
- IISP links
- VPCs

7.7 Traffic Management

The 8265 has enhanced ATM traffic management functions. These essential functions are fully distributed on each 8265 ATM module, instead of centralized on the switching fabric. This is a key factor in network availability, scalability and growth.

The distributed buffer pools provide improved link utilization and traffic shaping assistance. The 8265 has one of the most sophisticated ATM Forum-compliant PNNI implementations incorporated with a high level of ATM signalling performance and robustness.

The key traffic management functions are:

- Support for all ATM Quality of Service (QoS)
- Setting of priority queues based on ATM QoS
- VC policing for congestion control
- Regulation of traffic flow through the use of a relative rate for ABR traffic
- Partial packet discard for any kind of traffic
- Traffic shaping per VP for regulating speed
- Instant viewing of counters per connection, port and module
- Input and output buffer queues on all 8265 modules
- Port mirroring for traffic analysis

7.8 Network Management

Due to its totally *open* design and interoperability with other vendor equipment and software the 8265 is able to leverage the full suite of IBM′s Nways Campus Manager.

With one of the most advanced and integrated applications for ATM and LAN management Nways Campus Manager allows the 8265 to be managed from the IBM NetView for AIX platform.

Using standard ATM Forum MIBs with IBM-specific extensions the management application is able to automatically discover all ATM switches and devices in the network. Full graphical and topological displays will be shown of all devices automatically, as well as providing status and diagnostic events of the entire ATM network.

Simplification of network configurations and designs is made possible by utilizing Nways Campus Manager ATM and LAN in 8265 networks.

Nways Campus Manager provides the network administrator with a unique diagnostic feature called FaultBuster.

FaultBuster is an intelligent tool that provides:

- Graphical representation of network-related problems
- Possible reasons for failure of an ATM device
- Customization of the fault diagnostic database

- LAN Emulation path tracing
- Explicit testing facilities

FaultBuster diagnoses problems in:

- PNNI peer groups
- ATM clusters
- ATM devices
- ATM interfaces
- LAN Emulation resources

  FaultBuster enhances the user's ability to quickly diagnose and repair network-related problems thereby:

  – Limiting the overall network downtime to a minimum.

  – Providing vital network information for future growth of the existing network.

7.9 Superior Control Point and PNNI Implementation

The IBM 8265 uses a control architecture that is designed for:

- Scalability
- Reliability
- Performance

The key element of the 8265 switch is the control software, which is called the *control point*. This software is in command of the following major ATM functions:

- User signalling
- Switch-to-switch signalling
- Call admission control
- QoS route computation
- Setup of all hardware control elements

The performance of an ATM switch is measured on how many bits per second the switch can handle and also how quickly a control point can process the ATM subsystem changes in a dynamic network. A slow control point can seriously degrade the overall performance of a network.

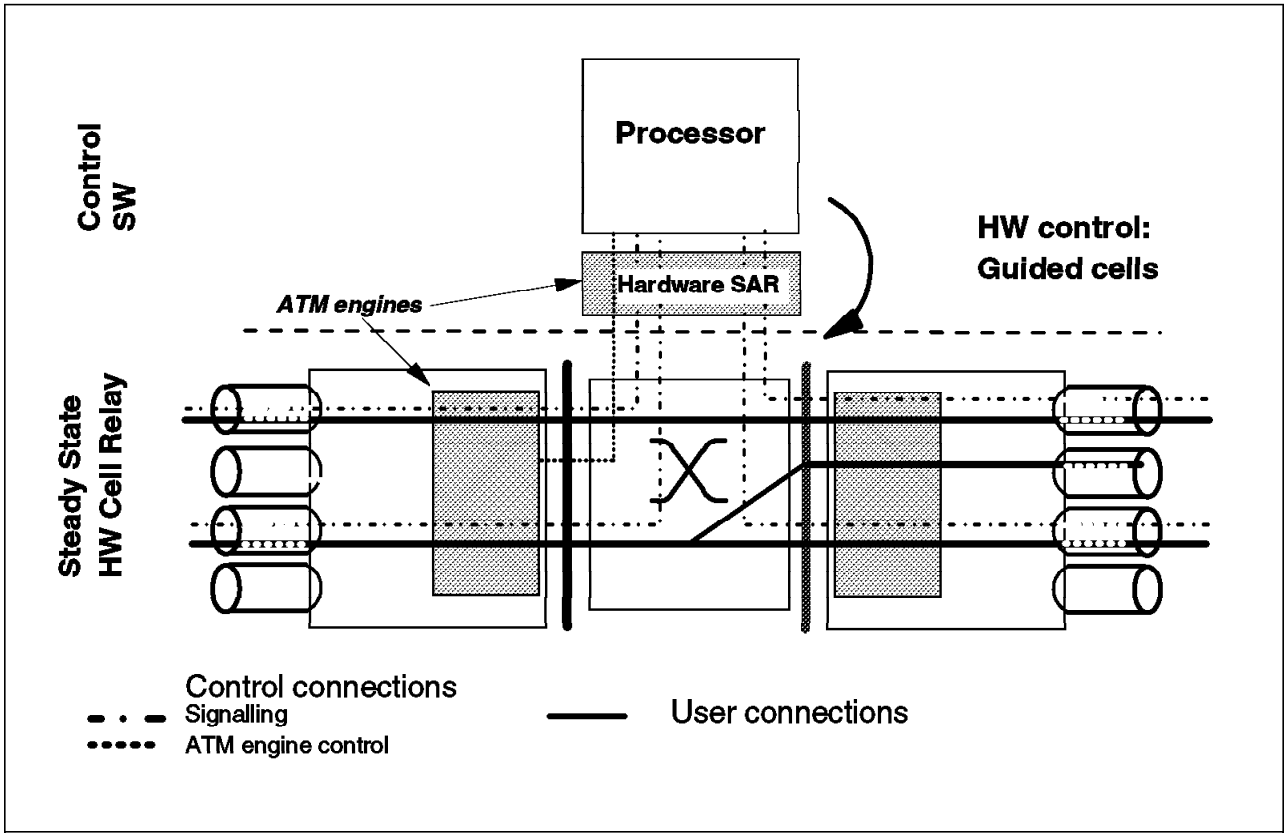


Figure 86. Control Point Structure

The 8265 uses a *unique* architecture where the control point communicates with all the ATM engines of modules using a patented technique called *guided cells*. This allows the control point to set up the ATM subsystem parameters at the speed of the switching fabric and not on a side control bus which runs at lower speeds. The guided cell technique provides:

- Reduction in the amount of hardware components
- Improved reliability
- Lower costs

The control point uses an internal dedicated port (port 0) for the guided cells and this ensures that control traffic is never interfered with by user traffic. The control point also uses a hardware assisted function called *segmentation and reassembly* for cell to frame conversions and vice versa. This relieves the software from this process thereby improving delays in conversion latencies normally associated with software conversion.

By implementing the superior PNNI Phase 1 protocol functions of the 8265 in a network environment it will provide the following benefits and features to the network:

- Widest and shortest path selection

  The automatic selection of least loaded links.
- On-demand and pre-computed paths

  Scalability and optimization of network resources.
- Load balancing

The even distribution of network traffic over available links.

- Alternate routes between peer groups

  The automatic re-routing of traffic in the event of failed links.
- Crankback

  Call setup time is reduced on PNNI and IISP links.
- Duplicate address support

  Server redundancy (for example, LECS and application servers).
- Auto-sensing and conversion of connecting interface types

  Support for UNI 3.0,3.1 and 4.0.
- Signalling optimization

  Improved performances for PVCs.
- PVP tunnelling

  Full PNNI operations over ATM WAN connections.
- Link sharing

  Controls the maximum bandwidth per QoS.
- Multiplexing

  UNI, PNNI and NNI links can be multiplexed over one port.
- Link aggregation

  Multiple links can be configured as one single connection.
- Fast call setup

  Improved user response time at initial logon.
- Bandwidth management

  The selection of optimal routes even if IISP links are configured.
- Access control

  Secure and controlled access to an ATM network.

7.10 Latency Performances and Connection Capacities for A-CPSW

The following table summarizes the main 8265 performances and the environment in which values provided were obtained.

Table 18 (Page 1 of 2). Hardware Performances

Performance Item	Description	Performance	Remarks
OC3 Cell Transfer Delay or Latency	Transit delay during transport	21.8 microsec at 8 Mbps; 22 microsec at 100 Mbps; 25.7 microsec at 149.76 Mbps	Latency was measured between 2 OC3 ports using reserved bandwidth.
0C12 Cell Transfer Delay or Latency	Transit delay during transport	14 microsec	Latency was measured between 2 OC12 ports using different throughputs with no queuing.

Table 18 (Page 2 of 2). Hardware Performances

Performance Item	Description	Performance	Remarks
Latency with saturated output port	Transit delay for CBR traffic with destination port saturated with UBR traffic.	24 microsec at 8 Mbps; 24.2 microsec at 100 Mbps; 25.8 microsec at 149.76 Mbps	Latency was measured between 2 OC3 ports with CBR traffic and the destination port saturated with UBR traffic.
Cell Delay Variation (CDV)	Variation measured for CBR	1.18 microsec at 8 Mbps; 0.8 microsec at 100 Mbps; 0.03 microsec at 149.76 Mbps	CDV measured for OC3 ports with CBR traffic.
Multicast latency for Intra-module	Delay for multicasting over another port on the same module	8.1 microsec	Value measured at both 8 and 100 Mbps throughput.
Multicast latency for Inter-module	Delay for multicasting over another port on a different module	0.1 microsec	Value measured at both 8 and 100 Mbps throughput.
Multicast throughput	Maximum measurement of multicast throughput	149.76 Mbps	Value measured on each output port of an 4-port OC3 module.
Cell Loss Ratio			
Peak Cell Rate (PCR) tolerance	The tolerance,measured in cells,to temporary excesses of PCR		

Table 19. A-CPSW Connection Capacity Figures for OC3 and OC12 8265 Modules

Feature	Per Port	Per Module	Per Switch
Maximum number of PtP connection control blocks	N/A	8000	32000 (32 MB) [1], 10000 (16 MB)
Maximum number of PtP connections with accounting OFF	8000	8000	16000 (32 MB) [1], 5000 (16 MB)
Maximum number of PtP connections with accounting ON	4000	4000	16000 (32 MB) [1], 5000 (16 MB)
Maximum number of CBR/VBR policed connections	4000	4000	16000 (32 MB), 5000 (16 MB)
Maximum number of point-to-multipoint connections	2000 (32 MB), 1000 (16 MB)	2000	2000 (32 MB), 1000 (16 MB)
Maximum number of point-to-multipoint multicast control blocks	N/A	N/A	16000 (32 MB) [1], 4000 (16 MB)
Maximum number of Add Parties in point-to-multipoint connections	8000 (32 MB), 2000 (16 MB)	8000 (32 MB), 2000 (16 MB)	8000 (32 MB) [1], 2000 (32 MB)
Maximum number of VPCs	64	256	512 [2]
Maximum number of PVCs	512	512	512 [3]
Maximum number of registered ATM addresses	512	512	512 [4]
Maximum number of reachable ATM addresses	64	64	64
Maximum Reservable Bandwidth	85% of the port bandwidth		

Notes:

[1] These figures are maximum values and not concurrent. The default concurrent values is 12000 for point-to-point.

[2] Limited to 64 per port due to 6 bits VPi maximum value.

[3] Maximum number of PVCs that can *originate* from the same 8265 due to NVRAM size. However, an 8285 may be the *destination* of other PVCs that do not require NVRAM space. In this scenario the number of PVCs is only limited by the total number of connections.

[4] ILMI DRAM size limitation.

7.11 Network Performance Factors

Many factors other than the throughput, capacity and speed specifications of the IBM 8265 ATM Switch can effect the overall network performance experienced by a network user working at an endstation attached to an 8265 switch. The network can only perform at the speed of its *weakest link*. These weak links in the network are commonly known as *bottlenecks* and can have an adverse effect on the user and the application he/she is trying to run across the network. Some of the most important bottleneck factors effecting end-to-end application performance are:

- Processor Speed

  Lesser powerful machines, for example, 486 machines are generally incapable of delivering frames at ATM media speeds. Maximum throughput is only achieved when only the most powerful processor machines (for example, Pentium processor machines) are used.

- Workstation Internal BUS

  Industry Standard Architecture (ISA) buses have a maximum theoretical throughput of around 64 Mbps. However, this figure changes with arbitration/transmission to about only 30 Mbps. This is not a problem in shared/switched Ethernet (10 Mbps) and token-ring (4/16 Mbps) networks but in ATM-based networks that are typically 155 Mbps, this bus speed becomes a severe limitation.

  When the workstation′s bus is either Micro Channel (maximum throughput: 40-160 Mbps) and Peripheral Component Interconnect (PCI-maximum throughput: 132 Mbps) the impact of the bus performance on ATM networks is reduced but not entirely removed.

- Protocols

  Most protocols are configured or *tuned* for efficient use over lower speed legacy networks rather than high-speed ATM-based networks. The tuning of these protocols is essential in a ATM network. Flow control and lost data recovery are the two main mechanisms that have the greatest impact on measured system performance.

  The window size of a higher layer protocol defines the maximum amount of data that will be transmitted before acknowledgement of receipt is required. This potentially limits the amount of data that can be transmitted. Typically the larger the window size, the greater the throughput but larger window sizes require additional buffering. Transmitter and receiver buffering must be accurately tuned between network delivery rate and adapter process rate in order for peak performance.

  All protocols introduce *overheads* into a network. These overheads are in essence non-user data that is used by the protocol and network for management, headers and padding.

- Device Drivers

  The adapter device driver has to compete for processor cycles with the operating system, protocol and user applications. The efficiency with which the adapter driver and protocol stack use the system processor determines the final end-to-end performance.

- Operating System

Operating systems can have a significant impact on network performance. Examples of these are:

- DOS
- OS/2

DOS was originally designed for Intel 8086 20-bit architecture and could not address more than 1 MB of real memory. Later processors were capable of addressing more memory leading to segmentation of memory into REAL and PROTECT regions. With the device driver having to switch between these memory modes throughput is dramatically reduced.

In OS/2 and other multitasking environments tasks share the processor power and thus the allocation of priority to different application tasks becomes important in an ATM network for performance purposes.

- Legacy LANs (Ethernet and Token-Ring)

  In traditional legacy LANs, bandwidth is shared between all devices connected to all segments of the network. Endstations compete for transmission time on the network. Collisions, network errors and time spent waiting for a free token all cause delays and re-transmissions for the endstations.

  In switched networks, bandwidth is dedicated to each switch port. Devices connected to a switched port do not share bandwidth with the other devices attached to the other ports. The capacity of switched networks is considerably higher than shared media networks but bottlenecks can still occur if the bandwidth port allocation setting does not take into account all the traffic of the devices connected to the same port.

7.12 Network Design

Effective network design can dramatically improve network throughput for the end application user. The following can significantly improve and enhance the performance of network administrator's networks and eliminate any potential network bottlenecks:

- Small segments
- High-speed switches
- ATM high-bandwidth networks
- Load balancing
- Distributed network resources

An example of the physical and logical design of a network is shown in diagrams Figure 88 on page 189 and Figure 87 on page 188.

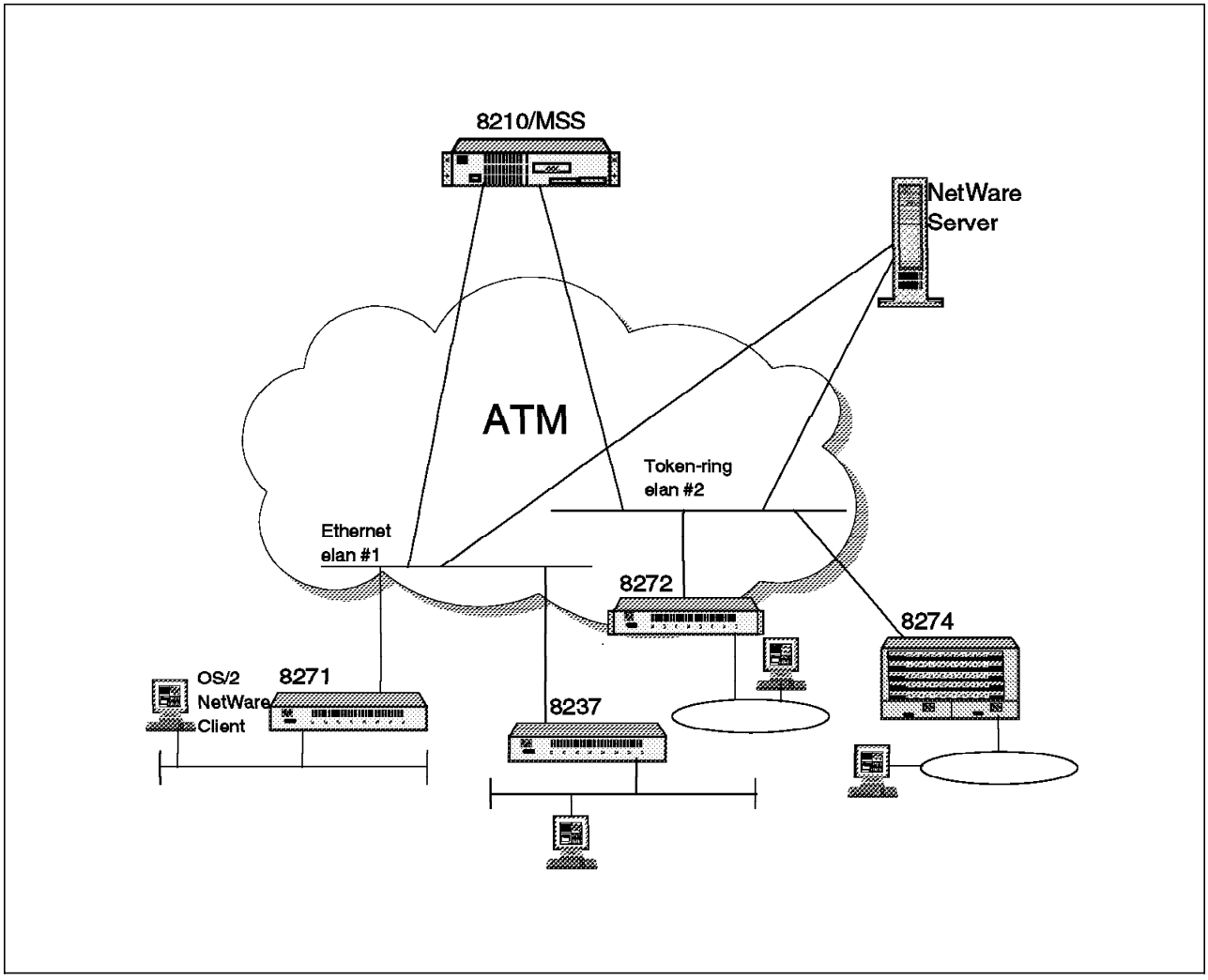


Figure 87. Logical Network Design

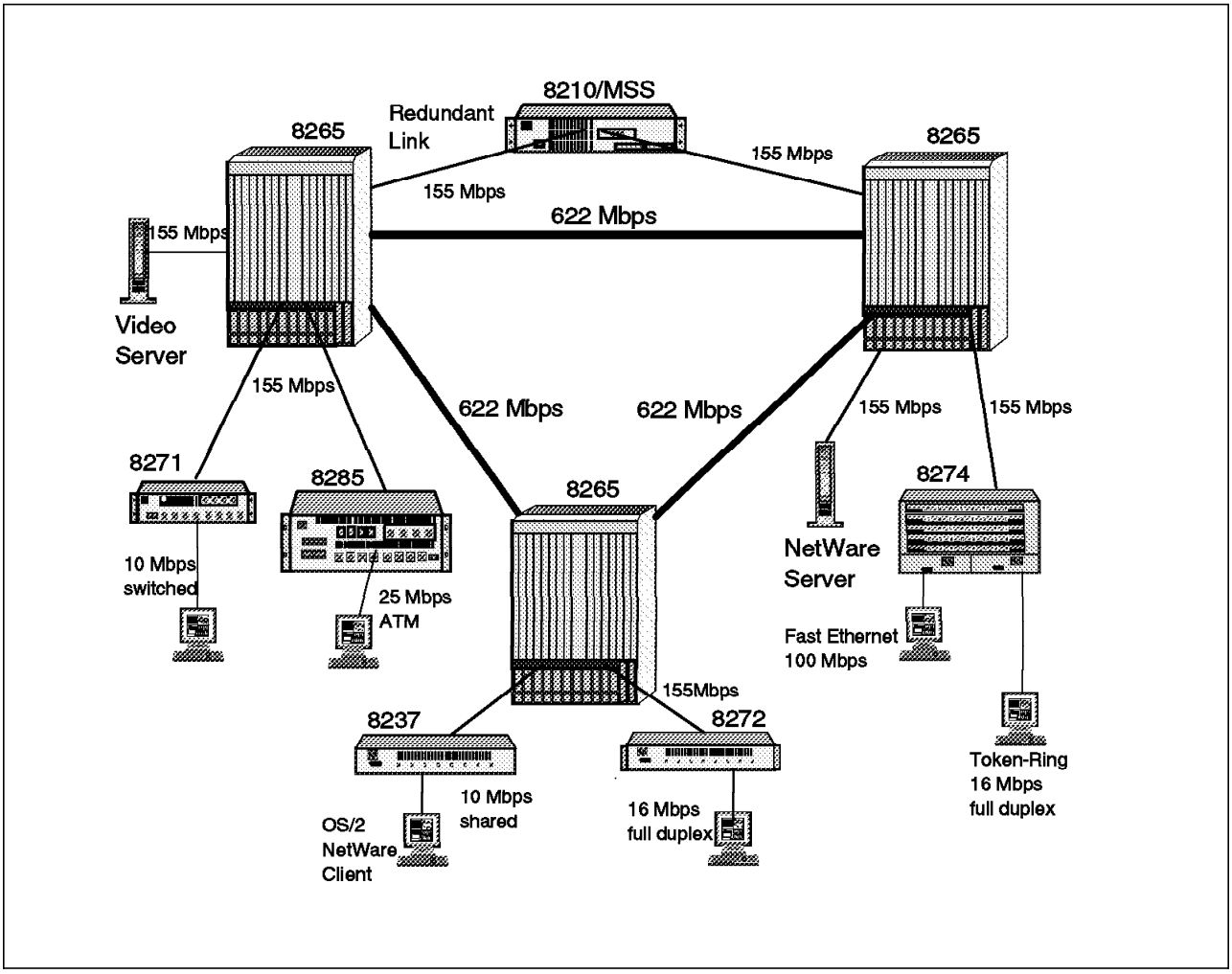


Figure 88. Effective Physical Network Design

7.12.1 Performance Hints and Tips

Some useful indicators for alleviating potential network performance problems are:

- Choose a network server that is capable of delivering enough power to manage the network traffic (for example, an IBM RISC System 6000).
- Tune higher layer protocols for the most efficient use over ATM networks.
- Use larger window sizes.
- Ensure client workstations have sufficient send and receive buffers to handle extra traffic queues resulting from increased window size.
- In TCP/IP increase the Maximum Transmission Unit (MTU).

Table 20 on page 190 shows the relationship between frame/transmission size and the data/media speeds for IBM′s RISC System 6000 running Classical IP and LANE 1.0. Since Ethernet frames are limited to 1500 neither emulated Ethernet nor Fast Ethernet (100Base-T) can achieve as high throughput as emulated token-ring or Classical IP.

Table 20. Relationship between MTU Size and Data Throughput

Protocol	**MTU Size**	**User Data Rate**	**Media Rate**
Classical IP	9180	133 Mbps	152 Mbps
Classical IP	1500	125 Mbps	143 Mbps
Token-Ring ELAN	9200	133 Mbps	152 Mbps
Token-Ring ELAN	4500	129 Mbps	147 Mbps
Ethernet ELAN	1500	125 Mbps	143 Mbps
Fast Ethernet	1500	<90 Mbps	100 Mbps

Appendix A. ATM Modules Summary Information

This appendix provides all the ATM 8265 modules specifications. This complements Chapter 3, “ATM Control Point Setup and Operations” on page 47 and the *IBM 8265 Nways ATM Switch Product Description*; therefore for more detailed specification, please consult the referenced book and the installation or user’s guide of the appropriate module.

A.1 8265-Only Modules

The following modules listed are specific to the 8265 switch and cannot be used in an 8260 ATM switch.

A.1.1 ATM Control Point/Switch Module

Table 21. Specifications: ATM Control Point/Switch Module

Faceplate marking	**A-CPSW**
Feature number	6501
Part number	13J8704
Public standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 • ATM Forum TM 4.0 ITU-TS • Q.2110, Service Specific Connection-Oriented Protocol (SSCOP) • Q.2130, Service Specific Coordination Function (SSCF) for supporting signaling at the user-to-network interface RFC • RFC 854, TELNET protocol • RFC 1350, Trivial File Transfer Protocol (TFTP) • RFC 1577, Classic IP and ARP over ATM • RFC 1155, SMI for TCP/IP-based Internet • RFC 1156, MIB I • RFC 1157, SNMP • RFC 1212, Concise MIB Definitions • RFC 1213, MIB II • RFC 1215, Convention for defining traps for use with SNMP
Slot width	2
Basic memory installed	16 MB
Switch port throughput	768 Mbps (636 Mbps pure ATM)
Control point port throughput	212 Mbps
Watts required @ +5 Volts	85

In order for the A-CPSW to run, at least one PCMCIA flash EEPROM should be installed and additional 16 MB of DRAM may be required.

The associate features and part numbers are given in Table 22 on page 192.

Table 22. A-CPSW Additional Requirements		
Description	**Feature Number**	**Part Number**
PCMCIA IISP code card Release 1.0	6505	13J8696
PCMCIA PNNI code card Release 1.0 [1]	6506	02L2415
PCMCIA IISP code card Release 2.0 [2]	6525	02L3056
PCMCIA PNNI code card Release 2.0 [1] [2]	6526	02L3057
CP/Switch Memory Upgrade (16 MB) [3]	6516	13J8698

Notes:

[1] Needs additional 16 MB of memory (feature number 6516, part number 13J8698).

[2] Includes support for OC-12 module, port mirroring function, WAN counters and counters per connection.

[3] Additional memory is needed when more connections are required for the base IISP code or when the enhanced PNNI code is run.

A.1.2 4-Port 155 Mbps Modules

Two 155-Mbps modules are available. Their main characteristics are listed in the following tables.

Table 23 (Page 1 of 2). Specifications: 4-Port 155 Mbps Module		
Faceplate marking	**A4-MF155**	**A4-MB155**
Feature number	6540	6543
Part number	02L2414	13J8738

Table 23 (Page 2 of 2). Specifications: 4-Port 155 Mbps Module

Faceplate marking	**A4-MF155**	**A4-MB155**
Public standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 • ATM Forum TM 4.0 ITU-TS • Q.2931, Signaling • I.413, B-ISDN User-to-Network Interface • I.432, Broadband Integrated Service Digital Network (B-ISDN) User-to-Network Interface - Physical Layer Specification • SDH STM-1 (SDH lite) RFC • RFC 854, TELNET protocol • RFC 1350, Trivial File Transfer Protocol (TFTP) • RFC 1577, Classic IP and ARP over ATM • RFC 1155, SMI for TCP/IP-based Internet • RFC 1156, MIB I • RFC 1157, SNMP • RFC 1212, Concise MIB Definitions • RFC 1213, MIB II • RFC 1215, Convention for defining traps for use with SNMP ANSI • SONET STS-3c (SONET lite)	
Data rate	155 Mbps	
Number of ports	4	
Slot width	1	
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI, Void	
Cell buffer size	8000 cells input, 2000 cells output	
Flow control	ABR Relative Rate	
Congestion control	Early Packet Discard/Partial Packet Discard	
Traffic shaping	per VP, multiple VPs per port	
Maximum usable throughput	4 x 155 Mbps non-blocking	
Connector	SC	On I/O daughter cards (Table 24 on page 194)
Optical power budget	7.5 dB (50/125 micron, NA 0.20, port to port) 11 dB (62.5/125 micron, NA 0.275, port to port) 9 dB (50/125 micron, NA 0.20, port to device) 9 dB (62.5/125 micron, NA 0.275, port to device)	On I/O daughter cards (Table 24 on page 194)
Watts required @ +5 Volts	51	35 plus I/O daughter cards (Table 24 on page 194)

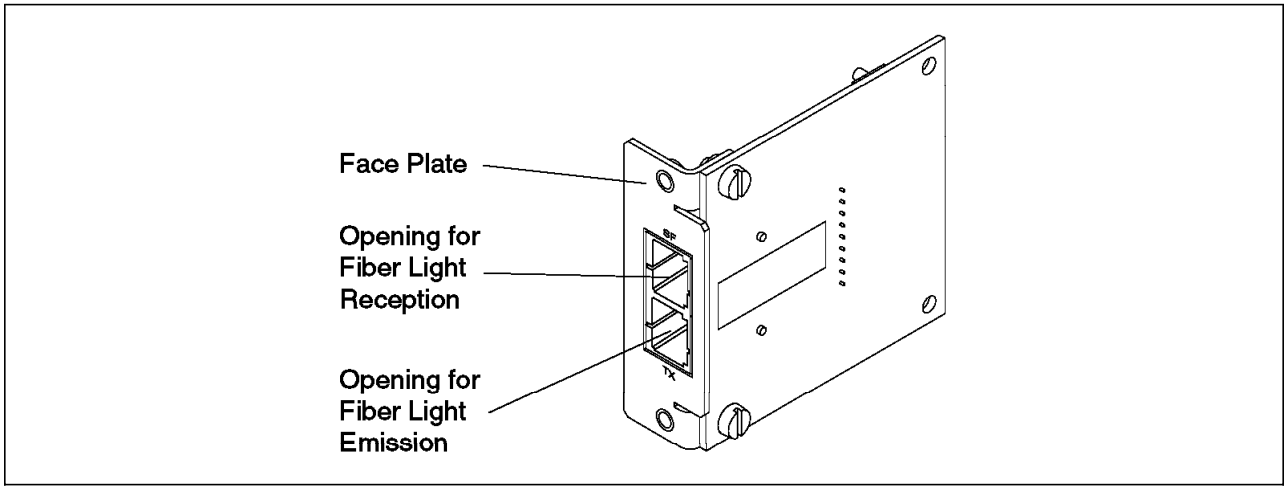


Figure 89. 155 Mbps Module Fiber Daughter Card

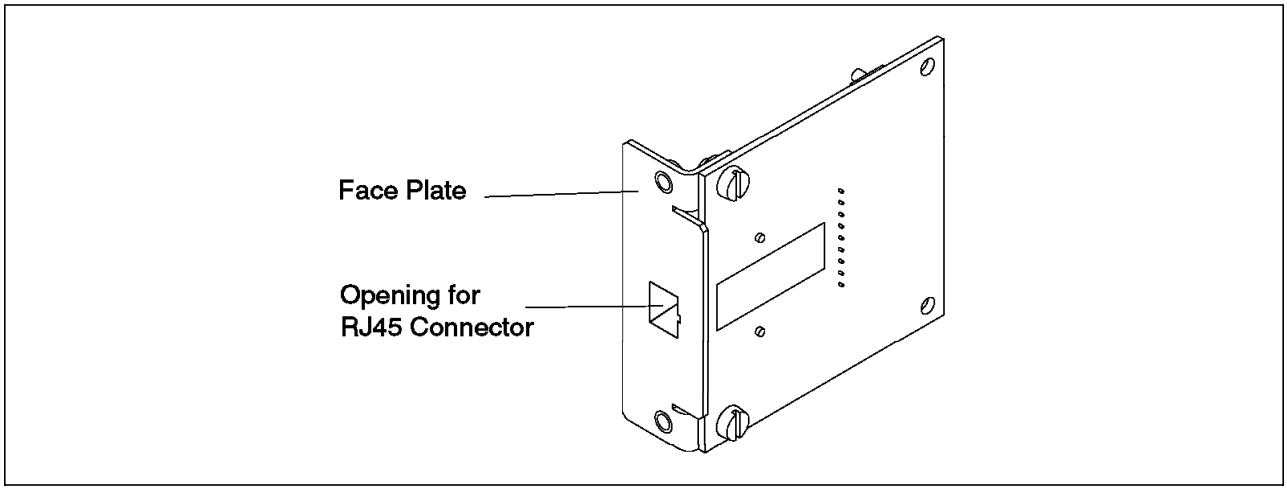


Figure 90. 155 Mbps Module UTP/STP Daughter Card

Table 24 (Page 1 of 2). Specifications: 155 Mbps Module Daughter Card

Faceplate marking	**MF**	**SF**	**SF**	**TP**
Module name	**Multimode Fiber I/O Card**	**Single-Mode Fiber I/O Card (20km)**	**Single-Mode Fiber I/O Card (40km)**	**UTP/STP I/O Card**
Feature number	6580	6581	RPQ 7L1349	6582
Part number	02L2416	02L2418	N/A	02L2420
Data rate	155 Mbps			
Connector	SC	SC	SC	RJ-45
Number of ports	1			
Cable type	Multimode fiber	Single-mode fiber	Single-mode fiber	UTP/STP

Table 24 (Page 2 of 2). Specifications: 155 Mbps Module Daughter Card				
Faceplate marking	**MF**	**SF**	**SF**	**TP**
Module name	**Multimode Fiber I/O Card**	**Single-Mode Fiber I/O Card (20km)**	**Single-Mode Fiber I/O Card (40km)**	**UTP/STP I/O Card**
Optical power budget	7.5 dB (50/125 micron, NA 0.20, port to port) 11 dB (62.5/125 micron, NA 0.275, port to port) 9 dB (50/125 micron, NA 0.20, port to device) 9 dB (62.5/125 micron, NA 0.275, port to device)	17.5 dB (9/125 micron, port to port)	38 dB (9/125 micron, port to port)	N/A
Watts required @ +5 Volts	4			

A.1.3 1-Port 622 Mbps Module

The following table summarizes the 622-Mbps module characteristics.

Table 25 (Page 1 of 2). Specifications: ATM 622-Mbps Module		
Faceplate marking	**A1-MF622**	**A1-SF622**
Feature number	6511	6512
Part number	02L2412	02L2413

Table 25 (Page 2 of 2). Specifications: ATM 622-Mbps Module

Faceplate marking	**A1-MF622**	**A1-SF622**
Public standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 • ATM Forum TM 4.0 • ATM Forum 622.08 Mbps Physical Layer ITU-TS • Q.2931, Signaling • I.413, B-ISDN User-to-Network Interface • I.432, Broadband Integrated Service Digital Network (B-ISDN) User-to-Network Interface - Physical Layer Specification • SDH STM-4 (SDH lite) RFC • RFC 854, TELNET protocol • RFC 1350, Trivial File Transfer Protocol (TFTP) • RFC 1577, Classic IP and ARP over ATM • RFC 1155, SMI for TCP/IP-based Internet • RFC 1156, MIB I • RFC 1157, SNMP • RFC 1212, Concise MIB Definitions • RFC 1213, MIB II • RFC 1215, Convention for defining traps for use with SNMP ANSI • SONET STS-12c (SONET lite)		
Data rate	622 Mbps	
Connector	SC	
Number of ports	1	
Slot width	1	
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI and Void	
Cell buffer size	8000 cells input, 2000 cells output	
Flow control	ABR Relative Rate	
Congestion control	Early Packet Discard/Partial Packet Discard	
Traffic shaping	per VP, multiple VPs per port	
Maximum usable throughput	1 x 622 Mbps non-blocking	
Cable type	Multimode fiber	Single-mode or multimode fiber
Optical power budget	1.5 dB (50/125 micron, NA 0.20, port to port or port to device) 6 dB (62.5/125 micron, NA 0.275, port to port or port to device)	13 dB to 20dB (9/125, port to port or port to device)
Watts required @ +5 Volts	38	

A.2 8260 ATM Media Modules

This section describes the various 8260 ATM media modules that can still be used on the 8265. The 8260 modules can only be installed in the dedicated slots 1, 3, 5 and 7 of the 8265, provided they have the correct FPGA level. The FPGA level required for each module is listed in its specific section hereafter.

A.2.1 ATM 12-Port 25-Mbps Module

The following tables summarize the 25-Mbps module characteristics

Table 26. Specifications: ATM 12-Port 25 Mbps Concentration Module

Faceplate marking	**A12-TP25**
Feature number	5012
Part number	13J8713
Public Standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 • Physical Interface Specifications for 25.6 Mb/s over Twisted Pair ITU-TS • I.413, B-ISDN User-to-Network Interface • I.432, Broadband Integrated Service Digital Network (B-ISDN) User-to-Network Interface - Physical Layer Specification • Q.2931, Signaling
Data rate	25 Mbps
Connector	RJ-45
Number of ports	12
Slot width	1
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI and Void
Cell buffer size	8000 cells input, 8000 cells output
Maximum usable throughput	212 Mbps
Flow control	EFCI Marking for ABR
Congestion control	Early Packet Discard/Partial Packet Discard
Required minimum FPGA level for 8265	C30
Cable type	UTP, FTP/SFTP, STP
Watts required @ +5 Volts	25

25-Mbps module daughter card characteristics table

Table 27 (Page 1 of 2). Specifications: MMF I/O Daughter Card

Faceplate marking	**MF**
Feature number	8510
Part number	13J8733

Table 27 (Page 2 of 2). Specifications: MMF I/O Daughter Card	
Faceplate marking	**MF**
Public standards (in addition to the base module)	ANSI • SONET STS-3c (SONET lite) ITU-TS • SDH STM-1 (SDH lite)
Data rate	155 Mbps
Connector	SC
Number of ports	1
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI and Void
Cable type	Multimode fiber
Watts required @ +5 Volts	10

A.2.2 ATM 4-Port 100 Mbps Module

The following table lists the 100 Mbps module characteristics.

Table 28 (Page 1 of 2). Specifications: 4-Port 100 Mbps Concentration Module	
Faceplate marking	**A4-SC100**
Feature number	5104
Part number	13J8722
Public Standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 ITU-TS • Q.2110, Service Specific Connection-Oriented Protocol (SSCOP) • Q.2130, Service Specific Coordination Function (SSCF) for supporting signaling at the user-to-network interface • Q.2931, Signaling • I.413, B-ISDN User-to-Network Interface • I.432, Broadband Integrated Service Digital Network (B-ISDN) User-to-Network Interface - Physical Layer Specification RFC • RFC 854, TELNET protocol • RFC 1350, Trivial File Transfer Protocol (TFTP) • RFC 1577, Classic IP and ARP over ATM • RFC 1155, SMI for TCP/IP-based Internet • RFC 1156, MIB I • RFC 1157, SNMP • RFC 1212, Concise MIB Definitions • RFC 1213, MIB II • RFC 1215, Convention for defining traps for use with SNMP

Table 28 (Page 2 of 2). Specifications: 4-Port 100 Mbps Concentration Module	
Faceplate marking	**A4-SC100**
Data rate	100 Mbps
Connector	SC
Number of ports	4
Slot width	1
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI and Void
Cell buffer size	2000 cells input, 1800 cells output
Maximum usable throughput	212 Mbps
Flow control	XON-XOFF for UBR
Congestion control	Early Packet Discard/Partial Packet Discard
Required minimum FPGA level	B50
Cable type	Multimode fiber
Optical power budget	9 dB (50/125 micron, NA 0.20, port to port) 11 dB (62.5/125 micron, NA 0.275, port to port)
Watts required @ +5 Volts	35

A.2.3 ATM WAN 2 Module

The following tables provide hardware characteristics for the WAN module and its associated daughter cards.

Table 29 (Page 1 of 3). Specifications: ATM WAN 2 Module	
Faceplate marking	**A8-WAN**
Feature number	5602
Part number	13J8734

Table 29 (Page 2 of 3). Specifications: ATM WAN 2 Module	
Faceplate marking	**A8-WAN**
Public Standards	ATM Forum • ATM Forum UNI 3.0, 3.1 and 4.0 • ATM Forum LAN Emulation over ATM (LANE 1.0) • ATM Forum PNNI Phase 1 • ATM Forum IISP • ATM Forum ILMI 4.0 • ATM Universal Test and Operations ATM-PHY Interface Specification Level 2, Version 0.95 ITU-TS • Q.2931, Signaling • I.413, B-ISDN User-to-Network Interface • I.432, Broadband Integrated Service Digital Network (B-ISDN) User-to-Network Interface - Physical Layer Specification • I.610, Broadband Integrated Service Digital Network (B-ISDN) Operation and Maintenance - Principles and Functions • G.703, Physical/Electrical Characteristics of Hierarchical Digital Interfaces • G.804, ATM Cell Mapping into Plesiochronous Digital Hierarchy (PDH) • G.832, Transport of SDH Elements on PDH Networks: Frame and Multiplexing Structures RFC • RFC 854, TELNET protocol • RFC 1350, Trivial File Transfer Protocol (TFTP) • RFC 1577, Classic IP and ARP over ATM • RFC 1155, SMI for TCP/IP-based Internet • RFC 1156, MIB I • RFC 1157, SNMP • RFC 1212, Concise MIB Definitions • RFC 1213, MIB II • RFC 1215, Convention for defining traps for use with SNMP
Data rate	On daughter card (Table 32 on page 203, Table 33 on page 204 and Table 30 on page 201)
Connector	On daughter card (Table 32 on page 203, Table 33 on page 204 and Table 30 on page 201)
Number of ports	On daughter card (Table 32 on page 203, Table 33 on page 204 and Table 30 on page 201)
Slot width	1
Supported interfaces	UNI, NNI (IISP), PNNI, Public UNI and Void
Cell buffer size	8000 cells input, 8000 cells output
Maximum usable throughput	212 Mbps
Flow control	EFCI marking for ABR
Congestion control	Early Packet Discard/Partial Packet Discard
Minimum required FPGA level	C31
Traffic shaping	per port
Cable type	On daughter card (Table 32 on page 203, Table 33 on page 204 and Table 30 on page 201)

Table 29 (Page 3 of 3). Specifications: ATM WAN 2 Module	
Faceplate marking	**A8-WAN**
Watts required @ +5 Volts	18.4

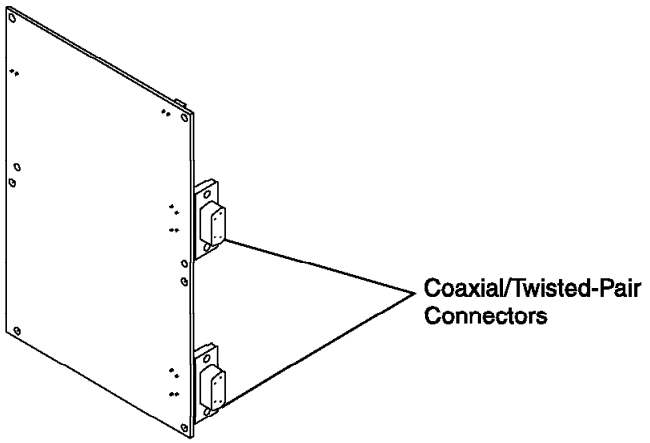


Figure 91. WAN Module E1/T1/J1 I/O Card

Table 30 (Page 1 of 2). Specifications: WAN Modules E1/T1/J1 I/O Card			
Faceplate marking	**T1**	**E1**	**J1**
Daughter Card Name	**E1/T1/J1 I/O Card**		
Feature number	Varies according to country		
Part number	Varies according to country		
Fractional support	No		
Line speed	1544 kbps	2048 kbps	1544 kbps
Payload	Clear channel: 1536 kbps	Clear channel: 1920 or 1984 kbps	Clear channel: 1536 kbps
Clock extraction	Yes	Yes	No
Connector type **1**	RJ48C/C148C DB15/CA31A **2**	E1 Coaxial • 75 ohm line impedance • BNC type connector E1 Twisted Pair • Open wires 120 ohm line impedance **3**	ISO IS8877
Number of line attachments	Up to 4 per I/O card		

Table 30 (Page 2 of 2). Specifications: WAN Modules E1/T1/J1 I/O Card			
Faceplate marking	**T1**	**E1**	**J1**
Daughter Card Name	**E1/T1/J1 I/O Card**		
Physical interface	Interface type: • DS1 • DSX1 (Maximum cable length to DSU-end is 110 ft). Standards: • AT&T 62411 • ANSI T1.403 • EIA IA.547	ITU-T G.703	Interface type: • NTT interface • DS1 • DSX1 (Maximum length cable to DSU-end is 110 ft). Standards: • JT-I411a • JT-I431a • ANSI T1.403
Code	B8ZS AMI	HDB3	B8ZS
Frame Format	D4 (SF), D5 (ESF) for: • T1.403 • T1.407 • AT&T 62411	ITU-T G.703 unstructured ITU-T G.704 with or without CRC ITU-T G.706 support for frame alignment/CRC procedure	NTT-I interface format
Alarm	T1.M1 AT&T 62411	ITU-T G.732	ITU-T G.732
Watts required @ +5 Volts	7.9		

Notes:

1 Each I/O card is delivered with two Y cables allowing attachments to four workstation cables. The type Y cable delivered depends on the country feature number. The I/O card is configurable to T1/J1 or E1 coax or E1 twisted pair using jumpers on the I/O card. Workstation cables must be ordered separately (see Table 31).

2 100 ohm line impedance with connector conforming to ISO 8877, ANSI 408, EIA/TIA 547 standards.

3 Connector should conform to ETSI 300-11 standard.

Table 31. Workstation Cables for E1/T1/J1 Card			
Cable	**Cable length**	**Feature number**	**Part number**
T1/J1 RJ48	15m	5241	57G8020
T1/J1 DB15	15m	5243	57G8023
E1 120 ohms (flying)	15m	5260	80G3983

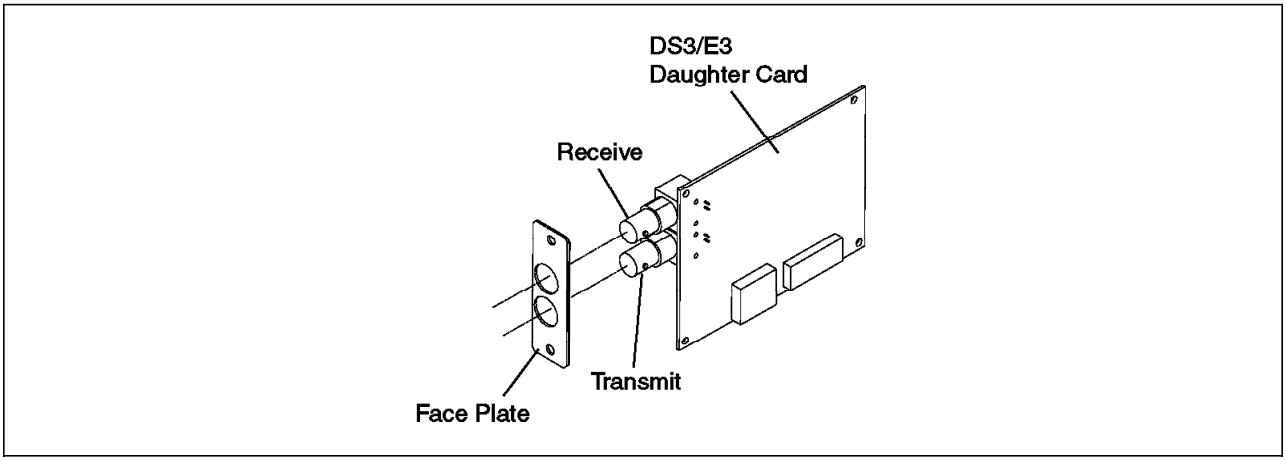


Figure 92. WAN Module DS3/E3 Daughter Card

Table 32. Specifications: DS3 and E3 WAN Daughter Cards		
Faceplate marking	**E3**	**DS3**
Daughter card name	**E3 I/O Card**	**DS3 I/O Card**
Feature number	Varies according to country	8502
Data rate	34.368 Mbps	44.736 Mbps
Number of line attachments	1 line per I/O card	
Connector	BNC	
Cable type	Coax RG59 (75 ohm)	
Fractional support	No Fractional E3	No Fractional DS3
Payload	1 x 33.920 kbps	1 x 42.209 kbps
Clock role	DTE or DCE	
Physical interfaces	ITU-T G.703	DS3
Code	HDB3	B8ZS
Frame format	ITU-T G.832	C-bit parity multiplex
Transmission convergence layer	Not applicable	PLCP HEC
Cell payload scrambling	Not applicable	PLCP: No HEC: Yes
Cell discard policy	ANSI, ANSI unassigned ATM Forum, ATM Forum unassigned CCITT, CCITT unassigned	
Idle cell character	Not supported	
Watts required @ +5 Volts	7.9	7.9

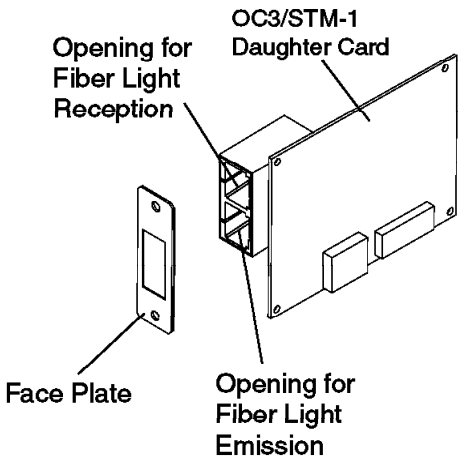


Figure 93. WAN Module OC3/STM-1 Daughter Card

Table 33. Specifications: OC3 and STM1 WAN Modules Daughter Cards

Faceplate marking	**O-SF**	**O-MF**	**S-SF**	**S-MF**
Daughter card name	**OC3 SMF I/O Card**	**OC3 MMF I/O Card**	**STM-1 SMF I/O Card**	**STM-1 MMF I/O Card**
Feature number	8503	8504	8505	8506
Data rate	155.520 Mbps			
Payload	149.760 Mbps			
Clock extraction	Yes			
Number of line attachments	1 line per I/O card			
Connector	SC			
Cable type	Single-mode fiber	Multimode fiber	Single-mode fiber	Multimode fiber
Physical Interface	OC3/STM1			
Frame format	SONET STS-3c (T1-105) SDH STM1 (ITU-T G.708/G709) ATM cells in VC-4			
Cell delineation	I.432			
Rate decoupling	I.432,I.361 and ATM Forum 3.0/3.1			
Cell discard policy	ANSI, ANSI unassigned ATM Forum, ATM Forum unassigned CCITT, CCITT unassigned			
Idle cell character	Not supported			
Watts required @ +5 Volts	7.9			

A.2.4 Multiprotocol Switched Services (MSS) Server Module

The following tables summarize the MSS main general characteristics.

Table 34. Specifications: A-MSS Module

Faceplate marking	**A-MSS**
Feature number	5300
Part number	02L3159
Public standards	ATM Forum • ATM Forum UNI V3.0 and V3.1 • ATM Forum LAN Emulation over ATM (LANE 1.0)
Slot width	2
ATM uplink	Backplane
Processor	PowerPC 603E at 100 MHz
Memory	8 KB non-volatile RAM 512 KB L2 cache memory 12 MB flash EPROM 32 MB dynamic RAM 10 MB ATM packet memory
Minimum required FPGA level	B50
Watts required @ +5 Volts	42

In order for the A-MSS to run properly, the feature described in Table 35 must also be ordered.

Table 35. A-MSS Additional Requirements

Description	**Feature Number**	**Part Number**
MSS Microcode Version 2.0 and MSS PCMCIA hard disk	8707	85H4658

A.2.5 Video Distribution Module

The following table provides information and the main video module characteristics.

Table 36 (Page 1 of 2). Specifications: A8-MPEG Module

Faceplate marking	**A8-MPEG**
Feature number	5008
Part number	13J8760

Table 36 (Page 2 of 2). Specifications: A8-MPEG Module	
Faceplate marking	**A8-MPEG**
Public standards	ATM Forum • ATM Forum UNI V3.1 ISO/IEC • ISO/IEC 13818-1, MPEG-2 System Layer • ISO/IEC 13818-2, MPEG-2 Video • ISO/IEC 11172-3, MPEG-1 Audio ITU • H.310 • H.262, MPEG-2 video • H.222.0, MPEG-2 Program and Transport Stream • H.222.1, MPEG-2 streams over ATM ANSI • EIA 608, Recommended practice for Line 21
Maximum throughput per port	15.4 Mbps
Aggregate throughput per module	125 Mbps
Connector	UTP
Number of ports	8
Slot width	2
Physical interface	• Eight video ports - BNC • Eight audio ports - 5 pin DIN • One EIA-232 console port - 9 pin D-shell • One genlock port - BNC
Supported connections	PVCs and SVCs
Video resolutions	• NTSC – SIF 352x240 pixels – HHR 352x480 pixels – CCIR-601 720x480 pixels – Square NTSC 640x480 pixels • PAL – SIF 352x288 pixels – HHR 352x576 pixels – CCIR-601 720x576 pixels
Transport stream video bit rates	Up to 15 Mbps
Transport stream audio bit rates	up to 384 kbps
Audio sample rate	32, 44.1,and 48 kHz
Cable type	• RG59/U (75 ohm) for video (8 cables provided) • unbalanced audio (8 cables provided) • EIA 232 for console • RG59/U (75 ohm) for genlock
Supported cable length	• Video 75 m (246 feet) • Audio 75 m (246 feet) • EIA 232 15 m (49 feet) • Genlock 75 m (246 feet)
Watts required @ +5 Volts	62.5

A.2.6 FiberCom ATM Circuit Emulation (ACE) Modules

Four modules are provided. Their characteristics are listed in the following table.

Table 37. Specifications: FiberCom ATM Circuit Emulation (ACE) Card

FiberCom model number	**8260-014-04**	**8260-018-08**	**8260-024-04**	**8260-028-08**
Public Standards	ATM Forum • ATM Circuit Emulation Services V2.0 • ATM Universal Test and Operations ATM-PHY Interface Specification Level 1, Version 2.01 ITU-T • ITU-T G703 for E1 • ITU-T DS1.403 for DS1			
Slot width	1			
Supported services	Constant Bit Rate			
Supported connections	Permanent Virtual Circuits (PVCs)			
DS1 and E1 Timing mode	Unstructured/Structured • Adaptive • External (port 1)			
DS1 Signaling	• CCS • CAS • Clear Channel		N/A	
DS1 Framing	• Super Frame (SF) • Extended Super Frame (ESF)			
Number of ports	4 ports	8 ports	4 ports	8 ports
Number of channels	192 unstructured channels per module		248 structured channels per module	
Cable type	120 ohms (comes with the card)		75 and 120 ohms (comes with the card)	
Watts required @ +5 Volts	15			

A.2.7 8271 ATM/Ethernet LAN Switch Module

Two modules are available. Their characteristics are listed hereunder.

Table 38. Specifications: 8271 ATM/Ethernet LAN Switch Modules

Faceplate marking	**A-E12LS2**	**A-E12LS4**
Feature number	5212	5312
Part number	13J8723	13J8724
Data rate	10 Mbps	
Connector	RJ-45	
Number of ports	12	
Slot width	2	3
Number of UFCs	2	4
Cable type	UTP	
Watts required @ +5 Volts	30	

Table 39. Specifications: ATM Backplane Connection	
Faceplate marking	**-**
Public standards	ATM Forum • ATM-Forum UNI 3.0 and 3.1 • ATM-Forum LANE 1.0 Client
MIB Supported	MIB II (RFC 1213) Interface MIB (RFC 1573) AToM MIB (RFC 1695) Bridge MIB (RFC 1493)
Data Rate	212 Mbps
Number of ports	1
Protocol support	ATM Forum LANE over ATM, Version 1.0 (Ethernet)
Signalling	ATM Forum UNI Version 3.0 and 3.1 (auto-detectable)
Maximum LECs	32 configurable 8 simultaneously enabled
Maximum VCCs	3072 (distributed over all active LECs)
VCC types	Multicast-Send VCC: configurable as CBR, VBR or UBR All other VCCs: UBR
Watts required @ +5 Volts	25

Table 40. UFCs for 8271 ATM/Ethernet LAN Switch Module			
Description	**Feature Number**	**Part Number**	**Watts required @ +5 Volts**
1 port 100BaseTX UFC	6995	41H6995	5.7
1 port 100BaseFX UFC	7000	41H7000	6.0
3 port 10BaseFL UFC	8603	41H7020	6.7
4 port 10Base-T UFC	9195	13H9195	5.5

A.2.8 8272 ATM/Token-Ring LAN Switch Module

Two modules are available. Their characteristics are listed herunder.

Table 41. Specifications: 8272 ATM/Token-Ring LAN Switch Module		
Faceplate marking	**A-TR8LS2**	**A-TR8LS4**
Feature number	5208	5308
Part number	13J8725	13J8726
Data rate	4/16 Mbps	
Connector	RJ-45	
Number of ports	8	
Slot width	2	3
Number of UFCs	2	4
Cable type	UTP	
Watts required @ +5 Volts	30	

Table 42. UFCs for 8272 ATM/Token-Ring LAN Switch Module			
Description	**Feature Number**	**Part Number**	**Watts required @ +5 Volts**
2 port Enh Fiber UFC	5087	85H5087	11
4 port Enh UTP/STP UFC	5092	85H5092	12

A.3 Additional 8260 ATM Media Modules

Other modules are available. They are listed hereunder for information.

Table 43. Additional 8260 ATM Media Modules				
Module	**Faceplate Marking**	**8260 Feature Number**	**Minimum Required FPGA Level**	**Watts Required @ +5 Volts**
4-Port 100 Mbps (MIC)	A4-FB100	5004	B50	35
2-Port 155 Mbps	A2-MB155	5002	B50	25
3-Port 155 Mbps	A3-MB155	5003	B50	25
ATM WAN	A2-WAN	5302	B50	18.4
ATM Carrier (2-slot)	A-CMU2	5202	B50	18.2
8281 ATM LAN Bridge	A04MB-BRG	5204	B50	70

Appendix B. Ports and Cable Pinouts

This appendix gives information on ports and cable pin assignments.

B.1 Pinouts for ATM 25 Mbps versus Common Network Connectors

Most networking standards have developed specifications for using shielded or unshielded twisted-pair cabling with RJ-45 modular plugs to connect devices together. Table 44 illustrates the differences between the following cabling specifications:

- ATM25.6 (ATM Forum standard)

  IBM adapters for this standard have an orange dot with a white line across them to easily distinguish from the next two types.

- ATM25.6 (Pre-standard used by some early ATM devices)

  This adapter has a green dot on it indicating that it uses standard token-ring pinouts.

- Token-ring

  This adapter has a green dot on it indicating that it uses standard token-ring pinouts.

- Ethernet (10Base-T)

Table 44. RJ-45 Pin Assignments by Network Type

Pin Number	ATM25 (Forum-Compliant)	ATM25 (Pre-Standard)	Token-Ring	Ethernet (10Base-T)
1	RD+			TD+
2	RD–			TD–
3		TD+	TD+	RD+
4		RD+	RD+	
5		RD–	RD–	
6		TD–	TD–	RD–
7	TD+			
8	TD–			

B.2 Other Cabling Considerations

Special cables are required in two specific instances:

- When connecting to pre-standard devices
- When connecting between two ATM switches

Both of these instances are discussed below.

B.2.1 Converter Cables

Some early ATM 25 Mbps adapters, such as the IBM TURBOWAYS 25 ATM adapter (P/N 04H7370), use a pre-standard pin assignment scheme based on the token-ring network cabling standard. To make these adapters compatible with the other ATM-compliant product ports, it is necessary to use a token-ring-to-ATM converter cable, available from IBM as P/N 10H3904. The pinouts for this cable are shown in Table 45.

Table 45. Pin Assignments for Converter Cable (P/N 10H3904)

Signal	Port Pin	Adapter Pin
RD+	1	4
RD–	2	5
TD+	7	3
TD–	8	6

B.2.2 Hubs Crossover Wiring

The hub ports are designed to connect user devices and require a switch-to-switch crossover cable to connect to other ATM switches, just as a 10Base-T hub does. The pinouts for this cable are shown in Table 46.

Table 46. Pin Assignments for Switch-to-Switch Crossover Cable

Signal	Port Pin	Adapter Pin
RD+	1	7
RD–	2	8
TD+	7	1
TD–	8	2

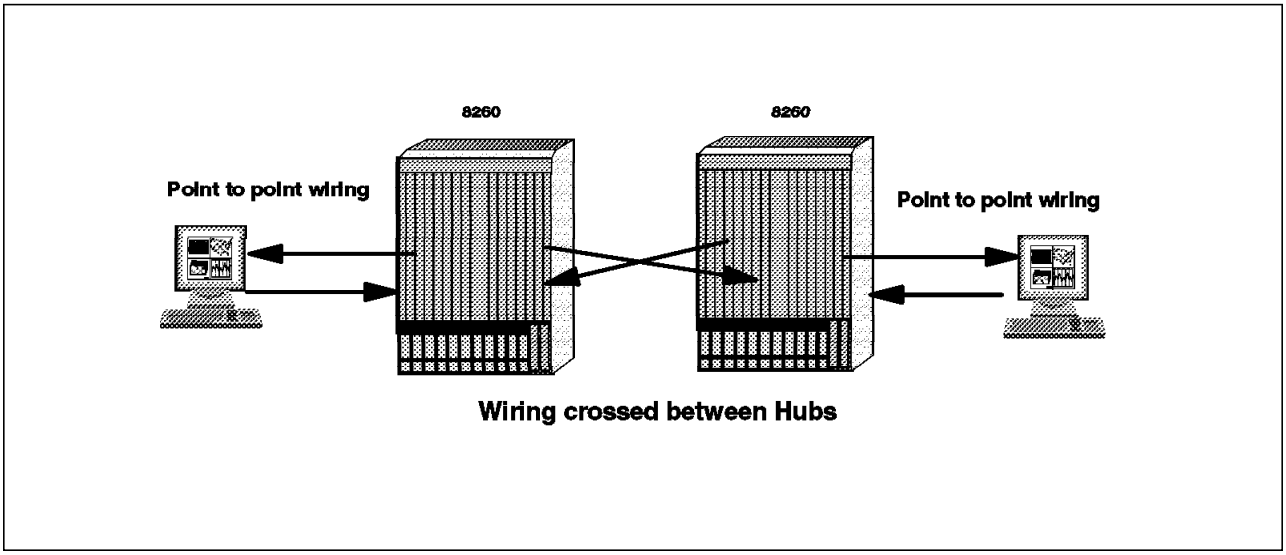


Figure 94. Wires Crossed between Hubs

Appendix C. UNI 3.0-3.1 Cause Maintenance Error Codes

This appendix lists error or maintenance codes available on LAN/ATM campus networks.

C.1 ATM Forum UNI Cause Codes

The following are the codes defined in the ATM Forum for events.

Table 47 (Page 1 of 5). Cause Codes

HEX	DEC	Definitions
01	1	Unallocated (unassigned) number. ATM address unassigned. This cause indicates that the called party cannot be reached because, although the number is in a valid format, it is not currently assigned (allocated). Check the destination ATM address.
02	2	No route to specified transit network. This cause indicates that the equipment sending this cause has received a request to route this call through a particular network which it does not recognize. The equipment sending this cause does not recognize the transit network either because the transit network does not exist or because that particular transit network, while it does exist, does not serve the equipment that is sending this cause. The diagnostic field contains a copy of the contents of the transit selection information identifying the unreachable network. This cause is supported on a network-dependent basis.
03	3	No route to destination. This cause indicates that the called party cannot be reached because the network through which the call has been routed does not serve the destination desired. Probable cause is that no station has registered this ATM address with the switch. Check configuration at both ends. This cause is supported on a network-dependent basis.
0A	10	VPI/VCI unacceptable. This cause indicates that the virtual channel most recently identified is not acceptable to the sending entity for use in this call.
10	16	Normal call clearing. This cause indicates that the call is being cleared because one of the users involved in the call has requested that the call be cleared. Under normal situations, the source of this cause is not the network.
11	17	Called party busy. This cause indicates that the called party is unable to accept another call because the user busy condition has been encountered. This cause value may be generated by the called user or the network.
12	18	No user responding. This cause is used when a called party does not respond to a call establishment message with a connect indication within the prescribed period of time allocated. For example, called party does not respond to SETUP message by the time timer T303 expired. The call is cleared.
15	21	Call rejected. This cause indicates that the equipment sending this cause does not wish to accept this call, although it could have accepted the call because the equipment sending this cause is neither busy nor incompatible.

Table 47 (Page 2 of 5). Cause Codes		
HEX	**DEC**	**Definitions**
16	22	Number changed, ATM address changed. This cause is returned to a calling party when the called party number indicated by the calling user is no longer assigned. The new called party number may optionally be included in the diagnostic field. If the network does not support this capability, cause #1 will be used instead.
17	23	User rejects all calls with calling line identification restriction (CLR). Caller address is required by the called party. This cause is returned by the called party when the call is offered without calling party number information and the called party requires this information.
1B	27	Destination out of order. This cause indicates that the destination indicated by the user cannot be reached because the interface to the destination is not functioning correctly. The term *not functioning correctly* indicates that a signalling message was unable to be delivered to the remote user, for example, a physical layer or SAAL failure at the remote user, or user equipment is offline. Cause posted when T309 expires before AAL signalling can be re-established with the destination. At the remote endstation, layer 2 (QSAAL) is down and/or the ATM address is not registered with the switch.
1C	28	Invalid number format or invalid ATM address. This cause indicates that the called user cannot be reached because the called party number is not in a valid format or is not complete.
1E	30	Response to STATUS ENQUIRY. This cause is included in the STATUS message when the reason for generating the STATUS message was the prior receipt of a STATUS ENQUIRY message. Reports the current call state. It does not directly affect the call state of the sender or the receiver.
1F	31	Normal, unspecified. This cause is used to report a normal event only when no other cause in the normal class applies. This is sending in call clearing (RELEASE COMPLETE) and results from an ADD PARTY reject when there are no other active parties.
23	35	Requested VPI/VCI not available. The network allocates a VPCI/VCI value and includes this value in the SETUP message. The user receiving the SETUP message accepts the indicated VPCI/VCI for the call. This cause indicates that the VCI is not available within the indicated VPCI. The user sends a RELEASE COMPLETE and this cause. Layer 3 (SVC) sends this code if the switch tries to assign to a call a VPI/VCI that is already in use. The AIX SVC device driver (L4 +) sends this code if the switch assigns a VCI that is reserved for a PVC.
24	36	VPI/VCI assignment failure. The network shall allocate a VPCI/VCI value and include this value in the SETUP message. The user receiving the SETUP message accepts the indicated VPCI/VCI for the call. If the VPCI/VCI values the user sends in its first response are not the values offered by the network, the network sends a RELEASE message to the user with this cause.
25	37	User cell rate unavailable. The network cannot route the call due to insufficient bandwidth. The network initiates call clearing.
26	38	Network out of order. This cause indicates that the network is not functioning correctly and the condition is likely to last a relatively long period of time, for example, immediately re-attempting the call is not likely to be successful.

Table 47 (Page 3 of 5). Cause Codes		
HEX	**DEC**	**Definitions**
29	41	Temporary failure. This cause indicates that the network is not functioning correctly and that the condition is not likely to last long. The user may wish to try another call attempt immediately. An in-process or established call was cleared due to a layer 2 (QSAAL) disconnection and re-establishment. For example, this cause can be posted if there is no STATUS response received for the STATUS ENQUIRY message (T322 expires) and the STATUS ENQUIRY has been retransmitted the maximum number of times. The maximum number of times is implementation-specific. The call is cleared to the local interface and the network may also clear the connection.
2B	43	Access information discarded. This cause indicates that the network could not deliver access information to the remote user as requested, that is, ATM adaptation layer parameters, broadband low layer information, broadband high layer information, or sub-address as indicated in the diagnostic. This can be content errors in non-mandatory fields. See also cause 100.
2D	45	No VPCI/VCI available. The network allocates a VPCI/VCI value and includes this value in the SETUP message. The network selects any available VPCI and VCI. The user receiving the SETUP message accepts the indicated VPCI/VCI for the call. This cause indicates that the network is not able to allocate VCI in any VPCI. The network sends RELEASE COMPLETE.
2F	47	Resource unavailable, unspecified. This cause is used to report a resource unavailable event only when no other cause in the resource unavailable class applies. (Some layer above layer 3 at the called party rejected the call due to lack of bandwidth or some other resource. Layer 3 never originates this cause code.) For example, with an ADD PARTY message, the QoS and bandwidth must be the same as the connection and are not explicitly indicated in the ADD PARTY message. If the user is not able to support the requested ATM traffic descriptor, the user will reject the call with this cause.
31	49	Quality of Service unavailable. This cause is used to report that the requested Quality of Service cannot be provided.
33	51	User cell rate not available. This cause is used to report that the requested ATM Traffic Descriptor is unobtainable. The network rejects the call. The diagnostics field of the cause information element should indicate those parameters that exceed the capacity of the network.
39	57	Bearer capability not authorized. This cause indicates that the user has requested a bearer capability which is implemented by the equipment that generated this cause, but the user is not authorized to use.
3A	58	Bearer capability not presently available. This cause indicates that the user has requested a bearer capability which is implemented by the equipment which generated this cause, but which is not available at this time. Sent by the network back to the user.
3F	63	Service or option not available, unspecified. This cause is used to report a service or option not available event only when no other cause in the service or option not available class applies. For example, the parameters specified in SETUP message should be consistent. Table F-1 in Appendix F of the UNI 3.1 Specs shows allowable combinations of some parameters. This cause will be returned when illegal combinations are specified. The network clears the call.
41	65	Bearer capability not implemented. This cause indicates that the equipment sending this cause does not support the bearer capability requested.

Table 47 (Page 4 of 5). Cause Codes		
HEX	**DEC**	**Definitions**
49	73	Unsupported combination of traffic parameters. This cause indicates that the combination of traffic parameters contained in the ATM traffic descriptor information elements is not supported.
4E	78	AAL parameter cannot be supported. When the calling endpoint wishes to indicate to the called endpoint the AAL common part parameters and service part to be used during the call, the calling endpoint includes ATM adaptation layer parameter information in the SETUP message. This information element is conveyed by the network and delivered to the called user. If the called user does not include the ATM adaptation layer parameters in the CONNECT message, the calling user shall assume that the called user accepts the values of the Forward and Backward Maximum CPCS-SDU size indicated by the caller in the SETUP message. If the calling party cannot use the Forward and Backward CPCS-SDU size indicated in the CONNECT message (that is, because the value negotiated by the called party is unacceptably small), the call will be cleared with this cause. See Appendix F of UNI 3.1 specifications.
51	81	Invalid call reference value. This cause indicates that the equipment sending this cause has received a message with a call reference that is not currently in use on the user-network interface. Whenever any message except SETUP, RELEASE COMPLETE, STATUS ENQUIRY, or STATUS is received that specifies a call reference that is not recognized as belonging to an active call or a call in progress this cause is returned. Also sent if an ADD PARTY, ADD PARTY ACKNOWLEDGE, ADD PARTY REJECT, DROP PARTY or DROP PARTY ACKNOWLEDGE message is received while in the null link state. The diagnostic field specifies the call reference.
52	82	Identified channel does not exist, VPI/VCI does not exist. This cause indicates that the equipment sending this cause has received a request to use a channel not activated on the interface for a call.
58	88	Incompatible destination. This cause indicates that the equipment sending this cause (usually a user) has received a request to establish a call which has broadband low layer information, broadband high layer information, or other AAL attributes which cannot be accommodated. Refer to Annex C on UNI 3.1 specification. Some layer above layer 3 at the called party rejected the call parameters. Check configuration at both ends.
59	89	Invalid endpoint reference value. The purpose of the endpoint reference IE is to identify the individual endpoints of a point-to-multipoint connection. A value of 0 in the Endpoint Reference identifier always is used to identify the first party of the point-to-multipoint call. A non-zero value is always used to identify subsequent parties of the call. This cause indicates that the equipment sending this cause has received a message with an endpoint reference which is currently not in use on the user-network interface. Whenever any message except SETUP, ADD PARTY, or DROP PARTY ACKNOWLEDGE is received for a party in the null party state, dropping is initiated by sending a DROP PARTY ACKNOWLEDGE with this cause and the sender will remain in the null party state.
5B	91	Invalid transit network selection, transit net does not exist. This cause indicates that a transit network identification was received which is of an incorrect format as defined in Annex D of the UNI 3.1 specification. Some networks may provide screening to the transit network (for example, to ensure that a business relationship exists between the user and the transit network). Should the screening fail, this cause will be returned.
5C	92	Too many pending add party requests. This cause indicates a temporary condition when the calling party sends an add party message but the network is unable to accept another add party message because its queues are full.
5D	93	AAL parameters cannot be supported. This cause indicates that the equipment sending this cause has received a request to establish a call which has ATM adaptation layer parameters that cannot be accommodated.

Table 47 (Page 5 of 5). Cause Codes

HEX	DEC	Definitions
60	96	Mandatory information element is missing. This cause indicates that the equipment sending this cause has received a message (SETUP, RELEASE, DROP PARTY, etc.) which is missing an information element that must be present in the message before the message can be processed. Could also be because a RELEASE message was received with the cause information element missing. The responding RELEASE COMPLETE will have this cause. Refer to the diagnostic field in the cause code element.
61	97	Message type non-existent or not implemented. This cause indicates that the equipment sending this cause has received a message with a message type it does not recognize either because this is a message not defined or one defined but not implemented by the equipment sending this cause. (If the offending message type were received by the sender of this cause when it was in the null state, it would not have sent this cause code, but ignored the message instead.)
63	99	Information element non-existent or not implemented. This cause indicates that the equipment sending this cause has received a message that includes information element(s) not recognized because the information element identifier(s) are not defined or are defined but not implemented by the equipment sending the cause. This cause indicates that the information element(s) were discarded. Action will be taken on the message and those information elements that are recognized and have valid content. However, the information element is not required to be present in the message in order for the equipment sending this cause to process the message. The diagnostic field, if present, will contain more information about the unrecognized element. A possible reason for the cause is if VP/VC information were included in the SETUP message from the user.
64	100	Invalid information elements contents. This cause indicates that the equipment sending this cause has received an information element which it has implemented; however, one or more of the fields in the information element are coded in a way that cannot be implemented by the equipment sending this cause. A common reason for this cause is incompatible UNI versions.
65	101	Message not compatible with call state. This cause indicates that a message has been received which is incompatible with the call state. For example, if a STATUS message indicating any call state except the null state is received in the null state, then the receiving entity will send a RELEASE COMPLETE with this cause and remain in the null state.
66	102	Recovery on timer expiry. This cause indicates that a procedure has been initiated by the expiration of a timer in association with error handling procedures. Layer 3 (SVC) sent a message and no response was received when the defined timer expired. This can be a retry of a previous event, and the cause indicates that the reason for the retry is that the response timer had expired.
68	104	Bad message length.
6F	111	Protocol error, unspecified, SVC protocol error. This cause is used to report a protocol error event only when no other cause in the protocol error class applies.

C.2 Maintenance Codes Valid on 8265 ATM Hub

The following is a list of prompts available in the maintenance mode, and their corresponding meanings.

Table 48. 8260/8285 Maintenance Codes

Codes	Explanation
0020	The NVRAM diagnostics failed, the battery may be low.
0021	Bad checksum, the loading or the de-compression of the operational code failed.
0022	After three retries, the switch FPGAs did not initialize properly.
0030	The initialization or the diagnostics failed for the switch, or the serial link.
0031	The ATM Wrap test from control point board to switch board failed.
0032	The initialization of the operational code stopped due to a lack of memory.
0033	The initialization of the operational code stopped due to a lack of memory.
0034	The initialization of the operational code stopped due to a lack of memory.
0040	Active to backup CPSW polling does not work. SPI serial link may fail.
0050	No FPGA picocode level (active or backup) in the A-CPSW module matches the active microcode level, and the backup microcode of the A-CPSW module is either unavailable or identical to the active one.
0051	The SWAP of the ATM control point FPGA picocode terminated in error.
0052	A connected ATM media module has no FPGA picocode matching the A-CPSW microcode level. This is a normal condition for the first A-CPSW of a redundant 8265 during the automatic migration process to an upper level. It makes the second A-CPSW active, allowing the upgrade of the rest of the 8265. Once the whole 8265 is upgraded, the A-CPSW displaying >>0052>> becomes either active or standby at the next reset.
00BA	Maintenance mode is running with the backup daemon.

Appendix D. Frequently Asked Questions (FAQ) on 8265

This chapter answers some of the frequently asked questions on the 8265 Nways ATM switch.

D.1 General Questions

Is IBM a member of the ATM Forum? Which membership category?

Yes. Principal member.

Is IBM a member of the ITU?

Yes.

Please list all other pertinent consortia that the company is involved with:

- ANSI T1 Committee
- Cross Industry Working Team (XIWT)
- Desktop 25ATM Alliance
- ATM Forum
- Digital Audio-visual Council (DAVIC)
- European Telecommunications Standards Institute (ETSI)
- Frame Relay Forum
- IEEE Project 802
- Interactive Media Association (IMA)
- International Organization for Standardization (ISO)/ International Electrotechnical Commission (IEC)
- Internet Engineering Task Force (IETF)
- National Information Infrastructure Testbed (NIIT)
- Network Management Forum (NMF)

How many pieces of the network solution can IBM provide?

Nways is IBM′s family of software and hardware products that help customers build distributed, multi-vendor ATM networks for today and tomorrow. We offer a full range of adapter cards, modular hubs, bridge, concentrator and LAN switches for the campus environment. Our ATM campus products and services include the following:

- LAN products supporting legacy LAN environments as well as ATM switching demands in the campus:
  - 8265 Nways ATM Switching Hub
  - 8260 Nways Multiprotocol Switching Hub
  - 8270 Nways Token-Ring LAN Switch (chassis base)
  - 8271 Nways Ethernet LAN Switch
  - 8272 Nways Token-Ring LAN Switch

  - 8273 Nways Ethernet RouteSwitch
  - 8274 Nways LAN RouteSwitch
  - 8285 LAN Workgroup Switch
- Family of ATM adapters:
  - TURBOWAYS 25 Mbps ATM Adapter
  - TURBOWAYS 100 Mbps ATM Adapter
  - TURBOWAYS 155 Mbps ATM Adapter
- Network Management platforms and applications, providing end-to-end management support:
  - Nways ATM Campus Manager LAN (for AIX)
- LAN Emulation Server application (ATM Forum LANE 1.0 compliant)
- RFC1577 ARP Server application
- Multimedia platforms and high bandwidth applications
- Multimedia workstations
- Consulting and outsourcing for networking services

With these, IBM can provide a complete end-to-end ATM networking solution.

D.2 8265 Hardware Questions

What are the following 8265 characteristic information for:

- **The type of switch architecture**
- **The rated capacity of the switch**
- **The number of switch stages**
- **The switch transit delay**

IBM Research at Zurich conceived and developed the ATM cell switch fabric, which is the cornerstone of the 8265 Nways ATM Switch. The ATM cell switch fabric is flexible and high speed, permitting us to build switch fabrics over a wide number of ports, port speeds and throughput requirements. The switch-on-a-chip design allows for transmission rates of up to 1.6 gigabits per second, per port. IBM′s switch-on-a-chip cell switch has the following characteristics:

- 16 input ports
- 16 output ports
- Non-blocking (No two or more cells with distinct output port destinations are being transferred to the same output port.)
- Single stage
- 768 Mbps per port, with a clock rate of 48 Mhz
- Transit delay = between 5 and 22 microseconds
- Built-in support for modular growth in number of ports
- Built-in support for modular support in port speed
- Self routing switch element

- 2.4 million transistors on 15mm chip
- 472 I/O pins

Are RISC processors or ASICs used in the 8265 Nways Hub?

The switch architecture is centered around a single stage 16x16 switching fabric composed of two Prizma ASIC chips running in speed expansion mode. This fabric is able to deliver a throughput of 768 Mbps full-duplex per port and an aggregate throughput of 12.3 Gbps full-duplex.

By having a central switching fabric, every ATM module uses a dedicated connection to the switching fabric. This allows the fabric to do the switching which lowers the cost per module and simplifies the backplane design.

The switch card also has an ATM engine like all the ATM media modules. The switch card ATM engine is used to connect the control point to port 0 of the switch.

Each media concentration module for the ATM switching functions also has Field Programmable Gate Arrays (FPGA) that are used for hardware functions which are deemed to be changed as ATM Forum standards evolve.

Is the switching fabric redundant?

Yes, the 8265 Nways ATM Hub can be equipped with a redundant A-CPSW module.

If the primary A-CPSW fails, the backup will release all active connections. Switched connections will be automatically re-established by the adapters in the workstations while permanent connections will be automatically re-established by the 8265 Nways Hub.

What traffic management capability is used by the 8265 Switch?

The 8265 brings a set of new enhanced ATM control and traffic management capability. These functions are fully distributed on each 8265 module as opposed to a centralized function residing on the switching fabric. The distribution is key to network availability, scalability, and growth. It offers consistent performance whatever the number of module/port is.

The key control and traffic management function are:

- Priority queues per Quality of Services:
  - Constant Bit Rate (CBR)
  - Variable Bit Rate (VBR)
  - Available Bit Rate (ABR) with any Minimum Cell Rate (MCR) value and relative rate flow control
  - Unspecified Bit Rate (UBR)
- Early and partial packet discard

  This smart function allows the switch to cleverly drop when required (for example, congestion) the cells belonging to the same end user packet. The link utilization of the network is significantly improved.
- Policing per virtual circuit

  The switch makes sure that the traffic is respected at the VC level by implementing a leaky bucket. It can take the decision to drop cells above

contract if required. Also, to reduce the burstiness of the traffic, a reshaping function is provided for traffic entering the switch (Ingres).

- Traffic shaping per VP

  Traffic shaping regulates traffic to a lower rate than the line speed. This function is active on out egress traffic. The control at VP level means that the switch can have different shaping values for different VPs that are active on the same port. Each of these VPs may have a different end-user address.

- Counters

  – Per connection counters

    These counters are:

    - Number of received valid cells
    - Number of received valid cells discarded due to policing or UBR
    - Number of transmitted valid cells
    - Number of valid cells discarded due congestion (early packet discard, partial packet discard)

    These counters are enabled:

    - Automatically for all connections (In this mode there is a limitation to 4000 connections per module.)
    - Manually for a given connection

  – Per port counters

    These counters are:

    - Number of cells with unknown VPI/VCI
    - Number of ABR RM cells with invalid CRC

  – Per module counter

    - Number of cells transmitted to Prizma switch fabric

  Note: Instant view of these counters is provided instead of an accounting view.

- Buffering

  The 8265 modules are equipped with both input buffer queues and output buffer queues, combining the benefits of the two queueing methods:

  – The output buffering helps in improving the link utilization in case of temporary traffic bursts, and delays the moment to exercise flow control on the traffic. In addition, it allows the shaping of traffic, down at the VP level, with fine granularity.

  – The input buffering, with the reshaping function, reduces the burstiness of the traffic in the network, and therefore minimizes the likelihood of contentions within the switch or the network. Moreover, input buffering removes the requirement to have a large output buffer that is a function of the number of modules trying to send to a given one. By exercising back pressure inside the switch, traffic can be held at the input in various modules without the need to increase significantly the size of the output buffer.

- Port mirroring

  This feature duplicates and re-directs traffic to any desired port. This allows traffic analysis by connecting a traffic analyzer to this port. Multiple mirrored

ports can be active at the same time. In one module, if one port is used for port mirroring, the other ports of this module are disabled.

Does the switch accept clocking from one interface and can it distribute clocking to other interfaces?

No for the IBM 8265 ATM Switch, but yes for the FibreCom ACE module.

Note: Media module as the ACE module can synchronize the traffic going through either by recovering the clock signal or using an external clock. Refer to 2.4.8, “FiberCom ATM Circuit Emulation (ACE) Module” on page 40 for more information.

What LAN switch modules are supported?

Currently the following LAN switch modules are supported:

- 8271 ATM/LAN Switch Module (2-s)
- 8271 ATM/LAN Switch Module (3-s)
  - ATM MMF Fiber/Eth. UFC for 8271
  - 100 BaseTx UFC (1p) for 8271
  - 100 BaseFx UFC (1p) for 8271
  - 10 BaseFL UFC (3p) for 8271
  - 10 Base-T UFC (4p) for 8271
- 8272 ATM/LAN Switch Module (2-s)
- 8272 ATM/LAN Switch Module (3-s)
  - ATM MMF Fiber/TR enhanced UFC for 8272
  - 2 port enhanced Fiber UFC for 8272
  - 4 port enhanced UTP/STP UFC for 8272

D.3 Signalling

What Quality of Service classes are supported?

The following Quality of Service classes are supported by the 8265 Nways Hub:

- Continuous Bit Rate (CBR)
- Variable Bit Rate - real time (VBR-rt)
- Variable Bit Rate - non-real time (VBR-nrt)
- Unspecified Bit Rate (UBR)
- Available Bit Rate (ABR)

Are Permanent Virtual Circuits (PVCs) supported?

Yes.

Are Permanent Virtual Paths (PVPs) supported?

Yes.

Are Switched Virtual Circuits (SVCs) supported?

Yes.

Are SVCs and PVCs concurrently supported on the same port?

Yes.

What is the signalling protocol used?

- ATM Forum UNI 3.0
- ATM Forum UNI 3.1
- ATM Forum UNI 4.0
- ATM Forum IISP for NNI connections
- ATM Forum PNNI 1.0 for NNI connections

How are PVCs established?

The 8265 Nways Hub Control Point supports smart PVCs; smart PVCs means that PVCs are internally mapped onto SVCs. This allows you, in case of a link or node failure on the original path supporting a PVC, to automatically re-establish the PVC using an alternate path. In addition, parameters specified for the setting of the PVCs are saved in the switch A-CPSW NVRAM of each origin 8265 Nways Hub to provide automatic PVC re-establishment after a power-on/reset condition.

Is connection management accomplished out-of-band?

No. Connection management, that is the sending/receiving of control information across the network to insure that a viable path exists satisfying the Quality of Service demands of the user's connection request, is accomplished in band. This plus other network management control information constitutes less than 15% of the available bandwidth. It is therefore recommended that the upper limit of link utilization be no greater than 85%.

Can 8265 Nways Hubs be interconnected through the WAN?

8265 control points use the VP Tunneling function to interconnect two 8265 clusters over the WAN via a permanent VP support.

D.4 Software Considerations

How is the control point architecture implemented in the 8265?

The control point architecture is implemented in the A-CPSW module. The control point provides a complete set of functions to control an ATM campus network. The network control functions are fully distributed (all nodes participate as peers in the control algorithms) as opposed to a centralized software function residing on a server. The distributed network control function is the key to network availability, scalability and growth.

D.5 Network Management

What kind of network management is supported?

8265 Nways Hub supports inband ATM Network Management, that is, the SNMP agent residing in each 8265 Nways Hub is accessible via the ATM network using Classic IP over ATM protocol (RFC1577) and IP over Forum-compliant LAN Emulation.

SNMP, TFTP, Telnet and Ping can be used. The SNMP agent may also be accessed by an IP network management station sitting on a legacy token-ring or Ethernet LAN network providing an IP to Classic IP router is used to interconnect the LAN network to the ATM network.

All functions available inband are also available out-of-band by using a command interface from a terminal attached either locally or remotely to the RS-232 connector of the A-CPSW module.

SLIP is also be available on the out-of-band RS-232 port.

How are control point microcode updates performed?

There are two possibilities:

- Inband using TFTP file transfer from a network server.
- Out-of-band using an RS-232 locally or remotely attached terminal using the XMODEM/YMODEM protocol.

Inband updates can be downloaded in the A-CPSW module flash EEPROM non-disruptively.

How are hardware picocode updates performed?

There are two possibilities:

- Inband using TFTP file transfer from a network server
- Out-of-band using an RS-232 locally or remotely attached terminal using the TFTP over SLIP protocol

Appendix E. Special Notices

This publication is intended to help marketing and service personnel that sell, install and support our campus products in the field. The information in this publication is not intended as the specification of any programming interfaces that are provided by user and command guide documentation provided with the campus productsfi See the PUBLICATIONS section of the IBM Programming Announcement for the 8265 ATM Campus Switch for more information about what publications are considered to be product documentation.

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Appendix F. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

F.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see “How to Get ITSO Redbooks” on page 235.

- *IBM ATM Workgroup Solutions: Implementing the 8285 ATM Switch*, SG24-4817
- *IBM 8260 As a Campus ATM Switch*, SG24-5003
- *Understanding and Using the IBM MSS Server*, SG24-4915
- *8260 ATM Architecture*, SG24-2110
- *IBM Networked Video Solution Over ATM Implementation*, SG24-4958
- *Troubleshooting IBM LAN/ATM Campus Network*, SG24-2105

F.2 Redbooks on CD-ROMs

Redbooks are also available on CD-ROMs. **Order a subscription** and receive updates 2-4 times a year at significant savings.

CD-ROM Title	Subscription Number	Collection Kit Number
System/390 Redbooks Collection	SBOF-7201	SK2T-2177
Networking and Systems Management Redbooks Collection	SBOF-7370	SK2T-6022
Transaction Processing and Data Management Redbook	SBOF-7240	SK2T-8038
Lotus Redbooks Collection	SBOF-6899	SK2T-8039
Tivoli Redbooks Collection	SBOF-6898	SK2T-8044
AS/400 Redbooks Collection	SBOF-7270	SK2T-2849
RS/6000 Redbooks Collection (HTML, BkMgr)	SBOF-7230	SK2T-8040
RS/6000 Redbooks Collection (PostScript)	SBOF-7205	SK2T-8041
RS/6000 Redbooks Collection (PDF Format)	SBOF-8700	SK2T-8043
Application Development Redbooks Collection	SBOF-7290	SK2T-8037

F.3 Other Publications

These publications are also relevant as further information sources:

- *8260 Nways Multiprotocol Switching Hub: ATM 4-Port 100 Mbps Module: Installation and User's Guide*, SA33-0324
- *8260 Nways Multiprotocol Switching Hub: ATM Control Point and Switch Module: Installation and User's Guide*, SA33-0326
- *IBM 8260 Nways Multiprotocol Switching Hub: ATM 155 Mbps Flexible Concentration Module: Installation and User's Guide*, SA33-0358
- *Nways 8260 ATM TR/Ethernet LAN Bridge Module Installation and User's Guide*, SA33-0361
- *IBM 8285 Nways ATM Workgroup Switch Installation and User's Guide*, SA33-0381

- *8260/8285 ATM 25 Mbps Concentration Module: Installation and User's Guide*, SA33-0383
- *IBM 8260/8285 ATM WAN Module: Installation and User's Guide*, SA33-0396
- *IBM 8260/8285 ATM 3-Port 155 Mbps Module Installation and User's Guide*, SA33-0397
- *ATM/WAN Daughter Card Installation Guide*,SA33-0403
- *8265 Nways ATM Switch Installation Guide*, SA33-0441
- *8265 Nways ATM Switch User's Guide*, SA33-0456
- *8265 Nways ATM Switch Command Reference Guide*, SA33-0458
- *8265 Nways ATM Switch Media Module Reference Guide*, SA33-0459
- *ATM 155-Mbps Multimode Fiber Universal Feature Card: Planning and Installation Guide*, GA27-4156
- *IBM Switch-on-a-Chip*, G325-3512
- *Video Distribution Module: User's Guide*, GA27-4173
- *IBM 8260 Multiprotocol Intelligent Switching Hub: Nways 8260 ATM TR/Ethernet LAN Bridge Module, Installation and User's Guide*, SA33-0361
- *Nways MSS Server Service Manual*, GY27-0354
- *Nways MSS Server Introduction and Planning Guide*, GC30-3820
- *Nways MSS Server Command Line Interface User's Guide*, SC30-3818
- *Nways MSS Server Command Line Interface Protocol Configuration Guide*, SC30-3819
- *Events Logging System Message Guide*, SC30-3682-01
- *Nways MSS Server Configuration Guide*, SC30-3821
- *Video Distribution Module Installation and User's Guide*, GA27-4173
- *ATM Campus Introduction, Planning, and Troubleshooting Overview*, GA27-4089
- *ATM 155-Mbps Multimode Fiber Universal Feature Card Planning and Installation Guide*, GA27-4156

F.4 Performance Information

These are sources of performance information:

- *Factors Influencing ATM Adapter Throughput*, by Andrew Rindos, Steven Woolet, David Cosby, Leonard Hango, Mladen Vouk (IBM Networking Hardware Division) available at URL http://www.networking.ibm.com/per/perprod.html
- *The IBM TURBOWAYS 155 PCI ATM Adapter: Clasical IP and LAN Emulation performance for AIX* (IBM Networking Hardware Division) available at URL http://www.networking.ibm.com/per/perprod.html
- *RFC 1323, TCP Extensions for High Performance*, May 1992
- *IBM Performance Monitoring Guide*, SC23-2365-04
- *RS/6000 and Asynchronous Transfer Mode,* SG24-4796

- *Banking on ATM Networking - Real LAN Emulation Interoperability Scenarios*, by David Cosby, Lon Hall, Wes Kinard, Cindy Kueck Young (IBM Corporation)

How to Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

This information was current at the time of publication, but is continually subject to change. The latest information may be found at http://www.redbooks.ibm.com/.

How IBM Employees Can Get ITSO Redbooks

Employees may request ITSO deliverables (redbooks, BookManager BOOKs, and CD-ROMs) and information about redbooks, workshops, and residencies in the following ways:

- **PUBORDER** — to order hardcopies in United States
- **GOPHER link to the Internet** - type GOPHER.WTSCPOK.ITSO.IBM.COM
- **Tools disks**

  To get LIST3820s of redbooks, type one of the following commands:

  ```
  TOOLS SENDTO EHONE4 TOOLS2 REDPRINT GET SG24xxxx PACKAGE
  TOOLS SENDTO CANVM2 TOOLS REDPRINT GET SG24xxxx PACKAGE (Canadian users only)
  ```

  To get BookManager BOOKs of redbooks, type the following command:

  ```
  TOOLCAT REDBOOKS
  ```

  To get lists of redbooks, type one of the following commands:

  ```
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET ITSOCAT TXT
  TOOLS SENDTO USDIST MKTTOOLS MKTTOOLS GET LISTSERV PACKAGE
  ```

  To register for information on workshops, residencies, and redbooks, type the following command:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ITSOREGI 1998
  ```

  For a list of product area specialists in the ITSO: type the following command:

  ```
  TOOLS SENDTO WTSCPOK TOOLS ZDISK GET ORGCARD PACKAGE
  ```

- **Redbooks Web Site on the World Wide Web**

  http://w3.itso.ibm.com/redbooks/

- **IBM Direct Publications Catalog on the World Wide Web**

  http://www.elink.ibmlink.ibm.com/pbl/pbl

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List of Abbreviations

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ACN	ATM Cluster Number
A-CPSW	ATM Control-Point and Switch
AIX	Advanced Interactive Executive
ANR	Automatic Network Routing
ANSI	American National Standards Institute
APPN	Advanced Peer-to-Peer Networking
ARB	All Routes Broadcast
ARE	All Routes Explorer
ARI	Address Recognize Information
ARP	Address Resolution Protocol
ASCII	American (National) Standard Code for Information Interchange
ASIC	Application Specific Integrated Circuit
ATM	Asynchronous Transfer Mode
AUI	Attachment Unit Interface
B-ISDN	Broadband ISDN
BCM	Broadcast Manager
BOOTP	Boot Protocol (IP)
BPDU	Bridge Protocol Data Unit
Bps	Bytes per second
bps	bits per second
BRI	Basic Rate Interface
BUS	Broadcast and Unknown Server
CAC	Call Admission Control
CAD	Common ATM Datamover
CAM	Content Addressable Memory
CAP	Common ATM Processor
CBR	Constant Bit Rate
CCITT	Comitee Consultatif International Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee) now ITU-T
CD	Compact Disc
CE	Circuit Emulation
CIP	Classical IP
CLD	Connection Less Data
CLP	Cell Loss Priority
COD	Connection Oriented Data
CPCS	Common Part Convergence Sublayer
CPU	Central Processor Unit
CRC	Cyclic Redundancy Check
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
CTL	Control Field (LLC field)
DA	Destination Address
DAAT	Destination Address Association Table
DAVIC	Digital Audio-visual Council
DCC	Data Country Code
DE	Discard Eligibility
DIX	Digital, Intel and Xerox
DMM	Distributed Management Module
DRAM	Dynamic Random Access Memory
DTL	Designated Transit Lists
DTR	Data Terminal Ready / Direct Token-Ring
DXI	Data Exchange Interface
ECC	Error Correction Code
EDEL	End Delimeter
EEC	Electrical Engineering Commission
EEPROM	Electrical Erasable Programmable Read Only Memory
EFCI	Explicit Forward Congestion Control
EISA	Enhanced Industry Standard Architecture
ELAN	Emulated LAN
ELID	Emulated LAN Identifier
EMC	Electro Magnetic Compatibility
EPD	Early Packet Discard

ER	External Reachability
ERM	Explicit Rate Marking
ESI	End System Identifier
ETSI	European Telecommunication Standards Institute
ELS	Event Logging System
FCI	Frame Copied Information
FCS	Frame Check Sequence
FDDI	Fiber Distributed Data Interface
FEP	Front End Processor
FPGA	Field Programmable Gate Array
FTP	File Transfer Protocol
Gbps	Gigabits Per Second
GCAC	Generic Connection Admission Control
GFC	Generic Flow Control
HDLC	High-level Data Link Control
HDTV	High-Definition Tele-Video
HEC	Header Error Check
HL	Horizontal Link
HPR	High Performance Routing
IBM	International Business Machines Corporation
ICD	International Code Designator
IDI	Initial Domain Identifier
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IISP	Interim Inter-Switch Signaling Protocol. (P-NNI phase 0)
ILMI	Interim Local Management Interface
IMA	Interactive Media Association
INARP	Inverse Address Resolution Protocol
IP	Internet Protocol
I-PNNI	Integrated PNNI
IPX	Internetwork Packet Exchange
IR	Internal Reachability
IRQ	Interrupt Request
ISA	Industry Standard Architecture
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITSO	International Technical Support Organization
ITU-T	International Telecommunication Union - Telecommunication
KB	kilobyte
Kbps	Kilobits per second
LAA	Locally Administered Address
LAN	Local Area Network
LANE	LAN Emulation (ATM Forum)
LE	LAN Emulation (also, LANE)
LEC	LAN Emulation Client (ATM Forum LANE)
LECS	LAN Emulation Configuration Server
LED	Light Emitting Diode
LES	LAN Emulation Server
LIS	Logical IP Subnetwork
LLC	Logical Link Control
LNNI	LAN Emulation Network Node Interface
LPDU	Logical Link Control Protocol Data Unit
LSU	Link State Update
LUNI	LAN Emulation User-to-Network Interface
MAC	Medium Access Control
MAT	Management Application Transporter
MARS	Multicast Address Resolution Server
MB	MegaBytes
Mbps	Megabits per second
MC	Micro Channel
MCR	Minimum Cell Rate
MIB	Management Information Base
MMF	Multi Mode Fiber
MPOA	Multi-Protocol Over ATM
MPM	Management Process and Control
MSS	Multiprotocol Switched Services
MTU	Maximum Transmission Unit

NBBS	Networking BroadBand Services
NBMA	NonBroadcast Multiaccess Network
NCM	Nways Campus Manager
NCMA	Nways Campus Manager ATM
NCML	Nways Campus Manager LAN
NDIS	Network Driver Interface Specification
NDPS	Non-Disruptive Path Switch
NetBIOS	Network Basic Input/Output System
NHRP	Next Hop Resolution Protocol
NHS	Next Hop Server
NIC	Network Information Center
NIG	Nodal Information Group
NIIF	National Information Infrastructure Testbed
NIX	Network Information Exchange
NMF	Network Management Forum
NMS	Network Management Station
NNI	Network-to-Network Interface
nrt-VBR	Non-real-Time Variable Bit Rate
NSAP	Network Service Access Point
NRB	Non Reserved Bandwidth
NSP	Nodal State Parameter
NVRAM	Non-volatile Random Access Memory
OAM	Operations Administration and Maintenance
OC-n	Optical Carrier level n
ODI	Open Data-link Interface
OID	Originator IDentifier
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First
PAR	PNNI Augmented Routing
PC	Personal Computer
PCR	Peak Cell Rate
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PCMCIA	Personal Computer Memory Card International Association
PDH	Plesiochronous Digital Hierarchy
PDU	Protocol Data Unit
PG	Peer Group
PGI	Peer Group Identifier
PGL	Peer Group Leader
PIM	Product Independent Module
PLCP	Physical Layer Convergence Protocol
PNNI	Private Network-to-Network Interface
PPD	Partial Packet Discard
PSM	Product Specific Module
PT	Payload Type
PTSE	PNNI Topology State Element
PTSP	PNNI Topology State Packet
PVC	Permanent Virtual Circuit
PVP	Permanent Virtual Path
QoS	Quality of Service
RAIG	Resource Availability Information Group
RAM	Random Access Memory
RB	Reserved Bandwidth
RCC	Routing Control Channel
RFC	Request for Comments
RIF	Route Information Field
RIP	Routing Information Protocol
RISC	Reduced Instruction Set Computer/cycles
RM	Resource Management
RMON	Remote Monitor
rt-VBR	Real-Time Variable Bit Rate
RTP	Rapid Transport Protocol
SA	Source Address
SAAL	Signaling ATM Adaptation Layer
SAAT	Source Address Association Table
SAP	Service Access Point
SAR	Segmentation And Reassembly
SDEL	Start Delimiter
SDH	Synchronous Digital Hierarchy
SDLC	Synchronous Data Link Control

SDU	Service Data Unit
SEAL	Simple and Efficiency Adaptation Layer (AAL5)
SFE	Specific Front End
SLIP	Serial Line Interface Protocol
SMF	Single Mode Fiber
SNA	Systems Network Architecture
SNAP	Subnetwork Access Protocol
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPAL	Speed Adaptation Layer
SRAM	System Random Access Memory
SR-TB	Source Route Translational Bridge
SRB	Single Route Broadcast / Source-Route Bridging
SRM	Source Route Manager
SRF	Specifically Routed Frame
SRT	Source Route Transparent bridging
SSAP	Source Service Access Point
SSCOP	Service-Specific Connection-Oriented Protocol
SSCS	Service-Specific Convergence Sublayer
SSI	Switch to Switch Interface
STE	Spanning Tree Explorer
STM	Synchronous Transfer Mode
STP	Shielded Twisted Pair / Spanning Tree Protocol
STS	Synchronous Transport Signal
SVC	Switched Virtual Circuit
SVN	Switched Virtual Networking
TA	Terminal Adapter
TAXI	Transparent Asynchronous Transmitter-Receiver Interface
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	Time Division Multiplexing
TE	Terminal Equipment
TFTP	Trivial File Transfer Protocol
TM	Traffic Management
TRS	Topology and Route Selection
TP	Twisted Pair (Wiring)
TTRT	Target Token Rotation Time
UAA	Universally Administered Address
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol
UFC	Universal Feature Card
UL	Up Link
ULEC	Unknown LAN Emulation Client
UME	UNI Management Entity
UNI	User-to-Network Interface
UTOPIA	Universal Test & Operations Physical Interface for ATM
UTP	Unshielded Twisted Pair
VBR	Variable Bit Rate
VC	Virtual Channel (ATM) Virtual Connection (Frame Relay) Virtual Circuit (X.25)
VCC	Virtual Circuit Connection (X.25 and ATM)
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link (UNI 3.0)
VDM	Video Distribution Module
VLAN	Virtual Local Area Network
VOID	Vector of IOS Driver
VP	Virtual Path
VPC	Virtual Path Connection
VPCI	Virtual Path Connection Identifier
VPI	Virtual Path Identifier
VPL	Virtual path Link (UNI 3.0)
VS/VD	Virtual Source/Virtual Destination
VSS	Viewing ATM Service Statistication
WAN	Wide Area Network
WKA	Well Known Address
XIWT	Cross Industry Working Team

Index

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V

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IBM 8265 Nways ATM Campus Switch
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