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Cramsession™ for Cisco Certified Network Professional WAN Switching BSSC

This study guide will help you to prepare for Cisco exam 640-425, Cisco Certified Network Professional WAN Switching BSSC. Exam topics include BPX 8600 Overview, Systems Hardware and Networking, ATM Connections, and Port and Channel Statistics, Connection Routing, and Networking Alarms, Troubleshooting and Synchronization.

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Contents:

BPX Switch

Introduction

BPX 8600 series switches are high capacity, standards based, broadband switches that provide ATM switching, ATM+IP services, multiprotocol label switching and a range of other services.

BPX 8620

- Support for narrowband and broadband user services.
- Multi-shelf architecture for scalability.
- Compatible with the MGX 8800 series wide area edge switch, the MGX 8220 edge concentrator, and the IGX 8400 series wide area switch.

BPX 8650

- Scalable ATM+IP switch with voice over IP, MPLS VPN, and web hosting over ATM backbone capabilities.
- Integrates with Cisco 7200 series routers to provide MPLS throughout the network.
- Provides advanced IP services, Layer 2 virtual circuit switching, and Layer2/3 interoperability.

BPX 8680

- Wan edge switch that provides extensive quality of service (QoS), queuing, buffering and scalability.
- Uses a modular multi-shelf architecture to scale from small sites to very large sites.
- Consists of a BPX 8620 and one ore more MGX 8850 connected as feeders.

Hardware

Broadband Controller Card

The Broadband Controller card (BCC) is the heart of the BPX switch, and controls overall operations of the switch.

Slot 7 (and 8 for redundant configurations) is reserved for the BCC.

There are four models of BCC. The BCC-32, BCC-3-32M and BCC-3-64M have a 12x12 cross-point switching matrix (peak throughput of 9.6 Gbps) and the BCC-4V, which has a 16x32 cross-point switching matrix (peak throughput of 19.2 Gbps). They all include:

- Motorolla 68EC040 processor (33 Mhz).
- 68302 utility processor.
- HDLC processor for LAN connection interface.
- SAR (segmentation and reassemble) engine processor operating at 33 Mhz.
- 32 MB of DRAM for running system software (32 MB or 64 MB options for BCC-3 and BCC-4V).
- 4 MB of Flash EEPROM for downloading system software.
- 512 KB of BRAM for storing configuration data.
- Communication bus interface.

Functions of the BCC:

- Runs system software.
- Contains the cross-point switch matrix with 800 Mbps per serial link operation (1600 Mbps for BCC-4V). The switch fabric is non-blocking (there are more potential connections than cards to request connections), but each card is only allowed one connection at a time.
- Generates system clock (Stratum 3) that can be synchronized to a trunk or an external clock.
- Backplane communication bus used to communicate configuration and control information to all cards in the node.
- The arbiter polls each data port and gives access to the switch matrix if a port has data to transfer. The arbiter configures the switch matrix to make connections between cards that need to communicate. Connections are unidirectional and operate at 800 Mbps.
- Communicates with all nodes on the network.
- Provides a processor for the LAN port, auxiliary port and control port.
    - Connectors are on the back cards.

BCC Back Cards

BCC Card	Back Card
BCC-32	BCC15-BC
BCC-3-32M BCC-3-64M BCC-4V	BCC-3-BC

Backplanes

Backplane is either 9.6 Gbps or 19.2 Gbps (identified by card slot fuses at the bottom, back of the backplane).

All wiring on the backplane is duplicated. Either the A side or B side wiring is active at any given time. Signals from the control bus enable the active side.

In addition to the 15 card slots the backplane has the following buses:

- ATM Crosspoint wiring - carries ATM traffic between the network interface, service interface modules and Crosspoint switching fabric.
- Polling bus - carries enable signals between the BCC and network interface modules.
- Communications bus - for communication between BCC and all other cards.
- Clock bus - carries timing signals between BCC and all other system cards.
- Control bus - enables the A bus or B bus wiring.

Alarm Status Module (ASM)

- One ASM is required per node.
- Slot 15 is reserved for ASM.

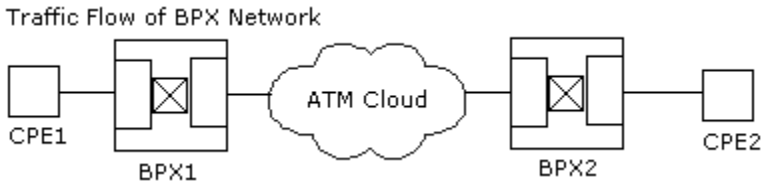
Features:

- Telco compatible alarm indicators, controls and outputs.
- Node power monitoring.
- Monitoring of cooling fans.
- Monitoring of ambient temperature.
- Detects the presence of other installed cards.

Switch Functions

Traffic Flow Example

Traffic flows from CPE1 (customer premises equipment) to a line card (ASI) or trunk card (BNI or BXM in UNI mode) on BXM1. The ATM cells are passed through the Crosspoint switch matrix to a trunk card (BNI or BXM configured as NNI) on the ATM cloud side. The traffic flow is reversed on the other side of the cloud where it will be passed to CPE2.



Configuration

Command Line Interface (CLI) Basics

A terminal can be run directly connected through the console port or remotely via a LAN connection or telnet.

The user command screen has three components:

- The top line lists the node name, user name, software revision, date, time and time zone.
- The middle area shows information returned by a command.
- The bottom part of the screen contains prompts for the next command or current command parameters.

Typing help or ? will display a list of the seven command categories.

Typing help and a command name will display the syntax for that command.

Typing help and a few letters of a command will display all commands that start with those characters (used to find a particular command).

To log into a BPX switch enter a valid username and password at the initial logon prompt (you may have to hit enter when the terminal is first connected to get the prompt).

From the command prompt type vt and the node name to log into a remote node (you cannot us the vt command from a virtual terminal session to daisy chain connections).

The bye command is used to log out of a BPX switch. If a virtual terminal session is open, the bye command closes only the vt session. (Typing the bye command twice would completely log you off).

For a complete list of the basic commands see the Cisco Wan Switching command guide.

Initial Configuration

Name a node using cnfname. Node name is case sensitive.

Configure the time zone using the cnftmzn command.

Set the date and time using cnfdate and cnftime respectively.

Use cnfterm to configure the baud rate, and other communication parameters of the control and auxiliary ports. Configure the ports functions with the cnftermfunc superuser command.

- control port can connect a terminal, modem or other RS-232 device.
- auxiliary port can connect a printer, modem or other RS-232 device.

Use dsptermcnf and dsptermfunc to display the current control or auxiliary port configuration.

Use the cnflan superuser command to configure the LAN port-used to connect the BPX to a Cisco WAN Manager workstation. Use dsplancnf to display the current configuration.

Viewing Network and Node Configuration

dspnw will display nodes on the network in tabular form. Information includes active trunks and alarm conditions. dsptrks displays all logical trunks configured for a node.

dspnds displays the name, type and alarm status of all nodes in the network where the command was issued.

dspnode displays access shelves configured for that node.

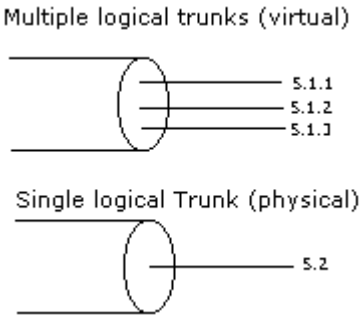
dspcds displays the cards (front and back) in a node. Information includes type revision and status of the cards.

dspcd displays serial number, status and revision of a card (if a back card is present the information is also displayed. If IMA is supported it is also indicated. Sonet APS configuration information (including mismatch information) is also displayed.

Setting up Trunks

With release 9.2 of the OS, you can have different interface types on the same card. Ports on the BXM cards can be physical or virtual trunks, interface shelf (feeder) trunks or ports (UNI).

64 logical (virtual and physical) are supported by each BPX node.



The total connection channels (LCNs) are shared by all the logical trunks on a card. A BXM card supports 65,535 channels max (16,320 default).

Queue depth per port is shared by all logical trunks on a card (over-subscription is possible due to the dynamic nature of the queues).

Virtual trunks cannot act as interface shelf trunks and interface shelf trunks cannot be used as virtual trunks.

The Ports and Trunks feature allows you to specify multiple trunk lines and circuit lines on a single BXM card (previously if you configured a port as a physical trunk, all ports on the card were physical trunks).

Common Trunk Commands

Command	Syntax	Description
addtrk	addtrk <slot.port>[.vtrk]	adds trunk to network
clrtrkalm	clrtrkalm <trunk number> <failure type>	clears trunk errors for logical trunk
clrtrkerrs	clrtrkerrs <trunk_number | *> (* clears errors on all trunks)	clears summary trunk statistics for logical trunk
clrtrkstats	clrtrkstats <*trunk number*>	clears trunk errors for physical line
cnflnalm	cnflnalm <fail_type> <alarm_class> <rate> <alarm_time> <clear_time>	configures statistical alarm thresholds for trunks and ports (affects all trunks on node)

cnfrsrc	cnfrsrc <slot>.<port> <maxpvclcns> <maxpvcbw> <partition> <e/d> <minvsilcns> <maxvsilcns> <vsistartvpi> <vsiendvpi><vsiminbw> <vsimaxbw>	configures statistical alarm thresholds for trunks and ports (affects all trunks on node)
cnftrk	cnftrk <*slot.port*>[.*vtrk*] <options for E1 | T1 | E3 | T3 | OC-3 | OC-12 | E2 | HSSI | SR >	configures logical trunk
cnftrkparm[1]	cnftrkparm <trk number> <parm index> <parm value>	configures parameters of a logical trunk
cnftrkstats[1]	cnftrkstats <line> <stat> <interval> <e|d> [<samples> <size> <peaks>]	configures interval collection statistics for a logical trunk
cnfphyslnstats[1]	cnfphyslnstats <port> <line> <stat> <interval> <e|d> [<samples> <size> <peaks>]	configures interval statistics for a physical line
deltrk	deltrk <slot.port>[.vtrk]	deletes trunk from the network
dntrk	dntrk <slot.port>[.vtrk]	downs trunk
dsptrkcnf	dsptrkcnf <slot.port>[.vtrk]	displays trunk configuration
dsptrkcons[1]	dsptrkcons <line number> Trunk number	displays number of connections routed over a trunk
dsptrkerrs	dsptrkerrs [slot | slot.port] or dsptrkerrs <slot.port> (for virtual trunks)	display trunk errors for a logical trunk
dsptrks	Dsptrks	displays upped/added physical and virtual trunks
dsptrkstatcnf[1]	dsptrkstatcnf <line> *line* can have the form *slot*, *slot.port* or *slot.port.vtrk*	displays configured statistics collection for a trunk
dsptrkstathist[1]	dspslotstathist <port>	displays configured statistics collection results for a trunk
dsptrkstats	dsptrkstats <slot.port> [clear] (clear directs the system to clear the system counters)	displays summary trunk statistics for a trunk
dsptrkutil	dsptrkutl <trunk number> [interval]	displays utilization/traffic for a logical trunk
prttrkerrs	Prttrkerrs	prints trunk errors for a logical trunk
prttrks	Prttrks	prints active logical trunks
uptrk	uptrk <slot.port>[.vtrk]	ups trunk

[1] denotes a superuser command

To set up a trunk:

1. Activate the trunk with uptrk.
    - Trunk will register an alarm condition if it is not upped at both ends.
2. Change the default trunk values with cnftrk.
    - Changes must be made at both ends of the trunk.
    - dsptrks displays current configuration.
3. Activate the trunk using addtrk.

To Reconfigure a trunk:

The cnftrk command will display and highlight all parameters that are configurable without first deleting the trunk. Changes made with cnftrk must be made at both ends of the trunk.

If you must first delete the trunk:

1. Use deltrk at one end of the trunk to delete the trunk.
2. Reconfigure the parameters using cnftrk at both ends of the trunk.
3. Use addtrk at one end of the trunk to add the trunk.

To remove a trunk:

1. Use the deltrk command to delete the trunk. If both ends of the trunk are reachable, execute on one end of the trunk, or you must delete the trunk at both ends.
2. Down the trunk at both ends using dntrk.

Virtual Trunks

A virtual trunk is a trunk defined over a public ATM service - it does not exist as a physical line. Cells are switched based on the VPI, which is assigned by the service provider. A single port can use virtual trunks to connect to multiple destinations.

Virtual trunks can connect BXM to BXM, BXM to UXM (on an IGX switch), or BNI to BNI. BNIs are not compatible with BXM or UXM (the BNI uses the STI ATM header while BXM and UXM use standard UNI or NNI headers).

A BMI T3 or E3 line can support up to 32 virtual trunks. A BNI OC-3 line can support up to 11 virtual trunks.

A BXM card can support up to 31 virtual trunks.

Nodes must be upgraded to revision 9.2 of system software for virtual trunking - mixed networks (different software releases) are not supported.

Firmware must be updated to support virtual trunks and virtual switch interface (VSI) on virtual trunks. See http://www.cisco.com/kobayashi/sw-center/wan/wan-planner.shtml to find the firmware revision best suited to your application (you need a valid CCO ID and password to access this information).

Virtual trunking is a payable option - Cisco customer service must be contacted to enable virtual trunking on your hardware.

To set up a virtual trunk:

1. Get a Virtual Path Connection (VPC) from ATM service provider.
2. Activate the trunk with uptrk.
3. Change the default trunk values with cnftrk.
    - The VPI configured must match the VPC assigned in step 1.

    Valid VPI ranges

Port Type	VPI Range
BXM (UNI)	1-255
BXM (NNI)	1-4095
BNI T3/E3	1-255
BNI OC-3	1-63

4. Configure the number of connection Ids (connids), bandwidth with cnfrsrc.
5. Repeat steps 2-4 on the node at the other end of the virtual trunk.
    - Transmit rate, VPC type, number of connection channels and traffic classes must be the same at both ends of the trunk. (Port types can be different - you can have a T3 at one end and an OC-3 at the other).
6. Activate the trunk using addtrk.
    - addtrk confirms that the parameters specified with cnftrk and cnfrsrc are the same at both ends of the trunk before the trunk is activated.
    - This can be performed at either end of the virtual trunk.

Virtual trunks support all types of traffic. Available traffic classes are:

- CBR trunks - for ATM CBR traffic, time delay sensitive traffic such as voice/data and streaming video.
- VBR trunks

- nrt-VBR for Frame Relay and nrt-VBR ATM traffic.
- rt-VBR for Frame Relay and rt-VBR ATM traffic.

- ABR trunks-for ATM ABR traffic and optimized bandwidth management traffic.

Virtual trunks share the total bandwidth available to a port.

Max Bandwidth of Ports

Port Type	Max Bandwidth (Cells/sec)
T3 (PLCP mode)	96000
T3 (HEC/Direct Mapping mode)	104000
E3	80000
OC-3	353208
OC-12	1412830
IMA	(# of lines)*(T1 or E1)

Setting up Lines and Ports

Configuring Lines

1. Activate a line using upln.
   - After you up a BXM line you will be prompted to use cnfrsrc to configure the Maximum PVC Channels, Maximum PVC Bandwidth, and Maximum VSI LCNs
2. Configure the line using cnfln.

Circuit Line Commands

Command	Syntax	Description
cnfln	cnfln <line> <*parameters*>	configures line parameters
dnln	dnln <line number>	downs a line
dsplncnf	dsplncnf <line number>	display line configuration for a particular line
dsplns	Dsplns	displays line configuration and alarm status for the node
prtlns	Prtlns	prints information provided by dsplns
upln	upln <line number>	ups a line

Note: cnfcln is an obsolete command as of revision 9.2 of the system software.

Configuring Ports

Once you have configured the lines, you can configure ports.

ATM Ports:

1. Use upport to up the port.
2. Configure the port with cnfport.

cnfportq is used to configure the port queue.

dspport displays the port configuration.

dspportstats displays the statistics of a port.

dspportq displays the port queue.

dnport deactivates a port (you must remove all connections prior to downing a port).

Configuring ATM Connections

There are two types of connection addressing modes:

- A unique VPI/VCI address - the BPX functions as a virtual circuit switch.
- Only a VPI address where all circuits are switched to the same destination port - the BPX acts as a virtual path switch.

VPI and VCI fields are only locally significant to the BPX.

- Tables in the BPX translate the VPI/VCI to route connections.
- Once the endpoints have been established, the Autoroute feature handles routing (if enabled).

To add an ATM Connection you need to have configured your lines and ports correctly (at both ends).

1. Modify the class with cnfcls if necessary (use dspcls to display current class parameters).
2. Use addcon at one node to add the connection.

addcon can be used to add the following types of connections by entering the required service type when prompted:

Service Types with addcon Command

Acronym	Service Type
CBR	Constant Bit Rate
rt-VBR	real time Variable Bit Rate
nrt-VBR	non-real time Variable Bit Rate
UBR	Unspecified Bit Rate
ABRSTD	Available Bit Rate per ATM forum standards
ABRFST	Available Bit Rate with Cisco Foresight congestion control
ATFR	Frame Relay to ATM internetworking connection
ATFST	ATFR with Foresight connection
ATFT	Frame Relay to ATM transparent internetworking connection
ATFTFST	ATFT with Foresight connection
ATFX	Frame Relay to ATM translational internetworking connection
ATFXFST	ATFX with Foresight connection

**Note: Links show the sequence of prompts for each service type.*

ATM Connection Commands

Command	Syntax	Description
addcon	addcon parameters	add connection
clrchstats	clrchstats <channel | *>	clear channel statistics
cnfabrparm	cnfcls <slot> <parameters]	configure ABR parameters
cnfatmcls	cnfatmcls <class number> [optional parameters]	configure ATM class
cnfcdparm[1]	cnfcdpparm <parameter number> <new value>	configure channel statistics level
cnfcls	cnfcls <class number> [optional parameters]	configure class
cnfcon	cnfcon <slot.port.vpi.vci> [bandwidth parameters]	configure connection
delcon	delcon <channel(s)>	delete connection
dspatmcls	dspatmcls <class number>	display ATM class
dspchstats	dspchstats <channel> [interval]	display channel statistics
dspcls	dspcls <class number>	display class
dspcon	dspcon <channel>	display connection
dspconcnf	dspconcnf <channel>	display connection configuration
dspcons	dspcons [start_channel] [nodename] [-f] [-v] [-d] [-atfr] [-abit] [-fabit] [-fail] [-down]	display connections

dsplmistats	dsplmistats <port> [clear]	display LMI statistics

[1]Superuser command

Routing and Optimization

Routing and Optimization Commands

Command	Syntax	Description
cnfchutl	cnfchutl <channel(s)> <%_util>	configure channel utilization
cnfcmb	cnfcmb <parameter number> <value>	configure combined timeout parameters
cnfcos	cnfcos <group | channel(s)> <cos>	configure class of service
cnfpref	cnfpref <channel(s) | *> <route> < + | -> [d]	configure preferred route
cnfrtcost	cnfrtcost <connection> <max cost>	configure cost-based routing
dncon	dncon {<group | local_chan(s)> | COS <cos_range>} {i | c}	down connection
dspload	dspload [nodename] [line number] [-j | -l]	display load for all trunks on a node
dspospace	dspospace <connection | group>	display open space for routes
dsprts	dsprts [start group | chan] [nodename]	display routes
dsptrkutil	dsptrkutl <trunk number> [interval]	display trunk utilization
prtrts	prtrts [start_channel] [dest_nodename]	print routes
upcon	upcon {<group | local_chan(s)> | COS <cos_range>}	up connection

Utilization

- Specify the expected utilization of voice, data or Frame channels, as a percentage, using cnfchutl.
  - default for Frame and data channels is 100%.
  - default for voice channels is 40%.
- Display utilization on a trunk using dspchutl.
  - time interval for utilization updates can be specified.
- Display the load over a specified trunk using dspload.
- The statistical reserve is the amount of bandwidth required for connection overhead in cells per second (CPS). Changing it will change the amount of bandwidth available for data and may affect routing decisions.

- The trunk load model is based on the % of available bandwidth available for a connection.

Class of Service (CoS)

Specify CoS for a voice, data or Frame channel using cnfcos.

- Cos is the delay (in seconds) before the network reroutes connections in the event of a trunk failure.

Bandwidth Management

- To allow more bandwidth for critical channels, less important channels (based on C0S) may have to be downed temporarily using dncon (use upcon to restore).
- Configure routing in an intra-domain environment using cnfpref for load balancing (do not use between domains).
    - Use dsprts and prtrts to display current routing configuration and to plan changes.

Multiprotocol Label Switching (MPLS)

- Formerly known as tag switching.
- Routers at the edge of the network apply simple labels to packets, so devices in the network core can switch the packets with minimal lookups.

Benefits of MPLS:

- Allows ATM, Frame Relay and IP internet services to run on the same platform and be scalable, cost-effective and easier to manage.
- When used with ATM switches, MPLS takes advantage of fixed length ATM cells to switch at wire speed.
- Combines the reachability information (layer 3) capabilities of routers with the traffic engineering optimization capabilities (data link, layer 2) of switches.
- Allows traffic engineering - traffic can be shifted from overused to underused portions of the network.

Label Switching Network Elements:

- Edge label routers.

    - Located at edge of the network.
    - Apply labels to packets.
- Label switches.
    - Switch packets based on the labels.
- Label distribution protocol.
    - Establishes peer sessions between label switches and exchanges the labels needed by the forwarding component.

Information in a label:

- destination
- precedence
- VPN membership
- QOS information from RSVP
- the route for the packet

Components of Label Switching Operation:

- Forwarding
    - Based on label swapping.
    - A label switch receives a packet with a label. The label is used as an index in the Label Forwarding Information Base (LFIB). The label and link level information is changed to correspond with the correct outgoing information and forwarded to the correct outgoing port.
- Control
    - Creates label bindings between labels and routes.
    - Distributes label bindings to label switches.

MPLS with the BPX8650

- The BPX8650 combines a BPX switch with a separate routing controller (Cisco 7200 or 7500), dividing the various services into separate logical spaces.
- Used to provide MPLS VPN services or advanced CoS services.

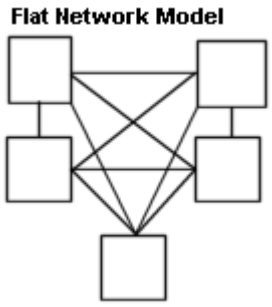
MPLS Applications

- IP+ATM integration: Allows ATM switches to support IP class of service, IP multicast, VPNs and RSVP in a more efficient manner than other overlay schemes.
- IP VPN Services: With the Border Gateway Protocol (BGP), MPLS offers highly flexible, scalable and manageable VPN services.
- IP Explicit Routing and Traffic Engineering: Allow specific routes to be selected for particular classes of traffic and uses special Label Switched Paths (LSP) to fine tune traffic flow.

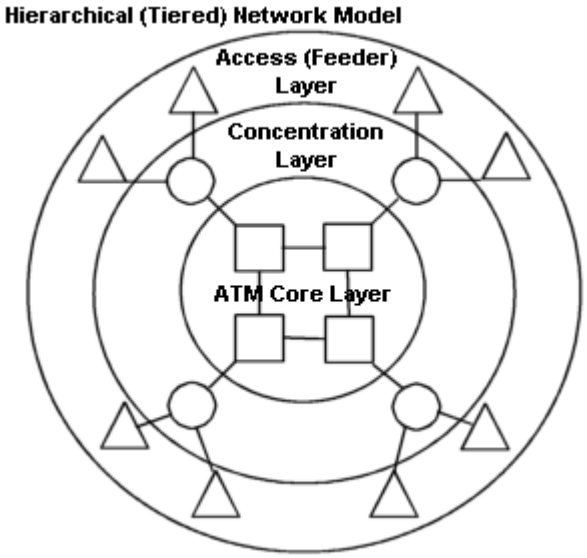
**Note: More information on Cisco's implementation of MPLS can be gained from the MPLS Guide.*

Private Network to Network Interface (PNNI)

- Also known as Private Network to Node Interface.
- Standards-based dynamic routing protocol (link state) for Frame Relay and ATM switched virtual circuits (SVC)/soft permanent virtual circuits (SPVC).
- Used between ATM switches and groups of switches (called peer groups).
- Defines two protocols:
    - Topology State Routing: distributes topology information.
    - PNNI Signaling: based on the ATM Forum UNI signaling with support for source routing, crankback, load balancing, and alternate routing, and defines message flows used to establish connections
- PNNI is best suited to a hierarchical network model (as opposed to a flat network model). A flat network model limits the scalability of a network. The concept of embedding topological information in hierarchical addressing is used to summarize route information.

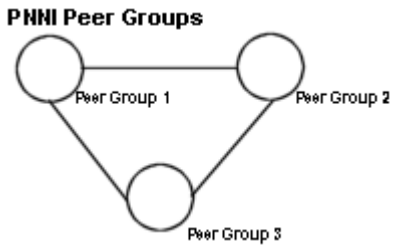


- Flat network model does not scale well as all nodes have routes to all other nodes.
- If all nodes are part of the same PNNI peer group, they are part of a flat network.
- Routing is optimized, as all nodes have a synchronized network topology database.



- PNNI allows 105 hierarchal network levels (numbered 0 through 104).
- Extremely scalable, as new layers can be added as the need arises.
- There is a trade-off between routing efficiency and scalability - the more hierarchal levels, the more scalable, but routing becomes less efficient.

- Nodes are grouped into clusters called peer groups (similar to an area in OSPF).
    - All nodes in a peer group have the same peer group ID.
    - Each node in a peer group is aware of the links to other nodes within the group as well as routes to connecting peer groups.



Note: Each peer group is a collection of ATM switches with the same peer group ID.

Routing information is passed between nodes in the form of PNNI Topology State Packets (PTSP). PTSPs contain link state, reachability and node status information used to calculate paths in the network.

A PTSP is made up of one or more PNNI Topology State Elements (PTSE). A node originates PTSEs to describe its environment, and receives PTSEs (in PTSPs) describing the other nodes in the network. PTSE information is stored in the PNNI Topology Database.

PTSE information includes:

- ATM address
- Node ID
- Peer group ID
- Logical link to neighbors in the peer group
- Internal reachable address
    - Locally reachable addresses such as connected end systems or members of the same peer group.
- Exterior reachable address
    - External address such as for nodes of other PNNI domains.

PNNI switches execute the Hello protocol on all enabled links. The Hello protocol:

- Indicates that a node is still active.
- Indicates whether or not a node is a member of the same peer group.
- Returns (echos) back the hello to the originator to indicate that the exchange has been successful.

After the Hello protocol determines that a link is functional, the PNNI nodes exchange a summary of their databases.

The status of links and nodes is described as metrics and attributes to make routing decisions.

Metrics are added end to end along a path.

If an attribute does not meet specified QoS requirements, the node or link is removed from route selection for a path.

Metrics:

- Administrative Weight (AW):
    - Administrative weight for a path is the sum of all individual weights for links on the path. Default AW is 5040.
- Maximum Cell Transfer Delay (MaxCTD):
    - The elapsed time for transmission of cells across a link or node.
    - Includes processing and queuing delays plus propagation delay, measured in calls per second.
- Peak-to peak cell delay variation (CDV):
    - The cell transfer delay minus the fixed delay experienced by all cells crossing the link or node.

Attributes:

- Available cell rate (AvCR):
    - Available capacity for CBR, rt-VBR and nrt-VBR service categories.
    - Minimum cell rate (MCR) reservation for ABR service.
- Maximum cell rate (MaxCR):
    - The maximum capacity available to certain service types.
    - MaxCR=0 indicates unavailability of bandwidth for new connections for UBR and ABR service categories
- Cell loss ratio for CLP=0 traffic (CLP0):
    - Maximum cell loss for CLP0 traffic over a link or node.
- Cell loss ratio for CLP=0+1 traffic (CLP0+1):
    - Maximum cell loss for CLP0+1 traffic over a link or node.

*Note: PNNI capability is added to the BPX switch with the addition of the Service Expansion Shelf PNNI Controller (SES). Detailed information on the installation and configuration of the SES as well as on PNNI are available on the ***SES documentation web site.***

Operation

Monitoring, Alarms and Troubleshooting

The BPX switches run self tests continuously. If an error that affects operation is found, it downs the card or trunk, logs the event and sets the alarm status on the node. Events that do not effect operations are logged and an alarm is set on the node.

Preventative Maintenance

There are three steps to preventative maintenance:

1. Check the supply voltage and cabinet temperature with the dspasm command (The dsppwr command will also show temperature and power supply condition).
2. Routinely check the event log with the dsplog command.
3. Routinely check the network alarm status with the dspalms command.
    - You can use the dspnds command to alarm status of nodes in the network.
    - The dspnode command will show the alarm status of connected interface shelves.
    - The dspnw command show the network in tabular form and includes the alarm status of each node.

*Note: A troubleshooting table for the BPX switch is available in the BPX Reference Guide. A complete description of the BPX troubleshooting commands can be found in the WAN Switching Command Reference.

Network Synchronization

- Clock source types are defined as primary (p), secondary (s), or tertiary (t) dependant on stability.
- Each node's clock is based on the most stable clock source.
- If more than one clock source of equal stability is available, the closest one is used (measured in hops).
- Clock sources are assessed using:
    - Stratum of the clock source.
        - Stratum of 2 is better that 4.
        - BPX BCC card has a built in Stratum 3 clock source

- Reliability of the clock source.
- Network configuration (distance of clock source).
- Availability of multiple clock sources.

Clock Sources:

- External (e) T1/E1
- Trunk (p) or circuit line (c) DS3/E3
- Internal (node oscillator provides the clocking signal)

When setting up clocks:

- Configure all primary clock sources first to avoid disruptions.
- A line must be upped and not in alarm before it can be used as a clock source.
- A trunk cannot be a clock source and be configured to pass clock.

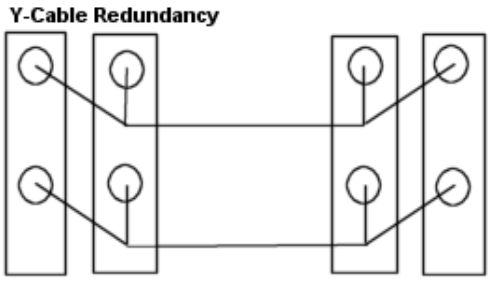
Commands used to set up clocks:

- Configure a clock source - cnfclksrc.
- Display clock sources - dspclksrcs.
- Display current clock - dspcurclk.
- Clear clock alarms - clrclkalm.
  - Clock alarms are "Bad Clock Source" and "Bad Clock Path".
  - Alarms must be cleared before a clock source can be used again.

Redundancy

Y-Cable Redundancy

Set up port redundancy by installing two identical front and back card sets, and connect them with a Y-cable on each paired port, then specify redundancy with the addyred command. Redundancy applies to the entire card and is not port or line-specific.



Y-Cable Redundancy commands

Command	Syntax	Description
Addyred	addyred <primary slot> <secondary slot>	add Y-Cable redundancy
Delyred	delyred <primary slot>	delete Y-Cable redundancy
Dspyred	dspyred [slot]	display Y-Cable redundancy
Prtyred	prtyred <start slot>	print Y-Cable redundancy
Switchyred	switchyred	switch from active to standby card

**Note: Only the front card/back card pair is redundant. For actual connection redundancy use APS.*

SONET APS

SONET Automatic Protection System:

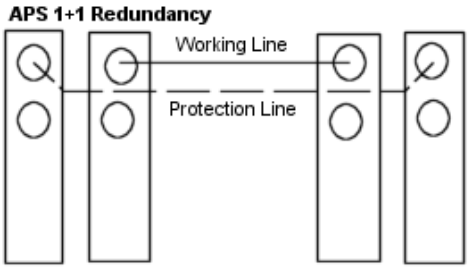
- A faster and more standards compliant alternative to Y-cable Redundancy.
- Supported on BXM Sonet trunks (OC-3 and OC-12).
- Can be used with virtual trunks.
- A pair of SONET lines can be configured for redundancy.
- If a line is cut, switchover can be achieved in less than 60 ms (Y-cable redundancy can take as much as 250ms).
- Switchovers occur at layer 1 (physical layer) of the OSI model
- Signal fail condition or signal degradation condition causes hardware to switch from working line to protection line (assume protection line not in alarm).
- If revertive option is enabled hardware switches back to the working line after a preset "wait to restore" period elapses (use cnfapsln to configure).
- Manually switch using the switchapsln command.

- An in-band protocol provides end-to-end coordination between interfaces.

APS 1+1 (Card and Line Redundancy)

- Provides both card and line redundancy.
- Uses two standard front cards with two special APS redundant back cards plugged into an APS redundant frame assembly.

First set up Y-redundancy, and then configure APS.

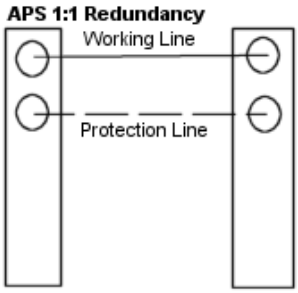


APS 1+1 Annex B

- Similar to APS 1+1, but only supports bi-directional operation and non-revertive switching.

APS 1:1 (Line Redundancy)

- Supported on standard OC-3 and OC-12 front and back cards.
- Two adjacent lines on the same card are used.



- You can only add APS 1:1 to lines in a standby state (not upped).

- Lines must be downed before APS 1:1 can be removed.
- Can only be configured for bi-directional, revertive operation.

**Note: Detailed configuration examples of APS can be found in the Cisco WAN Switching Command Reference.*

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