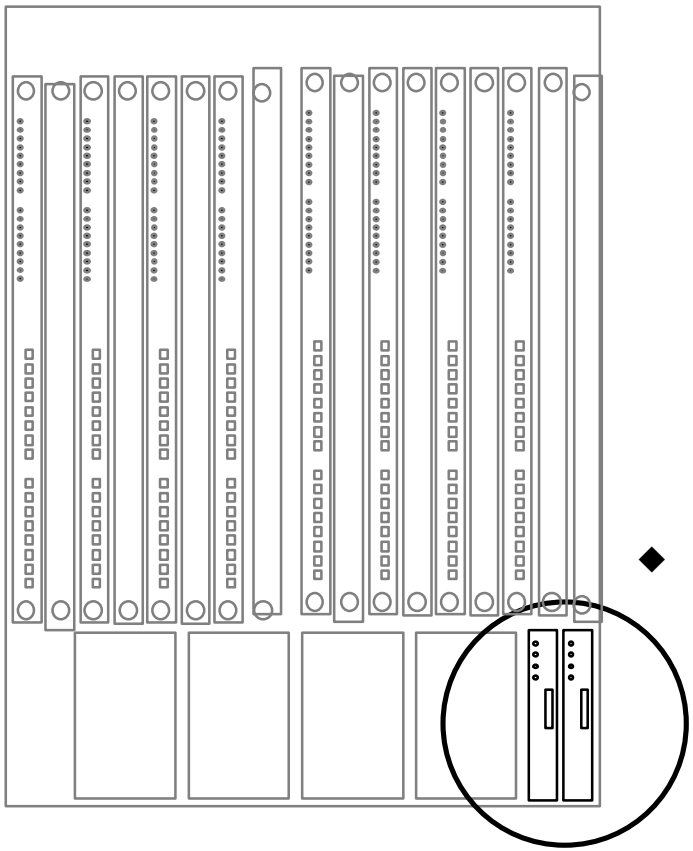
8265 Components Set-up

- The objectives of this section are to:
  - Provide detailed information and instructions about installing and configuring various components in IBM's 8265 ATM Switch
- After completing this topic you will:
  - Know how to install and configure 8265 components

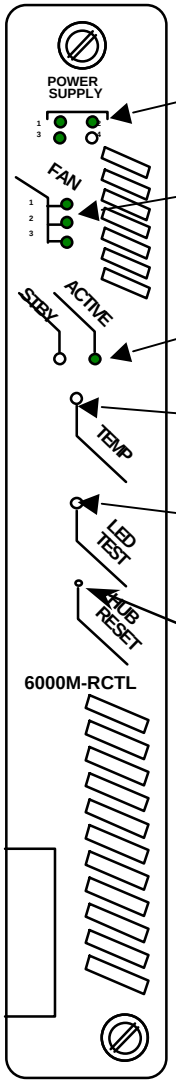
- The topics discussed in this section are:
  - Chassis
    - Intelligent Controller
    - Power Management
    - Environment
  - Installing and Configuring CPSW
  - Memory for configurations

Intelligent Control



- Controller Module
  - ACTIVE mode
    - Reports problems to the CPSW
    - Monitors chassis power
    - Provides power management
    - Monitors environment
    - Provides backplane clocking
    - Inventory Management
- Second Controller Module
  - STANDBY mode
    - Mirrors Active Module monitoring activities
    - When the Standby becomes Active, the switch is reset

Controller - LEDS and Buttons



Power supply status LEDs (4)

Fan status LEDs (3)

Controller status LEDs (Active/Standby)

Temperature LED

LED Test button
Test LEDs on all modules

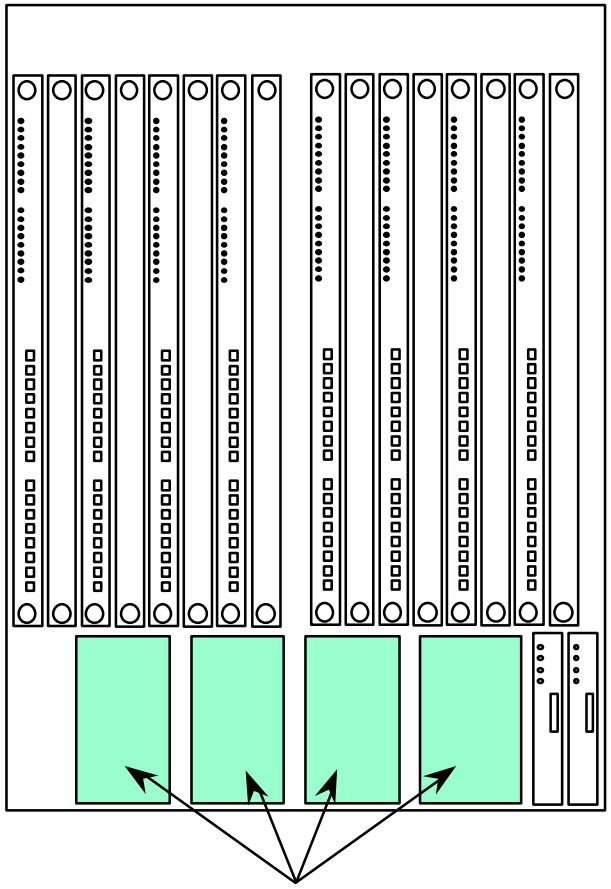
Switch Reset button
Resets Switch and Modules

Faceplate marking: 8000-RCTL
Power consumption: 5W at +5V

Controller Modules

- One or two Controller modules per switch
  - One Active and the other Standby, for fault tolerance
- Occupy slots 18 or 19
  - Active/Standby mode is not always determined by slot
- 8260 Controller Modules
  - Controller modules are interchangeable between the 8265 and 8260
  - 8260 Controller code versions
    - Operations code version 1.14 or higher and Boot code version 1.03 or higher
    - Upgrade the 8260 Controller in the 8260 Hub before installing it in the 8265 Switch

Load Sharing Power Supplies



LOAD BALANCING POWER SUPPLIES

Hot-swappable

Two different capacity power supplies:
295 watt and 415 watt

Automatically assume a share of the power load when installed

8265/8260 Module Power On

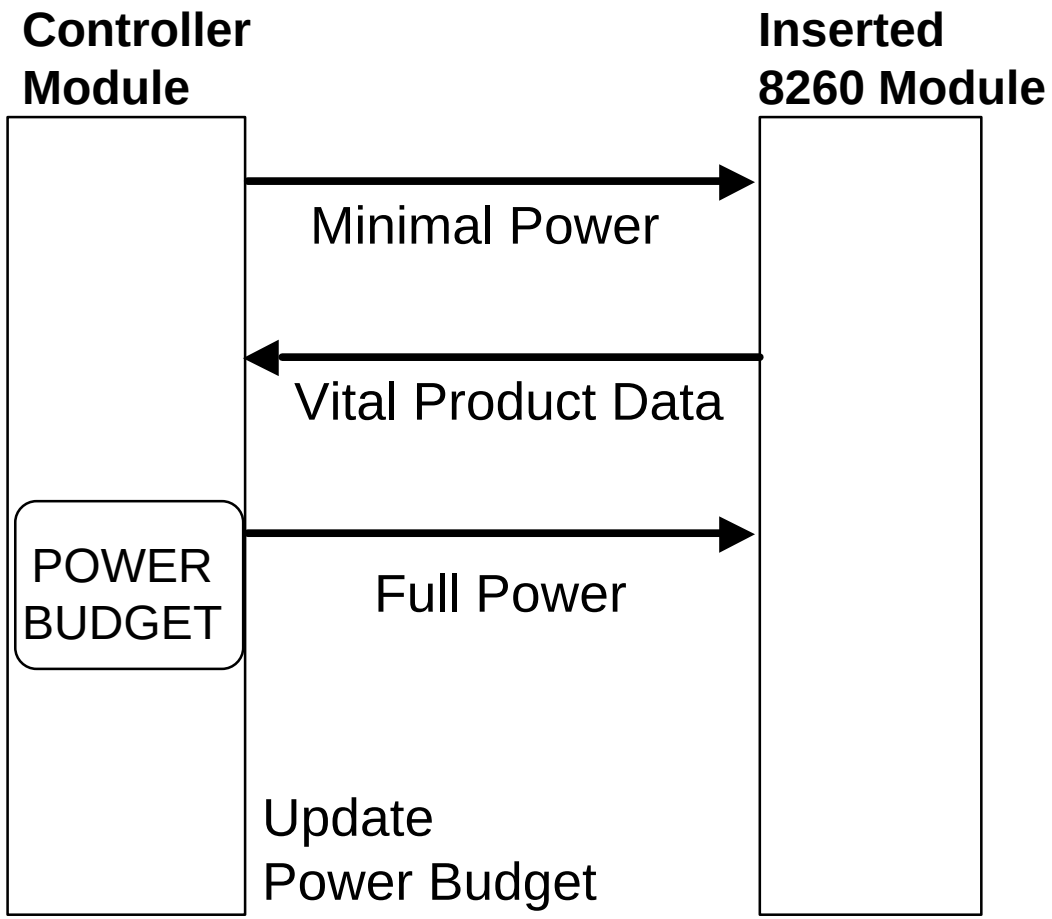
Vital Product Data:

Module Name

Hardware and Software versions

Manufacturer ID and date

Power requirements



Load Sharing Power Supplies

- Three types of power supplies available
  - 415 Watt AC
    - Feature Code 8027, P/N 13J8706
  - 295 Watt DC (-48Vdc)
    - Feature Code 8026, P/N 02L2438
    - For use where only DC power is available
  - Existing 295 Watt AC power supplies
    - From an IBM 8260 Hub
- An 8265 in non-fault tolerant mode with full power capacity (four power supplies) delivers up to 1500 Watts of power

Power Budget

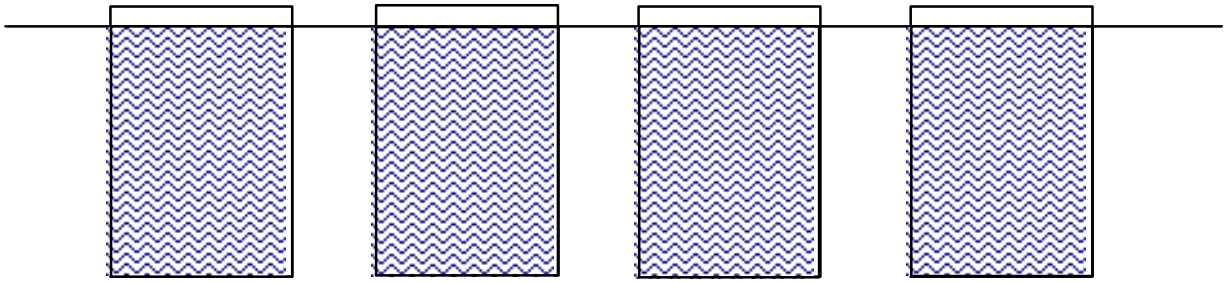
- The amount of power available to modules depends on the operating mode and rating of power supplies available
  - Modes: Fault Tolerant or Non-Fault Tolerant
    - The 8265 provides the requested mode of operation
  - Rating: 295 Watt, 415 Watt, or a mixture of power supplies
- The Controller module controls Power-On of new modules
  - Ensures there is sufficient power for newly installed modules before applying the power

Power Management Information

```
8265ATM> show power all
                Power Management Information
                ----------------------------
Hub Power Modes:
        Fault-Tolerant Mode:        NON_FAULT_TOLERANT
        Fault-Tolerant Status:      NON_FAULT_TOLERANT
        Overheat Power Down Mode:   DISABLE

Slot Power Information:
Slot     Class          Admin Status        Operating Status
----     -----          ------------        ----------------
1        9              ENABLE              ENABLED
3        4              ENABLE              ENABLED
6        5              ENABLE              ENABLED
9        8              ENABLE              ENABLED
14       7              ENABLE              ENABLED
```


Chassis Power Management

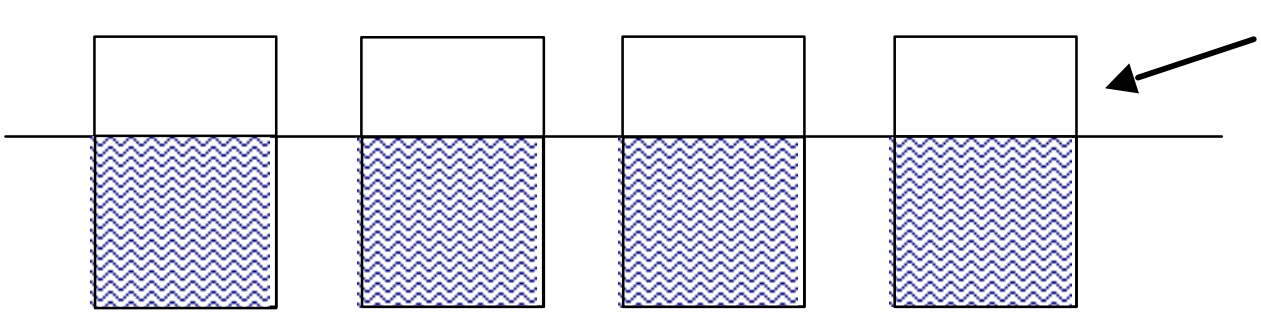
POWER NON-FAULT TOLERANT MODE



Full output power available to modules

Power Supplies

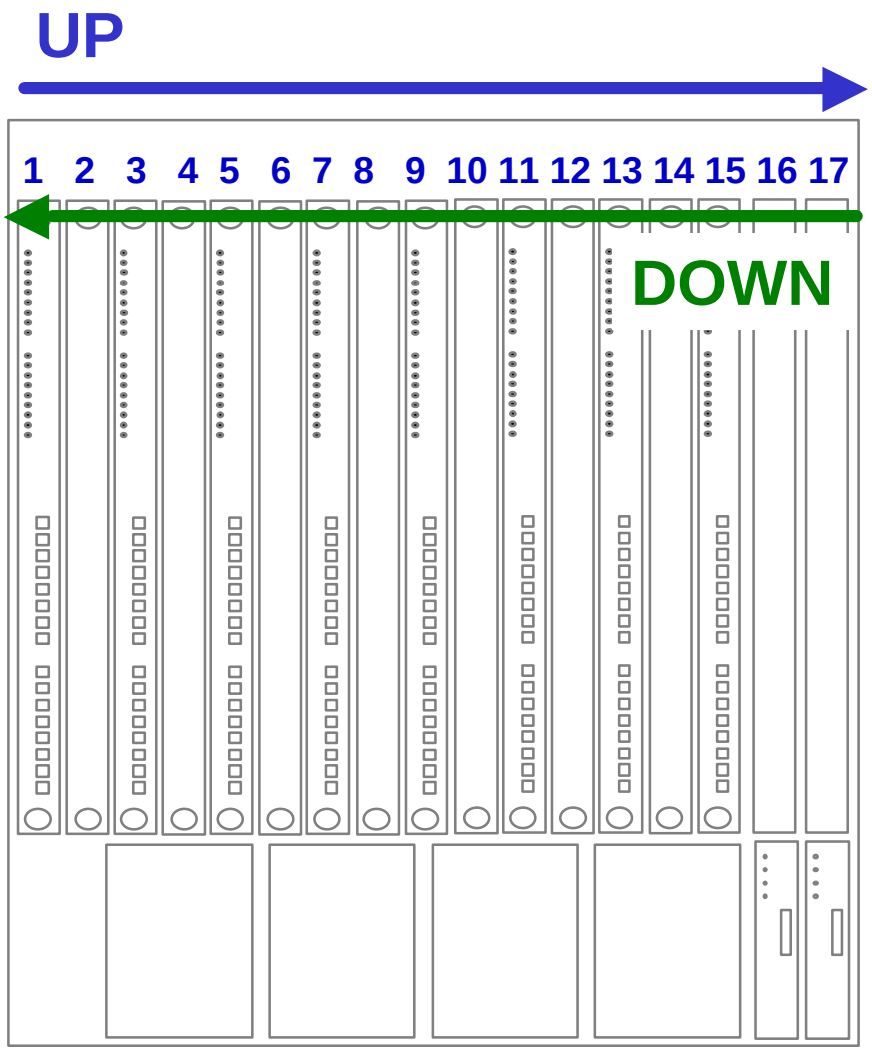
POWER FAULT TOLERANT MODE



Unreserved power available to modules

Power Supplies

Slot Power Class



POWER-UP direction
slots 1 to 17

POWER-DOWN direction
slots 17 to 1

Modules set to
Power Class 10
are never powered-off

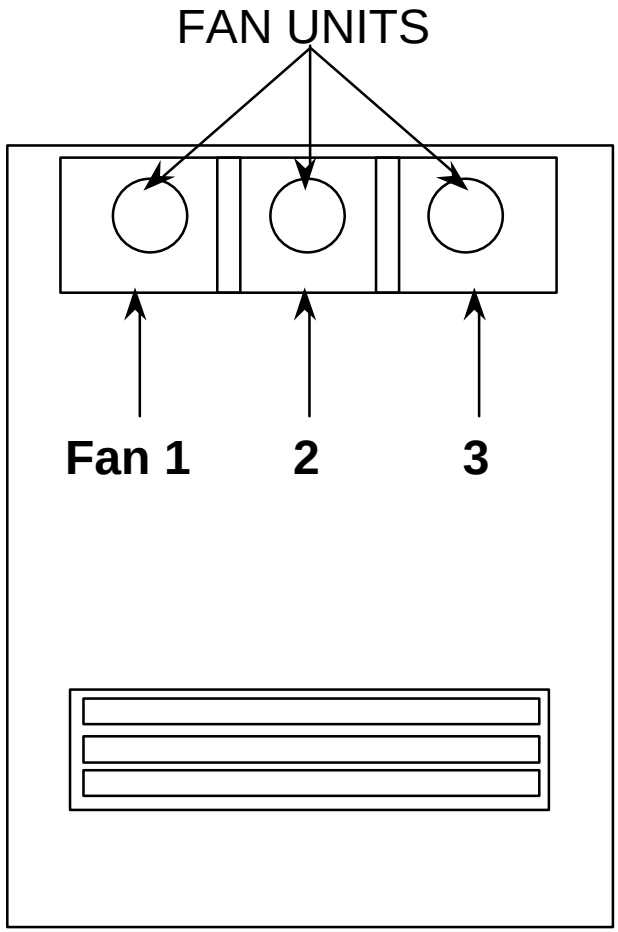
Computing the Power Budget

Computation for 415W or 219W DC power supplies

1. List all ATM modules and their I/O cards
   - Do not include the Primary CPSW nor the Active Controller
2. Add power budget requirements of all listed modules and call this value *p*
3. In the appropriate table below, locate the smallest entry that is greater than *p*
4. Read the corresponding number of power supplies

Fan Units and Overheat Detection

Rear View



The cooling subsystem protects the switch and installed modules from damage or loss that might result from a switch failure due to overheating

Overheat Recovery Process

- If an overheat is detected
  - SNMP agent is informed
    - Trap message is sent to the network management program
  - After 1 minute the temperature is sampled again
  - After 15 minutes, if temperature is still over threshold
    - All modules in overheat management area are powered down
    - Except those modules with Power Class 10

LAB 1

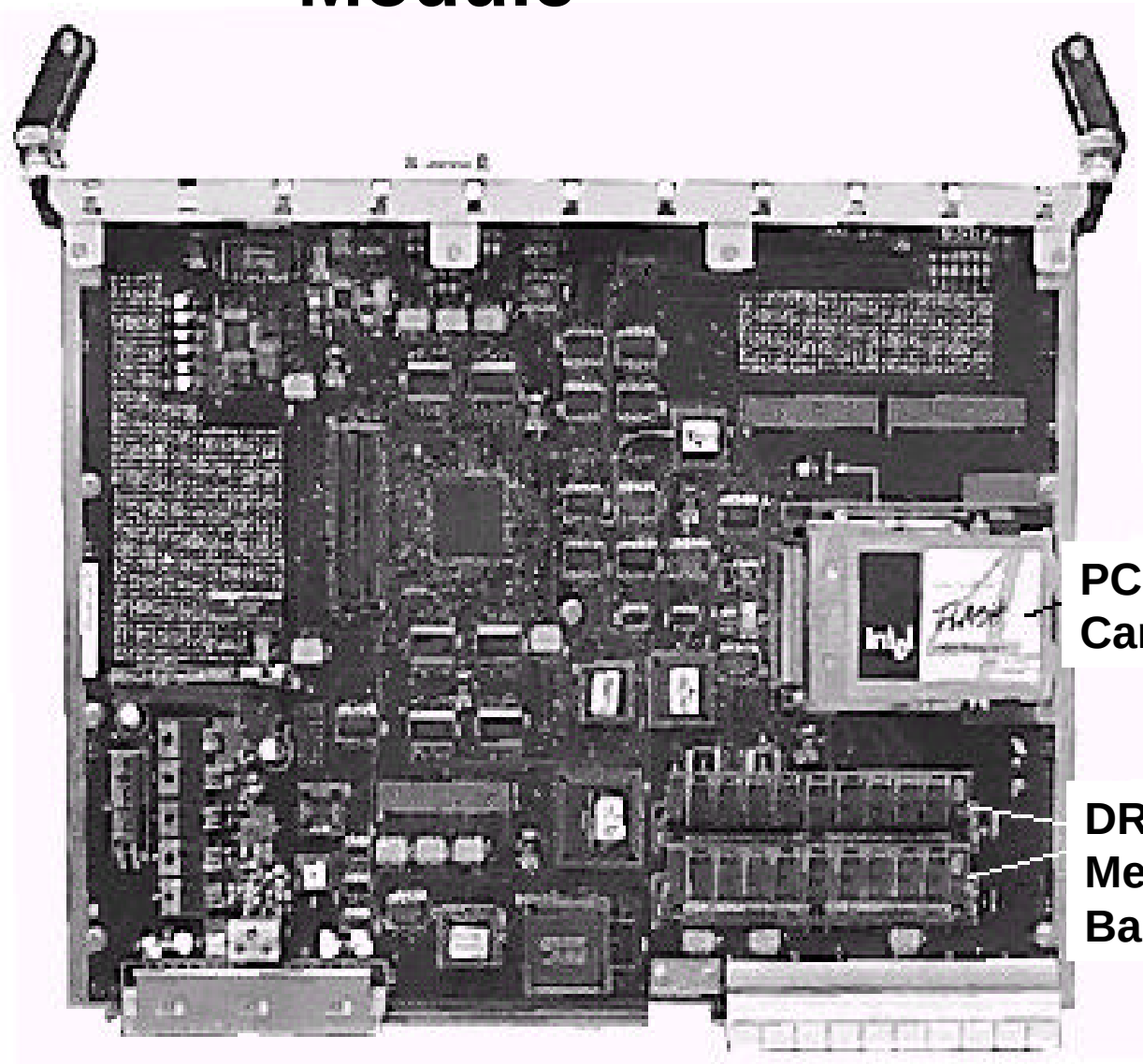
- GO TO SECTION 3 at the back of the course book.

Setting Up the 8265

- **Installation Steps:**
  - AC or DC power supplies and power cords
    - A minimum of 2 power supplies are required
  - Controller module
    - A minimum of 1 is required
  - Control Point and Switch module
    - A minimum of 1 is required
  - PCMCIA card for the CPSW module
    - Required
  - Media modules
    - A minimum of 1 is required
  - Configuration console connected to the CPSW

ATM Control Point and Switch Module

- Switches data between media modules in the ATM subsystem
- Each media module has a set of dedicated connections to the CPSW



IBM 8265 Nways ATM Switch

Consists of 3 Cards

- CPSW consists of 3 cards packaged into one double-slot module:
  - Daughter card
    - Fits into the base card
    - Provides logical and physical interfaces between the control point and the switch fabric
  - Base card which is the ATM Switch fabric
    - ATM cell switching is carried out by the Prizma chip
    - Switches cells from one ATM concentration port to another port or to another output link on the same module
  - Control Point card
    - Houses a processor where the control program resides

PCMCIA Card in the CPSW

- Must be installed in the CPSW module before the CPSW is installed in the 8265
  - Contains the CPSW module microcode
- Comes in two types:
  - Basic
    - Contains IISP and UNI protocol code
    - Requires 16 MB dynamic RAM
  - Enhanced
    - Contains the PNNI and IISP protocol code
    - Requires 32 MB dynamic RAM

CPSW Ethernet Port

- Supports all console functions, code file transfers, traces, dumps
- To use the Ethernet port on a CPSW module configure:
  - IP address and subnet mask
  - Ethernet MAC address
    - A burned-in address is supplied with each CPSW
      - Display it via **SHOW INVENTORY VERBOSE**
    - The address can be redefined with a Locally Administered Address (LAA)
      - Return to the burned-in address by entering a MAC address of 000000000000

SPAL Daughter Card

- Provides a Speed Adaptation Layer for 8260 modules
  - Only available for slots 1, 3, 5 and 7
- Physically located on the CPSW
- Performs the following functions:
  - Buffering and synchronization from the 8265 switch system to the 8260 media modules and vice versa
  - Generation/distribution of clocks for 8260 media modules
  - Attachment of either 8265 or 8260 media modules on the same switch port

6 Ways into CPSW

- 6 ways to connect to the CPSW console
  - RS-232 console direct connection
  - RS-232 console port modem connection
  - RS-232 console direct SLIP connection
  - RS-232 console port modem SLIP connection
  - ATM subsystem
  - Ethernet port
    - RJ-45 port
    - TCP/IP / TELNET / SNMP / Browser
    - Ethernet IP address must be in a unique IP subnet
      - A different subnet from any subnet that is already defined in the switch

Configuration Console

- Factory default settings of the CPSW
  - 9600 baud rate
  - 8 data bits
  - no parity
  - 1 stop bit
- Reset the baud rate using command
  - **SET TERMINAL BAUD {2400, 4800, 9600, 19200}**
  - After you enter the command, the connection to the ATM Control Point is lost
  - Enter **SAVE TERMINAL** to permanently save the new baud rate

Configuration Console (cont.'d)

- **Two operating modes for the Control Point console port**
  - NORMAL (default)
    - In this mode, the Control Point local console operates as an ASCII-type terminal
  - SLIP
    - In this mode, the Control Point local console is a workstation with an active IP stack
      - Its serial port is connected to the CPSW console port
    - Communications are over the IP SLIP protocol
    - This option can only be selected from a local console
      - Cannot be selected via Telnet

Display Sequence on CPSW LCD

- Each time the CPSW module is powered on or reset, the following sequence is displayed:
  - **INIT**- initialization process is started
  - **SET1, RFW1, RBW1, BRST** - testing the first bank of DRAM memory (only displays if diagnostics enabled)
  - **CLR1** - first bank of DRAM is being cleared (only displays if 2 banks of DRAM are installed)
  - **LOAD** - operational code is being copied from the PCMCIA card into the DRAM
  - **ACTV** or **STBY** - CPSW module is active (ACTV) or gone into standby (STBY) mode
    If neither displays an error has occurred

Administrative Password

- Administrator access
  - The administrator password gives read and write access to all ATM commands
  - Factory default Administrator password is **8265**
- If passwords do not work
  - Enter **force** at the password prompt
  - Press the Reset button on the front panel of the CPSW within 3 seconds
  - This will reboot the CPSW with factory default password settings

User Password

- Read only access to a subset of ATM commands
  - View CPSW status
  - Get help
  - Clear counters
  - Log off
- Factory default User password is null string
- If the same password is assigned to both the Administrator and the User
  - The User will have the same access rights as the Administrator

Configuring CPSW Parameters

- Set the User and Administrator passwords
- Set the CPSW node clock
  - Uses its own battery and functions even when the CPSW fails to operate
- Set the local CPSW parameters
  - Switch name, service contact information, console prompt,console timeout
- Define the ATM address
  - This resets the CPSW module so SAVE changes
- Configure the operating mode
  - PNNI, IISP, UNI
- Save all the configuration settings

SHOW 8265 Information

```
8265ATM> show hub
(1) HUB INFORMATION:
        Hub Type:  8265-17SLOT
(2) BACKPLANE INFORMATION:
BACKPLANE TYPE                                  REVISION
   Load-Sharing Power Distribution Board           0
   Unknown type Channel Backplane                  0
   Switch Channel Backplane                        0

(3) POWER SUPPLY INFORMATION:
POWER SUPPLY      STATUS            MODEL NUMBER
          1       NOT_INSTALLED
          2       OKAY              8265PS
          3       OKAY              8265PS
          4       OKAY              8265PS
(4) TEMPERATURE INFORMATION:
PROBE    LOCATION          TEMPERATURE
1        FAN_1             35 degrees Celsius
2        FAN_2             35 degrees Celsius
3        FAN_3             35 degrees Celsius
(5) FAN INFORMATION:
FAN      STATUS
1        OAKY
2        OKAY
3        OKAY
```


Switch Environment

```
8265ATM> show inventory verbose

Switch/                Hardware
Slot  Module     Version   Serial #  Vendor    Date
----- ---------  -------- ---------  -------- ------
HUB   8260_A17     A         K3385     IBM     980315

Note Pad:
02.01 1 E24PS      6/8       1001412   IBM     980928

Note Pad:
Operational Version: v1.04          Boot Version: v1.02
03.01 1E04M-MOD    2         2181632   IBM     971010

Note Pad:
Operational Version: v1.00          Boot Version: v1.00
```


Default Settings

Powering on the 8265 for the first time

- Loads a default configuration and default ATM address:
  - **ATM address =**
  - 39.99.99.99.99.99.99.00.00.99.99.01.01.99.99.99.99.99.99.00
  - **Level Identifier (bits) =** 96
  - **Peer Group ID =**
  - 39.99.99.99.99.99.99.00.00.99.99.01
  - **Internal Summary Address =**
  - 39.99.99.99.99.99.99.00.00.99.99.01.xx
    where xx is the switch identification
  - **External Summary Address =** none
  - **Path Selection =** ABR - precomputed, UBR - widest path

3 Burnt-in MAC Addresses

- Burnt-in MAC addresses on the board rather than the CPSW module itself
  - If a CPSW is swapped, the ATM address of the ATM switch remains unchanged
- The CPSW uses the backplane's 3 burnt-in MAC addresses for LAN interfaces:
  - Token Ring LAN emulation client
  - Ethernet LAN emulation client
  - Ethernet management port

LANE/CIP Functions

- 8265 internal LANE functions:
  - The 8265 has 2 internal LEC
  - No internal LES/BUS
  - No internal LECS
- 8265 internal CIP functions:
  - No internal ARP Server
  - No internal CIP Client

Reconfigure ATM Address

- Reconfigure the CPSW default ATM address
  - Networks with multiple switches require each switch to have a unique address
    - The address of all switches forming one peer group have one common 96 bit (12 byte) prefix called *peer group id*
    - Default length for the peer group id = 12 bytes
      - Use the 13th byte to uniquely identify a switch within a peer group
- Define a new ATM address for the 8265 switch
  - SET PNNI NODE_0 ATM_ADDRESS: **<20 byte address>**
    - To confirm, issue **COMMIT** after the last entry

Maintenance Mode

- Some operations can only be done in Maintenance mode
  - Only from a CPSW session via the RS-232 port
  - **MAINTAIN** command
    - Enters the Maintenance mode
    - Resets the CPSW
  - **SWAP ACTIVE** command
    - Activates the backup flash EEPROM without resetting the CPSW
  - **CLEAR ALL** command
    - Deletes all stored information; configuration, error log, restart counters.

Standby CPSW

- Standby CPSW installed in slots 11 - 12
  - Takes over if the primary CPSW fails
- Redundant CPSWs must be at the same code level
- Active CPSW permanently checks that the Standby CPSW is present and up-to-date
- The Standby CPSW will continually mirror any changes made to the Active CPSW
  - If this is not being done, the microcode versions may not be the same on both CPSWs

LAB 2

- GO TO SECTION 3 at the back of the course book.

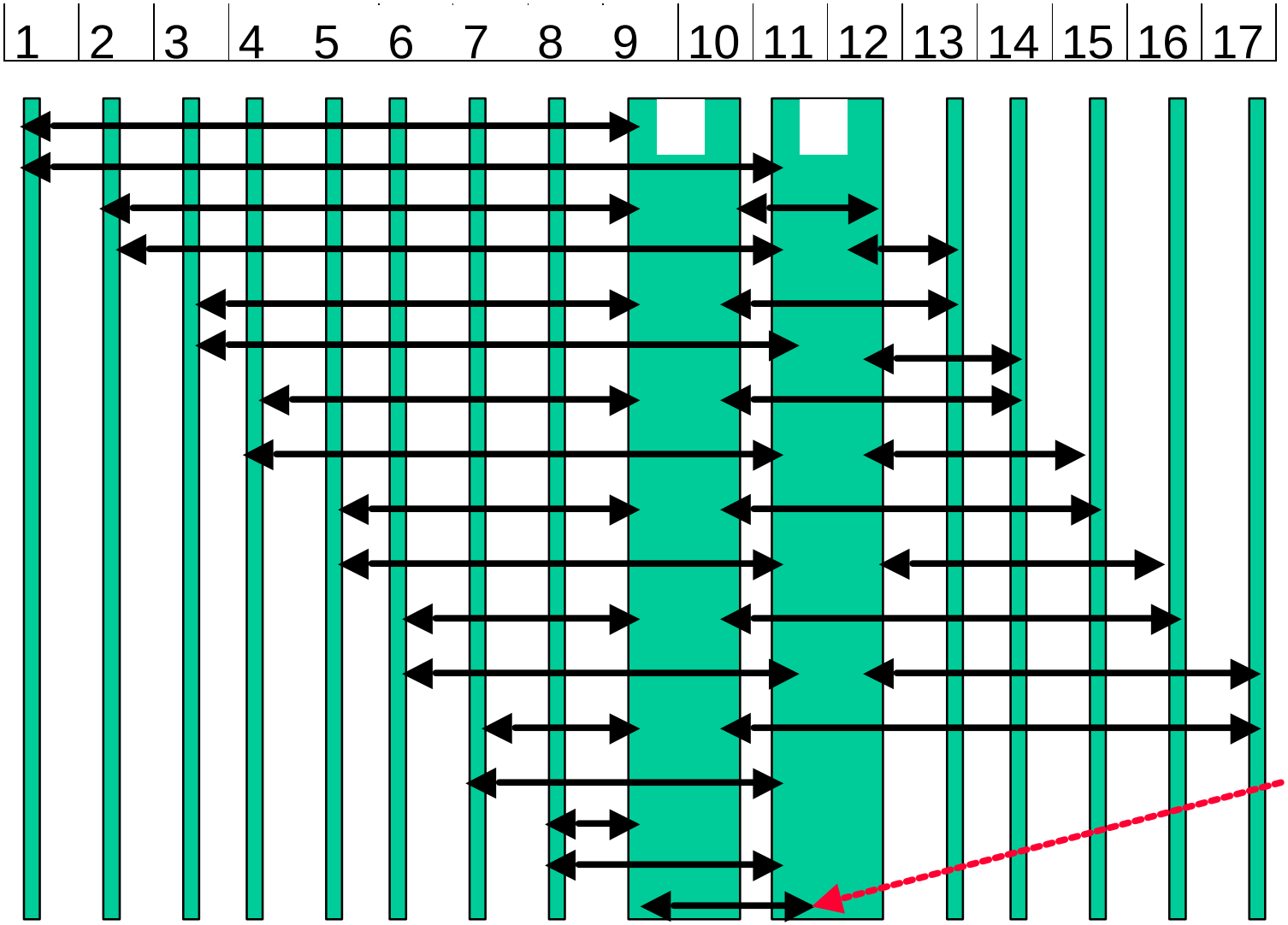
Components of the 8265 Switch Architecture

- The 8265 switch is comprised of 3 major hardware components:
  - ATM Backplane
  - Switch with Control Point (CPSW)
  - ATM Engines on the media modules

Prizma Chips

- Performs switching for ATM on the CPSW
  - Packet Routed Integrated Zurich Modular Architecture
    - Also called "switch-on-a-chip"
    - Multiport, single-stage switching
    - Two 8 bit chips for a total of 16 bits I/O
      - 16 input ports and 16 output ports
  - Data rate is based on a clock rate of 20ns cycle
- The maximum number of connections the Prizma supports depends upon
  - connection type and control blocks

ATM Backplane 2 Star Wiring



< Each slot connects to both CPSW slots

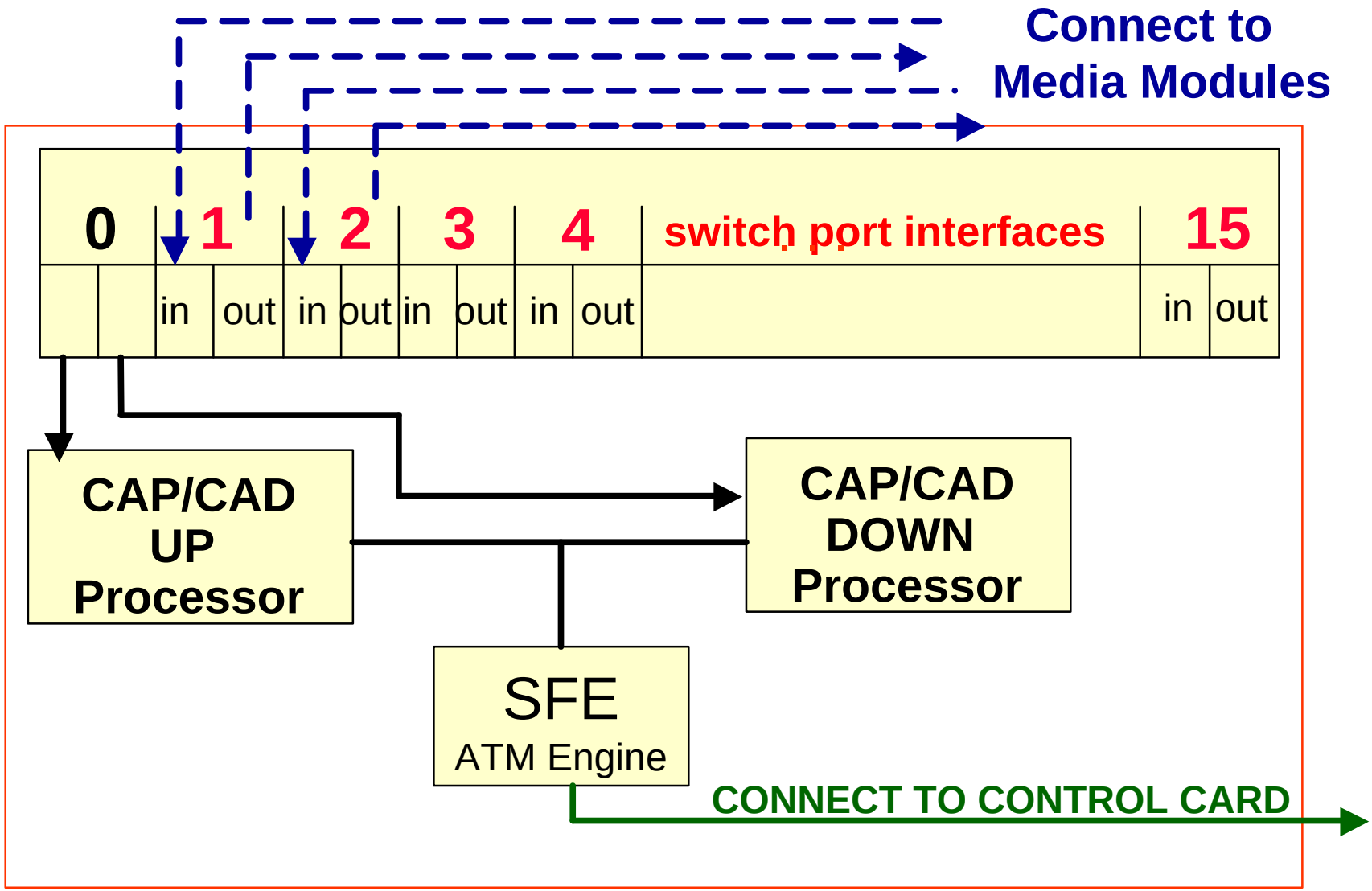
Serial interface linking 2 CPSW modules

IBM 8265 Nways ATM Switch

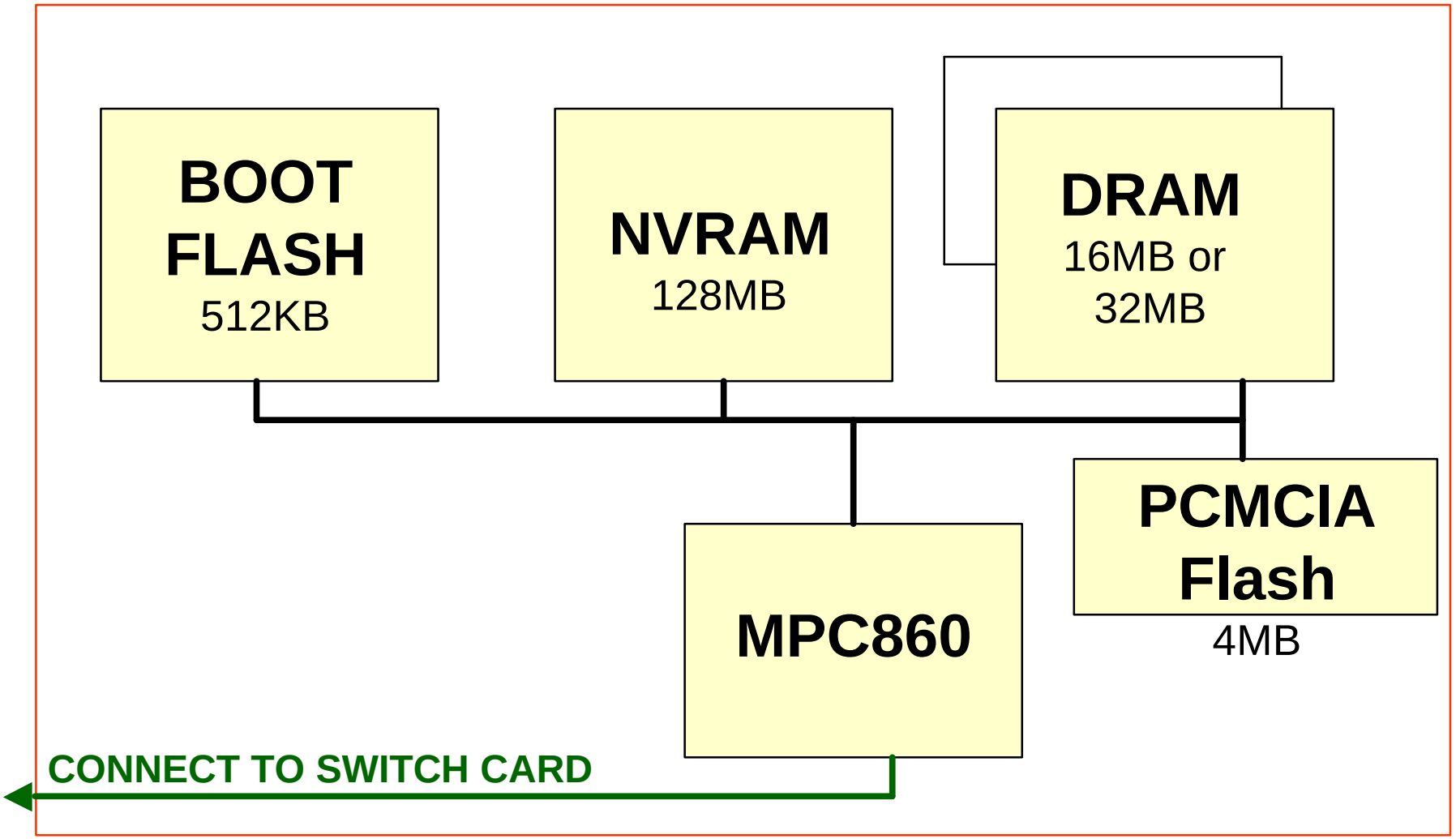
Switch Architecture

- Composed of 2 Prizma chips
- Single stage 16 x 16 switch fabric (Prizma)
  - Ensures low cell delay variation for voice & video
- A 25 Gbps ATM backplane
- 768 Mbps full duplex per port
- Full duplex aggregate throughput of 16 x 768 Mbps = 12.3 Gbps
  - Versus the 8260 4.2 Gbps
- Uses a 128-cell pool of output buffers to absorb contentions on output ports
  - With a full non-blocking architecture

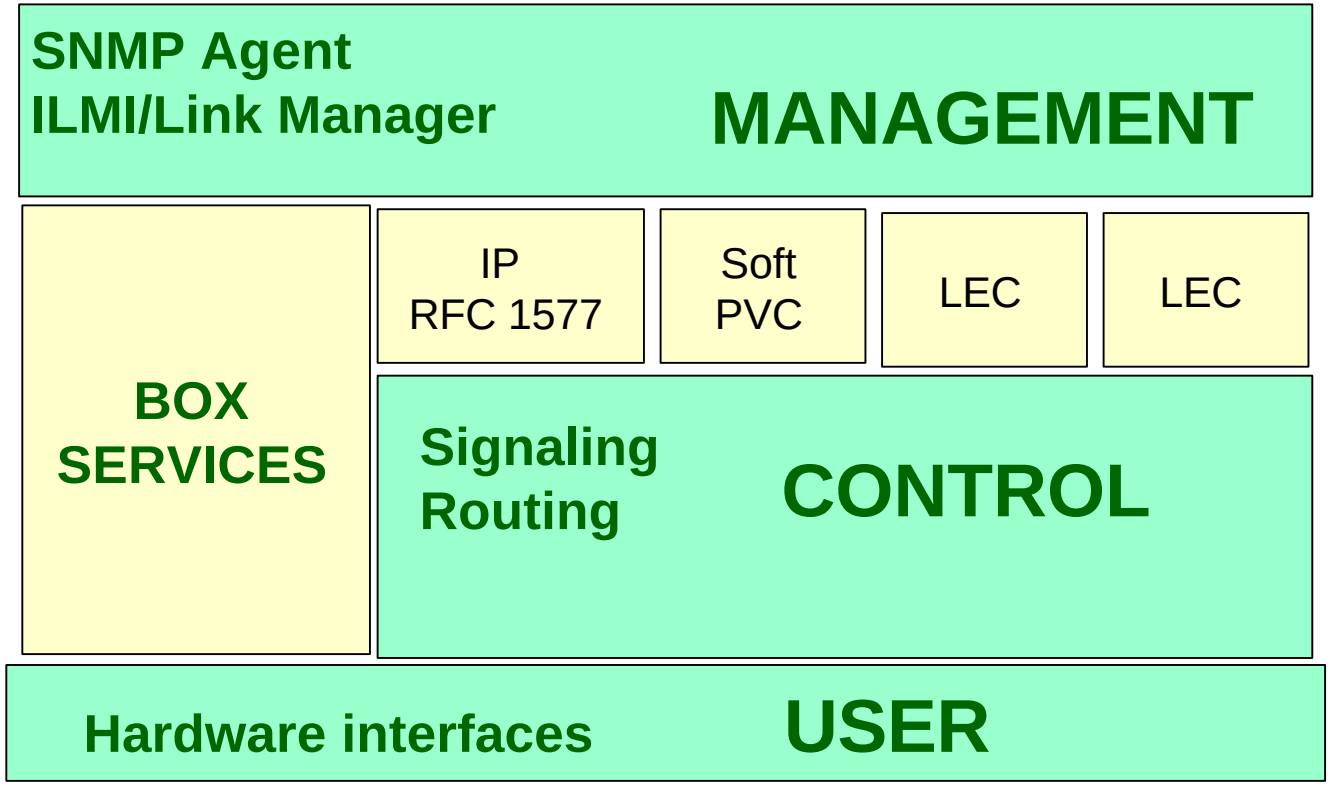
Switch Card



Control Point Card



Control Point Functions



The Control Point services three different functions:

User functions, Management functions, Control functions

Management Functions

- DMM-like Functions
  - Contains a subset of Distributed Management Module (DMM) functions for power and inventory management
- Access Control
  - Prevent unauthorized users from accessing the network
- Network Management support
  - SNMP
  - MIB 2
  - IETF ATM MIB
  - ATM Forum PNNI MIB (partial)
  - Chassis monitoring

Management Functions (cont.'d)

- Box Services
  - Command line interface
  - Code and hardware picocode upgrade via TFTP
  - Download of Controller module microcode
  - Troubleshooting support
  - Configuration Services
    - Upload and download of configuration
    - Management of configuration parameters in NVRAM
  - Module monitoring and failure handling
  - Switch redundancy
    - Automatic configuration synchronization
    - Monitoring and automatic takeover in case of active switch failure

User Functions

- Supports:
  - Reserved bandwidth connections
    - Constant Bit Rate (CBR)
    - real-time Variable Bit Rate (rt-VBR)
  - UBR and ABR connections
  - Frame discard
    - An ATM network retransmits an entire frame and not just a single cell
- ATM Layer switching
  - ATM traffic service categories are provided at the ATM Layer

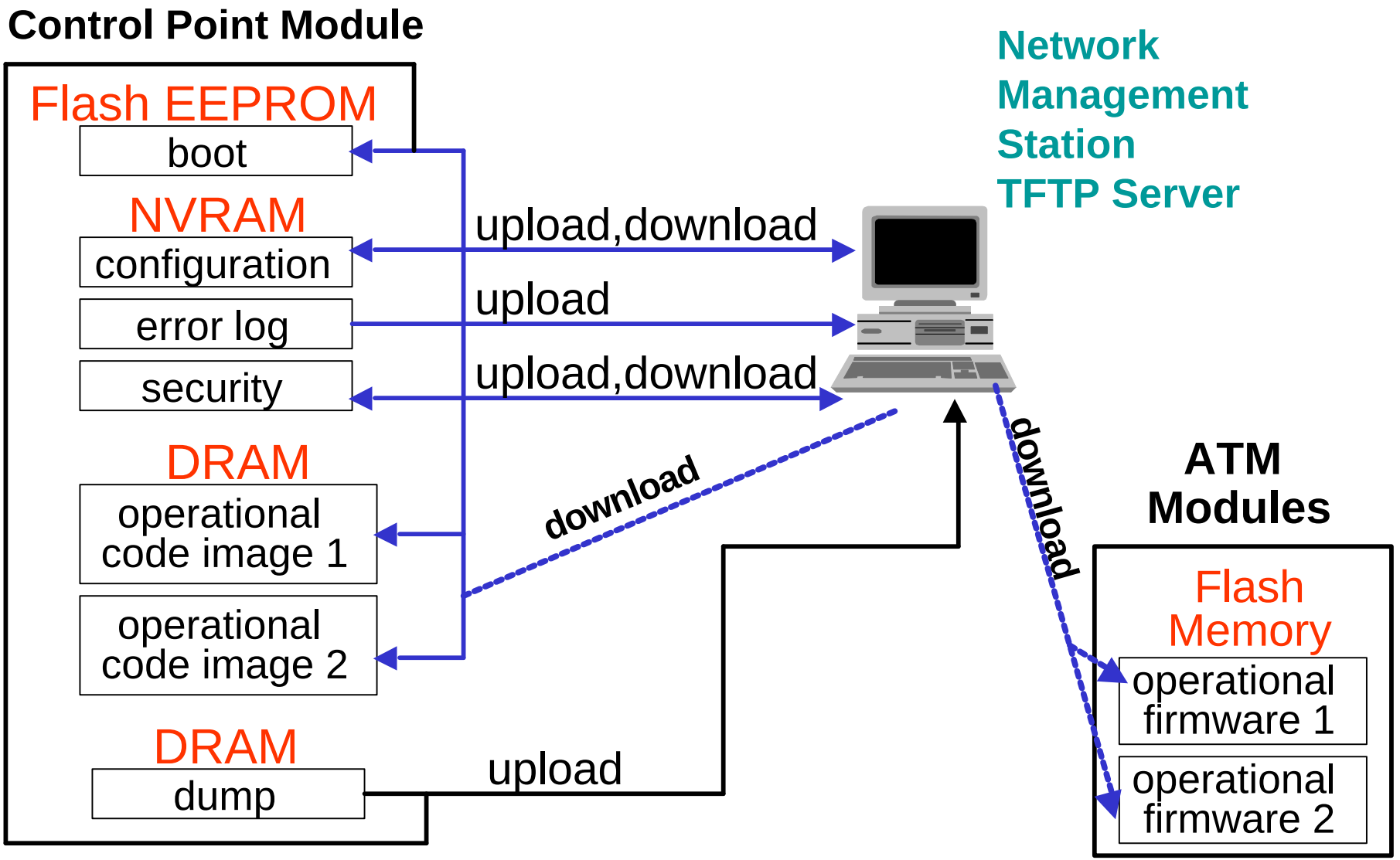
Control Functions

- Supports:
  - UNI
    - PVC/SVC connections, UNI without ILMI Registration
  - Public UNI
    - Connect to Public Networks
  - NNI (IISP)
    - Link backup and load balancing
  - PNNI-1
    - Path selection
  - VP Tunneling
    - Multiple VPs of differing types

Control Functions (cont.'d)

- Supports:
  - Path Selection
    - Precomputed or on-demand paths
  - Link Redundancy
    - On physical and VP tunnel interfaces
  - Link Sharing Control
    - Limit the proportion of the link bandwidth or VP tunnel
  - Switch Access for Switch Management and Services
    - Access over Classical IP or LEC for LANE

8265 Code Updates



Codes Used by the 8265

3 types of microcode for the Control Point

- Boot code
  - Resides in flash memory on the Control Point
  - First thing to execute after a power-on or a reset
  - Similar to BIOS on a personal computer
- Operational code
  - 2 copies of the code is stored in dynamic memory
  - Executes after the boot code is finished
  - Similar to an Operating System on a personal computer
- Firmware
  - 2 copies of the code are stored in flash memory
  - Configures the FPGAs on the Control Point's ATM engine

Codes Used by Media Modules

- Only firmware is used on the media modules
  - 2 copies of firmware are maintained in the media modules
  - Hardware picocode is upgraded in the FPGA of the CPSW and the media modules

SNMP

- The SNMP Agent is a function of the Control program in the CPSW
  - Supports the ATM MIB defined in the V3.0 UNI specification of the ATM Forum
    - Signaling is compatible with V3.0 and V3.1 UNI
    - Control messages are encapsulated in the SAAL Layer
  - Supports both SVCs and PVCs
  - Uses standard SNMP commands
    Get, GetNext, Set, Traps
- Counters for real-time statistics and monitoring
  - The Control Point SNMP agent can maintain a history log of up to 100 entries

SNMP ATM MIB

- Contains various information:
  - Size of the VPI/VCI address fields
  - Number of configured VPCs and VCCs
  - Maximum number of VPC/VCC allowed on a UNI link
  - UNI interface port type
  - Operational status of VPCs and VCCs
  - Transmit/receive QoS classes in use
  - Traffic descriptors for both the send and receive side of the connection
  - Address registration information
  - Support of 1-port 622 Mbps modules

SNMP Management

- Manage the ATM subsystem in the CPSW from an SNMP workstation
  - For example, use IBM NetView for AIX or HP Openview Unix network management applications
- Access the CPSW through SLIP, Ethernet port CIP subnetwork or LANE subnetwork
  - All subnetworks can be used at the same time
  - Each subnetwork is independent of the other
    - No communication between them
  - A single subnetwork must be chosen for the Default Gateway

CIP Subnetwork

- SNMP parameters to set for CIP:
  - Every network device must have a unique IP address and subnetwork mask
    - Set the IP address and mask on the CPSW
    - **SET DEVICE IP_ADDRESS {ATM, ETH} x.x.x.x m.m.m.m**
      - Where ATM specifies the IP address of the CPSW and ETH specifies the IP address of the Ethernet port on the CPSW
  - Set Default Gateway
  - Set ARP Server
    - Maps IP addresses to ATM addresses
  - Set Community Table
    - Lists which SNMP stations in the network can access information from the CPSW and receive Traps
  - Set Alerts

LANE Subnetwork

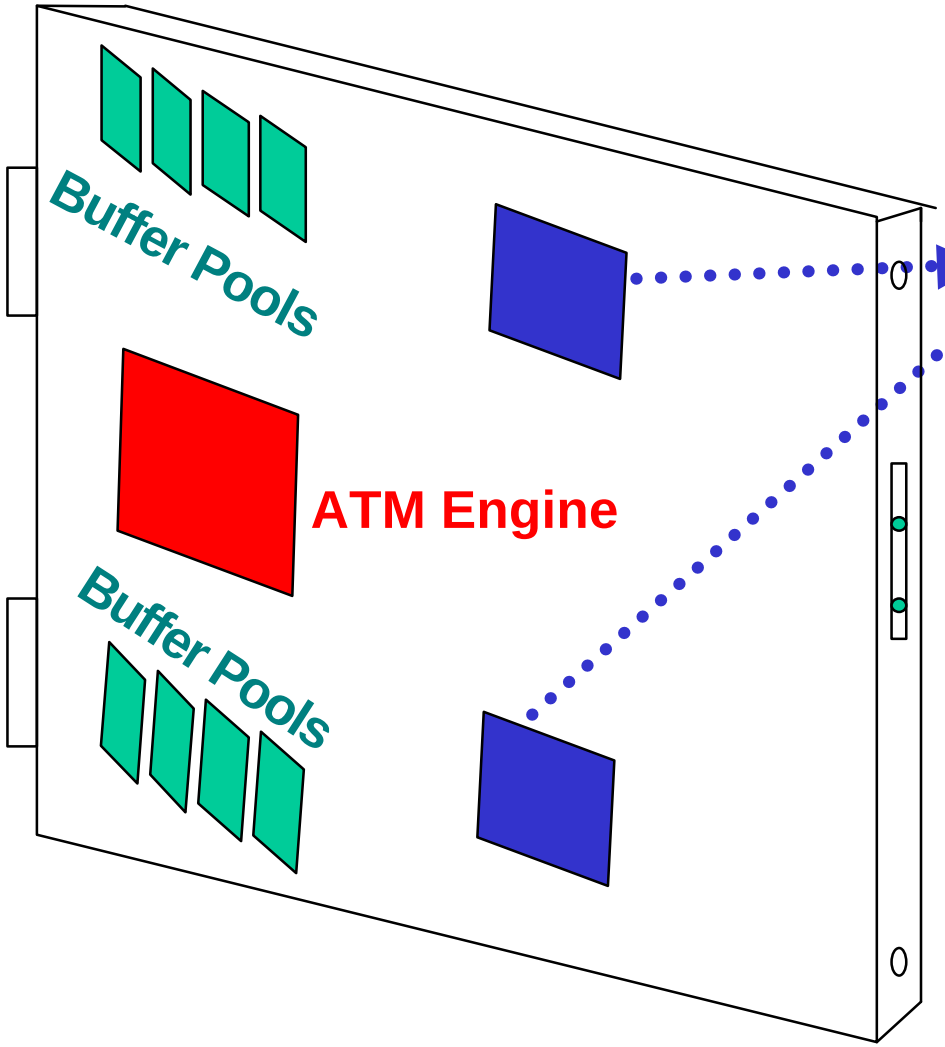
- SNMP parameters to set for LANE:
  - Every network device must have a unique IP address and subnetwork mask
  - Set LEC parameters
    - **SET DEVICE LAN_EMUALTION_CLIENT {ETH,TR} {parameter}**
      - This command automatically starts the internal LEC
        - There is no command to stop the LEC
      - Parameters: DIX/802_3, LAN_Name, subnet_mask, mac_address, LES_atm_address/NONE, IP_address, LECS_atm_address/NONE, no_lecs_with_les/no_les_with_lecs
  - Set Default Gateway
  - Set Community Table
  - Set Alerts

3 Ways to LECS

- LEC will connect to LECS by one of 3 methods:
  - Using a pre-configured ATM address
  - Using ILMI to get a list of LES addresses
  - Using the Well Known Address (WKA)
    - Defined by the ATM Forum
    - 20-byte ATM WKA:

47.00.79.00.00.00.00.00.00.00.00.00.00.A0.3E.00.00.01.00

ATM Engine on a Media Module



Field Programmable Gate Array Code (FPGA)

Each Media Module has an ATM Engine

Process ATM Cells

- Media modules interface to the 8265 by means of the CPSW module
- Media modules process ATM data cells by:
  - Checking their validity
  - Accessing the switching tables to locate the destination module
  - Preparing the internal ATM format required by the CPSW module
  - Sending the cells to the CPSW module

Network Traffic

- Problem: Serious Overload Situation
  - An ATM network can recover from overload by
    - Discarding cells marked as low priority
    - Discarding cells depending on the QoS characteristics
- QoS for Virtual Paths and Virtual Channels
  - Each VC and each VP have a QoS associated with it
    - VCs within a VP have a lower QoS than the VP
    - VCs cannot have a higher QoS than a VP

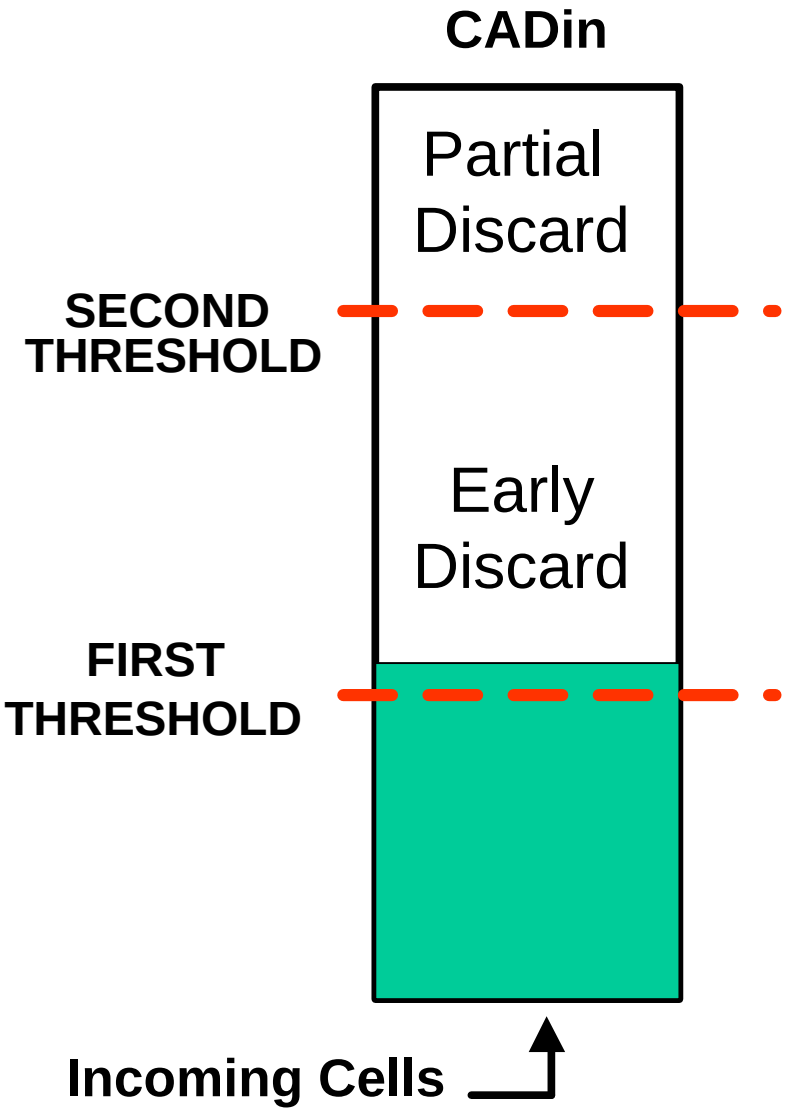
Media Module Traffic Management

- These functions assist in the management and control of traffic and congestion in ATM networks
  - Early and Partial Packet Discard
  - Policing per Virtual Circuit
  - Port Mirroring
  - Traffic Shaping per Virtual Path
  - Priority queues per QoS
  - Buffering
  - Counters
    - Per connection, per port, or per module

Early and Partial Packet Discard

- Allows the 8265 to drop, when required, cells belonging to the same end user packet
- Early Discard
  - When a pre-specified first threshold is reached, cells for in-progress packets are received and cells for new packets are discarded
- Partial Discard
  - When a pre-specified second threshold is reached, cells from partial packets are discarded
    - Early Discard would have already discarded new packets

Early Packet Discard



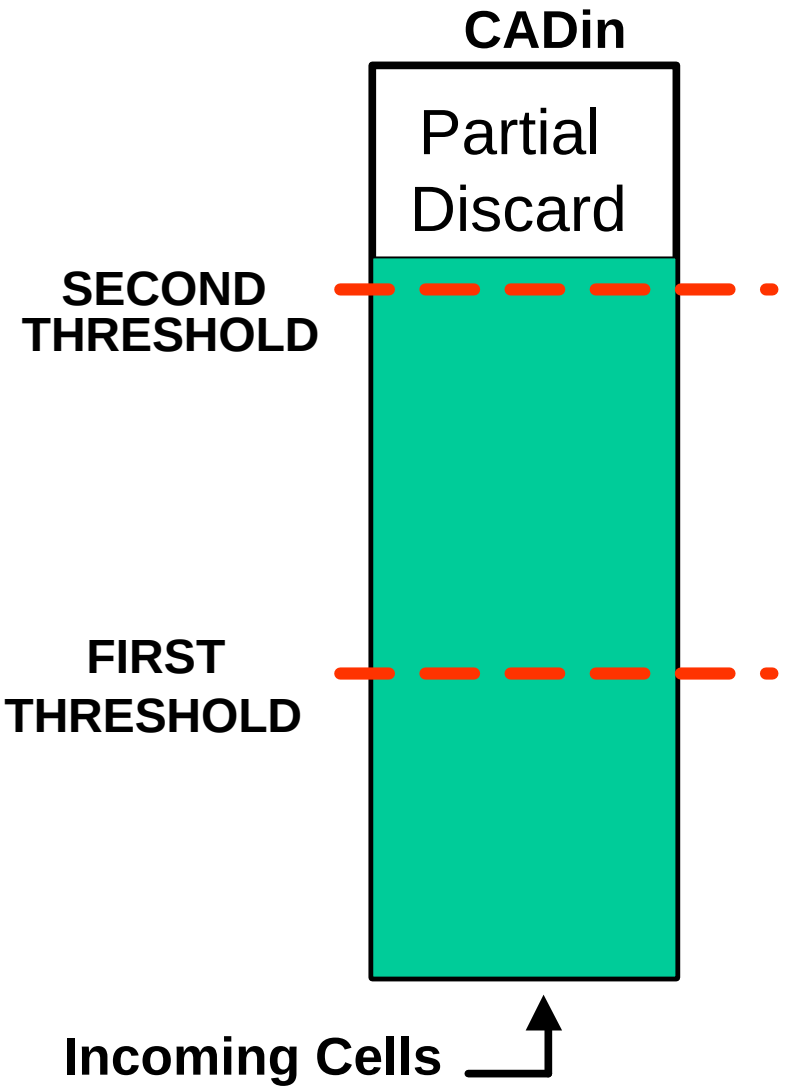
Applies to all packet traffic in both input and output queues

Usually seen in UBR queue

Traffic exceeds the first threshold - new incoming packets are discarded

Reserved bandwidth traffic is not affected

Partial Packet Discard



Traffic exceeds the second threshold - partial packets are discarded

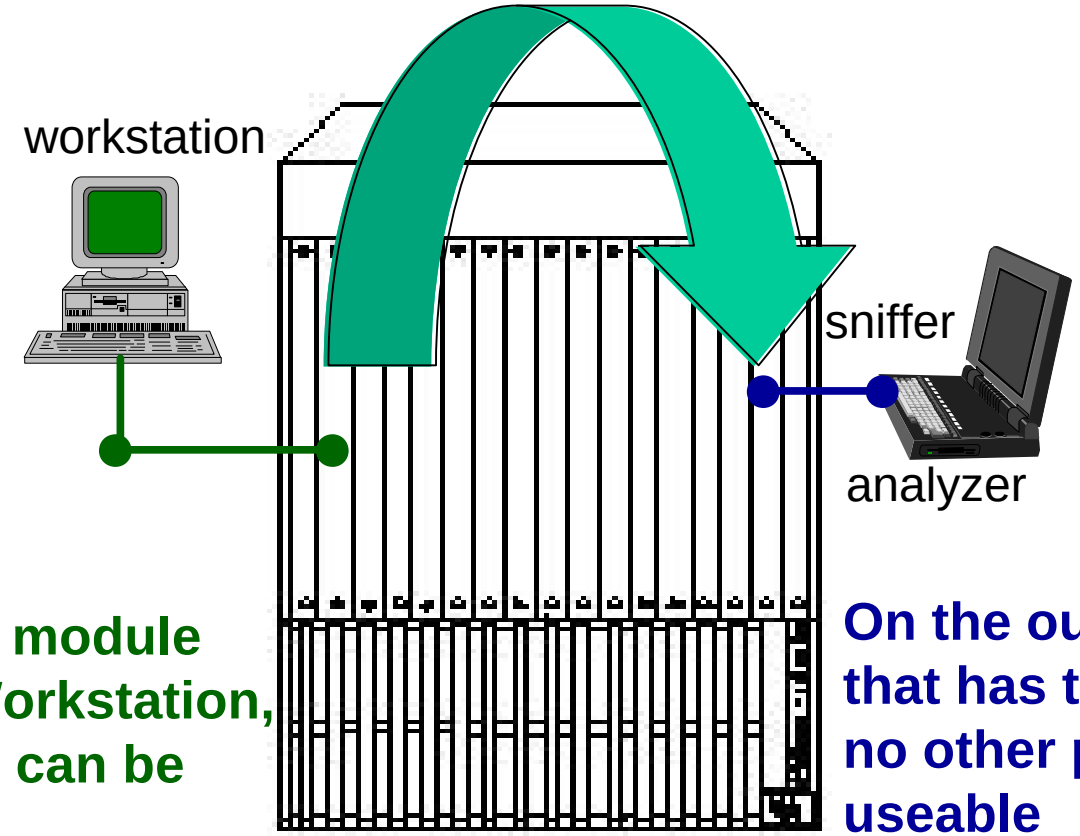
Reserved bandwidth traffic is not affected

Policing per Virtual Circuit

- The 8265 ensures that any traffic contract is enforced at the VC level
  - Occurs on cell input to the switch for reserved bandwidth connections
  - Drops cells over the contracted amount
- Checks that the source does not exceed its contract for cell transmission
  - Discards excess cells which cannot be processed
    - Using the "leaky bucket" technique
  - To reduce the burstiness of traffic, a reshaping function is provided

Media Module Port Mirroring

Duplicate and redirect traffic flow to a designated port

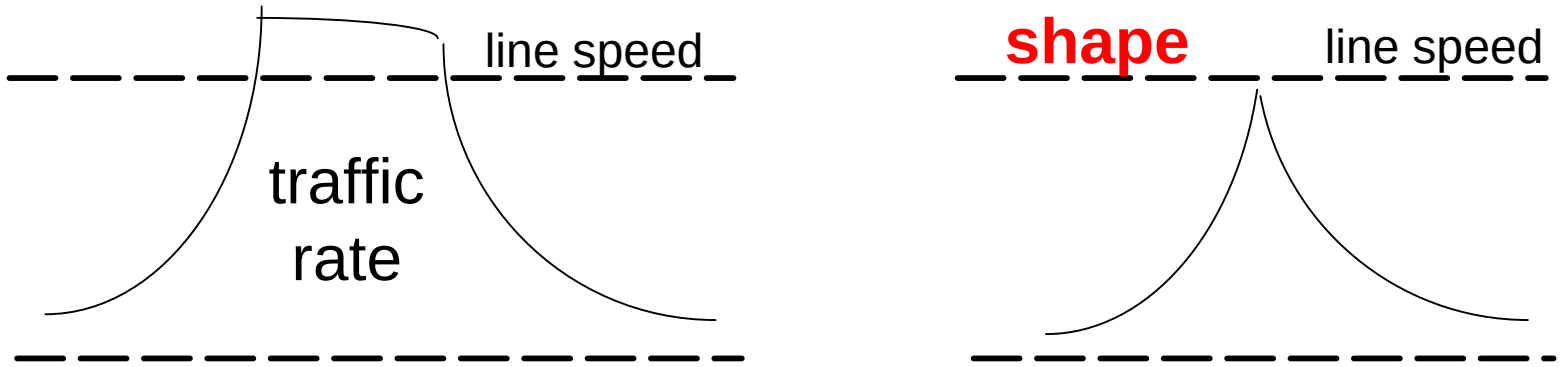


On the source module that has the Workstation, no other ports can be mirrored

On the output module that has the Analyzer, no other ports are useable

Media Module
Traffic Shaping at VP or Port

- Adjusts traffic to a lower rate than the line speed
  - Shaping is active for incoming and outgoing traffic
  - Usually used on connections to ATM service providers
  - Uses backward congestion indication and EPD/PPD mechanisms

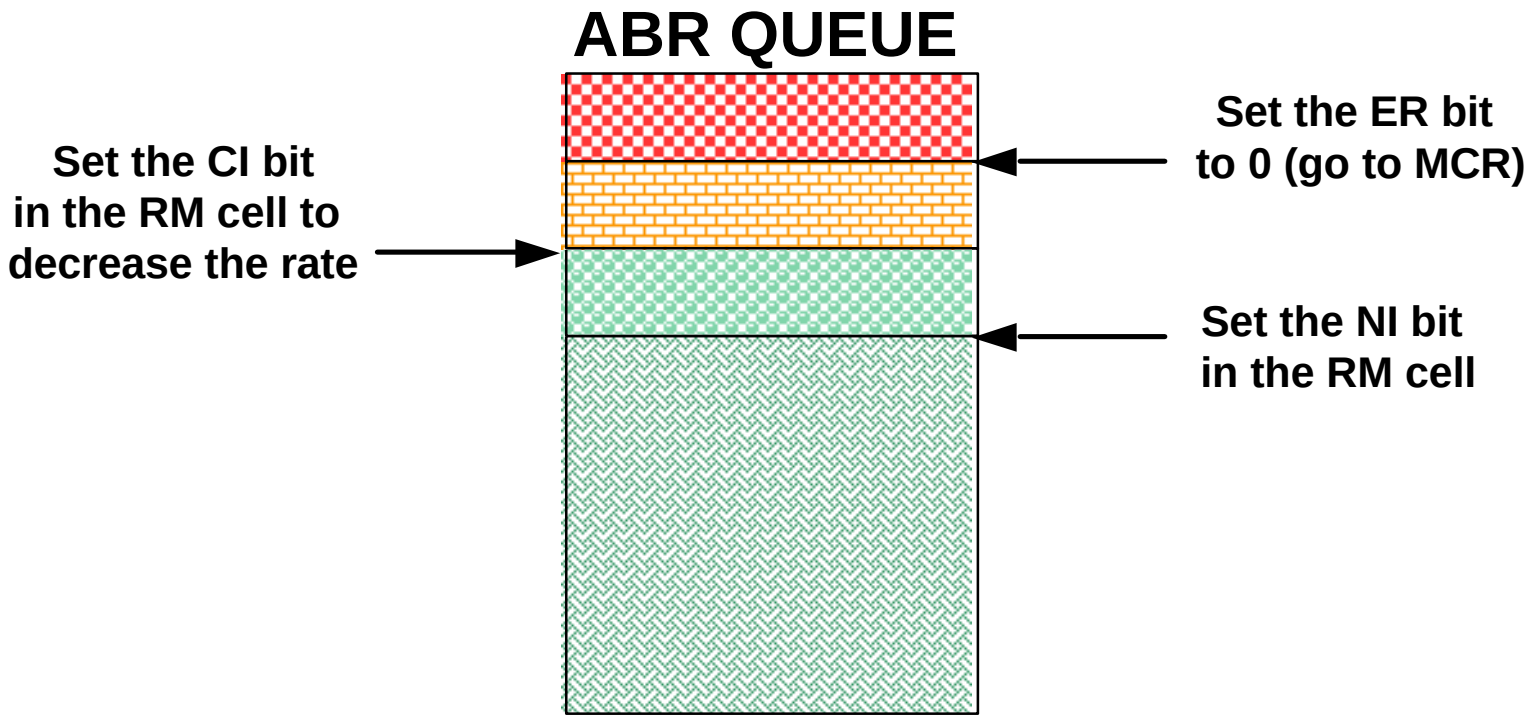


Flow Control Methods

- 3 methods of flow control in the 8265:
  - Relative Rate
    - For ABR traffic
  - Early and Partial Packet Discard
    - For any kind of traffic; ABR,UBR,CBR,VBR
  - Policing
    - For reserved bandwidth connections
- All 3 methods operate simultaneously and independently of each other
  - All 3 methods use the input/output buffer queues

ABR Relative Rate

- Applies to ABR traffic only
- It is always in operation



One Queue per connection
Allocated at Peak Rate

5 Service Categories

- Different kinds of network traffic require different service characteristics from the network
- 5 service categories (per the ATM Forum):
  - Constant Bit Rate (CBR)
  - real-time Variable Bit Rate (rt-VBR)
  - non-real-time Variable Bit Rate (nrt-VBR)
  - Unspecified Bit Rate (UBR)
  - Available Bit Rate (ABR)
- All service categories apply to both VCCs and VPCs

Real-Time or Non-Real-Time

Service Categories are broken into 2 categories:

- Real-Time (constant rate video or voice)
  - CBR
  - rt-VBR
- Non-Real-Time
  - nrt-VBR (bursty traffic)
  - UBR (FTP / e-mail)
  - ABR (traditional data traffic)

Priority Queues per QoS

- 5 Priority Queues
  - CBR
  - nrt-VBR
  - rt-VBR
  - ABR
  - UBR
- Media module Output queues
  - One per QoS and per physical or logical port (VP)
- Media module Input queues
  - One per QoS and per destination module

Media Module Buffer Queues

- Output buffers for queuing
  - Improves link utilization when traffic bursts occur
  - Delays the implementation of flow control on traffic
  - Allows traffic shaping on the port and VP levels
- Input buffers for queuing
  - Has a reshaping function
    - Buffers traffic when too much is destined for one output module from several sources
  - Supports non-blocking
  - CPSW utilizes a Backpressure Function
    - Holds traffic at the input buffer in various media modules without increasing the size of the output buffer

Media Module
Statistics and Counters

- Counters are provided to:
  - Control traffic on a per connection basis
  - Control policy violations on a per connection basis
  - Detect congestion
  - Track CPU and buffer initialization
- Counters can be enabled either
  - MANUALLY for a specific connection
  - AUTOMATICALLY for all connections
    - In the ALL connections mode there is a limitation of 4000 connections per module

Counters on Media Modules

- Counters per Connection:
  - Can be viewed at the SNMP MIB browser only
  - number of valid cells received
  - number of valid cells received discarded due to policing or UBR
  - number of valid cells transmitted
  - number of valid cells transmitted and discarded due to congestion
- Counters per Port:
  - number of unknown VP and VC identifiers
  - number of ABR Resource Management cells with invalid CRCs
- Counter per Module:
  - number of cells transmitted to the Control Point (Prizma)

Multicast Services

- Performed on the backplane (PRIZMA level)
  - Used for point-to-multipoint connections that span several ATM modules
    - Allows an unlimited number of multicast trees at the switching fabric level
- Performed on an ATM module (ATM engine)
  - Used for point-to-multipoint connections that span several ports
    - Transmits an ATM cell by pointing to 2 address locations: output VP/VC value, cell payload
    - When a cell is transmitted, the payload pointer is passed to the next port without moving data in memory

New 8265 Media Modules

- Four new 8265 Media Modules
  - 622 Mbps/OC-12 Modules
    - Media types MMF or SMF
    - 1-port modules
  - 155 Mbps/OC-3 MMF Module
    - 4-ports
  - 155 Mbps/OC-3 Flex module
    - 4-ports
    - Can host up to 4 individual OC3 I/O cards
    - Media types SMF, MMF, or UTP/STP
- WAN interfaces

Module Settings

- Install or remove media modules without disrupting switch operation
  - It is not necessary to power down the switch
- Default settings on ATM media modules
  - Module is set to **ISOLATED**
    - Module cannot be accessed by the network
  - All module ports are set to **DISABLED**
  - ATM media modules do not start up as part of the ATM subsystem when you power ON the 8265 switch
    - Modules must be CONNECTED and ENABLED

Moving Modules

- Module installed in a slot previously used by another module
  - Configuration settings are saved per slot
    - Not saved per module
    - The installed module will initialize with the SET MODULE parameters that were saved for that slot
  - A CPSW must be functioning in the 8265 for any media module to connect in the 8265
- Before removing a module from the 8265
  - Always isolate it from the network
    - **SET MODULE {slot} ISOLATED**
    - Isolated keeps the module in reset mode so no network activity takes place on it

SAVE and SET Commands

- SET command to make configuration changes
  - Changes are put into effect immediately but are not permanently saved
    - Changes are lost the next time the module or 8265 switch is rebooted or reset
- To permanently store changes
  - Use command **SAVE**
  - Stores configuration changes in NVRAM
- To save all ATM configuration settings
  - Enter command **SAVE ALL**

8265 4-Port OC-3 Mbps Modules

Two types of 4-port 155Mbps modules:

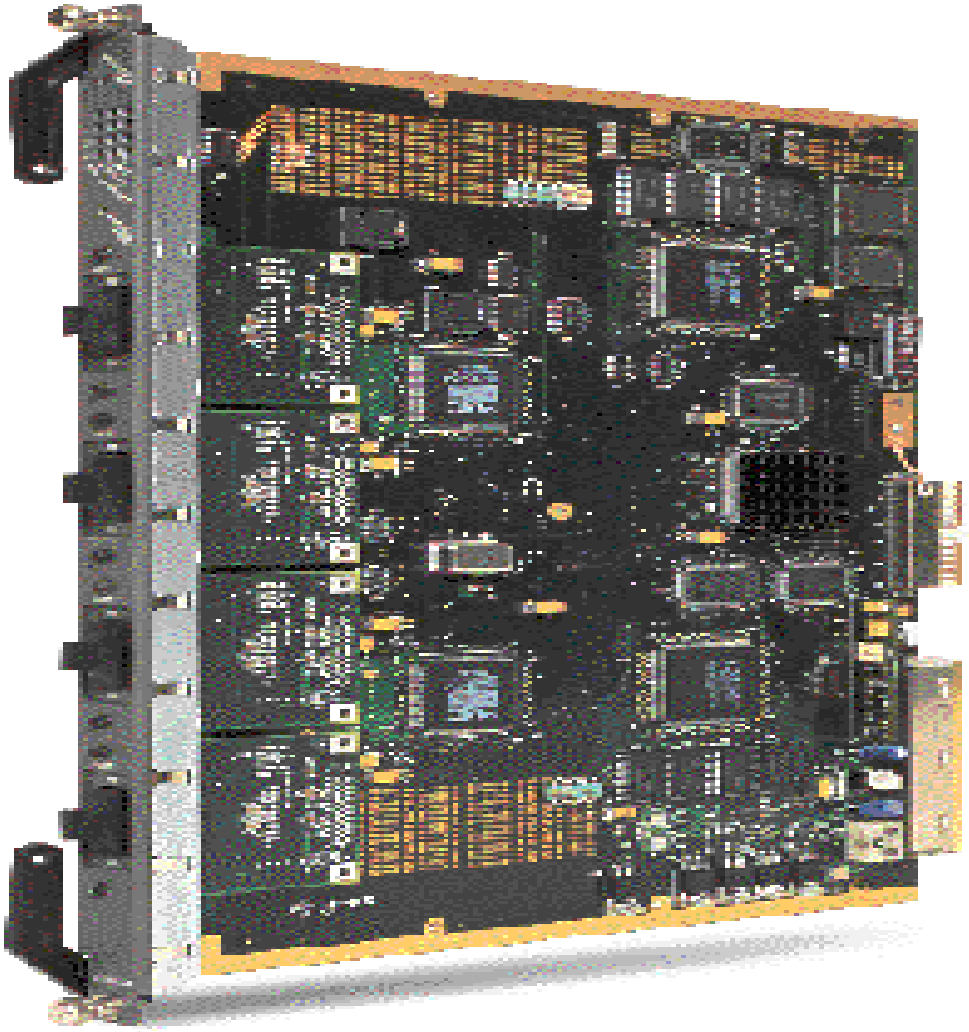
- Single-slot multimode fiber module
  - One module
  - Part Number 02L2414 / Feature Code 6540
- Single-slot flex module
  - One module motherboard
  - Up to 4 I/O cards can be installed on the motherboard
  - Up to 14 flex modules can be used in one 8265
  - Part Number 13J8738 / Feature Code 6543

4-Port OC-3 Module / FC 6540

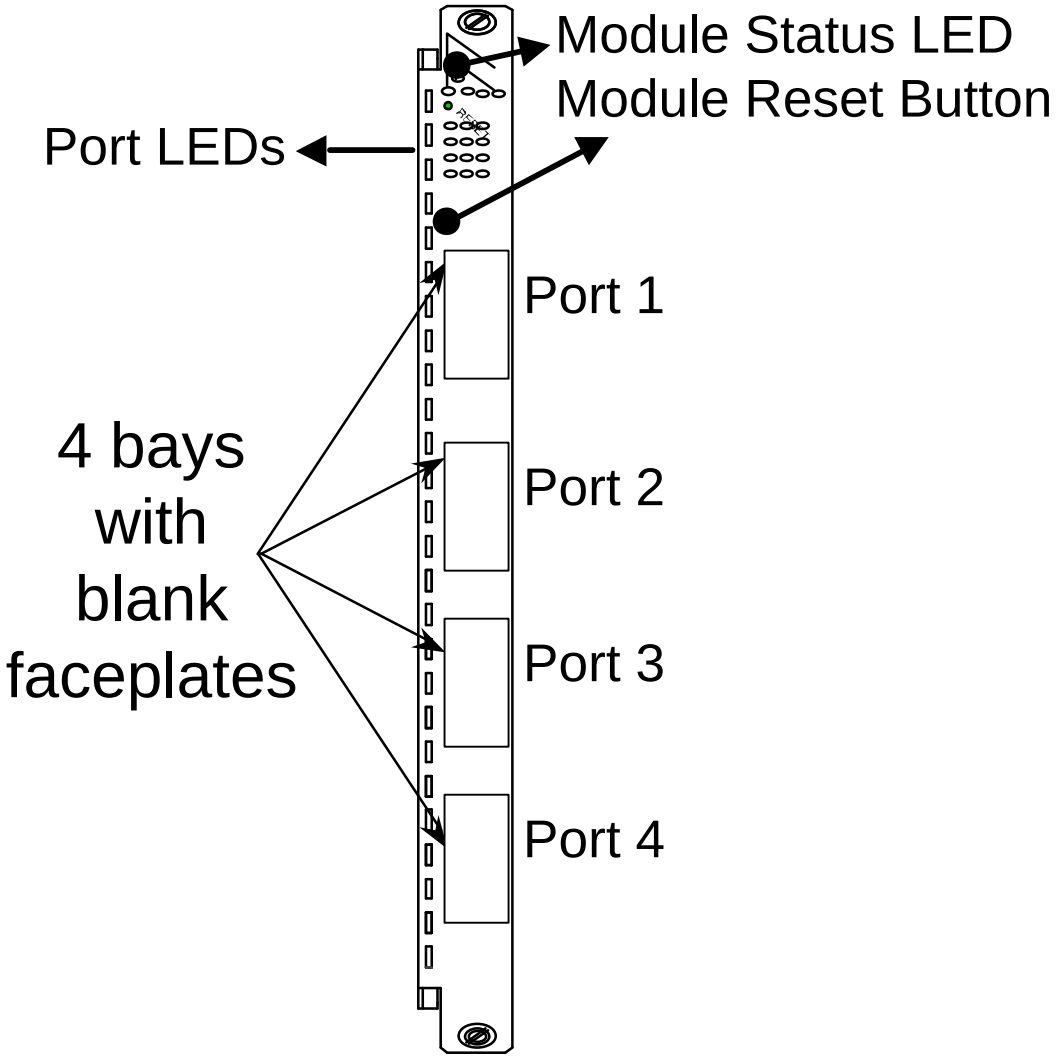
FACEPLATE MARKING:
A4-MF155

POWER REQUIREMENTS:
51W at +5V

CONNECTORS:
SC multimode fiber



4-Port OC-3 Flex Module / FC 6543



FACEPLATE MARKING:
A4-MB155

POWER REQUIREMENTS:
35W at +5V

CONNECTORS:
SC for fiber I/O cards,
RJ-45 for twisted pair I/O cards

4-Port Flex Module

- Install up to 4 different types of daughter cards
  - Up to 4 ports at up to 155 Mbps
- Mix and match different daughter cards and media types:
  - Multimode fiber (FN 6580)
    - Connections up to 2 km (1.24 miles)
  - Singlemode fiber (FN 6581)
    - Connections up to 20 km (12.4 miles)
  - Copper (FN 6582)
    - STP 150 ohm or UTP5 100 ohm
    - Connections up to 100 m (328 feet)

Replacing an I/O Card

- Replacing an I/O Card
  - If you replace an I/O card after the module has been configured, the new I/O card is automatically configured with the settings of the previous card
  - At the command prompt enter
    SET MODULE {slot} ISOLATED
    where slot is the slot number of the module
  - Replace the old I/O card with the new I/O card
  - Enter **SET MODULE {slot} CONNECTED**
    where slot is the slot number of the module

Configuring 4-Port OC-3 Modules

- Connect the module to the ATM network
  - **SET MODULE {slot} CONNECTED**
- Set port characteristics
  - **SET PORT {slot.port} {enable,disable,apply_defaults} {parameters}**
  - Parameters:
    UNI, IISP, PNNI, AUTO, VOID, PUBLIC_UNI, CLOCK, FRAME_FORMAT, FLOW_CONTROL
- Enable configured ports
  - **SET PORT or SET MODULE**
- Save port and module configuration settings
  - **SAVE MODULE_PORT**

SET PORT Example

```
8265ATM> set port 1.3 enable ?
Possible completions:
  auto
  iisp
  pnni
  public_uni
  uni
  void

8265ATM> set port 1.3 enable auto ?
Possible completions:
       rb_administrative_weight
       nrb_administrative_weight
       vpi_vci
```


Available Port Parameters

- rb_bandwidth
  - Maximum reserved bandwidth (rb) in Kbps
  - The value must be less than or equal to the port bandwidth
  - UNLIMITED allocates 85% of port bandwidth
    - The remaining bandwidth is management overhead
- admin_weight
  - Relative ranking of the port for shortest path computation
    - A 4-byte value with default value 5040
  - Available for Reserved Bandwidth (rb) and Non-reserved Bandwidth (nrb)

Port Parameters (cont.'d)

- vpi_vci_ bits
  - Defines maximum values for VPI and VCI values
  - Maximum values are set according to the number of bits available for each value
- ilmi_ vpi_vci
  - ILMI default vpi.vci 0.16
  - Setting this to NONE will disable ILMI on the port
    - Signaling version AUTO cannot be used if ILMI is disabled
- signaling_ vpi_vci
  - Signaling default vpi.vci 0.5
  - Setting this to NONE will disable signaling on the port

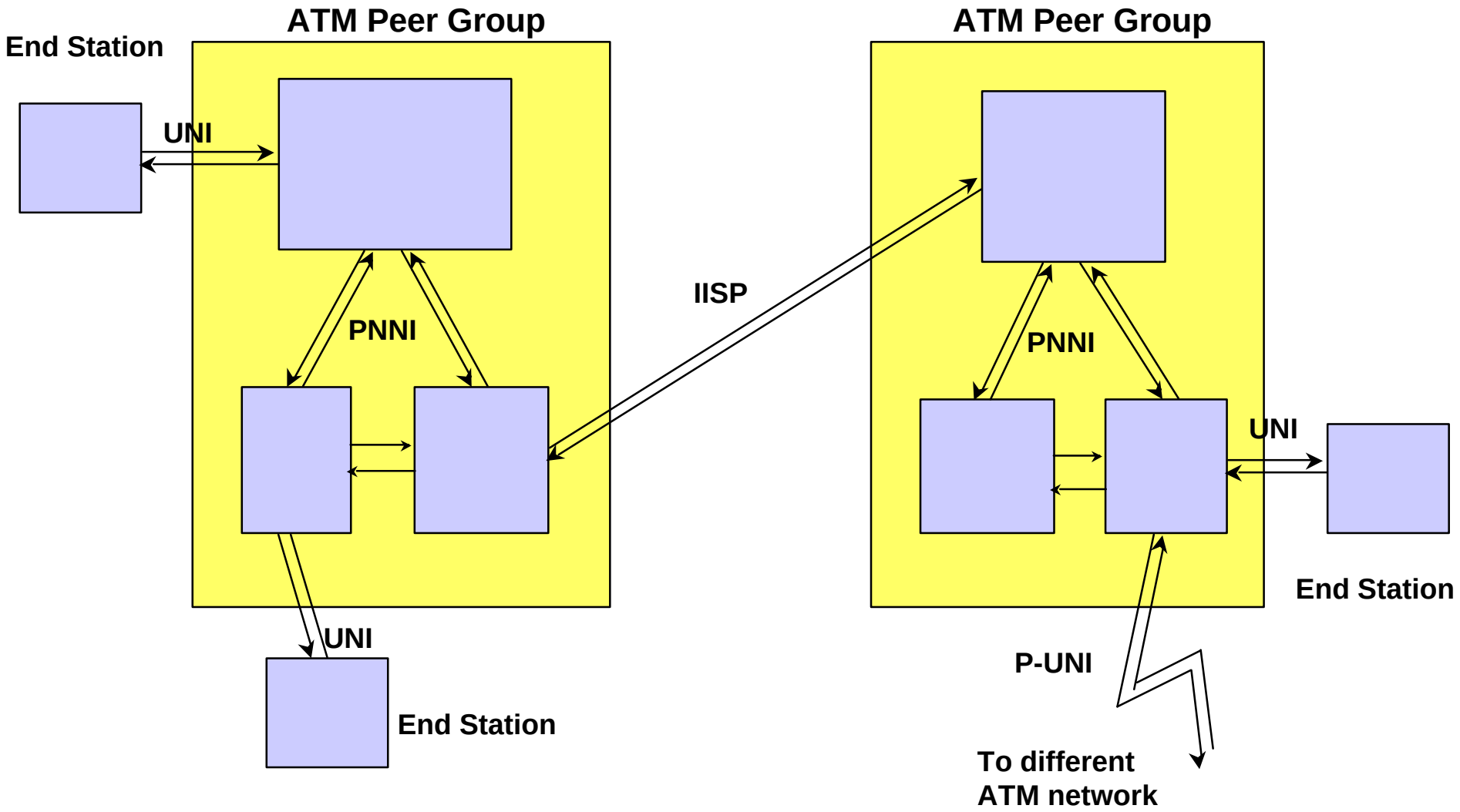
Port Parameters (cont.'d)

- signaling_version
  - Specifies the UNI signaling protocol version for the UNI port
  - Supports UNI signaling versions 3.0, 3.1, 4.0
  - Default setting is AUTO
    - AUTO uses ILMI
    - Automatically detects the port's UNI signaling version
- flow_control
  - Enable or disable flow control on the port
  - 3 methods of flow control
    - Relative Rate for ABR traffic
    - Early and Partial Packet Discard
    - Policing

Port Parameters (cont.'d)

- police
  - Enable or disable policing on the port
  - Not available for 8260 modules
  - Only occurs on the input side of CBR connections
  - Drops cells if the allocated buffers for Peak Cell Rate are exceeded
- routing_vpi_vci
  - The vpi.vci of the routing channel
  - Default vpi.vci 0.18
  - Setting this to NONE disables routing on the port

ATM Interfaces



Types of Network Interfaces

- UNI
  - Defines the interface between an ATM user device and the ATM network
    - Examples of ATM user devices: terminal, router, bridge, server, workstation, concentrator equipped with an ATM adapter
  - The ATM subsystem supports the signaling versions defined by the ATM Forum UNI Specifications V3.0, V3.1, and V4.0
  - UNI POLICING is not available for 8260 modules

Network Interfaces (cont.'d)

- VOID
  - VP tunnels can be defined on such a port and signaling can be supported through the VP
  - Does not support ILMI
- Public UNI ILMI
  - Not supported in the 8265 November 1997 release
  - VP tunnels can be defined on such a port and signaling can be supported through the VP

Network Interfaces (cont.'d)

- IISP
  - Defines the interface between two ATM switches belonging to different ATM routing domains
  - The November 1997 release of the 8265 uses IISP switches to interconnect PNNI peer groups
  - Operator intervention is required in order to define the addresses reachable over IISP links
  - Multiple IISP connections can be defined between two different peer groups

Network Interfaces (cont.'d)

- PNNI
  - Defines the interface between ATM switches in the same peer group
  - The PNNI interface supports networking functions without the need of operator intervention
    - Examples of functions: routing, backup, topology management, node failure, node recovery
- AUTO
  - The interface is automatically set according to that of the incoming signal
    - Interface parameters are detected by ILMI signaling

Port Interface Parameters

- CLOCK per port
  - Selects between internal and external clocking
- FRAME_FORMAT
  - Selects the frame format:
    - SONET_STS_3C or SDH_STM_1
- FLOW_CONTROL
  - For UNI ports only
  - Enables/disables flow control on selected ports
  - Packet discard for marked cells

LAB 3

- GO TO SECTION 3 at the back of the course book.

8265 1-Port OC-12 Mbps Modules

Two types of 1-port 622Mbps modules:

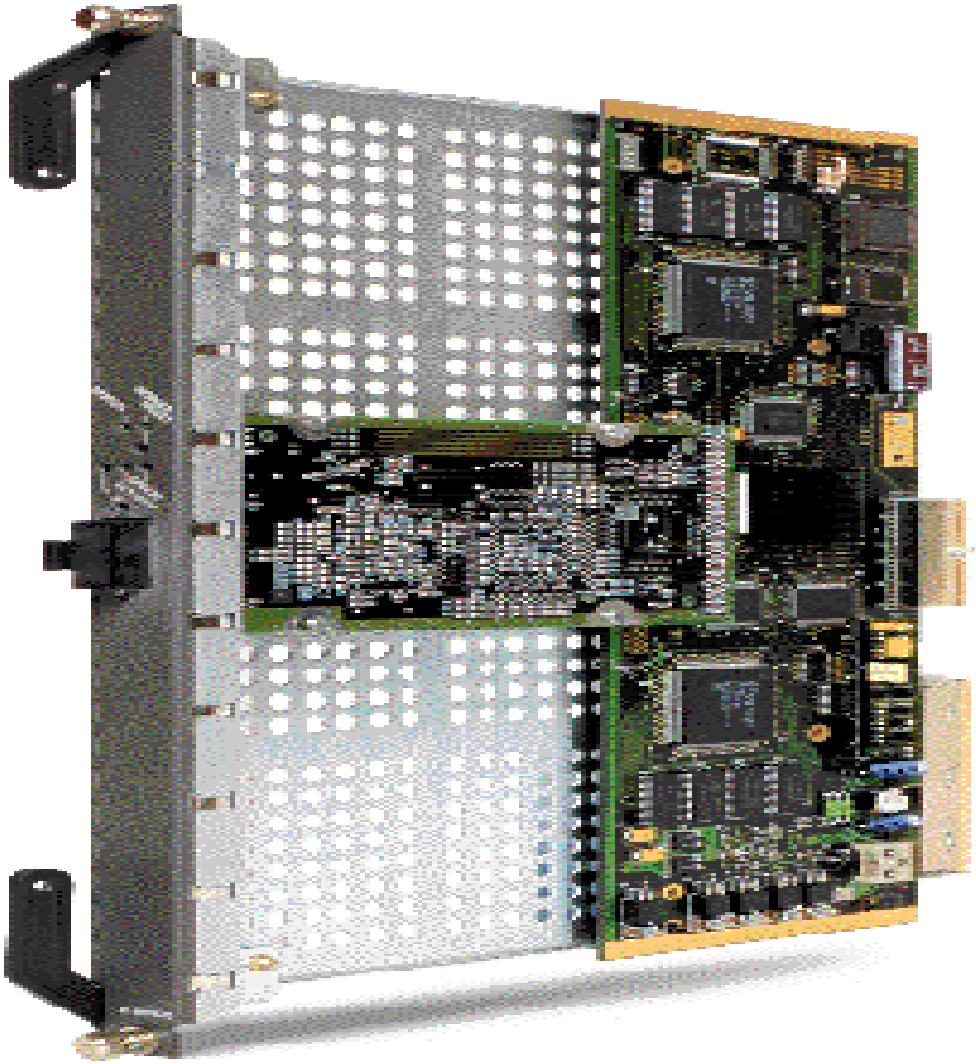
- Single-slot multimode fiber module
  - Connections up to 500m (1640 feet)
  - Feature Code 6511
  - Part Number 02L2412
- Single-slot singlemode fiber module
  - Connections up to 15km (9.32 miles)
  - Feature Code 6512
  - Part Number 02L2413

8265 1-Port OC-12 Module

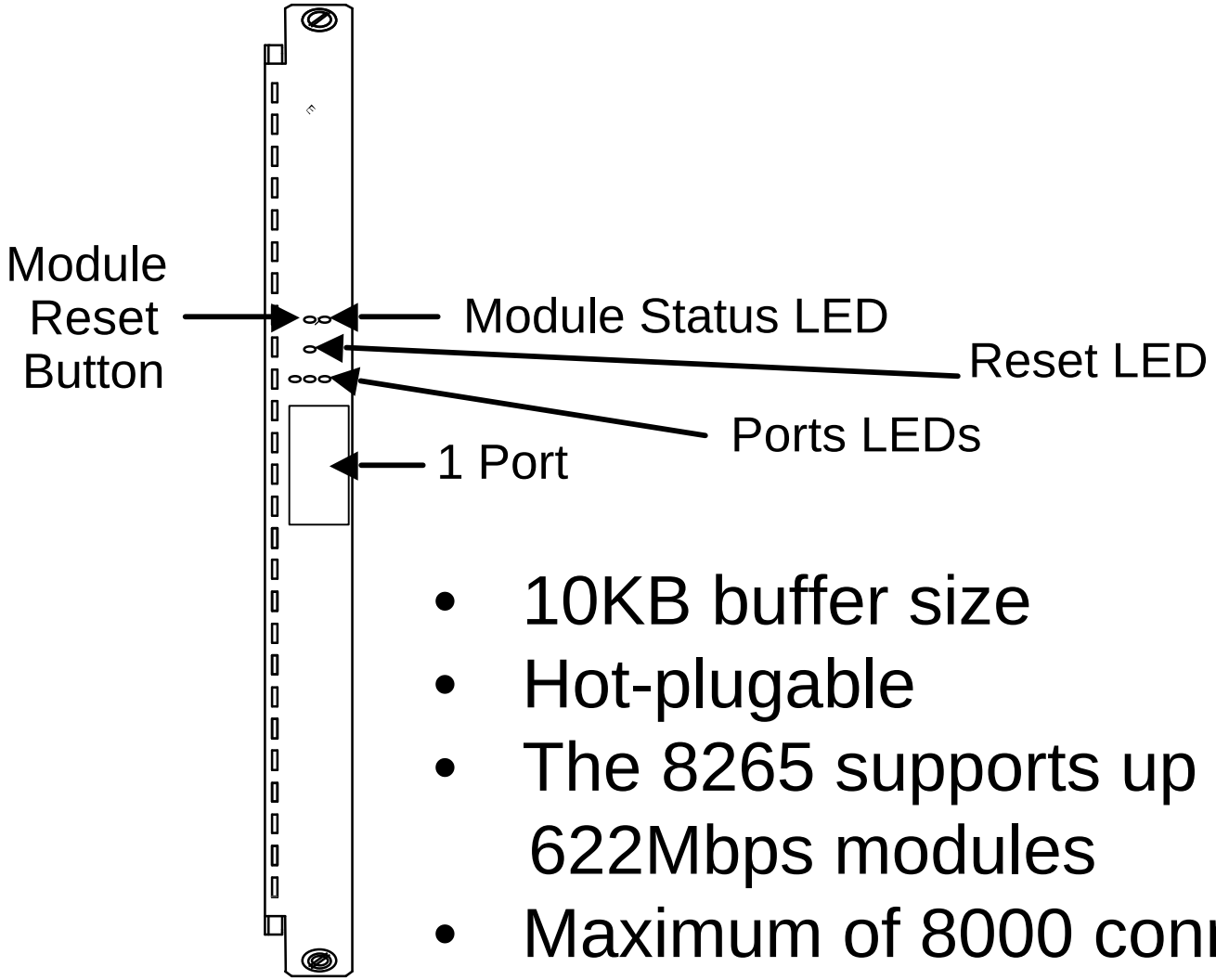
FACEPLATE MARKING:
A1-MF622 or
A1-SF622

POWER REQUIREMENTS:
38W at +5V

CONNECTORS:
SC optical fiber



622Mbps Module Faceplate



- 10KB buffer size
- Hot-plugable
- The 8265 supports up to 14 622Mbps modules
- Maximum of 8000 connections

Configuring 1-Port OC-12 Modules

- Connect the module to the ATM network
  - **SET MODULE {slot} CONNECTED**
- Set port characteristics
  - **SET PORT {slot.port} {enable,disable,apply_defaults} {parameter}**
    - Parameters:
      AUTO, VOID, PUBLIC_UNI ports,
      SCRAMBLE_XMT_PAYLOAD,
      DESCRAMBLE_RCV_PAYLOAD,
- Enable configured ports
  - **SET PORT or SET MODULE**
- Save port and module configuration settings
  - **SAVE MODULE_PORT**

Available Port Parameters

OC-3 Port Parameters:	OC-12 Port Parameters:
rb_bandwidth	rb_bandwidth
admin_weight	admin_weight
vpi_vci_bits	vpi_vci_bits
ilmi_vpi_vci	ilmi_vpi_vci
signaling_vpi_vci	signaling_vpi_vci
flow_control	flow_control
routing_vpi_vci	routing_vpi_vci
signaling_version	

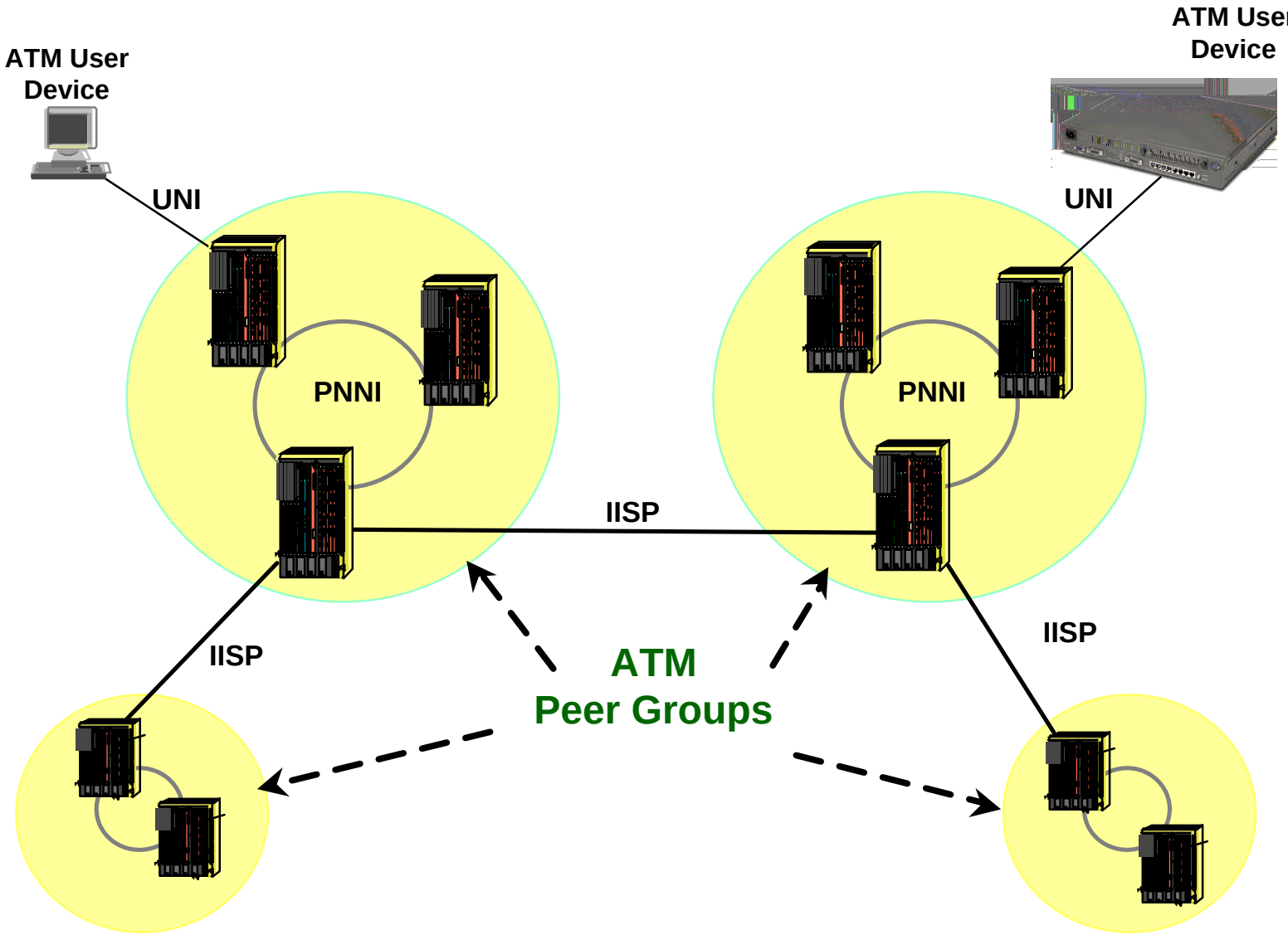
Types of Network Interfaces

OC-3 Port Interfaces:	OC-12 Port Interfaces:
void auto public uni ilmi uni iisp pnni	void auto public uni ilmi note: This module is usually used for WAN connections

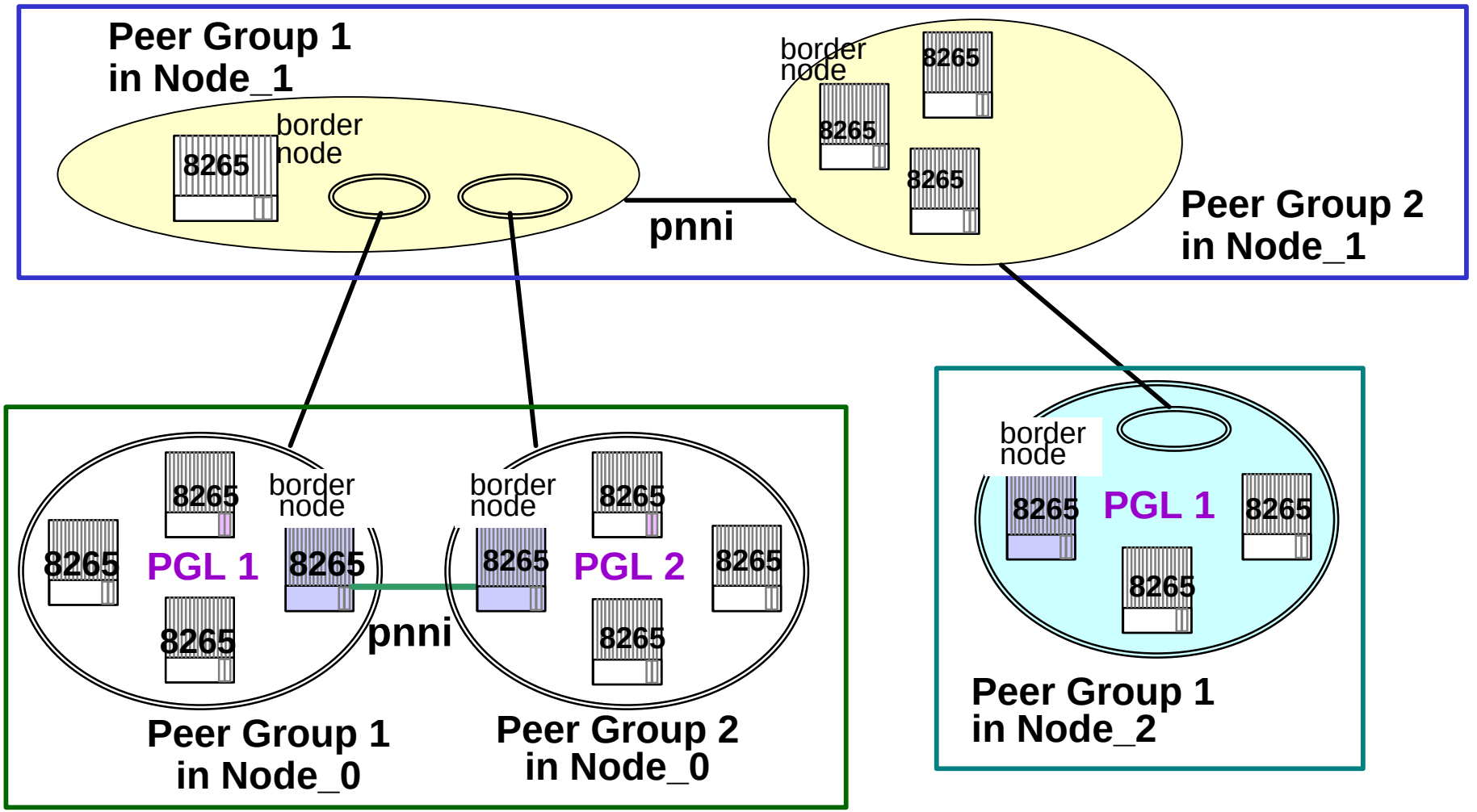
Port Interface Parameters

- Descramble Received Payload
  - The cell payload received by the 622 Mbps port is unscrambled by default
  - Default setting is to unscramble (Yes)
    - Set to Yes (default setting) or No
- Scramble Transmitted Payload
  - The cell payload transmitted by the 622 Mbps port is scrambled by default
  - Default is to scramble (Yes)
    - Set to Yes (default setting) or No

PNNI



Nodal Hierarchy- Future



PNNI Parameters

- Default PNNI parameter values:

  ATM address =

  39.9999.99.99.99.99.00.00.99.99.01.01.99.99.99.99.99.99.00

  Level identifier = 96 bits

  Peer Group ID = 39.99.99.99.99.99.99.00.00.99.99.01

  Internal Summary Address =39.99.99.99.99.99.99.00.00.99.99.01.xx

  Path Selection = ABR - precomputed and UBR - widest path

  - The default configuration includes the same private ATM address for every Control Point
    - It needs to be reconfigured so each switch has a unique address
    - The command for address reconfiguration :

      SET PNNI NODE_0 ATM_ADDRESS {atm address}

PNNI Commands

- SHOW PNNI NODE_0
  - Inspect the Active configuration
- After issuing COMMIT
  - Both Future and Active show the same information
  - The Future configuration becomes Active
- SHOW PNNI CONFIGURATION STATE
  - States whether the active configuration is saved yes or no and if there is a pending commit
- SAVE PNNI
  - Save the Active configuration
    - Ensures that the current Active configuration is automatically reinstalled after a reset or power up

SET Port PNNI

```
8265ATM> set port {slot.port} enable pnni

      Possible completions:
            bandwidth_rb
            rb_administrative_weight
            nrb_administrative_weight
            aggregation_token
            ilmi_vpi_vci
            routing_vpi_vci
            signalling_vpi_vci
            vpi_vci
```

A list of PNNI port parameters

SHOW Port Verbose

```
8265ATM> show port 1.3 verbose
Type  Mode                  Status
----------------------------------------
1.03: PNNI  enabled   UP
ILMI  status                  : UP
ILMI  VCI                     : 16
RB Bandwidth                  : unlimited
Police                        : off
Signalling VCI                : 0.5
Routing VCI                   : 0.18
RB Administrative weight      : 5040
NRB Administrative 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
```


SHOW Future PNNI

```
8265ATM> show future_pnni configuration_state
       There is no uncommited change pending.
       Active configuration is saved.

8265ATM> show future_pnni node_0
---------------------- Node 0 --------------------
ATM addr :
39.99.99.99.99.99.99.00.00.99.09.01.52.52.52.52.52.52.52.00

Level Identifier : 96 (in decimal format)

PGroup Id: 60.39.99.99.99.99.99.99.00.00.99.99.01

Node Id :
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.52.52.52.52.52.52.00

Unrestricted Transit.
```


SHOW Future PNNI

```
8265ATM> show future_pnni path_selection
      Unspecified bit rate : widest path.
      Available bit rate : precomputed Path.

8265ATM> show future_pnni summary_address
------ Internal Summary Addresses of Node 0-----
  Entry l-Prefix Length=104 non default,advertised:
  List of Summary Addresses:
  39.99.99.99.99.99.99.00.00.99.99.01.52. . . . . .
  39.99.99.99.99.99.99.00.00.99.98.02.51. . . . . .
  28 empty entries.
```

switch ids

The 8265 supports a maximum of 30 internal summary addresses

SHOW PNNI Neighbor

```
8265ATM> show pnni
Possible completions:
             neighbor
             peer_group_members
             ptse
             configuration_state
             node_0
             path_selection
             summary_address

8265ATM> show pnni neighbor
------ Neighbors of Node 0-----
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.60.60.60.60.60.60.60.00
Port 14.01 vpi=0
60.A0.39.99.99.99.99.99.99.0C.00.99.99.01.51.51.51.51.51.51.51.00
Port 14.03 vpi=0
```


SHOW Peer Group Members

```
8265ATM> show pnni peer_group_members
------ Peer Group of Node 0 -----
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.52.52.52.52.52.
52.52.00 connected
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.61.61.61.61.61.
61.61.00 connected
60.A0.39.99.99.99.99.99.99.00.00.99.99.01.59.59.59.59.59.
59.59.00 connected
```

This command lists all Node IDs included
in the currently active peer group

SET PNNI Node 0 Commands

```
8265ATM> set pnni
     Possible completions:
           node_0
           path_selection

8265ATM> set pnni node_0
     Possible completions:
           peer_group id
           level_identifier
           atm_address
           summary_addr
```


PNNI Path Selection

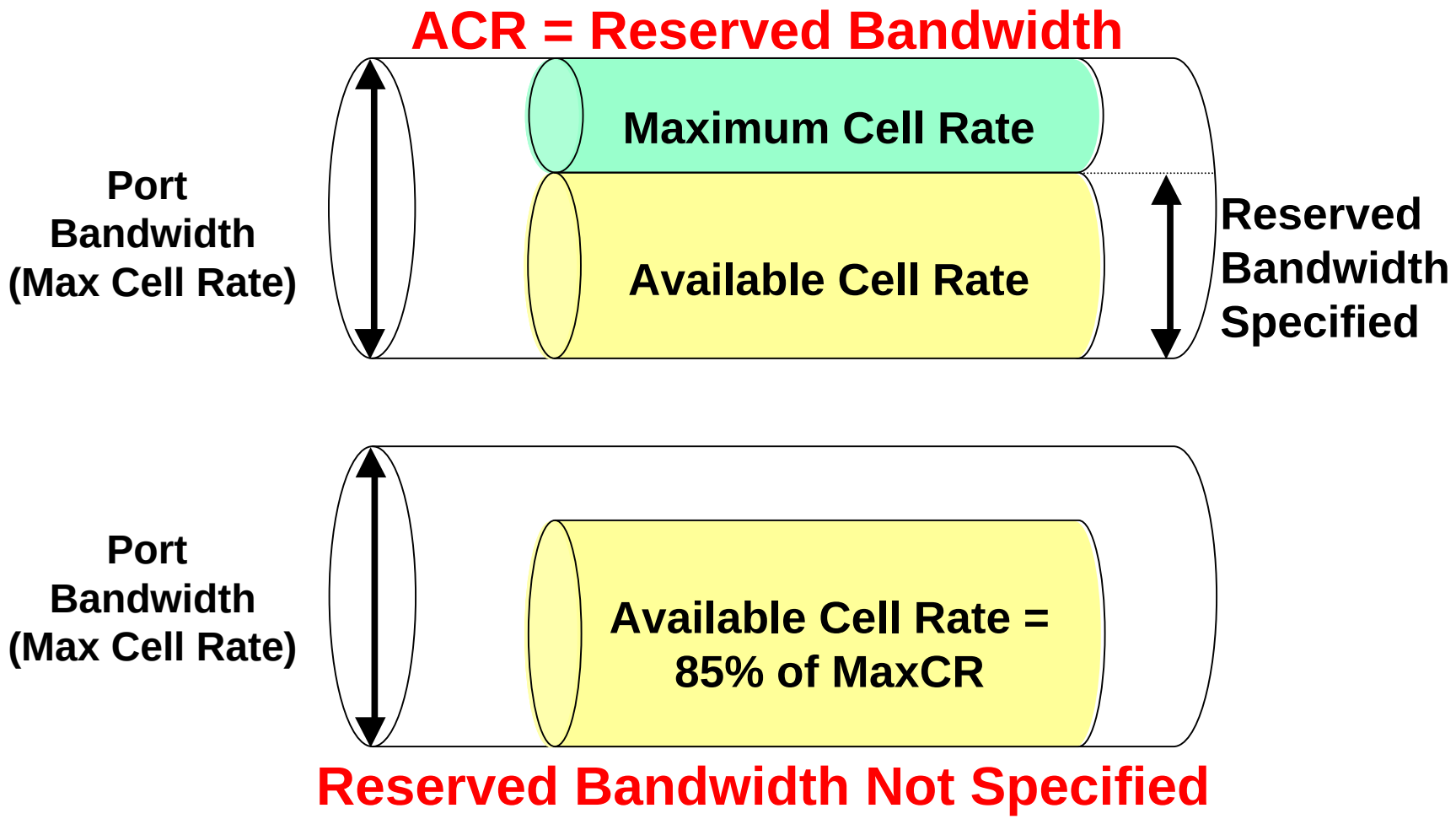
```
8265ATM> set pnni path_selection
       Possible completions:
              ABR
              UBR

8265ATM> set pnni path_selection UBR:
       Possible completions:
              shortest_path
              widest_path

8265ATM> set pnni path_selection ABR:
       Possible completions:
              on_demand_path
              precomputed_path
```

These commands configure path selection methods used for Available Bit Rate (ABR) and Unspecified Bit Rate (UBR) connections

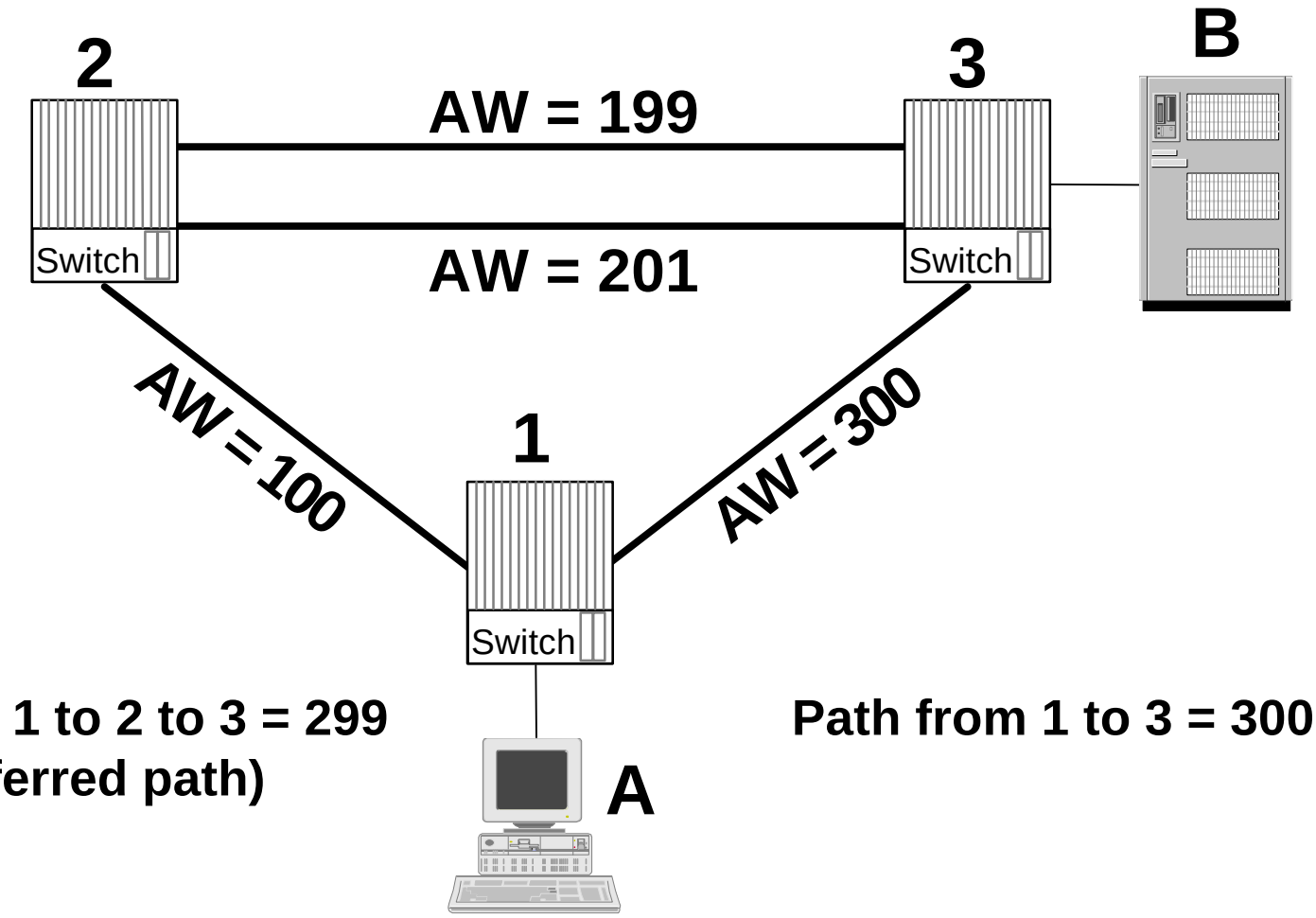
Widest Path Utilization
Non-Reserved Bandwidth (NRB)

- Method to decrease MaxCR for NRB calls:
  - Physical port bandwidth (in Kbps) divided by max number of connections per blade (8000)
- Max Cell Rate (MaxCR)
  - Full bandwidth of the port (PNNI and IISP)
    - Max Bandwidth of all ports = 636 Mbps total
  - If Reserved Bandwidth is specified, then MaxCR = port bandwidth - reserved bandwidth
  - If Reserved Bandwidth is not specified, then MaxCR = port bandwidth
  - If MaxCR exists, never decrease it to 0

Widest Path Utilization
Reserved Bandwidth



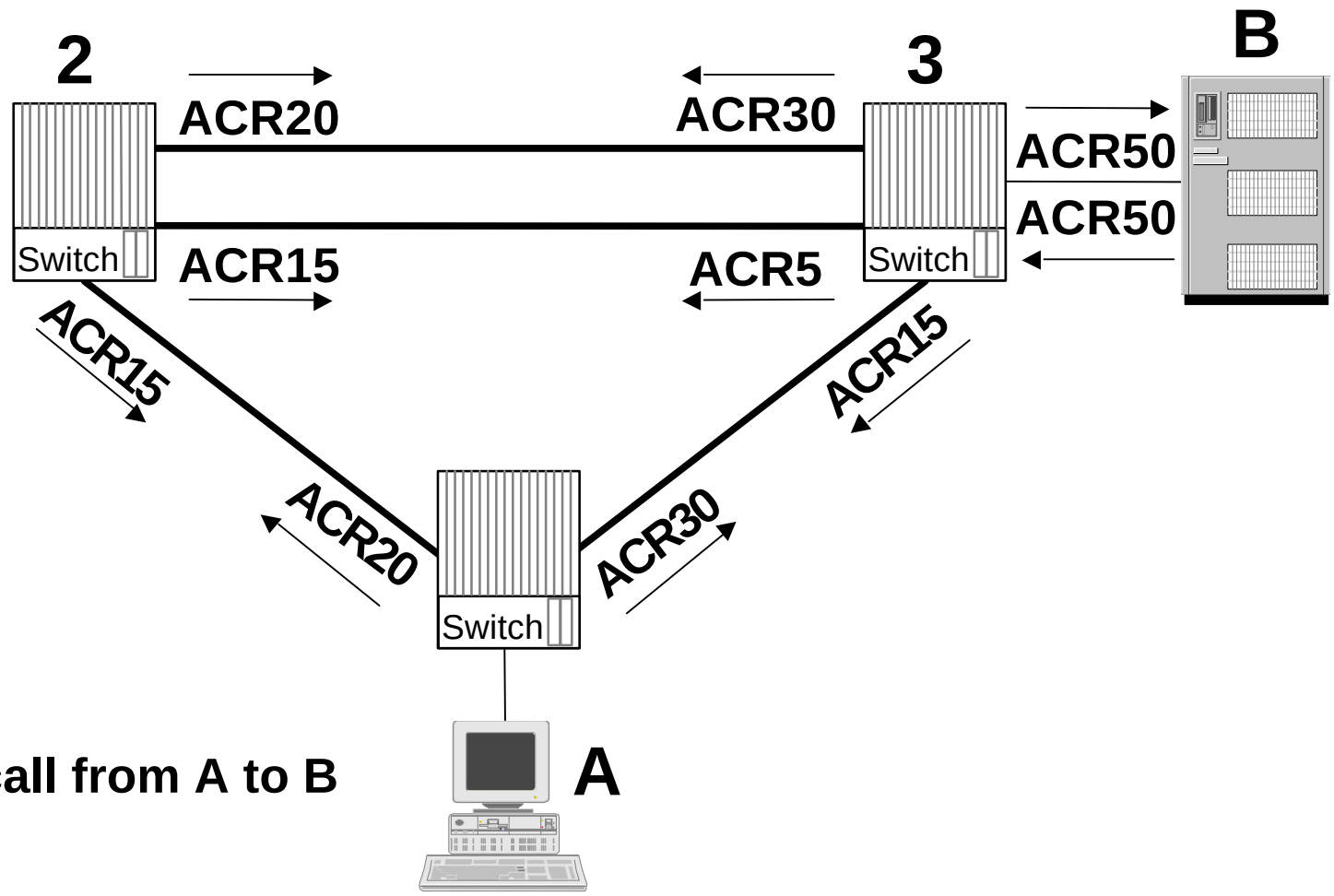
Shortest Path Utilization
Non-Reserved Bandwidth



Path from 1 to 2 to 3 = 299
(Preferred path)

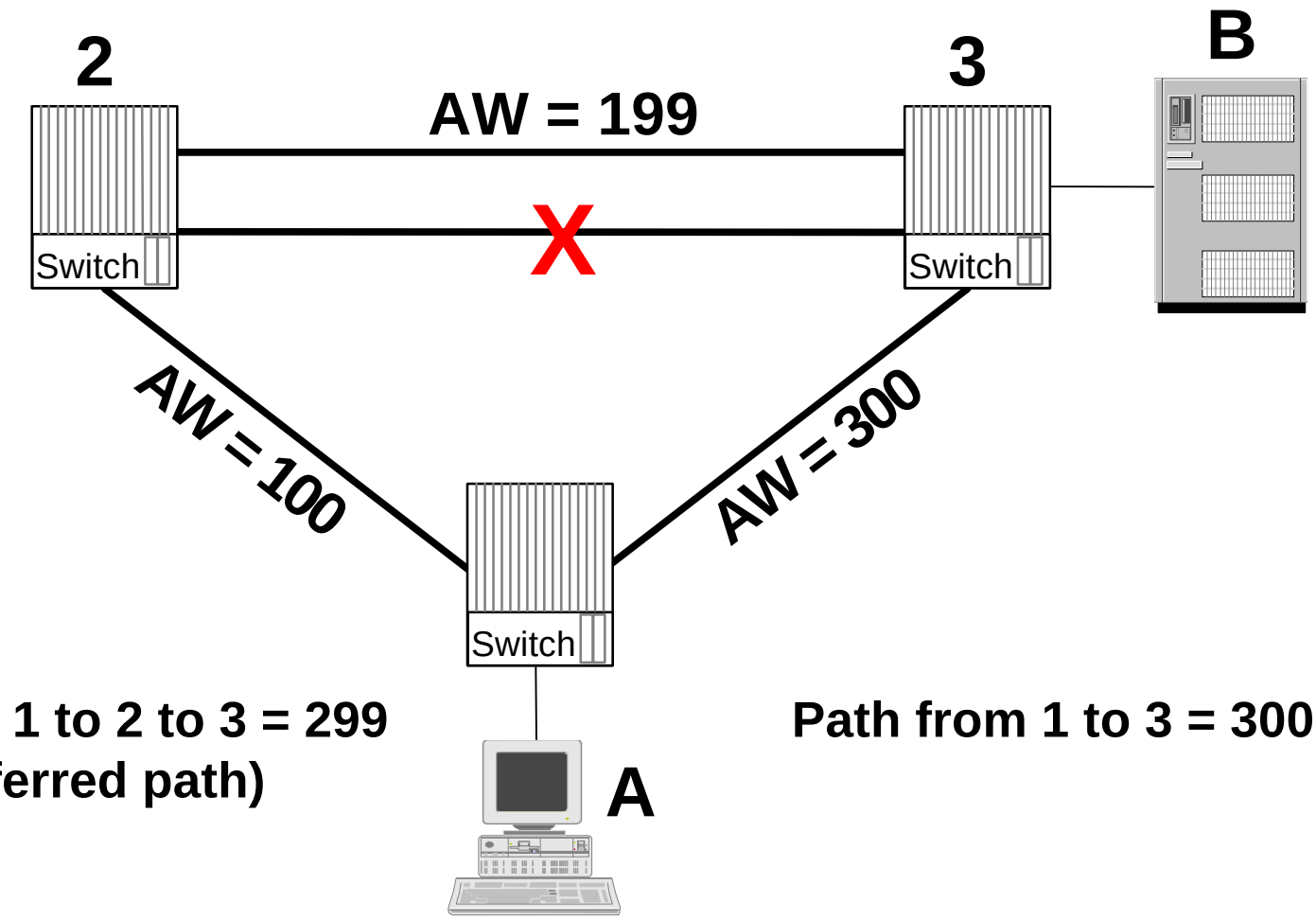
Path from 1 to 3 = 300

Shortest Path Utilization
Reserved Bandwidth - Step 1



RB call from A to B

Shortest Path Utilization
Reserved Bandwidth - Step 2



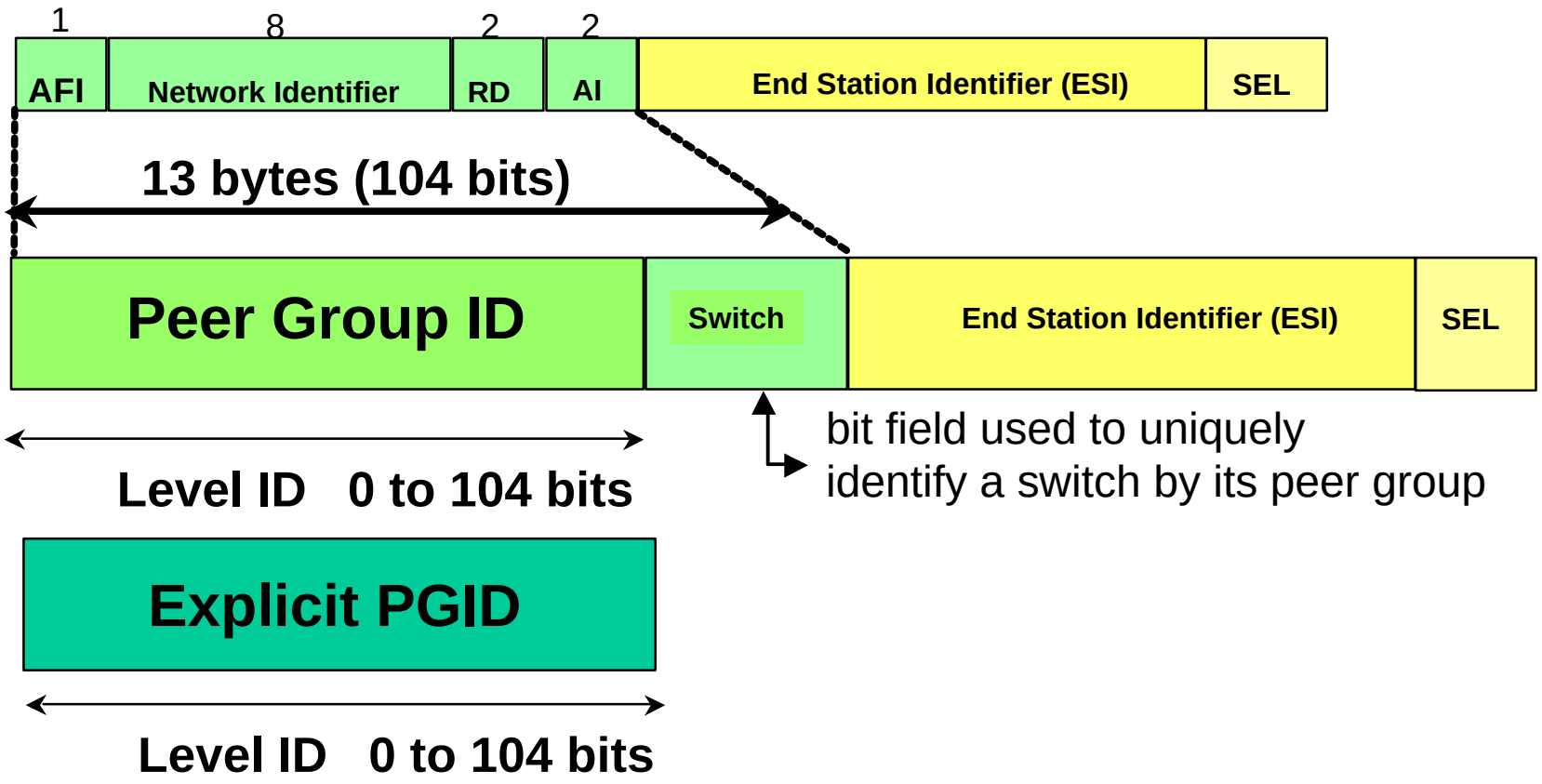
Path from 1 to 2 to 3 = 299
(Preferred path)

Path from 1 to 3 = 300

Peer Group Identifier (PGID)

- A grouping mechanism for a peer group using PNNI to interconnect switches
  - All switches within a peer group must have a common identifier (PGID)
- PGID can be variable in length
  - 0 to 104 bits, default is 96 bits (12 bytes)
  - 2^{104} possible combinations
  - PGID length is specified by the Level Indicator
- No need to correlate with the ATM address
  - PGID can be part of the ATM address
  - PGID can be an explicitly entered number

PGID and Switch Number



PGID = part of private ATM Address or Explicit ID

Configure Explicit Peer Group ID

- Specify both the length and content:

SET PNNI NODE_0 PEER_GROUP_ID: 51 47.a5.32.4e.b7.48.19

  - length = 51, content = 47.a5.32.4e.b7.48.19

- Node_0 takes the first 51 bits of the entered string 47.a5.32.4e.b7.48.19 as the switch's new peer group id
- This removes the restraint that every switch address in a peer group has to have a common prefix of level id length
  - The new peer group id must conform to the prefix of the private ATM address
    - PNNI applies address checking to entered peer groups ids
- Set the LID by using the same command

Configure Level ID

- By default, Peer Group ID is based on the ATM address of the node
- To change the LID default value of 96 bits to 77 bits:

  SET PNNI NODE_0 LEVEL_ IDENTIFIER:77

  - Node_0 selects the first 77 bits of the switch's address as the new peer group id
  - If the level id is changed in one switch, it must be changed in all other switches of that same peer group

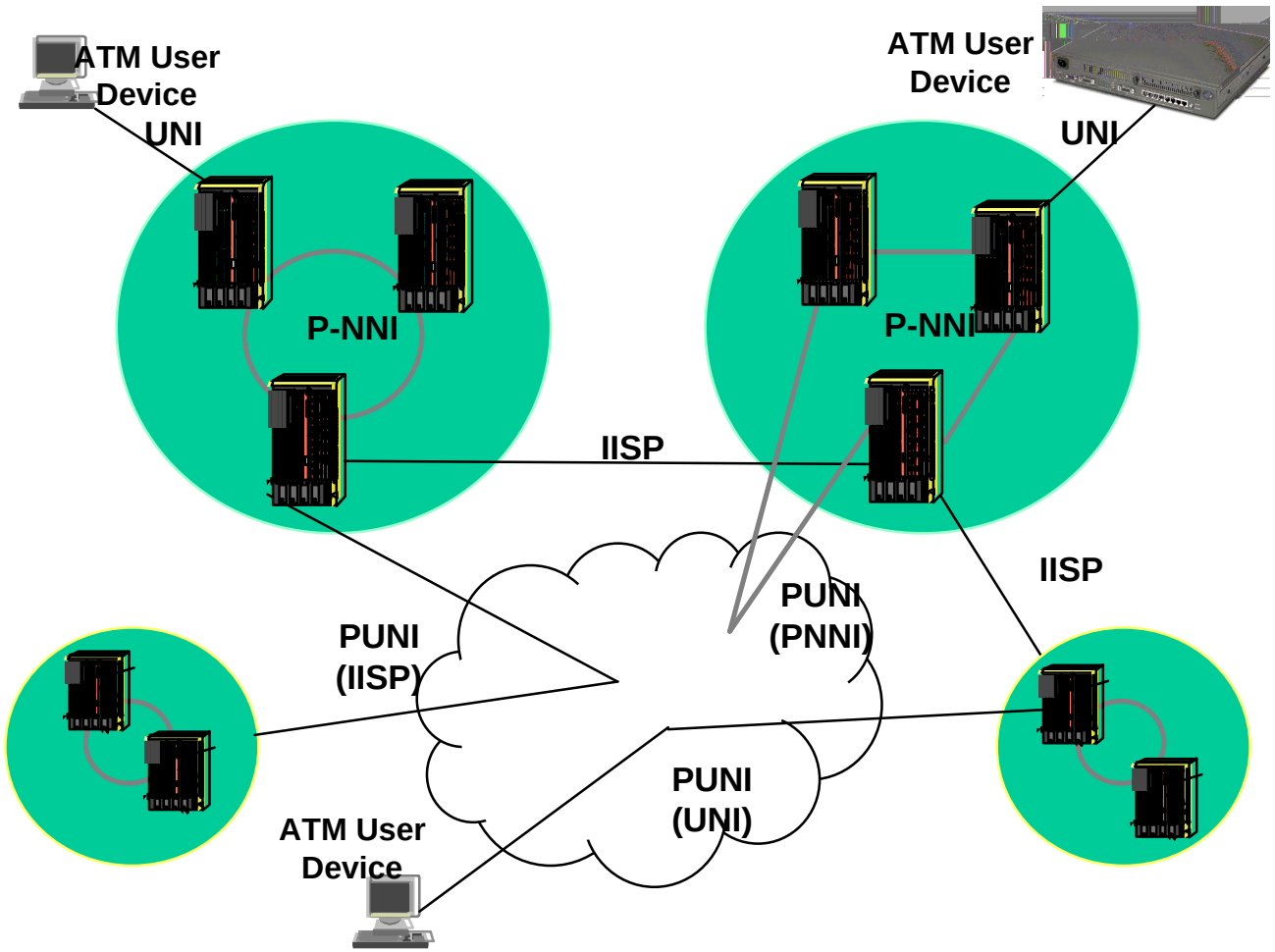
Special Case Level Identifier 104

- Setting the Level ID to 104 (13 bytes) is a special case that affects PNNI's Summary Address configuration
  - It implies no uniqueness of nodes in the Peer Group
  - It causes the LID field to disappear
  - Because the default summary address is absent
    - The addresses of all end stations locally attached to the switch must be entered via the switch's console or TELNET
      - Use the SET REACHABLE_ADDRESS command

LAB 4

- **GO TO SECTION 3 at the back of the course book.**

WAN Connections



With PNNI-1, these wide area connections

are configured as Virtual Paths

They still provide

full functionality as if locally attached

Connecting 2 Switches via WAN

- Define the 2 connecting ports as either
  - **PUBLIC_ UNI** port or **VOID** port
- Define a VPC link between the ports:
  - VPC **IISP** if the switches belong to different peer groups
  - VPC **PNNI** if the switches belong to the same peer group
  - Use command **SET VPC_LINK**
- VPC link of type IISP
  - Define the address to be reached over the link, at both ends
    - At the other switch, enter the reachable address of your switch
  - Use command **SET REACHABLE_ADDRESS**
- VPC link of type PNNI
  - The peer group id of both switches must match
    - Are less than 104 bits in length

SET PVC Command

```
8265ATM> set pvc {slot.port} ?
        Possible completions:
                this_hub_port
                remote atm_address
```

- Use this command to define PVCs
  - PtP and PtMP PVCs for both VCCs and VPCs
  - A PVC can be set from
    - The local port to an endpoint
    - The endpoint can be
      - A remote hub using an ATM address
      - Another port in the local hub

Setting PVC to a Remote Address

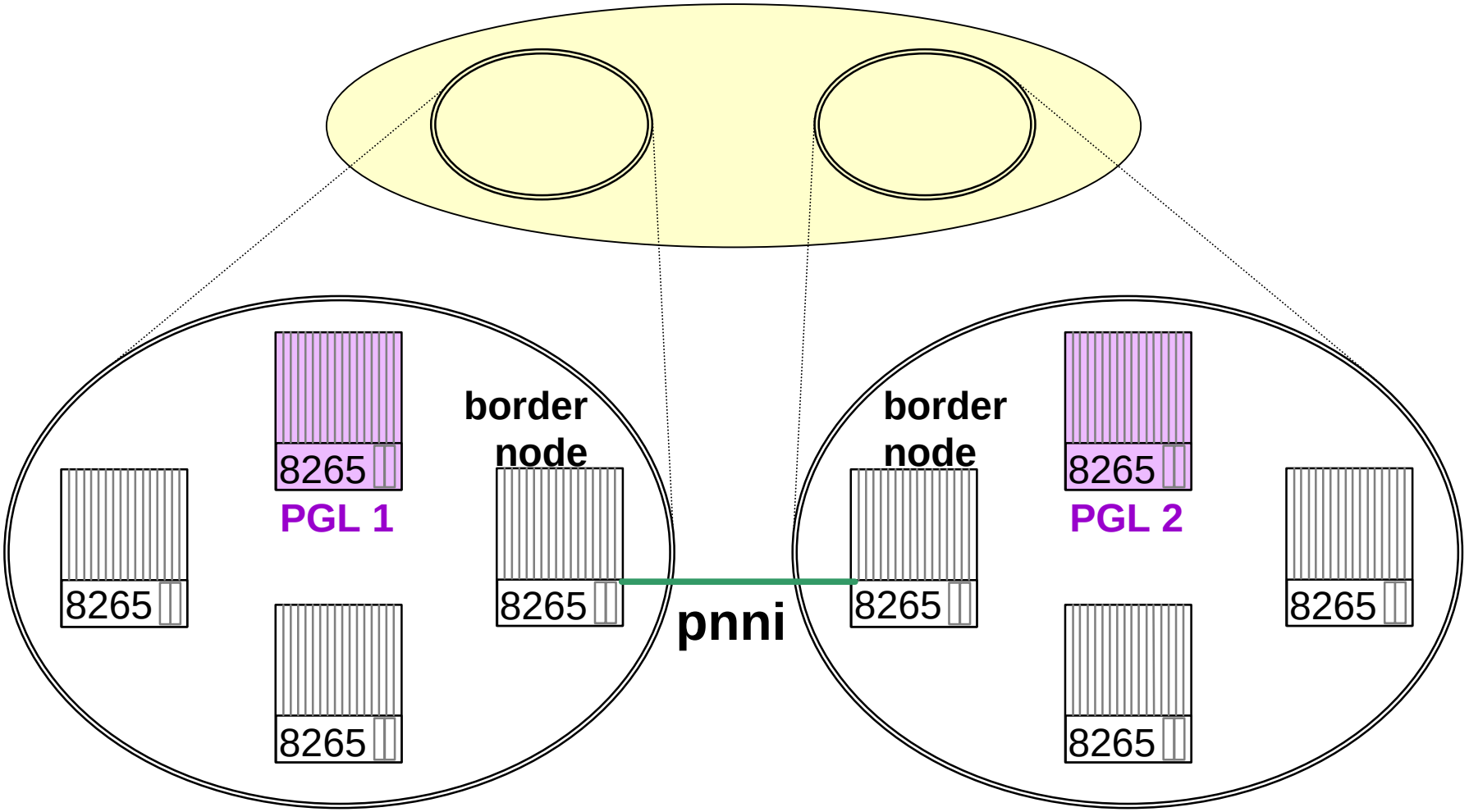
```
8265ATM> set pvc {slot.port}1 39.99.99.99.99.99.99.00.00.99.99.01.60
                Enter ATM address (bytes 14 - 17) :  42.00.00.00.
(Bytes 14 through 17 of the Remote ATM Address must be this value)
**************************************************************
                Enter ATM address (bytes 18 - 20) :  14.01.00
(Bytes 18 and 19 of the Remote ATM Address represent
  the module and slot of the end point of this PVC)
**************************************************************
                Enter call type:
                Possible completions:
                        channel_point_to_ multi_point
                        path_point_to_ multi_point
                        channel_point_to_point
                        path_point_to_point
```


Setting PVC to a Remote ATM Address

PNNI Routing

- PNNI uses a link state routing algorithm
  - Uses the best features of OSPF and ISIS link state algorithms
  - A route is determined not just by the reachability of the end point but also by the Quality of Service requirements of the connection
    - Allows routing to include characteristics of the connection, destination, and QoS
- SVC connections are routed between switches using PNNI
  - Routed according to Destination
  - Routed according to connection type (QoS)

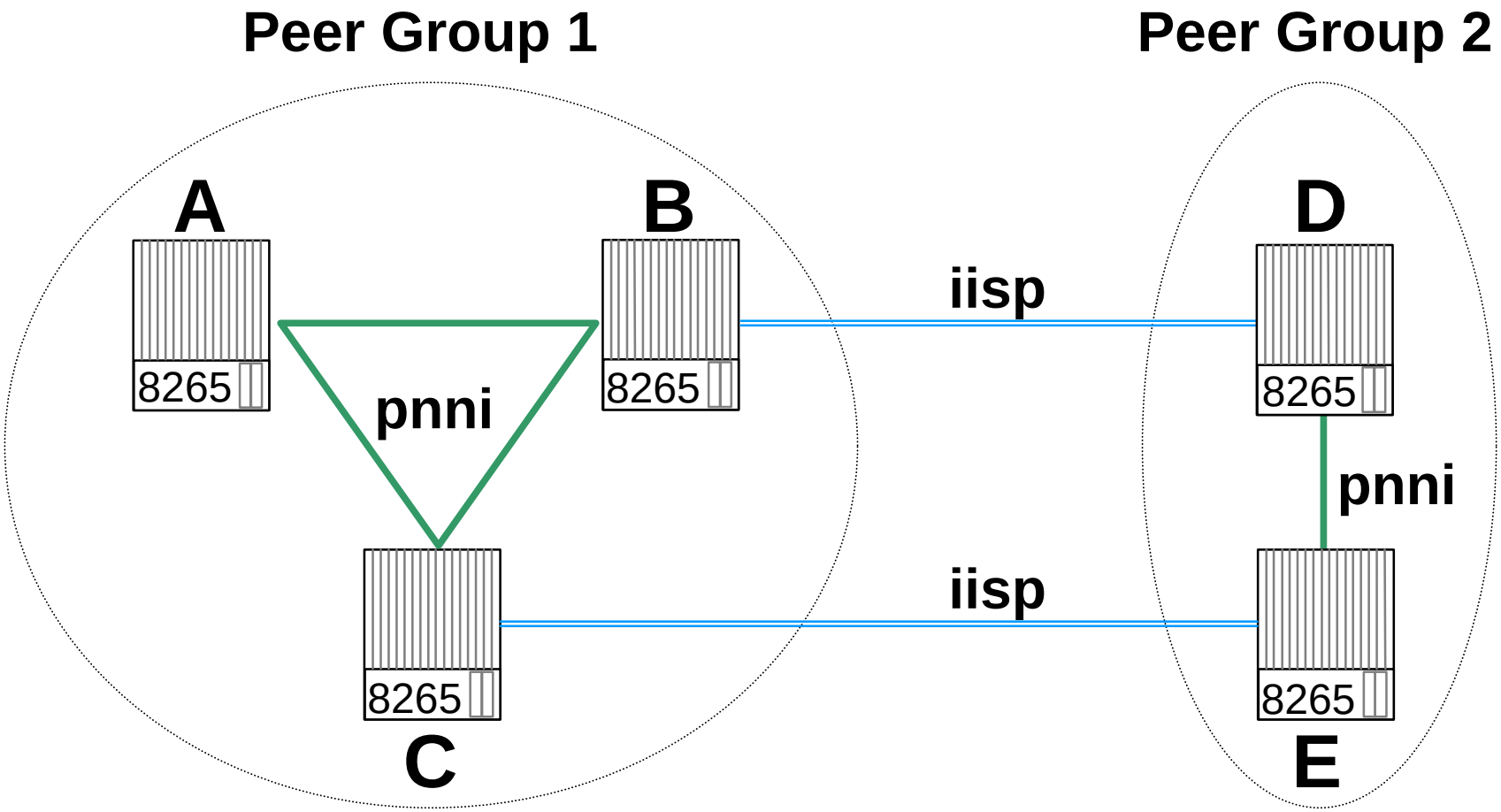
Connecting Two Peer Groups with a Peer Group Leader



IISP Routing

- Use IISP when PNNI is not applicable
  - Use IISP connections between different domains
  - Multiple links between domains
    - Manually configured Reachable Address
  - Use IISP when high node levels are not supported
- IISP does not support the dynamic routing functions of PNNI
  - IISP is a semi-static function
    - Each switch port would be configured as to which addresses can be reached through that interface
    - Switches do not broadcast available addresses

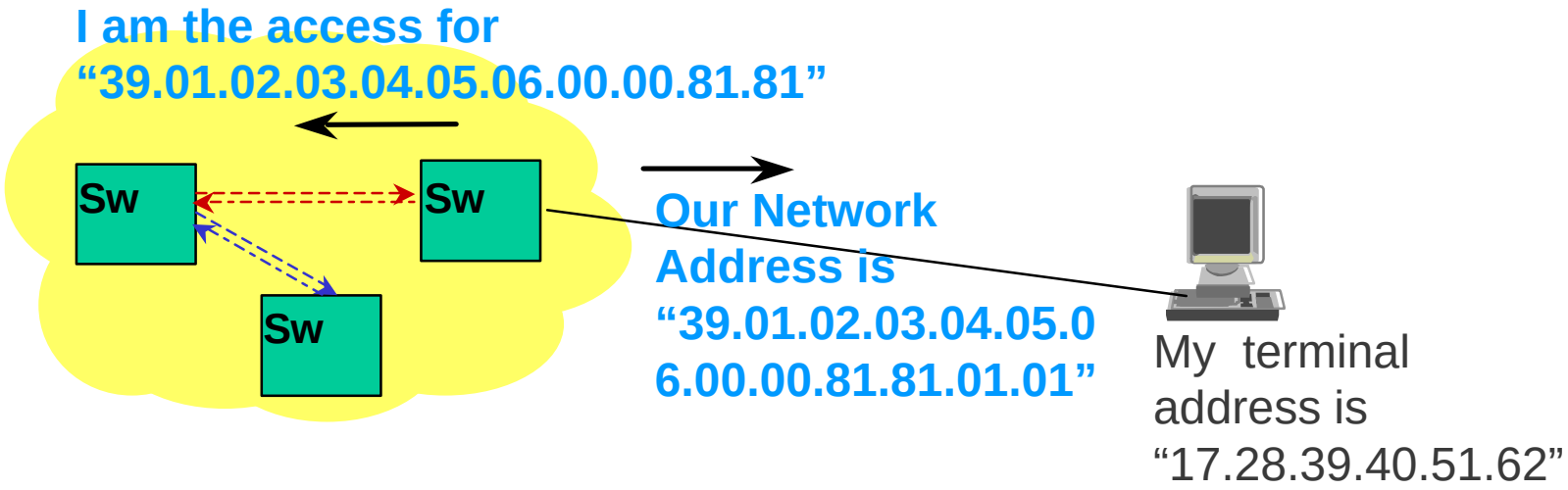
Connecting 2 Peer Groups with No Peer Group Leader



Connecting 2 Peer Groups - No PGL

Reachability

- A switch uses Summary Addresses to advertise the ATM addresses that are reachable through itself
  - Advertise End stations attached to that switch
  - Advertise other switches attached to that switch



Default and Non-default Summary Addresses

- PNNI automatically generates a default summary address
  - Provides reachability to all end systems attached to the switch whose addresses share the switch's 13 byte ATM address prefix
    - Addresses are generated by the ILMI address notification protocol
- Non-default summary addresses
  - Configured to provide reachability for addresses that are entered via the command **SET REACHABLE_ADDRESS**
  - Not expected to share their switch's 13 byte address prefix

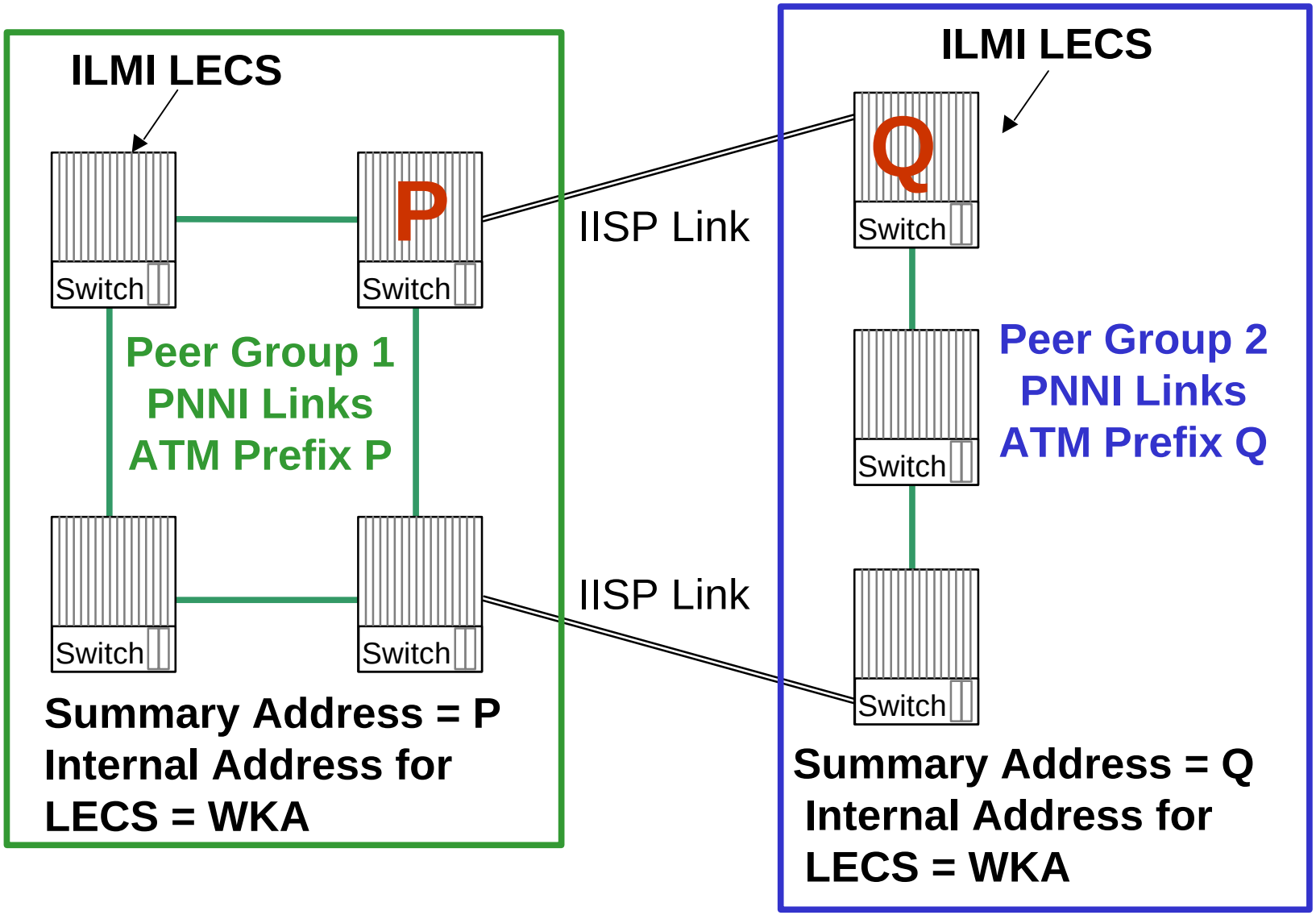
Summary Addresses

- 4 types of configurable Summary Address
  - Internal, external, suppressed internal, suppressed external
  - 8265 supports maximum of 30 Summary Addresses
- End Stations attached to a switch
  - Maximum Summary Address length is 13 bytes
  - Uses ILMI
- Other switches attached to a switch
  - Summary address is optional
    - Reduces the size of the routing tables
    - Maximum Summary Address length is 13 bytes
  - Does not use ILMI
    - Manually configured

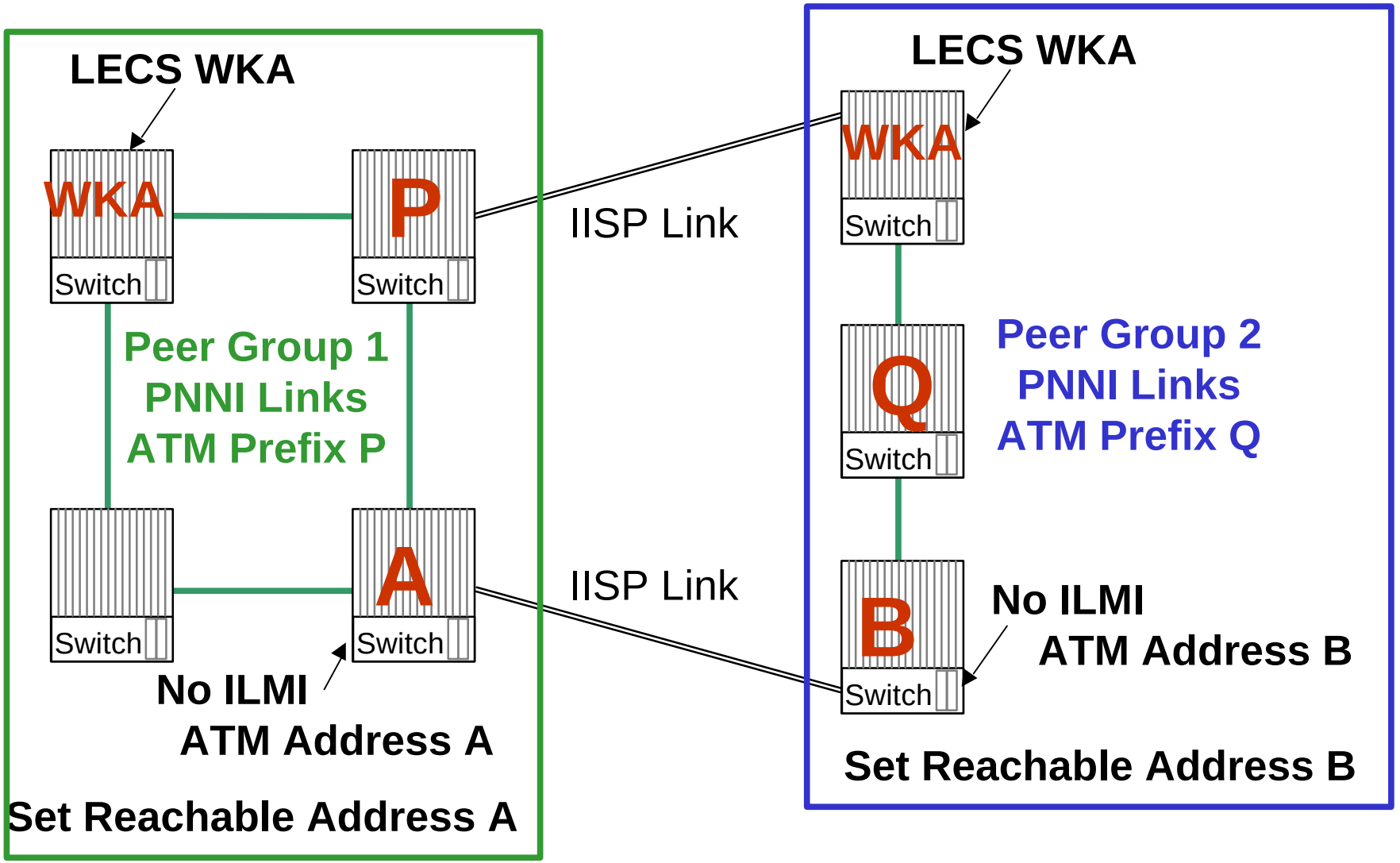
Summary Addresses

- Summary address internal
  - An address that has a different prefix
  - Relies on ILMI and acceptance of the node's prefix
  - A group of addresses with a common prefix
  - Automatically generated by the node
  - Can configure suppressed addresses
- Summary address exterior
  - Addresses that lie outside a peer group
  - A group of addresses with a common prefix
  - Must be manually generated
  - Can configure suppressed addresses

PNNI Internal Reachability



PNNI Exterior Reachability

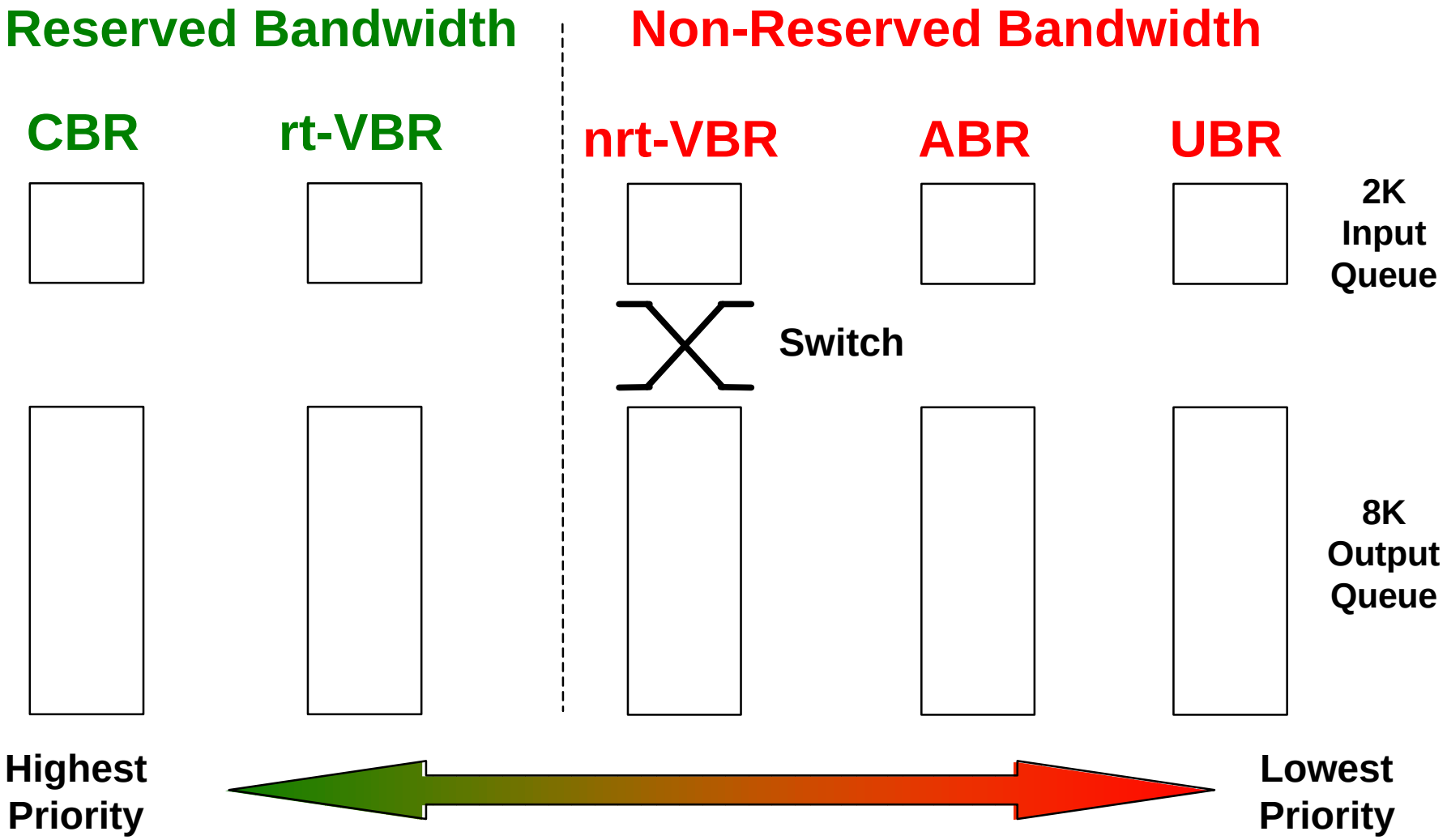


Suppressed Internal/Exterior Summary Addresses

- Suppressed internal end system ATM connections
  - Cannot be setup by end systems attached to other switches of the same peer group
    - This does not prevent the internal end systems from communicating locally (with other end systems attached to the same switch)
  - Suppressed exterior would have the same effect but only applied to exterior addresses
- PNNI will not configure the same address prefix as both Summary and Suppressed Summary

LAB 5

Queues



Service Category Attributes

- ABR
  - Non-real time traffic with a widely varying throughput rate
    - Uses any bandwidth left over from guaranteed bandwidth traffic
    - Used for applications not requiring tightly constrained delay and delay variation
  - Uses a flow control method with feedback mechanisms
    - Controls the source rate in response to changing ATM Layer traffic characteristics
      - Feedback is conveyed to the source through Resource Management (RM) cells
    - An end system that adapts its traffic will have a low cell loss ratio and keep a fair share of available bandwidth

RM Cell Format

Service Category Attributes (cont.'d)

- UBR
  - Non-real time traffic with no traffic related service guarantees
    - FTP, E-mail, traditional data applications
    - Applications not requiring tightly constrained delay and delay variation
  - If a resource indicates congestion, the network throws data away
    - This method is not severe if the network has end-to-end recovery protocols
      - Congestion control can be performed at a higher layer on an end-to-end basis
  - Setup UBR by use of the Best Effort indicator in the User Cell Rate Information element

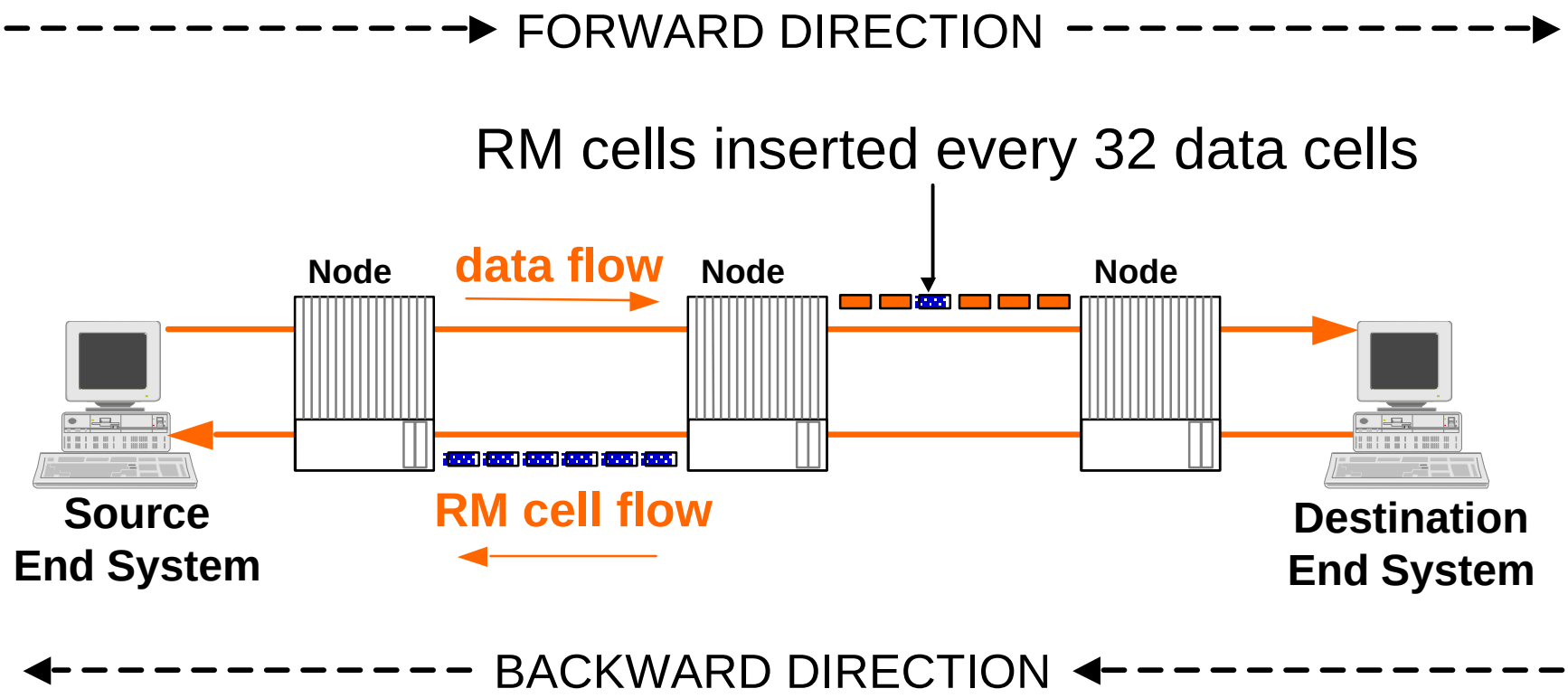
Service Category Attributes (cont.'d)

- nrt-VBR
  - Non-real time, bursty traffic in terms of PCR, SCR, and MBS
    - MPEG-2, encoded video distribution, 1-way television
  - No delay bounds are associated with this service category
    - A few seconds delay is not a problem but cell loss affects the video
  - May support Statistical Multiplexing of connections

Service Category Attributes (cont.'d)

- rt-VBR
  - Tightly constrained delay and delay variation
  - Sources transmit at a rate which varies with time
    - Bursty traffic
  - Cells delayed beyond the maxCTD (cell transfer delay) are of reduced value to the application
- CBR
  - Static amount of bandwidth that is continuously available
  - Sources transmit at or below the peak cell rate
  - Cells delayed beyond the maxCTD are of reduced value to the application

Flow Control Model for ABR



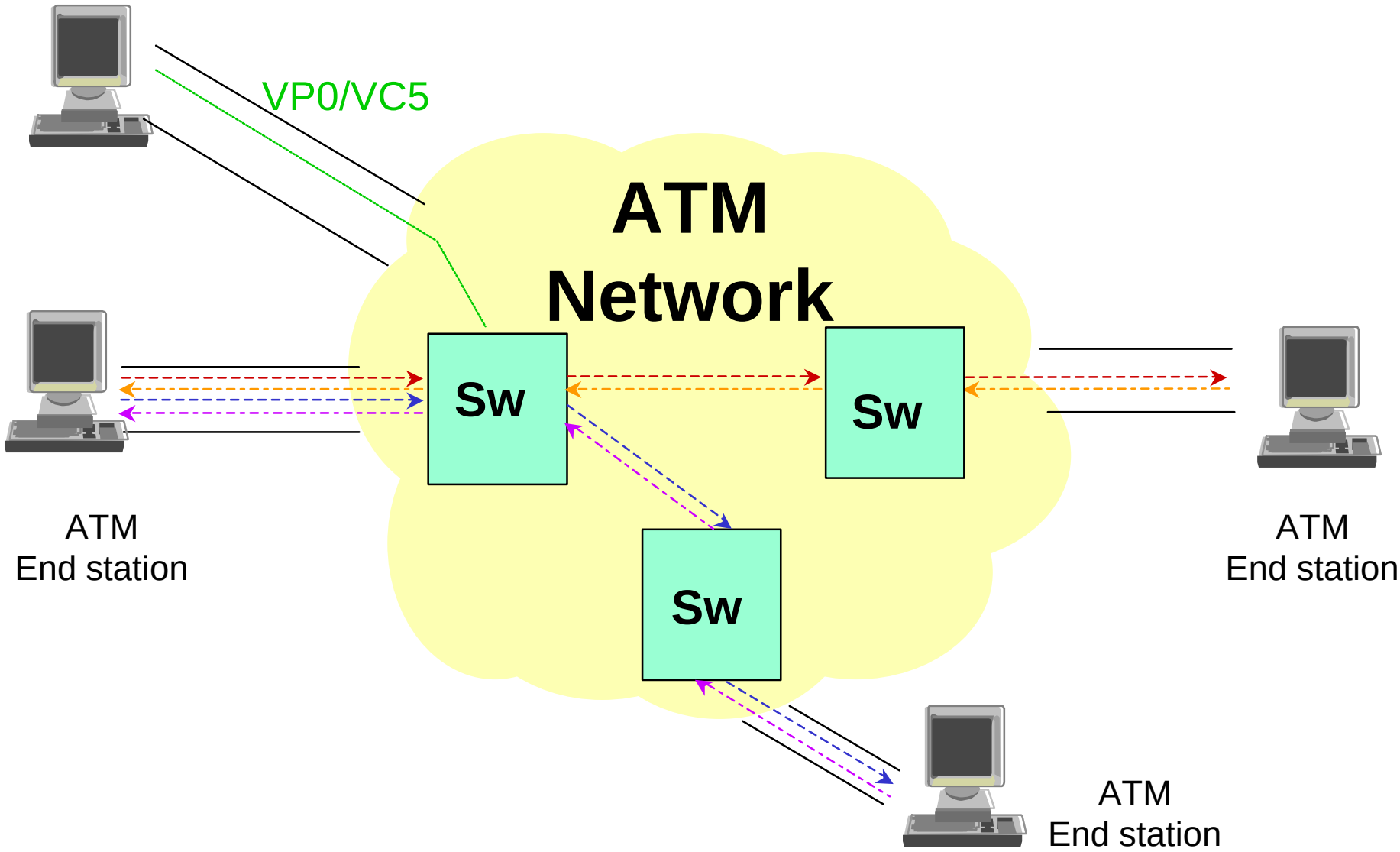
ATM Switch Behavior

- EFCI Marking
  - Sets the EFCI state in the data cell header
- Relative Rate Marking
  - Sets CI=1 or NI=1 in forward/backward RM cells
- Explicit Rate Marking
  - Reduce ER field of forward/backward RM cells
- Virtual Source/Virtual Destination Control
  - Segment ABR control loop by using virtual source/destination

Explicit Forward Congestion Indicator

- A network element in an impending congestion state may set an EFCI bit
  - EFCI is set in the Payload Type (PT) field of the cell header of a data cell
    - Only for Point-to-Point connections; SVCs and PVCs
  - The EFCI tells the receiver that there is congestion
    - ATM congestion notification is only presented one way - in the forward direction
    - The path in the other direction may not be congested
  - The receiver notifies the sender to slow down
    - End systems set MCR = 0

Signaling Channels



Show Signaling - Cross Connections

```
8265ATM> show signalling
Possible completions:
             cross_connections
             atm_interfaces
             control

8265ATM> show signaling cross_connections port 13.1

In:slot.port VPI.VCI type Out:slot.port VPI.VCI type Conn Cat
-------------------------------------------------------------

    13.1     0.33    SVC       13.1     0.34    SVC   P2P UBR
    13.1     0.34    SVC       13.1     0.33    SVC   P2P UBR
    13.1     0.35    SVC       13.1     0.36    SVC   P2P UBR
    13.1     0.36    SVC       13.1     0.35    SVC   P2P UBR
    13.1     0.37    SVC       13.1     0.38    SVC   P2M UBR

Total number of cross connections = 5
```


Showing Signaling - ATM Interface

```
8265ATM> show signalling atm_interface

      Enter parameter: port 13.1

      Interface Type    : private UNI
      Signaling Version : UN1 3.0
      Signaling Side    : Network
      Routing Protocol  : N/A
      Sscop State       : Active
      Max VPI bits      : 4
      Max VCI bits      : 10
      Active VPs        : 0
      Active VCs        : 16
      Nb Connections    : 16
```


Show Signaling - Control

```
8265ATM> show signalling control

Control:
Crankback:  OFF

Monitoring:
Limited resources:  NO

                        Current     Maximum
Multicast tree          9.44%       9.44%
Cross connection        1.04%       1.15%
Connection              1.18%       1.30%
Party                   0.73%       0.73%
```


UNI 3.0 and 3.1

- The 8265 is backwards compatible to ATM Forum UNI 3.0 and 3.1
  - UNI 4.0 is interoperable with UNI 3.0 and UNI 3.1 versions as far as basic operations are concerned
    - Nothing has been changed for the basic support of point-to-point and point-to-multipoint calls
    - A Classical IP or LAN Emulation call which does not use the additional features of UNI 4.0 should continue to operate as before
  - The switch automatically detects UNI version 3.0 and 3.1 signaling on a port and sets that port accordingly

UNI 4.0 Signaling

Functions implemented in the 8265 Control Point:

CAPABILITY (M = mandatory, O = optional)	**STD**	**SUPPORT**
Point-to-Point calls	M	Y
Point-to-Multipoint calls	M	Y
Signaling of individual QoS parameters	M	Y
ATM Anycast	M	Y
Frame discard	O	Y
ABR signaling for point-to-point calls	O	Y
Virtual UNIs	O	Y
Switched Virtual Path (SVP) service	O	Y
Generic identifier transport	O	Y
Traffic parameter negotiation	O	Y
Leaf initiated join	O	-
Proxy signaling	O	-
Supplementary services	O	-

UNI 4.0 Signaling

New functions added by ATM Forum UNI 4.0:

- Anycast routing to group addresses
  - Requires the new PNNI hierarchy structure
- Signaling of individual QoS
  - Messages, information elements, and procedures are used to signal individual QoS parameters
  - Extended QoS
    - An information element used in signaling QoS
    - Constant values are inserted by hardware
  - End-to-end transit delay
    - An information element used in signaling QoS
    - A coding requirement for translation from UNI to PNNI

UNI Anycast

- Allows a user to request a point-to-point connection to a single end system in a group
  - The calling user sends a SETUP message
    - The message contains the desired ATM group address in the called-party-number information_element
    - When the connection request reaches one member of the called group, the called member can return his individual ATM address to the calling user
- Supports ILMI registration and routing to group addresses
  - 8265 supports the connection-scope-information
    - It is of no real use until the PNNI hierarchy (I.e. multiple tiered node levels) is fully supported
  - Implemented on UNI 3.0 and UNI 3.1 interfaces

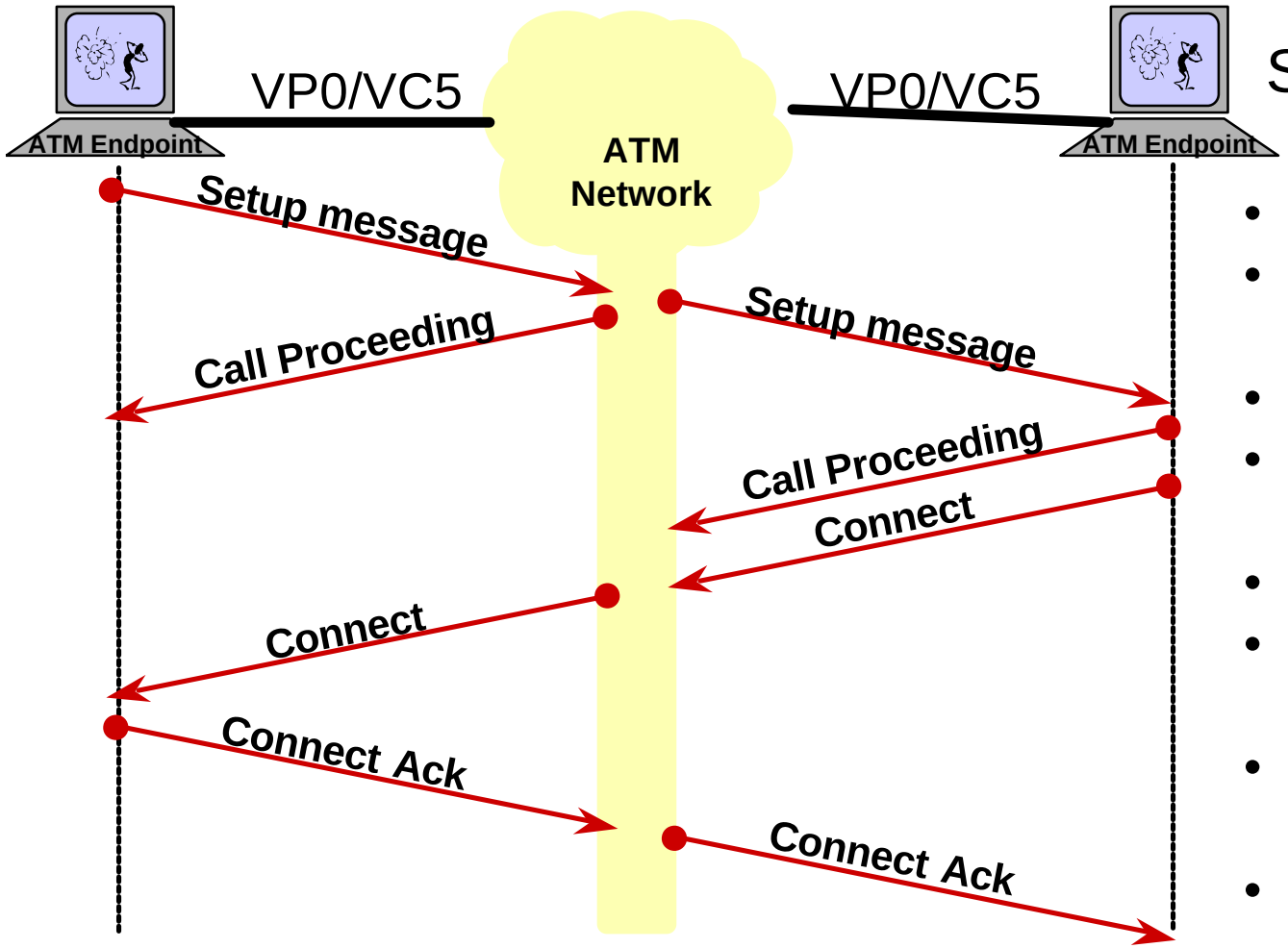
UNI Extended QoS

- This information element indicates
  - The QoS values that are acceptable on a per call basis
  - The cumulative QoS parameter values
- If no Extended QoS information is contained in the received setup message
  - The network may generate an Extended QoS parameters information element and/or an end-to-end transit delay information element
- Not supported on UNI 3.0 and UNI 3.1 interfaces

UNI End-to-End Transit Delay

- This information element contains the maximum end-to-end transit delay acceptable on a per call basis
  - Includes end user delay (AAL handling delay) and maxCTD (max cell transfer delay)
  - UNI and PNNI interfaces use different end-to-end transit delay information element formats
    - This means that a translation has to be performed along the call setup path
- Not supported on UNI 3.0 and UNI 3.1 interfaces

Call Setup



SETUP Message Contents:

- AAL parameters
- ATM Traffic Descriptor
- Connection Identifier
- Called party number
  Calling party number
- QoS parameter
- Broadband Bearer Capability
- Broadband Low Layer Information
- Designated Transit List (DTL)

Frame Discard

- SETUP message with forward frame discard bit allowed
  - The network can discard the frame in the forward direction of the connection
    - This is passed from the calling party to the called party
    - The bit is located in the traffic management byte of the ATM Traffic Descriptor information element
- CONNECT message with backward frame discard bit allowed
  - The network can discard the frame in the backward direction of the connection
    - This is passed from the called party to the calling party

Frame Discard (cont.'d)

- PNNI Control Point mapping provides end-to-end detection and setting of the frame discard process
- Translation is performed:
  - From UNI 3.0 or UNI 3.1 to PNNI 1.0 or UNI 4.0
    - If the call is based on AAL5 service, the ATM Traffic Descriptor bits are set to ON
  - From PNNI 1.0 or UNI 4.0 to UNI 3.0 or UNI 3.1
    - In any case, ATM Traffic Descriptor bits are set to OFF because they are not supported by the UNI signaling versions 3.0 and 3.1

ABR Signaling Parameters

- To establish an ABR PtP connection:
  - The end system specifies both a maximum required bandwidth and a minimum usable bandwidth to the network
    - Designated as Peak Cell Rate (PCR) and Minimum Cell Rate (MinCR)
    - MinCR has 2 values: Requested MinCR and Minimum Acceptable Value
    - MinCR can be set to zero
  - The network's available bandwidth may vary but will not become less than MinCR
    - PCR cannot be less than MinCR

ABR Signaling for PtP Calls

- If a network does not support ABR
  - It rejects the ABR SETUP Message with Cause Code #65: "Bearer service not implemented"
- 3 different levels of ABR Point-to-Point calls can be set up through the 8265 CPSW:
- ABR Calls with only MinCR
  - Only the transfer capability has been set to ABR
  - MinCR is specified in the ATM Traffic Descriptor
    - Implemented on UNI 3.0 and UNI 3.1 interfaces
    - Supported by PNNI

ABR Source Behavior

- Before the first cell is sent, ACR is set equal to the initial cell rate (ICR)
  - ACR is never greater than PCR nor less than MinCR
- The forwarding rate for ACR is increased per the information in RM cells
- When backward RM cells have Congestion Indication (CI) set to 1
  - ACR is reduced by the formula (ACR x RDF)
  - ACR is never less than MCR
- Source sets the EFCI to off on every data cell it sends

ABR Destination Behavior

- The destination notes the value of the EFCI bit on the received data cells
- It receives the RM cell, turns it around, and sends it back to the source
  - If the EFCI bit is set to on
    - The destination end station sets the CI (congestion indication) bit to 1 in the RM cell
    - Resets the EFCI state (No Increase (NI) set to 1)

Virtual UNI

- If a switch supports VP muxes, it is required to support multiple virtual UNIs on the single interface connecting it to the mux
  - A unique VPI is used to distinguish between users
  - Switches send/receive signaling messages on VPI=n/VCI=5, where a different n is associated with each individual user
  - ILMI messages use VPI=n/VCI=16
- VP mux combines all user VPCs onto a single switch facility via the user cells VPI
  - The VP mux must be transparent to user devices

Switched Virtual Path Service

- If a network does not support SVP services
  - It rejects the SETUP Message with Cause#65 "Bearer service not implemented"
- A point-to-point Virtual Path connection extends between 2 ATM interfaces
  - On the local ATM Layer interface, the VPC is identified by the VPI value
  - SVP is used to carry data for video applications
  - It may be present in many signaling messages
  - It is supported except in clearing messages

Generic Identifier Transport

- Generic ID is an information element
  - It is transported by the network without modification
- It is present in most signaling messages
  - Not present in Clearing messages
- Signaling messages that contain the generic identifier transport information element:
    - Setup & Add Party
    - Connect & Add Party Acknowledge
    - Alerting & Party Alerting

Traffic Parameter Negotiation

- Allows the negotiation of various cell rates during call establishment
  - Alternative ATM Traffic Descriptor
    - Used to negotiate the whole ATM Traffic Descriptor of the connection
    - Fully supported by the PNNI Control Point
  - Minimum acceptable ATM Traffic Descriptor
    - Used to negotiate the peak cell rates
    - Used to negotiate the minimum cell rates for ABR calls
    - Restriction on choosing a PCR
- Not supported on UNI 3.0 and UNI 3.1 interfaces

Traffic Management

These functions assist in the management and control of traffic and congestion in ATM networks

- They can be used in combinations, depending on the selected service category:
  - Frame Discard
  - ABR Flow Control
  - Connection Admission Control (CAC)
  - Feedback Controls
  - Usage Parameter Control (UPC)
  - Cell Loss Priority Control (CLP)
  - Traffic Shaping
  - Network Resource Management (NRM)

Traffic Management (cont.'d)

- Frame Discard
  - A congested network can discard at the frame level rather than at the cell level
    - "Frame" means the AAL protocol data unit
    - Frame discard can only be performed on connections for which it is specifically enabled
- ABR Flow Control
  - Adaptively shares available bandwidth among users
- Connection Admission Control (CAC)
  - The network decides whether to accept or reject a connection request during the call setup phase
- Feedback Controls
  - The network and end-systems regulate traffic connections according to the state of specified network elements

Traffic Management (cont.'d)

- Usage Parameter Control (UPC)
  - The network monitors the QoS of connections
  - Violations of negotiated parameters may result in cell discard or cell tagging
- Cell Loss Priority Control (CLP)
  - End systems generate traffic with cell markings for CLP
  - If the network treats this marking as significant, the network can selectively discard the marked cells
- Traffic Shaping
  - Techniques used to modify traffic characteristics
- Network Resource Management (NRM)
  - A logical separation of connections according to service characteristics (Virtual Paths are a tool for NRM)

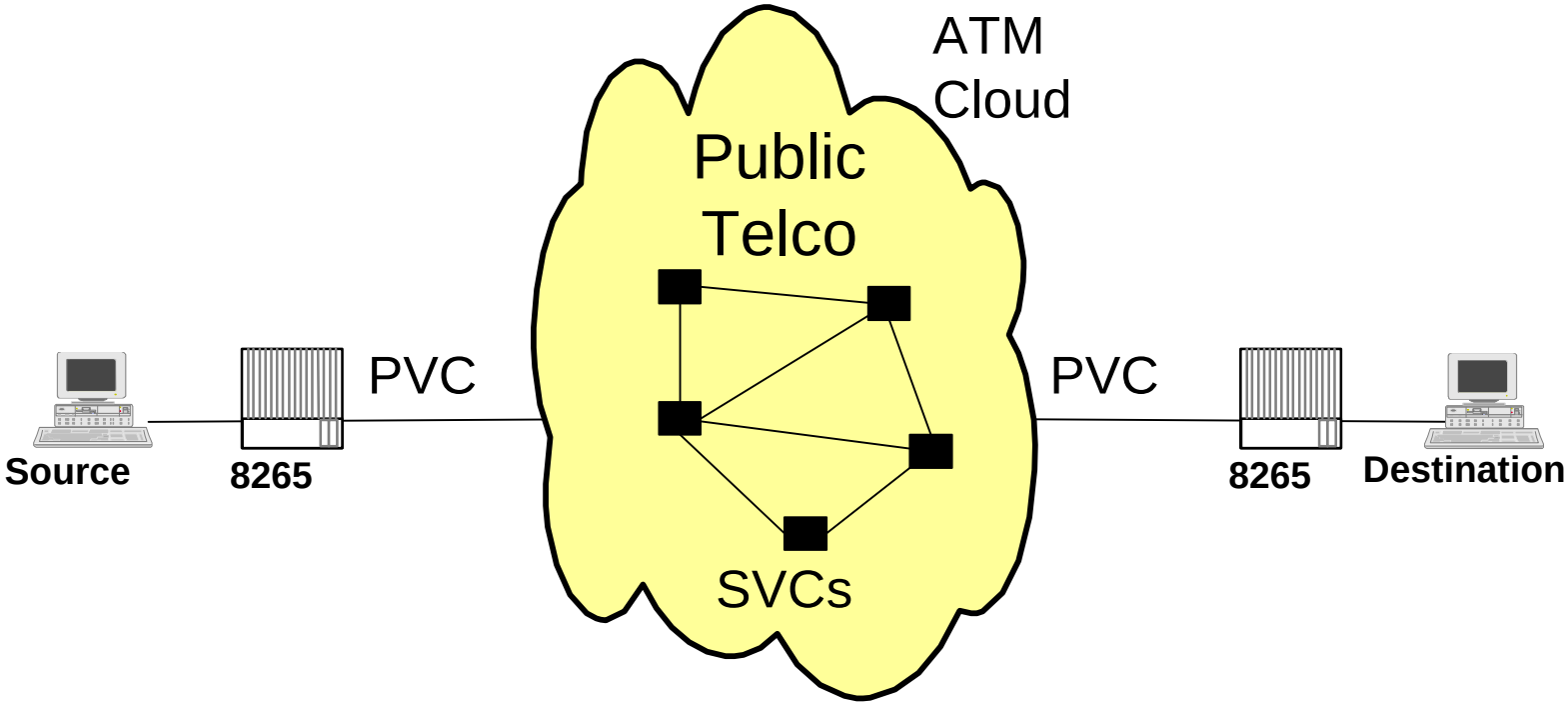
PNNI Signaling

- Based on a subset of UNI 4.0 signaling
  - Does not support some UNI 4.0 features
    - Proxy signaling, leaf initiated join, or user supplementary service
- Adds new features for dynamic call setup
  - Designated Transit Lists (DTL), Soft Permanent VPCs/VCCs (PVPC/PVCC), Crankback and alternate routing
  - Uses route calculations derived from reachability, connectivity, and resource information
    - This information is dynamically maintained by PNNI routing

Designated Transit Lists (DTL)

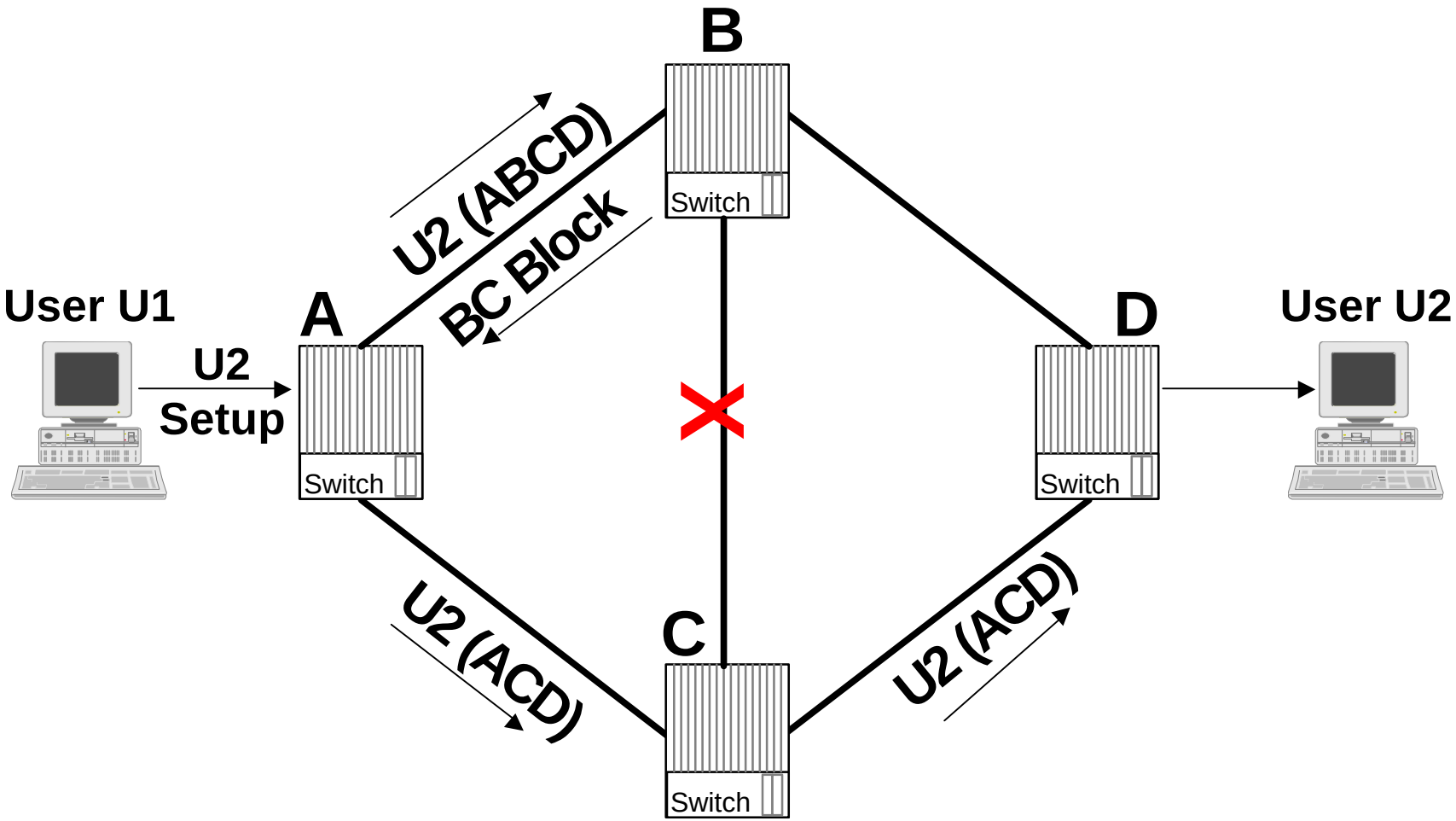
- Used for specifying PNNI routes
  - In processing a call, PNNI signaling requests a route from PNNI routing
- DTL is a complete path across a peer group
  - DTL is a sequence of Node IDs and Port IDs
  - DTL is provided by the Source Node or Entry Border Node to a peer group

Soft Permanent Virtual Path Connection /Virtual Channel Connection



- PVC is manually established
  - Rather than created on demand
- Establishment within the network is done by signaling

Crankback / Alternate Links



Diagnosing Hardware Configuration Problems

If a trap or error message is displayed on the client end when you start the 8265

- Enter **SHOW PORT** command on the 8265 to make sure that the media port's status is UP
- If the status is not UP, restart the client machine
- If the port's status does not change to UP, run a trace
  - Use the **SET TRACE** and **UPLOAD INBAND** commands

ATM Address Registration Problem

Faulty ATM address registration between a switch and an attached ATM device

- Check that the media port is configured with a UNI interface
  - Enter the **SHOW PORT** command
  - Enter **SET PORT** and set UNI for the interface
- Check that the port status is UP
  - Address registration can only occur when ILMI is up
- Check the ATM network prefix in the ATM address
  - The attached device must support the prefix used by the switch
- Check the switch and attached ATM device are using the same protocol

Diagnosing LANE Problems

If the LEC cannot register with the LES/BUS

- Check the LANE status message from the 8265
  - **SHOW DEVICE SUBNET LAN EMULATION ETHERNET/802.3**

    ABNORMAL TERMINATION: LES connection cleared.
    ATM Forum cause xxx:
    - **xxx** is the Cause Code, look up the Cause Code
- The LEC automatically tries to reconnect to the LES/BUS when the connection is lost
  - The LEC attempts every 5 seconds for 5 attempts and then once per minute

Diagnosing LANE Problems

If 2 LECs cannot PING each other

- Check that the 8265 port for the LEC is enabled
  - If it is enabled and its status is UP, there is a problem with the LEC or the cable attached to it
- Check that both LEC support the same LAN types
  - Both LEC are emulating IEEE 802.3 or DIX Ethernet frames or Token Ring 802.5
- If the LECs are not in the same IP subnet
  - Check the Default Gateway addresses

Diagnosing CIP Client Problems

8265 Cannot PING ARP Client

- Check that the ARP client has TCP/IP running
  - Check the address configured for its ARP server
- Verify the port of that ARP client is enabled and UP
- Check the Default Gateway in both machines

Diagnosing CIP Server Problems

8265 Cannot PING ARP Server

- Check the Q2931 Cause Code
- Enter **SHOW DEVICE**
  - Code 1: Wrong ARP server address entered in **SET DEVICE ARP_SERVER** or ARP server port is DOWN
  - Code 31: Switch IP address is not in the same IP subnet as the ARP server
  - Code 3 (PNNI links): If the ARP server is in the same peer group, a PNNI port does not have enough bandwidth or it is a failed connection
    - Do a PNNI dump on all PTSE headers, use command

    DUMP PNNI TOPOLOGY_DATA_BASE

LAB 6