

CLSC Course Objectives Explained

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Overall CLSC Course Objectives

- 1) Describe the major features of the Catalyst switches.
- 2) Describe the architecture and functions of the major components of the Catalyst switches.
- 3) Place Catalyst series switches in a network for optimal performance benefit.
- 4) Use the command-line menu or menu-driven interface to configure the Catalyst series switches and their switching modules.
- 5) Use the command-line menu or menu-driven interface to configure trunks, virtual LANSs, and ATM LAN Emulation.
- 6) Maintain Catalyst series switches and perform basic troubleshooting.

Introduction to Switching Concepts

- 7) Describe the advantages of LAN segmentation.
 - Achieve more bandwidth per user
 - Supports traffic between same-segment nodes
- 8) Describe LAN segmentation using bridges.
 - Operate at layer 2
 - Bridges forward multicast and broadcast frames
 - Segmentations provides fewer user per segment
 - Bridges store, then forward all frames
 - Protocol-independent, plug and play
 - Bridges replaced in marketplace by switches
- 9) Describe LAN segmentation using routers.
 - Operate at layer 3
 - More manageable, greater functionality, multiple active paths
 - More complex
- 10) Describe LAN segmentation using switches.
 - Enables multiple high-speed data exchanges
 - Low latency and high frame-forwarding rates
 - Increases available bandwidth of a network
 - Works with existing 802.3 compliant network interfaces cards and cabling
- 11) Name and describe two switching methods.
 - **Store-and-forward** – in the store and forward mode, the switch receives the complete frame before forwarding takes place. The destination and source addresses are read, the cyclic redundancy check (CRC) is performed, relevant filters are applied, and the frame is forwarded. (If the CRC is bad, the frame is discarded.) This is the mode used by the Catalyst 5000 series switches.

- **Cut-through** – In the cut-through mode, the switch checks the destination address (DA) as soon as the header is received and immediately begins forwarding the frame. Some switches continue to read the CRC and keep a count of errors. If the error rate is too high, the switch can be set to use store-and-forward, either manually or automatically.

12) Describe full- and half-duplex Ethernet operation.

- Full Duplex Ethernet – Uses point-to-point Ethernet and Fast Ethernet connections. This arrangement is collision free as a result. Full duplex port connections can use 10BaseT, 10BaseFL, 100BaseTX, 100BaseFX, and ATM media to provide point-to-point links between switches or end nodes, but not between shared hubs. **Loopback and collision detection MUST be disabled.**
- Half-Duplex Ethernet – With Half-duplex Ethernet, a single physical connector provides several circuits. Most important are receive (RX), transmit (TX), and collision detection.

13) Describe Token Ring switching concepts.

Source-route switching forwards frames that do not contain routing information the same way that transparent bridging does. It forwards frames that contain RIFs based on the next ring number. All rings that are source-route switched have the same ring number, and the switch learns the MAC addresses of adapters on these rings. In addition to learning MAC addresses, the switch also learns Route Descriptors. A Route Descriptor (RD) is a portion of a RIF that indicates a single hop. RD is a ring number, bridge number, and ring number triple. When a source-routed frame enters the switch, the switch will learn the RD for the hop closest to the switch. Future frames with the same next hop RD are forwarded only to the port with the correct source-route bridge. This practice has two benefits. First, the switch does not need to learn the MAC addresses of devices on the other side of a source-route bridge. Second, the switch can support parallel source-routing paths by sending the frame to the correct source-routing bridge. A switch with only source-route switching could be used to microsegment an existing Token Ring in a source-route bridge network, but could not be used to replace existing source-route bridges without renumbering the existing rings.

A Token Ring:

- Is based on IEEE standard 802.5
- Consists of ring stations and transmission media
- Uses a deterministic media access method
- Passes a special bit pattern token from station to station

Virtual LANs

14) Define VLANs – VLANs logically segment the physical LAN infrastructure into different subnets (broadcast domains for Ethernet) so that broadcast frames are switched only between ports within the same VLAN.

- A group of ports or users in the same broadcast domain
- Can be based on port ID, MAC addresses, protocol, or application
- LAN switches and network management software provide a mechanism to create VLANs
- Frames tagged with VLAN ID

15) Name seven reasons to create VLANs.

- I. Simplify moves, adds, and changes
- II. Reduce administrative costs
- III. Better control of broadcasts
- IV. Tighten network security

- V. Microsegment with scalability
- VI. Distribute traffic load
- VII. Relocate servers into secured locations

16) Describe the role switches play in the creation of VLANs.

- Are entry points for end-station devices into switched fabric
- Provide intelligence to:
 - Group users, ports, or logical addresses
 - Make filtering and forwarding decisions
 - Communicate with other switches and routers
- Use frame filtering or frame identification (tagging)

17) Describe VLAN frame filtering and VLAN frame tagging.

Frame filtering is a technique that examines particular information about each frame based on user-defined offsets. It is a concept similar to that used by routers in that a filtering table is developed for each switch, switches share address table information, table entries are compared with the frames, and the switch takes appropriate action. **The Catalyst 5000 series switches do NOT use frame filtering.**

Frame Tagging uniquely assigns a user-defined ID to each frame. **It is used by the Catalyst 3000 and 5000 series switches** and developed specially for multi-VLAN, interswitch communications. Frame tagging places a unique identifier in the header of each frame, which is removed before the frame exits the switch on nontrunk links. Frame tagging also functions at Layer 2 and requires little processing or administrative overhead.

18) Describe how switches can be used with hubs.

Each hub segment connected to a switch port can be assigned to only one VLAN.

19) Name the five components of VLAN implementations.

- I. Switches
- II. Routing
- III. Interoperability
- IV. VLAN Management
- V. VLAN Transport Protocols

20) Describe static and dynamic VLANs.

Static VLANs are ports on a switch that you statically assign to a VLAN, using a VLAN management application or by working directly within the switch. These ports maintain their assigned VLAN configurations until you change them. Dynamic VLANs are ports on a switch that can automatically determine their VLAN assignments. Cisco offers a MAC-based version of this capability for the Catalyst 5000 series switch with the release of software version 2.4. When a station is initially connected to an unassigned switch port, the appropriate switch checks the MAC address entry in the VLAN management database and dynamically configures the port with the corresponding VLAN configuration.

21) Describe the VLAN technologies.

Several different, yet interoperable, transport mechanisms are used for communicating VLAN information across high-performance backbones. Among them are the Lane Emulation (LANE) standard that has been approved by the ATM forum, ISL for Fast Ethernet, and the IEEE 802.10 protocol, which provides VLAN communication across shared FDDI backbones. All of these VLAN technologies are supported on the Catalyst 5000 family switches. Each allows a single link to carry

information from multiple VLANs. VLAN Trunk Protocol (VTP) is a software feature on the Catalyst 5000 that allows you to map these trunking protocols together to create an integrated VLAN implementation across a user defined management domain.

22) Describe Token Ring VLANs.

A Token Ring LAN is:

- Defined independent of physical connections
- A Layer 2 broadcast (bridged) domain
- A logical construct using LAN switches

23) Describe Cisco's VLAN architecture.

Cisco's VLAN architecture includes the following:

- VLANs cross all high-speed technologies, using frame tagging (fast Ethernet) or virtual circuits (ATM)
- Multiple VLAN access to centralized resources
- Dynamic VLANs with VTP
- Dynamic ISL
- VlanDirector

Note: the Catalyst 5000 uses separate instances of Spanning Tree Protocol (STP) for each VLAN.

Placing Catalyst 5000 Series Switches in Your Network

24) Describe demand nodes and resource nodes.

Demand nodes include the following:

- Workstations
- Personal Computers
- Client applications
- Terminal Servers

Resource Nodes include the following:

- Servers
- Network backbone
- WAN routers
- Minicomputer or mainframe hosts

25) Describe configuration rules for demand nodes and resource nodes.

- I. Place resource nodes on dedicated, not shared links
- II. Use Fast Ethernet where appropriate
- III. Use full duplex where appropriate
- IV. Place local resource nodes close to associate demand nodes

26) Describe local resources and remote resources.

local resource – A resource node in the same collision domain as that of the demand node.

remote resource – A resource node located in a different collision domain.

27) Describe configuration rules for local resources and remote resources.

- Place local resources on segments with high user access

- Place global resources on their own segment. Servers should be 100 Mbps, preferably operating in full-duplex mode.

28) Name five applications for Catalyst 5000 series switches.

- I. Improve network performance
- II. Backbone switch
- III. Server cluster
- IV. 10/100-Mbps workgroups
- V. Desktop switched Fast Ethernet

Catalyst 5000 Series Switch

29) Describe Catalyst 5000 series switch product evolution.

Optimized for the Wiring Closet

- High/Low-port density switch
- Wide range of media connectivity options
- Flexible uplinks (Fast Ethernet, Gigabit Ethernet, ATM)
- Cisco IOS software for wiring closet
- Powerful embedded switch management

Scalable Backbone Performance

- High availability
- Capacity
- Wide range of media/port density
- VLAN management
- Cisco IOS software technologies

30) Describe Catalyst 5000 product features.

The Catalyst 5000 is a five-slot, modular switching system that provides high-density switched interfaces for wiring closet and data-center applications. The rack-mounted chassis has one slot dedicated to the Supervisor engine. The Supervisor engine enables Layer 2 switching and network management. This module contains two Fast Ethernet interfaces to connect to workstations, servers, other switches, and routers. The Catalyst 5000 has a 1.2 Gbps backplane. The architecture of the Catalyst 5000 can support the following topologies:

- Ethernet
- Fast Ethernet
- Token Ring
- FDDI
- ATM

31) Describe Catalyst 5002 product features.

The Catalyst 5002 is a two-slot modular platform that is capable of accommodating any one of the Catalyst 5000 switching modules and one Supervisor engine. Although the Catalyst 5002 has power supply redundancy, the power supplies are not hot swappable. If one of the power supplies fails, the chassis must be replaced. The Catalyst 5002 has a 1.2 Gbps backplane.

32) Describe Catalyst 5500 product features.

The 13-slot Catalyst 5500 is based on the Catalyst 5000 and LS1010 products. The Catalyst 5500 is designed to be a production-ready backbone switch that can also be used in the wiring closet. The same line modules used in the Catalyst 5000 will work in the Catalyst 5500. The chassis uses separate frame and cell switching backplane fabrics with separate switching engines for cell and frame switching. The

user can install what is needed, and all line modules and power supplies are on the same side of the chassis. The Catalyst 5500 has a 3.6 Gbps backplane and a 5.0 Gbps LS1010 bus.

The clocks on the Supervisors are not used when installed in the Catalyst 5500 chassis. Two redundant external clocks are used. The clocks are mounted on the back of the chassis and are separate from the backplane. If one fails, there is an immediate switchover. A red LED indicates a failure on the clock module and an SNMP trap is sent to the network manager.

| Catalyst 5000 | Catalyst 5500 |
|--------------------------------------|--|
| 5 slots | 13 slots |
| 1 Supervisor engine (slot 1) | 2 Supervisor engines (slots 1 and 2) |
| No redundancy (Supervisor Engine) | Redundancy (Supervisor engine in slot 2) |
| No chassis slot for LS1010 module | LS1010 module shares chassis slot (ASP in slot 13) |
| No support for ATM switching modules | Slots 9-12 support ATM switching modules |
| 1.2-Gbps support (1 bus) | 3.6-Gbps support with Supervisor III (3 buses) |

Catalyst 5000 Series Switch Product Architecture

ADDITIONAL INFORMATION: EARL = Encoded Address Recognition Logic, listens and learns MAC addresses. The EARL associates source port, VLAN ID, and MAC address, controls address aging, and determines where to send frames.

- 33) Describe the architecture and function of major components of the Catalyst 5000 series switch:
- Processors: NMP, MCP, and LCP
 - 1) NMP = Network Management Processor, the NMP performs system control, system configuration, system diagnostics, spanning tree per VLAN, and network management (CLI, Telnet, or SNMP).
 - 2) MCP = Master Control Processor, the primary function of the MCP on the Supervisor engine is to communicate information between the NMP and the line module communications processors (LCPs).
 - 3) LCP = Line Module Communications Processor, each line module LCP, like the MCP, is an 8051 processor. It processes information sent to it by the MCP across the management bus. The Serial Communications Protocol (SCP) is an internal communications protocol used for this communication between modules.
 - Logic Units: LTL, CBL, Arbiter, and Phoenix
 - 1) LTL = Local Target Logic. Used to select which port or ports on the switching bus are to receive the current packet on the bus.
 - 2) CBL = Color Blocking Logic, Blocks VLAN traffic going out of a port or coming in from a port. CBL also assists spanning tree in blocking ports.
 - 3) ARB = Arbiter, one arbiter is located on each line card and on each Supervisor engine Control arbitration for each bus. Uses low, high, and system (critical) priorities. Low and high priorities are user settable.
 - ASICs: SAINT, SAGE, SAMBA, and Phoenix
 - 1) SAINT = Synergy Advanced Interface and Network Termination (Ethernet), 192KB dedicated frame buffer per port.
 - 2) SAGE = Synergy Advanced Gate Array Engine. Equivalent to SAINT without Ethernet MAC. (Non-Ethernet), 1 to 2 MB (ATM has 2 MB) of additional buffering.
 - 3) SAMBA = Synergy Advanced Multipurpose Bus Adaptor, located on both line modules and the Supervisor engine, provides arbitration to the switching bus both among the ports and among the line modules in the chassis. The SAMBA ASIC

works in either master or slave mode. A master can support up to 13 line cards, and a slave can support up to 48 ports on a single device. Broadcast/multicast suppression capability is available when SAMBA is in slave mode. Counters gather statistics in both master and slave mode.

- 4) Phoenix = A gate array ASIC used to connect the switching buses, allows you to continue to use all the Catalyst 5000 switch modules. While also providing a migration path to switching modules that are capable of 3.6 Gbps switching.

34) Trace a frame's progress through a Catalyst 5000 series switch.

Frame Flow Step 1 – When an Ethernet frame arrives at a port, the ports DMA controller stores it in its receive buffer. The port fully receives, buffers, and checks the frame's FCS, adds the 12-byte frame header containing port number and VLAN number, and increments the Ethernet MIB and RMON counters before storing the frame in the frame buffer and requesting access to the switching bus to forward the frame.

Frame Flow Step 2 – Once the entire frame is received and stored in the frame buffer, the SAINT ASIC posts a request to the bus arbiter to transmit the frame across the high-speed switching bus. The Supervisor engine performs the necessary bus arbitration and grants bus access to the line module as soon as it becomes available using a round robin method. The local arbiter on the line module then uses a round robin method to grants each port permission to transmit one frame at the priority level being serviced.

Frame Flow Step 3 – The bus arbiter issues a grant to the local arbiter, which, at the appropriate time, signals the SAINT ASIC to initiate the data transfer. The frame that is stored in the buffer is then transmitted across the high-speed switching backplane by the DMA controller.

Frame Flow Step 4 – As the frame is transmitted across the switching backplane, all ports receive the frame and store it in their frame input buffers. As with all bus architectures, because all ports on the bus receive the frame, there is no need for multiple copies of broadcast and multicast frames.

Frame Flow Step 5 – The last step in the frame flow process varies depending on the following factors:

Unicast and Multicast – When the EARL, in conjunction with LTL and CBL identifies a specific port or set of ports as the destination, it instructs the SAINT ASICs on the destination ports via the control bus to continue to receive the frame and subsequently transmit it out its port. The SAINT ASIC on the other ports will flush their buffers.

Broadcasts and Unknown DAs – If the destination address is unknown to the EARL, or is a broadcast or multicast address, then the frames are forwarded to all ports on the same VLAN as the source address.

Local Port – If the EARL determines that the frame does not require switching into the system, it issues a flush to terminate frame transfer on the bus from the source interface and causes all ports to flush their buffers. However, only a few bits of the packet are stored in each buffer before the EARL orders the flush. The EARL then flushes the buffer of only that packet.

Buffers Full – If the destination interface has no buffer to accommodate a frame, it issues a retry to the source. The source terminates the frame transfer and retries the frame at a later time.

Catalyst 5000 Series Switch Hardware

35) Describe the hardware features, functions, and benefits of Catalyst 5000 series switches.

Catalyst 5000

- 1.2 Gbps media-independent backplane
- Support for 10/100-Mbps switched Ethernet
- Fast Ethernet, FDDI/CDDI, and ATM connectivity
- Fully Manageable with SNMP and RMON
- 1000 VLANs and 16,000 MAC addresses

Catalyst 5500

- 3.6 Gbps cross bar matrix
- 5-Gbps LS1010 cell switching fabric
- Supervisor II provides 1.2-Gbps I/O
- Supervisor III will provide 3.6-Gbps I/O
- Clock source dependent on chassis type (Catalyst 5000 or 5500)
- EPROM on backplane stores MAC addresses

| Product | Slots | PS | Fixed PS | Modular | Sups | LS1010 |
|-------------|-------|----|----------|---------|------|--------|
| 2900 | 2 | 1 | Y | N | 1 | N |
| 5002 | 2 | 2 | Y | Y | 1 | N |
| 5000 | 5 | 2 | N | Y | 1 | N |
| 5500 | 13 | 2 | N | Y | 2 | Y |

36) Describe the hardware features and functions of the Supervisor engine.

| Supervisor | Supervisor II | Supervisor III |
|--|---|---|
| <ul style="list-style-type: none"> • 2 x Fast Ethernet • Supports: <ul style="list-style-type: none"> - Catalyst 5000 (1.2) - Catalyst 5002 (1.2) | <ul style="list-style-type: none"> • Ships with Catalyst 5500 • Supports: <ul style="list-style-type: none"> - Catalyst 5000 - Catalyst 5002 - Catalyst 5500 • 2 x Fast Ethernet • Modular Feature card option • Increased NMP performance (2-3X) • Redundancy • Fast EtherChannel | <ul style="list-style-type: none"> • Supports: <ul style="list-style-type: none"> - Catalyst 5000 - Catalyst 5002 - Catalyst 5500 • Modular Uplinks: <ul style="list-style-type: none"> - 2 x Fast Ethernet - 2 x Gigabit Ethernet • Modular Feature card option • L3 with feature card option • 3.6-Gbps Crossbar Fabric support • Increased NMP performance (10X) • Redundancy • Fast/Gigabit EtherChannel |

37) Describe the hardware features and functions of the modules in the Catalyst 5000 series switches.

All the Ethernet and Fast Ethernet modules share the following features:

- Media-rate performance
- Half- or full-duplex operation
- ASIC with embedded RMON and MIB on each port
- Per-port traffic management and prioritization
- Large per-interface buffers (192KB)

Ethernet and Fast Ethernet modules are as follows:

- Ethernet Switching Module – 10BaseT 24 Port, Telco 50 (WS-X5010)
- Ethernet Switching Module – 10BaseT 24 Port, RZJ-45 (WS-X5013)
- Ethernet Switching Module – 10BaseFL 12 Port (WS-X5011)
- 10/100-Mbps Fast Ethernet Switching Module – 10/100BaseTX 12 Port (WS-X5213A)
- Fast Ethernet Switching Module – 10/100BaseFX 12 Port Multimode Fiber Module (WS-5111)
- Fast Ethernet Switching Single-Mode/Multimode Fiber Module – 100BaseFX 12 Port (WS-5114)
- Group Switching Fast Ethernet Module – 100BaseTX 24 port (WS-X5223)
- Group Switching Ethernet Module – 10BaseT 48 port (WS-X5020)

The module features for all of the Ethernet and Fast Ethernet switching modules include the following:

- Module status
 - Green (operational)
 - Red (faulty)
 - Orange (minor fault or manually disabled)
- Link
 - Green (good)
 - Orange (disabled by software)
 - Orange flashing (link is bad and has been disabled)
 - Off (not connected)

Token Ring Switching Module – The Token Ring Switching Module requires Supervisor II and supports the following features:

- 16 RJ-45 Token Ring ports (WS-X5030)
- or 16 Token Ring Fiber ports (WS-X5031)
- Media speed throughput
- Dedicated Token Ring on every port
- Integrated source-route switching (SRS), source-route bridging (SRB), and source-route transparent (SRT) bridging.
- ATM TR LANE, Token Ring in ISL

FDDI/CDDI Modules –

ATM LAN Emulation Dual PHY Modules

Route Switching Module

Configuring Catalyst 5000 Series Switches

38) Prepare network connections

When preparing your site for network connections to the switch, consider:

- Type and cabling required for each interface
- Distance limitations for each signal type
- Estimate of link loss value to determine sufficient power to operate transceiver for each interface
- Specific cables you need to connect each interface
- Any additional interface equipment you need: transceivers, modems, CSUs/DSUs

39) Establish a serial connection

The Supervisor engine module console port is a DCE DB-25 receptacle, which supports a DCE EIA/TIA-232 interface type and mode. When connecting a serial device, consider the cable as an extension of the switch for an external connection, therefore, use a null-modem cable to connect the switch to a remote DCE device such as a modem or data service unit (DSU), and use a straight-through

cable to connect the switch to a DTE device such as a terminal or PC. Use the console port to connect to a data terminal, which needs to be configured as follows: 9600 baud, 8 data bits, 1 stop bit, no parity.

40) Use the Catalyst 5000 switch CLI to:

- Enter privileged mode. **Consol e>enabl e** <enabl e_password>
- Set system information.

| Task | Command |
|-------------------------|--|
| Set the system contact | Set system contact <i>contact_string</i> |
| Set the system location | Set system locati on <i>locati on_string</i> |
| Set the system name | Set system name <i>name_string</i> |
| Set the system clock | Set time <i>day_of_week mm/dd/yy hh:mm:ss</i> |
| Set the system prompt | Set prompt <i>prompt_string</i> |
| Set normal password | Set password |
| Set enable password | Set enabl epass |

Examples:

```

Consol e> (enabl e) Set system contact Bill x1234
Consol e> (enabl e) Set system locati on Operations 1, Cube 1111
Consol e> (enabl e) Set system name Catalyst 5000-48
Consol e> (enabl e) Set time wed 6/23/99 10:40:00
Consol e> (enabl e) Set prompt Catalyst 5000-48>

```

- Configure interface types.

| Task | Command |
|--|--|
| If you use a LAN connection to the console port, activate the logical port sc0 | Set interface sc0 up Set interface sc0 [<i>vlan_num</i>] <i>ip_address [netmask [broadcast]]</i> |
| If you use a SLIP connection to the console port, activate the SLIP port. | Set interface sl0 up Set interface sl0 <i>slip_address</i> <i>dest_address</i> |
| Check the Interface status | Show i nterface |

Managing the Catalyst 5000 Series Switch Family

41) Upon completion of this module, you will be able to describe the different ways of managing the Catalyst 5000 series switch, including:

- Out-of-band management (console port) – Uses direct connection to the EIA/TIZ-232 serial port on the Supervisor module and includes terminal, modem, and SLIP access
- In-band management (network connection using SNMP) – uses a modem attached to the console serial port via a straight through cable with a 25-pin D-type connector. You can also connect via Telnet and SNMP across the network using a line module. You can maintain up to 8 telnet connections.
- RMON – Optional agent supports four RMON groups on all Ethernet and Fast Ethernet ports
 - 1) Statistics Group: Port utilization and error statistics
 - 2) History Group: Periodic statistics stored
 - 3) Alarm Group: You set sampling interval and threshold
 - 4) Event Group: Logs events to network management station
- SPAN – Enhanced Switched Port Analyzer, lets you monitor traffic for analysis by a network analyzer or RMON probe. Lets you monitor traffic from Ethernet, Fast Ethernet, and FDDI ports as well as VLANs. You can monitor a single port or VLAN using a dedicated protocol analyzer such as a Network General Sniffer, or, RMON probe, such as a Cisco SwitchProbe.

The TrafficDirector management application can access Cisco SwitchProbes and the Catalyst 5000 series switch embedded RMON agent from the same console.

- CWSI – CiscoWorks Switched Internet Solutions is a set of management applications including CiscoView, VlanDirector, and TrafficDirector. There is also an optional solution, AtmDirector, available as well.

Troubleshooting the Catalyst 5000 series Switches

42) Upon completion of this module, you will be able to:

- Describe the approach for troubleshooting the Catalyst.
 - Where to start: Is this a new installation? Was something changed? Was here work being performed near the switch?
 - LEDs
 - LEDs flash during startup, then should turn green
 - Check for LEDs that indicate a problem
 - Red LED indicates a failure
 - Orange LED can also indicate a problem
 - Hardware
 - Commands
 - Physical Layer
 - Network Testing
- Describe the physical-layer problem areas.
 - In most networks, the majority of network problems can be traced to cabling problems.
 - Incorrect or malfunctioning device connections can also be the cause of network problems.
- Use the *show* commands to troubleshoot problems.

The following **show** commands can assist in troubleshooting

 - **sh config** – displays the current system configuration
 - **sh int** – displays the Supervisor module network interface information
 - **sh module** – displays the module status and information (hardware/firmware/software)
 - **sh spantree** – displays the spanning-tree information for the VLANs, including port states.
 - **sh trunk** – displays the ISL information including trunking status
 - **sh vlan** – displays the virtual LAN type, status, and assigned modules/ports.
- Describe the switch hardware status.
 - Power Supply
 - AC or DC OK LED - Green
 - Fan OK LED - Green
 - The Output Fail LED – Red if the power supply is not within normal limits
 - POST
 - Check for normal console status
 - Check for correct firmware version
 - Check diagnostics, make sure line cards are seated
 - Use **show test** and **show log** commands for additional diagnostic information
- Describe the network test equipment – Two important tools that can be used for network testing are:
 - The *ping* command
 - Is there a cable problem?

- Can the testing terminal communicate with any other devices
- Can any other devices communicate with the switch?
- Are there port errors on the switch? (Check with the **sh port** command)
- Is there normal port traffic? (Check with the **sh mac** command)
- Are the port and interface sc0 in the same VLAN? (Check with the **sh port** and **sh int** commands)
- Test Equipment
 - Time Domain Reflectometer (TDR) – Measures cable length and impedance
 - Protocol Analyzer – Capture and display protocol information
 - Cable testers – Scanners for STP, UTP, or Fiber
 - Network monitors – continuously monitor network traffic

Catalyst 5000 Series Switch FDDI Module

43) Describe the major features and functions of the Catalyst 5000 FDDI/CDDI Module.

- 85,000-pps translational bridging between FDDI and Ethernet
- 1000 IEEE 802.10 protocol based VLANs
- Spanning-tree algorithm (802.1d), CDP, VTP, and 802.10 support
- 4000 active MAC addresses
- Variety of connectors and media types
- Multiple cards in same chassis
- MTU discovery, ApaRT, and fddicheck

44) Describe IEEE 802.10 VLANS

The 802.10 protocol incorporates a mechanism whereby LAN traffic can carry a VLAN identifier, thus allowing selective switching of packets with this identifier. **This protocol is the IEEE 802.10 interoperable LAN/MAN Security (SLS) standard, ratified in late 1992. Originally conceived to address security needs at layer 2**, it incorporates authentication and encryption techniques to ensure data confidentiality. The 802.10 standard defined a single protocol data unit, known as a Secure Data Exchange (SDE) PDU. This is a MAC-layer frame with an 802.10 header inserted between the MAC header and the frame's data. The 802.10 header comprises an inner and an outer header, known respectively as the "Clear Header" and "Protected Header" portions. The **Protected Header replicates the source address** contained in the MAC header to allow for address validation, which prevents another station from being identified as the real source. **The Integrity Check Value (ICV) is like FCS** and safeguards against unauthorized internal data modification using a security algorithm.

- Security Association Identifier (SAID) used as VLAN ID
- For just VLAN use, high-throughput devices need support only Clear Header portion of packet.
- Four-byte SAID allows for 2^{32} distinct VLANs
- Configure ports for multiple VLANs, map VLAN membership to interface and protocol.
- VLAN numbers, SAID numbers are independent of one another
- 802.10 VLAN packets are valid MAC frames, handled transparently by non-802.10 devices.
- 802.10 allows VLANs across enterprise backbone
- VTP advertises VLAN translation mappings.

45) Configure the Catalyst 5000 FDDI/CDDI Module.

The default values suit most environments:

- All FDDI ports enabled
- IPX protocol translations
- IP fragmentation
- ICMP unreachable messages enabled

Creating an FDDI VLAN – `set vlan vlan_num type fddi [mtu mtu] [said said]`

Deciding whether to disable ApaRT

- ApaRT enabled by default
- Advantages to disabling APaRT are increased throughput (5,000 to 10,000 more pps) while the EARL continues to provide packet forwarding information
- Disadvantages to disabling ApaRT include only default IPX translations are used, all traffic from FDDI ring is translated and forwarded to Catalyst backplane, and automatically disables fddicheck.
- May want to disable ApaRT in IP-only environments

Deciding whether to enable fddicheck

- Fddi check disabled by default
- Can prevent loss of connectivity
- Increases latency by performing lookup
- Leave off unless you need it
- Requires ApaRT to be enabled

Introduction to ATM LAN Emulation

46) Define LAN emulation – Developed in 1994 and ratified in 1995, LAN emulation (LANE) is an ATM Forum standard used to connect legacy Ethernet and Token Ring networks to an ATM network. The LANE specification hides the ATM network from the users and allows the ATM network to look like a legacy Ethernet or Token Ring LAN. It works by making the ATM network emulate a MAC network, which allows all endpoints to transparently send MAC-based packets to each other. An emulated LAN (ELAN) is a group of ATM-attached devices, including legacy shared-media devices and fully ATM-attached devices. An ELAN is treated as an independent broadcast domain, and can be thought of as a single Ethernet segment or independent Token Ring.

47) Describe the LAN Emulation components – LAN Emulation defines two components, the LAN Emulation Client (LEC) and LAN Emulation Services. LAN Emulation Services are made up of the LAN Emulation Configuration Server (LECS), the LAN Emulation Server (LES), and the Broadcast and Unknown Server (BUS). The LANE services can all be located in the same device, or distributed among one, two, or three devices. The LEC can be located in the same device(s) as the LANE Services. In the Cisco implementation, the LES and the BUS must be located in the same device.

48) Describe the start-up procedure of a LAN Emulation Client.

To join an ELAN, the first thing an LEC needs to do is contact the LECS. The LECS provide the ATM address of the LES for the ELAN.

The LEC contacts the LECS via one of the following methods (in the listed order):

- Using a preconfigured address for the LECS
- Using ILMI
- Using the well-known address of the configuration service.

The LEC and LECS communicate using a Configuration Direct VCC. After the LES allows the LEC to join the ELAN, the LEC must learn the address of the BUS. The LEC does this by sending an LE-ARP request to the broadcast address. The LES responds to the LE-ARP request with the ATM address of the BUS. The LEC sets up a Multicast Send VCC with the BUS. The BUS forwards the address of the LEC to its Multicast Forward VCC, which is a point-to-multipoint VCC used by the BUS to broadcast data to all LECs in the ELAN.

49) Describe how one LEC establishes communication with another LEC.

For Client A to send information to client B, the following transactions must occur:

- Client A knows the MAC address of client B, but needs to learn the ATM address of client B. It sends an LE-ARP request to the LES.
- Simultaneously with step 1, client A begins forwarding data frames to the BUS.
- The LES checks its LE-ARP table for the ATM address of client B. If it is in the table, the LES sends the ATM address to client A. If the ATM address is not in the LE-ARP table, the LES forwards the LE-ARP request to all of the LECs using the Control Distribute VCC (point-to-multipoint). Note that if the LEC is a bridge, the ATM address will not be in the table.
- Simultaneously with step 3, the BUS forwards the initial frames to all stations using the Multicast Forward VCC.
- Client B responds to the LE-ARP sent by the LES.
- The LES relays the LE-ARP response (contains the ATM address of client B) to client A.
- Client A sets up a Data Direct VCC with client B.
- Client A sends a Flush message to the BUS. The Flush message tells the BUS to stop forwarding any remaining frames that have not yet been sent.
- Client A uses the Data Direct VCC to communicate with client B.

50) Discuss how internetworking is achieved in a LANE environment.

When two end systems reside within the same ELAN, the various switches in the ELAN handle their data transmissions. If the two end systems reside in different ELANs, a Layer 3 router or switch must be used to interconnect the ELANs, even if the two end systems are physically connected to the same edge device.

Catalyst 5000 Series Switch ATM LANE Module

51) List the features of the Catalyst 5000 LANE module.

- Provides connectivity to ATM backbone
- Support for SONET/SDH OC-3 (155 Mbps)
- Available with dual physical connections
- Supports multiple cards in same chassis
- PVC and SVC support
 - SVC through Signaling Q.2931
 - PVC through configuration
- ILMI address registration
- Online insertion and removal
- LAN Emulation Client
- LAN Emulation Configuration Server
- LAN Emulation Server
- LAN Emulation Broadcast and Unknown Server
- Up to 256 LANE Clients supported
- Up to three LANE modules in Catalyst 5000
- DUAL PHY ATM – redundant connections similar to FDDI Dual Homing

52) Outline the performance ratings for the ATM bus and the switching bus.

The default number of circuits is 1024, but is expandable to 4096, depending upon memory and other requirements. In order to provide 155-Mbps throughput, two ATMizer chips are used: one for transmit (segmentation) and one for receive (reassembly). Traffic shaping is provided by a single rate queue. The ATM LAN Emulation module uses AAL5 as the adaptation layer for segmentation and reassembly.

53) Describe how to access the CLI for the LANE module.

The LANE module uses a CLI for configuration and maintenance. The CLI is provided on the card itself, and is not part of the Supervisor module code. Access to the ATM configuration software is via the administration port on the Supervisor module. The CLI is based on Cisco's IOS software CLI. The CLI offers software support for the following SNMP MOBS: MIB II, ATM MIB, LANE MIB, and ILMI MIB.

54) Describe the Simple Server Redundancy Protocol (SSRP).

SSRP for LAN Emulation is a new Cisco IOS software release 11.2 feature that adds a measure of fault tolerance to the standard LAN Emulation. It is always enabled with LANE and used by redundant server configurations. SSRP allows fault tolerance for the LECS and LES/BUS and operates only on Cisco LECS and LES/BUS combinations.

Configuring the Catalyst 5000 Series Switch ATM LANE Module

55) Explain ATM address structure.

- Every LEC must have a MAC address
- Every LANE component (LECS, LES, BUS, and LEC) must have a unique ATM address
- All LECs on the same ATM interface have the same, automatically assigned MAC address
- MAC address is used as the end-system identifier (ESI) part of the ATM address
- LEC MAC addresses are not unique
- All ATM addresses are unique

ATM routing protocols operate on ATM private network, NSAP format addresses. ATM private network address space can be obtained from ATM service providers or directly from the various national authorities designated by ISO to allocate the NSAP address space. ATM addresses have a substructure defined in the UNI specification. There are three types of ATM addresses identified by the first byte, called the AFI (Authority and Format Identifier):

- Data Country Code (DCC), AFI = 39. The DCC code is assigned by the ISO.
- International Code Designator (ICD), AFI = 47. The British Standards Institute assigns the ICD.
- E.164, AFI = 45

The remaining portion of the address is domain-specific. The domain-specific part contains the ESI and the selector byte. The prefix of the domain-specific part can be further subdivided to create the appropriate hierarchy that the user needs to operate its ATM network. The ESI is a six-byte field and the selector is a one-byte field.

56) Describe how ATM addresses are automatically assigned.

- A pool of MAC addresses is assigned to each LANE module.
- Pool contains 16 MAC addresses
- MAC addresses are assigned to LANE components as follows:
 1. Prefix fields are identical for all LANE components, indicates the identity of the switch.
 2. First ESI in pool assigned to every LEC on interface
 3. Second ESI assigned to every LES on interface
 4. Third ESI assigned to every BUS on interface
 5. Fourth ESI assigned to LECS
 6. Selector field value is set to the subinterface number of the LANE component – except for LECS, which has selector field value of 0

EXAMPLE:

- MAC addresses assigned to interface are 0800.200c.1000 through 0800.200c.100f

- ESI part of ATM addresses are assigned to LANE components as follows:
 1. Any LEC gets the ESI 0800.200c.1000
 2. Any LES gets the ESI 0800.200c.1001
 3. Any BUS gets the ESI 0800.200c.1002
 4. The LECS gets the ESI 0800.200c.1003

57) Describe the rules for assigning ATM components to interfaces.

- LECS is always assigned to major interfaces
- LES and LEC of same ELAN can be configured on same subinterface
- LECs of two different ELANs cannot be configured on same subinterface.
- LESs of two different ELANs cannot be configured on same subinterface
- LEC and LES of two different ELANs cannot be configured on same subinterface

58) Configure LANE components on a Catalyst 5000 switch.

- Create a LANE plan and worksheet
- Configure LECS, BUS, LES, and LEC addresses, or use auto-address configuration
- Configure LES, BUS, and LEC
- Set up the LECS database
- Enable the LECS ATM address
- Configure the server ATM address on a LightStream 1010

Catalyst 1900 and Catalyst 2820 Hardware

59) Describe the major features and benefits of the Catalyst 1900 and Catalyst 2820 switches.

Catalyst 1900 Switch

- 24 switched 10BaseT ports (25th AUI port)
- 1 or 2 fixed 100BaseT ports (3 models)
- 1024 MAX addresses
- No expansion slots
- Cut-through or store-and-forward switching
- CiscoView and Telnet management

Catalyst 2820 SwitchB

- 24 switched 10BaseT ports (25th AUI port)
- 2 expansion slots for high-speed modules (100BaseT, FDDI, and ATM modules)
- 2048 or 8192 MAC addresses (not field upgradeable)
- Cut-through or store-and-forward switching
- CiscoView and Telnet management

Both the Catalyst 1900 and 2829 support the following features:

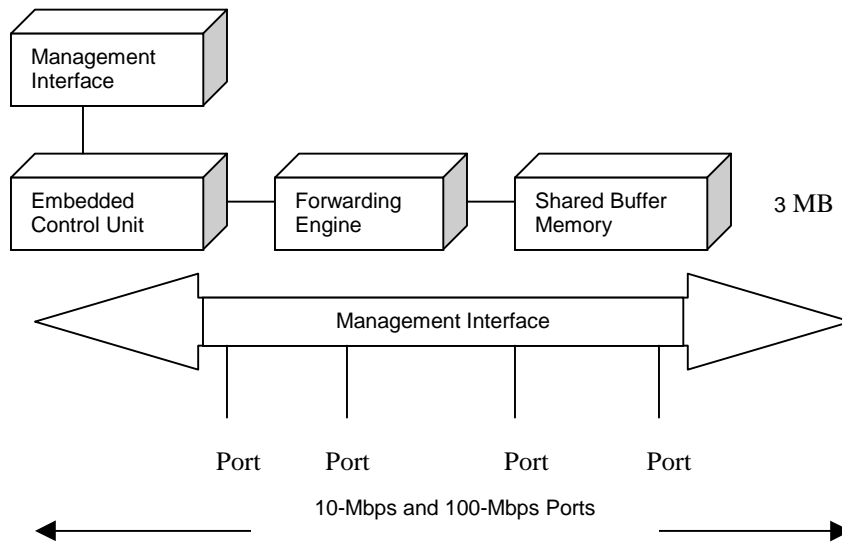
- IEEE 802.1d STP support
- Shared memory architecture with 3-MB packet buffer
- Connection to a redundant power system
- Up to four VLANs allowing ports to be grouped into separate logical networks.
- Cisco Group Membership Protocol (CGMP)
- Port security to prevent unauthorized access to the network
- Flooding and broadcast storm controls
- Management support with CiscoView device-management, Cisco Discovery Protocol (CDP), four groups of embedded RMON and Telnet and SNMP support for in-band and a menu-driven out-of-band management console.

60) Describe the hardware components and their functions of the Catalyst 1900 and Catalyst 2820 switches.

| Catalyst 1900 | Catalyst 1900C | Catalyst 1912 |
|---|--|---|
| 24 10BaseT ports 1 AUI port 2 100BaseTX ports 1024 MAC address | 24 10BaseT ports 1 AUI port 1 100BaseTX ports 1 100BaseFX ports 1024 MAC address | 12 10BaseT ports 1 AUI port 1 100BaseTX ports 1024 MAC address |

| Catalyst 2822 | Catalyst 2828 |
|---|---|
| 24 10BaseT ports 1 AUI port 2 high-speed expansion module slots 2048 MAC address cache | 24 10BaseT ports 1 AUI port 2 high-speed expansion module slots 8192 MAC address cache |

61) Describe the architecture.



The ClearChannel Architecture comprises the following components: Packet exchange bus (X-bus), forwarding engine, embedded control unit (ECU), management interface, share buffer memory, and switched ports. The Catalyst 2820 and 1900 switches employ shared memory buffering with a 3-MB memory capacity. The ClearChannel architecture uses a 1-Gbps packet exchange bus.

Forwarding Engine

- Implemented in hardware (ASIC)
- Address learning and matching
- Packet queuing and buffer allocation
- Forwarding Decisions
- Maintains statistics

Embedded Control Unit (EC)

- Configuration and Supervision
- Interface for in-band and out-of-band management
- Statistics Reporting
- Diagnostics and error handling

- Control of the front panel display.

Shared Buffer Memory

- 3-MB DRAM memory for 2048-packet buffer.
- Dynamic allocation
- One-half maximum to a single port (1.5 MB)
- Packets never copied or moved to another memory location
- Packets dynamically linked to the transmit queue

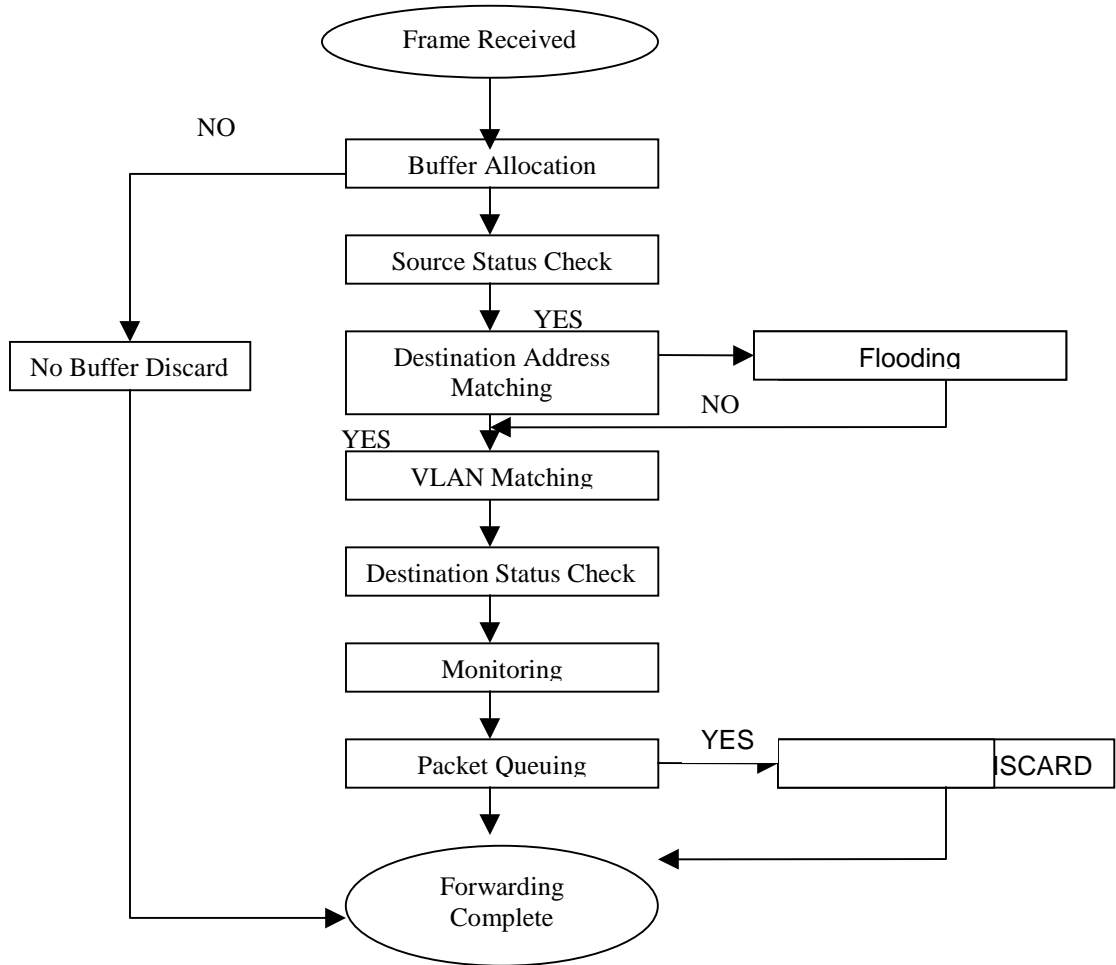
Catalyst 1900 and Catalyst 2820 Features

62) Describe the following key features and applications of the Catalyst 1900 and Catalyst 2820 switches:

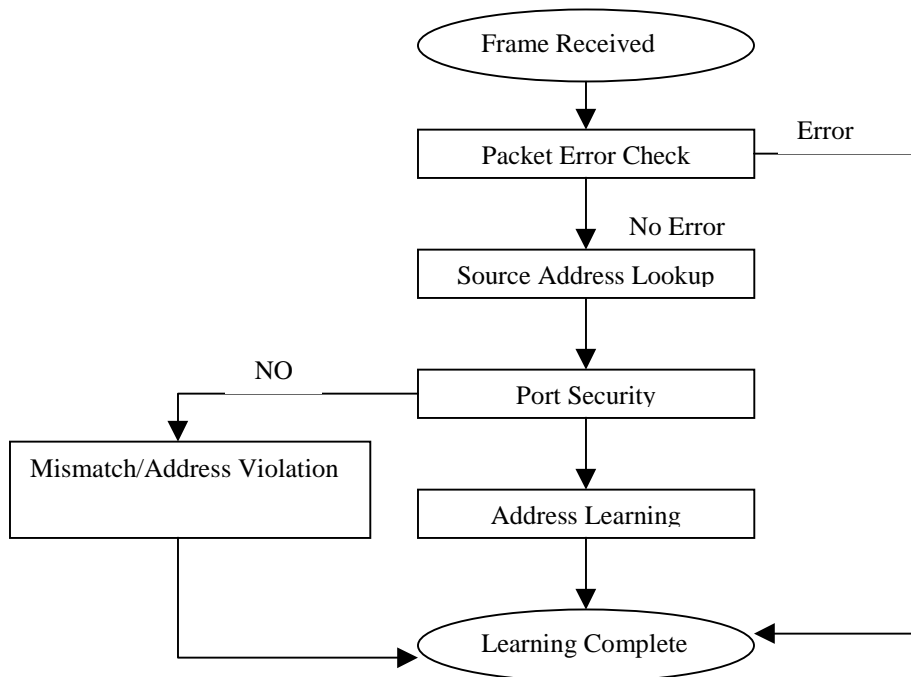
- Switching modes.
 - 1) FastForward (cut-through)
 - 2) FragmentFree (cut-through, but makes sure not a collision packet)
 - 3) Store-and-Forward
- Virtual LANs.
 - 1) Four VLANs supported per switch; configurable on a per-port basis
 - 2) Each VLAN has its own bridge MIB and spanning tree
 - 3) Inter-VLAN communication requires a router
- Multicast packet filtering and registration.
 - 1) Intelligent Filtering of multicast or broadcast packets reduces congestion
 - 2) Handle IP- and MAC address-based multicast protocols
 - 3) Achieve load balancing across servers
 - 4) Interoperate with routers to restrict transmission of packets to specific ports
 - 5) Communicate with routers through Cisco Group Management Protocol (CGMP)
 - 6) In-band or out-of-band registration of multicast addresses
 - 7) List of ports to which multicast packets are to be forwarded
 - 8) Use multicast packets for dedicated groupcast application.
 - 9) Default set to flood all ports but can be disabled on per-port basis
 - 10) Use multicast filtering with source port filtering for load balancing
 - 11) Can be forced to store-and-forward mode
- Broadcast storm control.
 - 1) Configured at the switch level, but implemented at the port level
 - 2) Disabled by default
 - 3) Broadcast forwarding disabled when port below reenable pps threshold
 - 4) Does not eliminate broadcasts
 - 5) Always uses store-and-forward mode
- Management support, CDP, and CGMP.
 - 1) Compatible with any SNMP or SMT-based management platform
 - 2) Menu-based management console through EIA/TIA-232 (RS-232) port except for the LANE module.
 - 3) Telnet support for in-band management (up to seven simultaneous sessions)
 - 4) Statistics for nine groups with SPAN port and external RMON probe
 - 5) Embedded RMON MIB
 - o Statistics, History, Alarms, and Events
 - 6) Cisco Discovery Protocol
 - 7) CiscoWorks Windows support
 - 8) TrafficDirector support
 - 9) AtmDirector
 - 10) CWSI

63) Trace a frame's progress through a Catalyst 1900 or a Catalyst 2820 switch.

FRAME PROCESSING Forwarding Decision



FRAME PROCESSING – Address Learning



Configuring Catalyst 1900 and Catalyst 2820 Switches

64) Use the Catalyst 1900 and Catalyst 2820 switch menus for configuration.

```
Catalyst 2820 Main Menu
[C] Console Password
[S] System
[N] Network Management
[P] Port Configuration
[A] Port Addressing
[D] Port Statistics Detail
[M] Monitoring
[V] Virtual LAN
[R] Multicast Registration
[F] Firmware
[I] RS-232 Interface
[U] Usage Summaries
[H] Help

[X] Exit Management Console
Enter Selection:
```

65) Configure IP addresses and ports on the Catalyst 1900 and Catalyst 2820 switches.

From the Network Management Menu, Select Option I

```

Catalyst 2820 – Network Management
[I] IP Configuration
[S] SNMP Management
[B] Bridge
[C] Cisco Discovery Protocol
[G] Cisco Group Management Protocol
[X] Exit to Main Menu

Enter Selection:

Catalyst 2820 – Network Management

Ethernet Address: 00-C0-1D-81-1E-E4

-----SETTINGS-----
[I] IP Address                172.20.249.28
[S] Subnet Mask              255.255.255.0
[G] Default Gateway         0.0.0.0
[V] Management VLAN         1

[X] Exit to previous menu

Enter Selection:

```

```

Catalyst 2820 – Port 1 Configuration

Built-in 10Base-T
802.1d STP State: Forwarding Forward Transitions: 1

-----Settings-----
[D] Description/name of port
[S] Status of port           Enabled
[I] Port priority (spanning tree) 128 (80 hex)
[C] Path Cost (spanning tree)    100
[Port fast mode (spanning tree)  Enabled

-----Related Menus-----
[A] Port Addressing          [V] View Port statistics
[N] Next Port                [G] Goto port
[P] Previous port           [X] Exit to Main Menu

Enter Selection:

```

66) Configure VLANs on the Catalyst 1900 and Catalyst 2820 switches - From the Main menu, select option From the Main menu, select option V

```

Catalyst 1900 – Virtual LAN Configuration

VLAN Name Member Ports
-----
1 1-24, AUI, A, B

-----Actions-----
[C] Configure VLAN
[X] Exit to Main Menu

Enter Selection:

```

- 67) View the Catalyst 1900 and Catalyst 2820 switch reports and summaries – From the Main menu, select option U

```

Catalyst 2820 – Usage Summaries

[P] Port Status Report
[M] Module Status Report
[A] Port Addressing Report
[E] Exception Statistics Report
[U] Utilization Statistics Report
[B] Bandwidth Usage Report

[X] Exit to Main Menu

Enter Selection:

```

- 68) Configure the ATM LANE module on the Catalyst 2820 switch.

- Configure Catalyst 2820 only as a LANE client
- Configure connected device as one of the following: BUS, LECS, LES
- Get Configuration information (VLAN ID and emulated LAN names) configured in LECS
- Supports only one emulated LAN

Using the Catalyst 2820 CLI, you can enter Cisco IOS software commands to configure the LANE client software on the ATM module. To access the CLI from the Catalyst 2820 management console, do the following:

1. Select [P] Port Configuration from the Catalyst 2820 Main menu. Be sure to select the port where the ATM module is installed. If the ATM module is installed in slot A, enter A (interface 0); if the module is installed in slot B, enter B (interface 1).
2. Select [K] command Line Interface from the Port Configuration Menu. The CLI screen is displayed. A CLI session with ATM module will open. To end the CLI session, enter [CTRL-G]

```

Port Configuration Menu

Catalyst 2820 – Port B Configuration (Right Slot)

Module Name: ATM 155 MM Fiber, Version 01
Description: Multimode Fiber
ATM Network Status: Operational
802.1d STP State: Forwarding Forward Transitions: 9

-----Settings-----
[D] Description/name of port
-----Module Settings-----
[M] Module Status Enabled
[I] Port Priority (spanning tree) 128 (80 hex)
[C] Path Cost (spanning tree) 10
[H] Port fast mode (spanning tree) Enabled

-----Actions-----
[R] Reset Module [F] Reset module with factory
-----Related Menus-----

[K] Command Line Interface

```

```

[A] Port Addressing
[N] Next Port
[P] Previous Port
[L] ATM and LANE status
[V] View port statistics
[G] Goto port
[X] Exit to Main Menu

Enter Selection:

```

Catalyst 3000 Series Switches

69) Describe Catalyst 3000 series LAN switch products.

The Catalyst 3000 switch system is designed to incorporate the advantages of stacked systems for growth, expansion capability for mixed resource delivery, and modular, pay-as-you-go cost effectiveness. Used in conjunction with the Catalyst Matrix, the Catalyst 3000 series switch provides up to 224 switched ports in a mixed 10-Mbps, 100-Mbps, and 155-Mbps environment. The Advanced Feature Set is available to facilitate VLANs, EtherChannel, and full-duplex port operation. The slide shows the primary features of the Catalyst 3000, Catalyst Matrix, and Catalyst Stack System.

| Product | Catalyst Matrix | Catalyst Stack System |
|--------------------|-----------------------|--------------------------|
| Ports | 8 | 24-224 |
| Modular | Yes | Yes |
| Connection | SCSI-2 | 10BaseT/F, AUI, ATM |
| Application | Catalyst Stack System | Wiring Closet |
| Management | None | SNMP MIB II, EIA/TIA-232 |
| Capacity | 480 Mbps – 4.8 Gbps | 160 Mbps – 4.8 Gbps |
| Throughput | 480 Mbps – 2.2 Gbps | 160 Mbps – 520 Mbps |

70) Describe Catalyst 3000 series LAN switch product differences.

| Product | Catalyst 3000 | Catalyst 3100 | Catalyst 3200 |
|--------------------|--|--|--|
| Ports | 16-24 | 24-48 | 1-28 |
| Modular | 2 Slots for Modules | 1 Module or WAN slot | 7 Slots for Modules |
| Connection | 10BaseT/F, AUI, ATM, 100BaseT/F, 100VG | 10BaseT/F, AUI, ATM, 100BaseT/F, 100VG | 10BaseT/F, AUI, ATM, 100BaseT/F, 100VG |
| Application | Wiring Closet, WrkGrp | Wiring Closet, WrkGp | Wiring Closet, campus |
| Management | SNMP MIB II, EIA/TIA-232 | SNMP MIB II, EIA/TIA-232 | SNMP MIB II, EIA/TIA-232 |
| Capacity | 160 Mbps – 560 Mbps | 240 Mbps – 570 Mbps | 40 Mbps – 700 Mbps |
| Throughput | 160 Mbps – 360 Mbps | 120 Mbps – 570 Mbps | 40 Mbps – 480 Mbps |

71) Describe the Catalyst Stack System.

The Catalyst 3000 is a 16- to 24-port LAN switch. The standard configuration includes 16 10BaseT ports, 4 MB of memory (all models now ship with 8 MB of memory), 1 MB of Flash memory, real-time clock, console port, SwitchProbe port, AUI port, and the following:

- Two slots for operational modules
 - 4-port 10BaseT
 - 1-port 100BaseT/F
 - 2-Port 100VG-AnyLAN
 - 3-port 10BaseFL

- 1-port 155-Mbps ATM
- 3-port 10Base2 Thinwire
- 2-port 100BaseT/ISL
- 2-port 100BaseF/ISL
- Switch-controlled half-duplex and full-duplex capability on all ports
- User-selectable cut-through or store-and-forward switching
- User-selectable thresholds for error-free or cut-through and runt-free operation
- Demand aging for port and master address tables (see note)
- EtherChannel and VLAN support
- Port 1 is auto-selectable between 10BaseT and AUI
- Port 16 is selectable between MDI and MDIX
- Security, destination, and source address filtering
- Optional additional 4 MB of system memory
- 1700 Addresses per port, 6000 addresses per system (10000 addresses per system with optional 4-MB memory expansion.)
- EtherChannel connectivity for certain models of Cisco and Kalpana switches. Avoiding obsolescence of current network assets
- Catalyst Stack system for connection up to eight Catalyst 3000 series switches in a stack

Note: If the demand aging percentage is set to 90 percent, when the table reached maximum address capacity, a random purge of 10 percent of the addresses is executed.

Configuring the Catalyst 3000 Series Switches

72) Perform initial setup of a Catalyst 3000 series switch.

- Connect a dumb terminal or a PC to the console port
- Autobaud the terminal by repeatedly pressing the enter key
- Perform the following tasks for initial setup of a Catalyst 3000 series switch
 - Enter switch/Stack information
 - Set system password
 - Perform console configuration

73) Configure the switch for management.

Perform the following tasks to prepare the Catalyst 3000 series switch to be managed:

- Configure IP parameters
- Configure SNMP parameters
- Configure RMON
- Configure SwitchProbe
- Configure Cisco Discovery Protocol (CDP)

74) Configure port parameters.

Perform the following tasks to configure ports on the Catalyst 3000 series switch:

- Configure Port Switching Mode
- Configure Broadcast Suppression
- Configure EtherChannel
- Configure MAX Filters and Port Security
- Configure Learn and Lock

75) Configure VLANs and trunk links.

Perform the following tasks to configure VLANs and LAN Emulation

- Configure VLANs and VTP

- Configure VLAN Ports
- Configure VTP administrative parameters
- Configure ATM and LANE

VLAN and VTP Configuration

Return to Previous Menu

Local VLAN Port Configuration

VTP Administrative Configuration

VTP VLAN Configuration

Local Preferred VLANs Configuration

Reassign Ports in Local VLAN

Display the Main Menu

Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu.

Local VLAN Port Configuration

| Port | Mode | VLAN |
|--------|--------|---------|
| 9 | Static | Default |
| 13 | Static | Default |
| 15 | Static | Default |
| 17 | Static | Default |
| 18 | Static | Default |
| 19 | Static | Default |
| 20 | Static | Default |
| 21 | Trunk | Default |
| 25 | Static | Default |
| Return | More | Chance |

Return to Previous Menu

Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu.

```

VTP Administrative Configuration
Return to Previous Menu
Domain Name
Local Mode                Server
Domain Password
Configuration Storage
Configuration TFTP Server
Server VLAN
Configuration File Directory
Domain Revision Number    0
Time of Last Revision Change 12/12/96 17:27:32
Last Updater              0.0.0.0

Display the Main Menu
Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu.

```

76) Configure the ATM LANE module.

Access the configuration menus in the following order:

- Catalyst 3000 Series Switch Configuration menu
- ATM Configuration menu
- ATM LANE Global Configuration menu

```

ATM Configuration
ATM LANE Global Configuration
LANE Client Configuration
LANE Server Configuration
LANE Configuration Server

Return to Previous Menu
Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu

```

```

ATM Port 21 Global Configuration
Operation Mode            Client
Configuration Type        ILMI
ATM SNAP Prefix          00.000000000000000000000000

Return to Previous Menu

```

Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu

77) Perform basic router module configuration.

Router Configuration

Return to Previous Menu

Enter a Port number

Return to Previous Menu

Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu

```

Router Configuration

Return to Previous Menu
Boot Up Console Selects...
Switch to Router Console...
Router Reset...
Board Information          0x22 0x0
Net Addr                  10. 10. 10. 1
Op State                  Up
Router Boot Option...
Router Flow Control ...

Return to Previous Menu
Use cursor keys to choose item. Press <RETURN> to confirm choice.
Press <CTRL><P> to return to Main Menu

```

The Router Boot Option screen displays two choices for the default boot-up procedure, as follows:

- With Switch – This selection forces the router card to reboot whenever the switch is rebooted
- Leave Alone – This selection sets the router card to remain in running mode when the switch is rebooted.

The Router Flow Control screen displays the following two options:

- None – No flow control. This is the default flow control for the router.
- Software Flow Control – If characters are not displayed correctly on the router CLI, change the router flow control to software flow control.

Maintaining the Catalyst 1900 and Catalyst 2820 Switches

78) Describe the POST and diagnostic messages on the Catalyst 1900 and Catalyst 2820 switches.

- Power-On-Self-Test, executed only when switch is powered on
- 13 tests – all LEDs light initially, Port LED is off during each test number
- LED remains off if test fails

79) Describe the cabling guidelines for the Catalyst 1900 and Catalyst 2820 switches.

| Type of Port | Cabling Type | Connector Type | Distance |
|--------------|---|----------------|--|
| 100BaseT | Category 5 UTP (100BaseTX) | RJ-45 | 100 Meters |
| 100BaseT | 50/125 or 62.5/125 multimode fiber (100BaseFX) | SC/ST/MIC | 412 Meters (Half-duplex) 2 Kilometers (Full-duplex) |

80) Use the statistics and reports to maintain the Catalyst 1900 and Catalyst 2820 switches.

Use Port status information for troubleshooting:

- Enabled – port is active, receiving and transmitting packets
- Suspended – Port is not active but will become active when condition causing suspension is removed
- Disabled – Port is inactive and must be manually returned to enabled state

Identifying Port LED Status

| Visual Identification | Status |
|-------------------------|------------------------|
| Green | Link Present |
| Flashing Green/Off | Activity |
| Alternating Green/Amber | Link Fault |
| Amber | Port is not forwarding |
| Off | No Link |

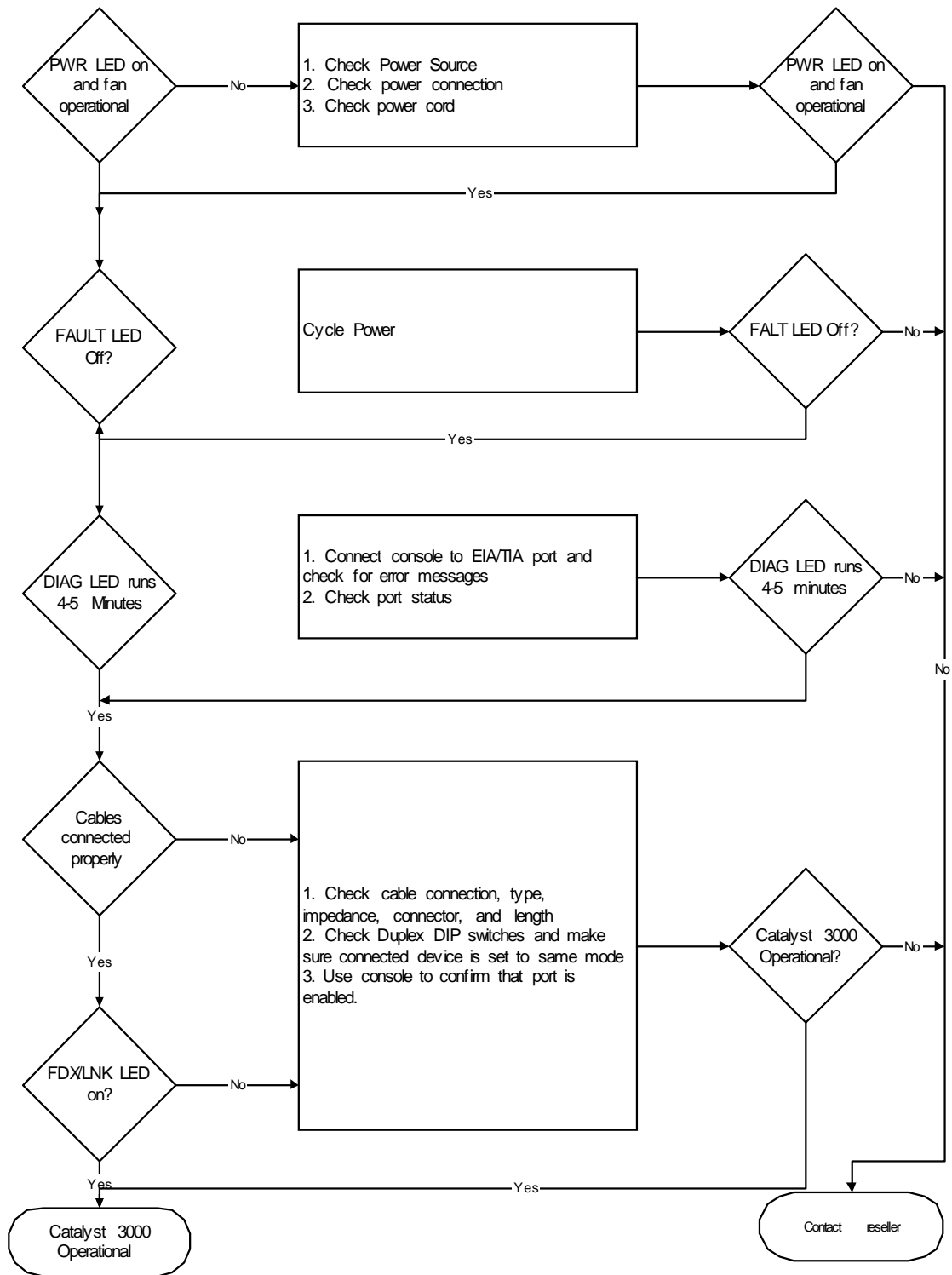
The Port Statistics Detailed Report displays much information that will help in troubleshooting the network problems. You may also want to use the information in the summary reports available under the usage Summaries menu.

81) Describe the firmware upgrade procedures for Catalyst 1900 and Catalyst 2820 switches.

- Three methods of upgrading switch software
 1. In-band TFTP server
 2. In-band TFTP client
 3. Serial via XMODEM
- New Firmware gets written over old
- During switch firmware upgrade, switch might not respond for up to 1 minute (normal)
 - **WARNING: DO NOT POWER OFF** when the switch freezes (up to 1 minute delay)

Troubleshooting the Catalyst 3000 Series Switches

82) Troubleshooting the Catalyst 3000 series switch subsystems.



83) Troubleshooting network interfaces and connections.

Check for the following symptoms:

- A network interface is not recognized by the system:
 - Check the interface cable and connection
 - Check the LED that corresponds to the network interface
- A network interface is recognized, but it will not communicate properly:
 - Check the interface cable and connections
- System boots, but the console is frozen:
 - Check the external console connection.
 - Verify the console setup procedures

If the system will not boot properly or intermittently reboots, the processor may be faulty or the hardware/software setup may be wrong.

84) Use the switch LEDs to isolate problems.

| LED | STATUS | WHAT TO DO |
|----------|--------------|--|
| PWR | Off | If the PWR LED is off and both of the fans are not running, check for power to the switch. |
| DIAG | Remains On | The DIAG LED is on during self-test. The self-test runs after power-on or reset. The LED should not remain on after this test. If you are unable to correct this problem call the TAC. |
| FAULT | On | The FAULT LED should remain off during normal operation. If it is on, an error has occurred. Cycle the power on the switch. The FAULT LED should not come back on. |
| LNK/FDX | Off | Check all port connections. Check the cables and all cable connections. Recheck the system configuration. |
| XMIT/RCV | Not Blinking | The XMIT and RCV LEDs should blink as packets are forwarded to other ports. If the LEDs do not blink, verify that the physical network configuration is correct. Check the console for proper configuration and operation. |

85) Isolate network segment problems.

Check that devices on the same segment can communicate. If the segment has a server, try sending to it. If the segment does not have a server, use available applications to exchange packets with other stations.

In a TCP/IP environment, try issuing a “ping” to another station on the segment. If the workstation does not receive the signal, check the connections, and verify that you are using the appropriate network software and hardware.

Verify that all segments belong to the same logical network:

- All segments should have the same IP subnet
- All segments must have the same network number

Send data to the local network devices:

- Attach to the local server to send and retrieve data
- If there is no server, use diagnostic utilities to exchange data with other workstations (such as the UNIX ping command)

Check the switch LEDs for performance:

- Verify that the Diag LED is on after power is applied to the switch while POST are run. After POST, the Diag LED is off

- If the switch has network connectivity, verify that the RCV, EMIT, and FWD LEDs are active.

Use a cable tester, Time Domain Reflectometer (TDR), or similar device to verify that the segment lengths attached to the Catalyst 3000 series switch meet Ethernet/IEEE 802.3 specifications.