About the Authors

Scott Empson is the associate chair of the Bachelor of Applied Information Systems Technology degree program at the Northern Alberta Institute of Technology in Edmonton, Alberta, Canada, where he teaches Cisco routing, switching, and network design courses in a variety of different programs—certificate, diploma, and applied degree—at the postsecondary level. Scott is also the program coordinator of the Cisco Networking Academy Program at NAIT, a Regional Academy covering central and northern Alberta. He has earned three undergraduate degrees: a Bachelor of Arts, with a major in English; a Bachelor of Education, again with a major in English/Language Arts; and a Bachelor of Applied Information Systems Technology, with a major in Network Management. Scott is currently completing his Master of Education from the University of Portland. He holds several industry certifications, including CCNP, CCAI, Network+, and CIEH. Prior to instructing at NAIT, he was a junior/senior high school English/Language Arts/Computer Science teacher at different schools throughout Northern Alberta. Scott lives in Edmonton, Alberta, with his wife, Trina, and two children, Zachariah and Shaelyn.

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About the Technical Reviewer

Sean Wilkins is an accomplished networking consultant and has been in the field of IT since the mid-1990s, working with companies such as Cisco, Lucent, Verizon, AT&T, and several other private companies. Sean currently holds certifications with Cisco (CCNP/CCDP), Microsoft (MCSE), and CompTIA (A+ and Network+). He also has a Master of Science degree in information technology with a focus in network architecture and design, a Master's certificate in network security, a Bachelor of Science degree in computer networking, and an Associate of Applied Science degree in computer information systems. In addition to working as a consultant, Sean spends a lot of his time as a technical writer and editor for various companies.

Dedications

This book is again dedicated to my wonderful family—Trina, Zach, and Shae. Working on these books as well as my master's classes took me away from you all too often, and I thank you for all of your love and support.

—Scott

I'd like to again thank my wife, Carol, and daughter, Tess, for their constant support and understanding during those times I've spent cloistered in the basement writing.

—Hans

- WS-C3560-24-EMI Catalyst Switch, running Cisco IOS Release 12.2(25)SE
- WS-C3550-24-EMI Catalyst Switch, running Cisco IOS Release 12.1(9)EA1c
- WS-2960-24TT-L Catalyst Switch, running Cisco IOS Release 12.2(25)SE
- WS-2950-12 Catalyst Switch, running version C2950-C3.0(5.3)WC(1) Enterprise Edition Software
- WS-C3750-24TS Catalyst Switches, running ipservicesk9 release 12.2(52)SE
- C1760-V Voice Router with PVDM-256K-20, WIC-4ESW, VIC-2FXO, VIC-2FXS running ENTSERVICESK9 release 12.4(11)T2

You might notice that some of the devices were not running the latest and greatest IOS. Some of them are running code that is quite old.

Those of you familiar with Cisco devices will recognize that a majority of these commands work across the entire range of the Cisco product line. These commands are not limited to the platforms and IOS versions listed. In fact, in most cases, these devices are adequate for someone to continue their studies beyond the CCNP level as well. We have endeavored to identify throughout the book commands that are specific to a platform and/or IOS version.

Who Should Read This Book?

This book is for those people preparing for the CCNP SWITCH exam, whether through self-study, on-the-job training and practice, study within the Cisco Academy Program, or study through the use of a Cisco Training Partner. This book includes some handy hints and tips along the way to make life a bit easier for you in this endeavor. It is small enough that you will find it easy to carry around with you. Big, heavy textbooks might look impressive on your bookshelf in your office, but can you really carry them all around with you when you are working in a server room or equipment closet somewhere?

Strategies for Exam Preparation

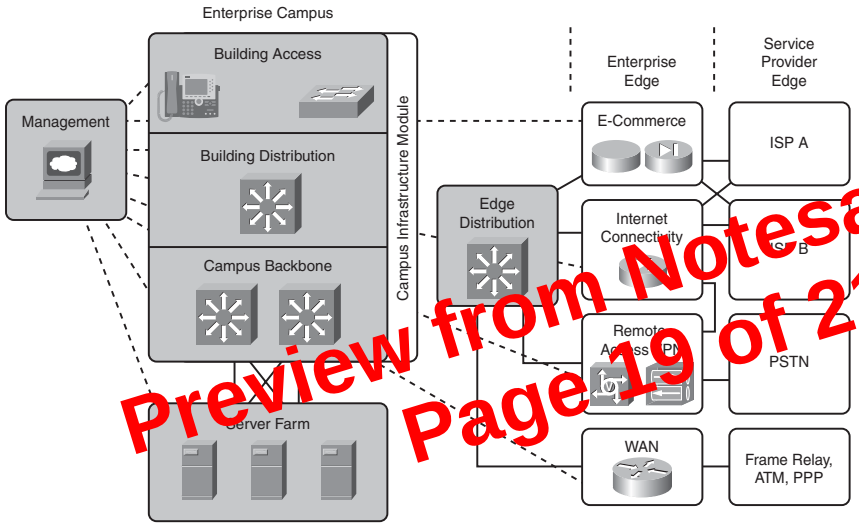
The strategy that you use for CCNP SWITCH might be slightly different from strategies that other readers use, mainly based on the skills, knowledge, and experience you already have obtained. For example, if you have attended the SWITCH course, you might take a different approach than someone who learned routing via on-the-job training.

Regardless of the strategy you use or the background you have, the book is designed to help you get to the point where you can pass the exam with the least amount of time required. For instance, there is no need for you to practice or read about VLANs or Spanning Tree if you fully understand it already. However, many people like to make sure they truly know a topic, and thus read over material they already know. Several book features help you gain the confidence you need to be convinced that you know some material already, and determine which topics you need to study more.

Cisco Enterprise Composite Network Model

Figure 1-2 shows the Cisco Enterprise Composite Network Model.

Figure 1-2 Cisco Enterprise Composite Network Model



`Switch(config)#vtp v2-mode`	Sets the VTP domain to Version 2. This command is for Cisco IOS Software Release 12.3 and later. If you are using a Cisco IOS release earlier than 12.3, the command is **vtp version 2**.
	NOTE: VTP Versions 1 and 2 are not interoperable. All switches must use the same version. The biggest difference between Versions 1 and 2 is that Version 2 has support for Token Ring VLANs.
`Switch(config)#vtp pruning`	Enables VTP pruning.
	NOTE: By default, VTP pruning is disabled. You need to enable VTP pruning on only one switch in VTP server mode.

NOTE: Only VLANs included in the pruning eligible list can be pruned. VLANs 2 through 1001 are pruning eligible by default on trunk ports. Reserved VLANs and extended-range VLANs cannot be pruned. To change which eligible VLANs can be pruned, use the interface-specific **switchport trunk pruning vlan** command:

```
Switch(config-if)#switchport trunk pruning vlan remove 4, 20-30
! Removes VLANs 4 and 20-30
Switch(config-if)#switchport trunk pruning vlan except 40-50
! All VLANs are added to the pruning list except for 40-50
```

Using VLAN Database Mode

CAUTION: The VLAN Database mode has been deprecated and will be removed in some future Cisco IOS release. Recommended practice dictates using only the VLAN-configuration mode.

`Switch#vlan database`	Enters VLAN Database mode.
`Switch(vlan)#vtp client`	Changes the switch to VTP client mode.
`Switch(vlan)#vtp server`	Changes the switch to VTP server mode.
`Switch(vlan)#vtp transparent`	Changes the switch to VTP transparent mode.
	NOTE: By default, all Catalyst switches are in server mode.

NOTE: Private VLANs are implemented to varying degrees on Catalyst 6500/4500/3750/3560 as well as the Metro Ethernet line of switches. All PVLAN configuration commands are not supported on all switch platforms. For more information, see Appendix A, "Private VLAN Catalyst Switch Support Matrix."

`Switch(config)#vtp mode transparent`	Sets VTP mode to transparent.
`Switch(config)#vlan 20`	Creates VLAN 20 and moves to VLAN-configuration mode.
`Switch(config-vlan)#private-vlan primary`	Creates a private, primary VLAN.
`Switch(config-vlan)#vlan 101`	Creates VLAN 101 and moves to VLAN-config mode.
`Switch(config-vlan)#private-vlan isolated`	Creates a private, isolated VLAN for VLAN 101.
	NOTE: An isolated VLAN can communicate only with promiscuous ports.
`Switch(config-vlan)#exit`	Returns to global configuration mode.
`Switch(config)#vlan 102`	Creates VLAN 102 and moves to VLAN-config mode.
`Switch(config-vlan)#private-vlan community`	Creates a private, community VLAN for VLAN 102.
	NOTE: A community VLAN can communicate with all promiscuous ports and with other ports in the same community.
`Switch(config-vlan)#exit`	Returns to global config mode.
`Switch(config)#vlan 103`	Creates VLAN 103 and moves to VLAN-config mode.
`Switch(config-vlan)#private-vlan community`	Creates a private, community VLAN for VLAN 103.
`Switch(config-vlan)#vlan 20`	Returns to VLAN-config mode for VLAN 20.
`Switch(config-vlan)#private-vlan association 101-103`	Associates secondary VLANs 101–103 with primary VLAN 20.

	NOTE: Only one isolated VLAN can be mapped to a primary VLAN, but more than one community VLAN can be mapped to a primary VLAN.
`Switch(config)#interface fastethernet 0/20`	Moves to interface config mode
`Switch(config-if)#switchport mode private-vlan host`	Configures the port as a private VLAN host port.
`Switch(config-if)#switchport private-vlan host-association 20 101`	Associates the port with primary private VLAN 20 and secondary private VLAN 101.
`Switch(config-if)#exit`	Moves to global configuration mode.
`Switch(config)#interface fastethernet 0/21`	Moves to interface config mode.
`Switch(config-if)#switchport mode private-vlan promiscuous`	Configures the port as a private VLAN promiscuous port.
`Switch(config-if)#switchport private-vlan mapping 20 101 102 103`	Maps VLAN 20, 101, 102, and 103 to promiscuous port.

PVLAN Trunk on the Catalyst 3560/3750

`Switch(config)# interface fastethernet 0/23`	Moves to interface configuration mode.
`Switch(config-if)# switchport trunk encapsulation dot1q`	Specifies 802.1Q encapsulation on the trunk link.
`Switch(config-if)# switchport trunk native vlan 99`	Specifies the native VLAN as 99.
`Switch(config-if)# switchport mode trunk`	Puts the interface into permanent trunking mode and negotiates to convert the link into a trunk link.
	NOTE: Do not prohibit primary or secondary private VLANs on the trunk through policy or pruning.

Verifying PVLANs

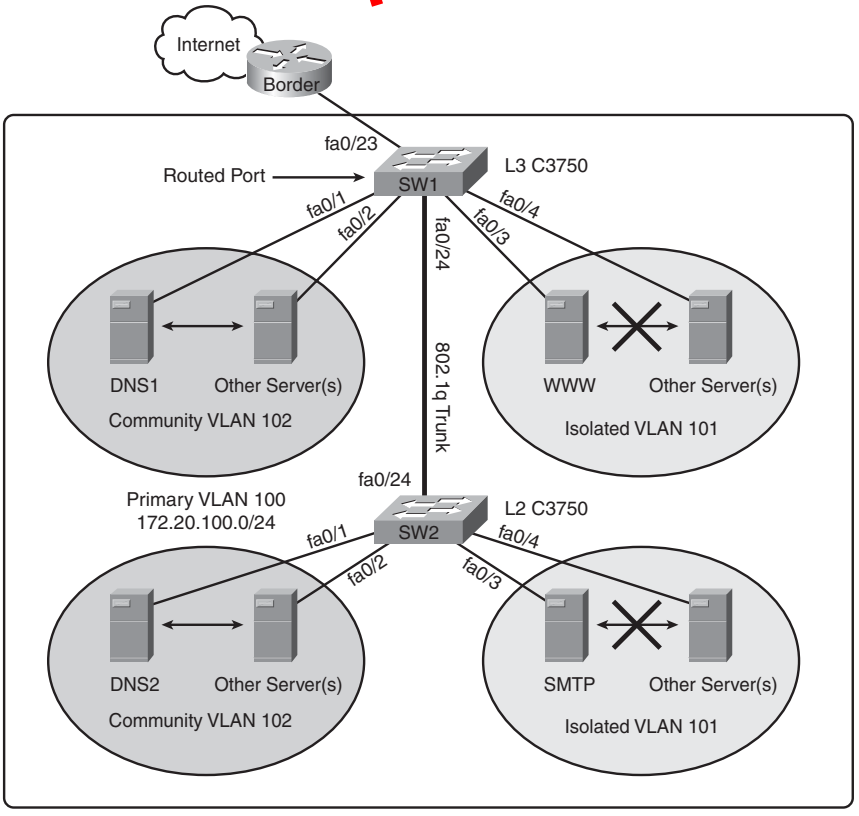
`Switch#show vlan private-vlan type`	Verifies private VLAN configuration.
`Switch#show interface fastethernet 0/20 switchport`	Verifies all configuration on fastethernet 0/20, including private VLAN associations.

Configuration Example: PVLAN

Figure 2-2 shows the network topology for the configuration that follows, which shows how to configure PVLANs using the commands covered in this chapter. The following network functionality is required:

- DNS, WWW, and SMTP are in server farm, same subnet.
- WWW and SMTP servers can communicate only with router.
- DNS servers can communicate with each other and with router.
- The servers are attached to two switches.
- One switch is required to route traffic (L3) from the servers.

Figure 2-2 Network Topology for PVLAN Configuration Example



`Switch(config)#hostname ALSwitch2`	Sets the host name.
`ALSwitch2(config)#no ip domain-lookup`	Turns off DNS queries so that spelling mistakes will not slow you down.
`ALSwitch2(config)#vtp mode client`	Changes the switch to VTP client mode.
`ALSwitch2(config)#vtp domain testdomain`	Configures the VTP domain name to testdomain.
`ALSwitch2(config)#interface range fastethernet 0/5 - 8`	Moves to interface range config mode.
`ALSwitch2(config-if-range)#switchport mode access`	Sets ports 5–8 as access ports.
`ALSwitch2(config-if-range)#switchport access vlan 10`	Assigns ports to VLAN 10.
`ALSwitch2(config-if-range)#exit`	Moves to global config mode.
`ALSwitch2(config)#interface range fastethernet 0/9 - 12`	Moves to interface range config mode.
`ALSwitch2(config-if-range)#switchport mode access`	Sets ports 9–12 as access ports.
`ALSwitch2(config-if-range)#switchport access vlan 20`	Assigns ports to VLAN 20.
`ALSwitch2(config-if-range)#exit`	Moves to global config mode.
`ALSwitch2(config)#interface range fastethernet 0/1 - 2`	Moves to interface range config mode.
`ALSwitch2(config-if-range)#switchport mode trunk`	Puts the interface into permanent trunking mode and negotiates to convert the link into a trunk link.
`ALSwitch2(config-if-range)#channel-group 1 mode desirable`	Creates channel group 1 and assigns interfaces 0/1–0/2 as part of it.
`ALSwitch2(config-if-range)#exit`	Moves to global config mode.
`ALSwitch2(config)#exit`	Moves to privileged mode.
`ALSwitch2#copy running-config startup-config`	Saves the configuration to NVRAM.

Configuring STP Timers

`Switch(config)#spanning-tree vlan 5 hello-time 4`	Changes the hello-delay timer to 4 seconds on VLAN 5.
`Switch(config)#spanning-tree vlan 5 forward-time 20`	Changes the forward-delay timer to 20 seconds on VLAN 5.
`Switch(config)#spanning-tree vlan 5 max-age 25`	Changes the maximum-aging timer to 25 seconds on VLAN 5.

NOTE: For the **hello-time** command, the range is 1 to 10 seconds. The default is 2 seconds.

NOTE: For the **forward-time** command, the range is 4 to 30 seconds. The default is 15 seconds.

For the **max-age** command, the range is 6 to 40 seconds. The default is 20 seconds.

CAUTION: Cisco recommends caution when using this command. Cisco further recommends that the **spanning-tree vlan** *x* **root primary** or the **spanning-tree vlan** *x* **root secondary** command be used instead to modify the switch timers.

FlexLinks

`Switch(config)#interface fastethernet1/0/1`	Moves to interface configuration mode.
`Switch(config-if)#switchport backup interface fastethernet1/0/2`	Configures FastEthernet 1/0/2 to provide Layer 2 backup to FastEthernet 1/0/1.
`Switch#show interface switchport backup`	Shows all the Layer 2 switch backup interface pairs.
	NOTE: FlexLink is an alternative solution to the Spanning Tree Protocol.

`Switch#show spanning-tree summary`	Display a summary of port states, statistics, and enabled features.
`Switch#show running-config`	Display the current volatile device configuration.

Enabling Rapid Spanning Tree

`Switch(config)#spanning-tree mode rapid-pvst`	Enables Rapid PVST+.
`Switch(config)#interface fastethernet 0/1`	Moves to interface config mode.
`Switch(config-if)#spanning-tree link-type point-to-point`	Sets an interface to be a point-to-point interface.
	NOTE: By setting the link type to point-to-point, this means that if you connect this port to a remote port, and this port becomes a designated port, the switch will negotiate with the remote port and transition the local port to a forwarding state.
`Switch(config-if)#exit`	
`Switch(config)#clear spanning-tree detected-protocols`	
	NOTE: The **clear spanning-tree detected-protocols** command restarts the protocol migration process on the switch if any port is connected to a port on a legacy 802.1D switch.

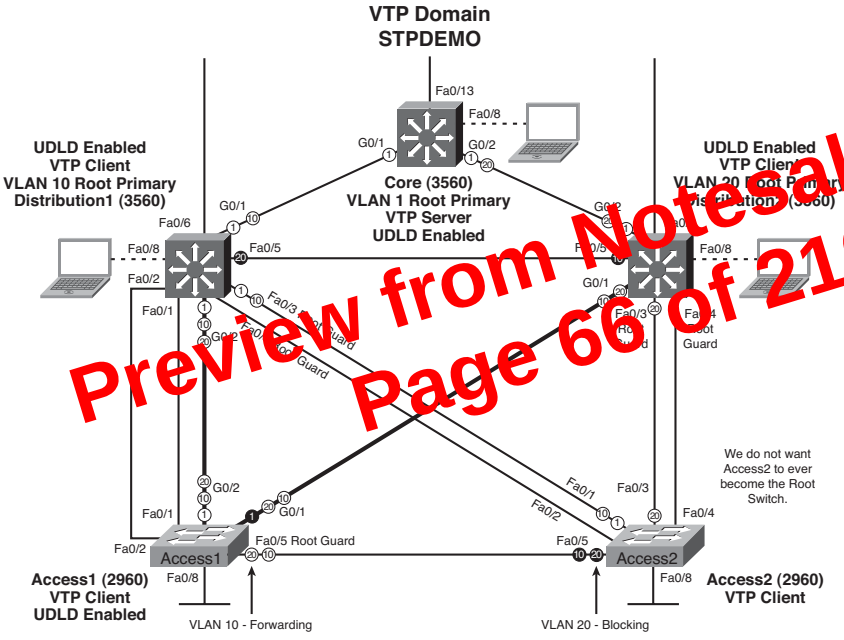
Enabling Multiple Spanning Tree

`Switch(config)#spanning-tree mst configuration`	Enters MST configuration mode.
`Switch(config-mst)#instance 1 vlan 4`	Maps VLAN 4 to a Multiple Spanning Tree (MST) instance.

Configuration Example: STP

Figure 3-1 shows the network topology for the configuration that follows, which shows how to configure STP using commands covered in this chapter.

Figure 3-1 Network Topology for STP Configuration Example



Core Switch (3560)

`Switch>enable`	Moves to privileged mode.
`Switch#configure terminal`	Moves to global config mode.
`Switch(config)#hostname Core`	Sets the host name.
`Core(config)#no ip domain-lookup`	Turns off Dynamic Name System (DNS) queries so that spelling mistakes will not slow you down.
`Core(config)#vtp mode server`	Changes the switch to VTP server mode. This is the default mode.
`Core(config)#vtp domain stpdemo`	Configures the VTP domain name to stpdemo.

Access 2 Switch (2960)

`Switch>enable`	Moves to privileged mode.
`Switch#configure terminal`	Moves to global configuration mode.
`Switch(config)#hostname Access2`	Sets host name.
`Access2(config)#no ip domain-lookup`	Turns off DNS queries so that spelling mistakes will not slow you down.
`Access2(config)#vtp domain stpdemo`	Configures the VTP domain name to stpdemo.
`Access2(config)#vtp mode client`	Changes the switch to VTP client mode.
`Access2(config)#interface range fastethernet 0/6 - 12`	Moves to interface range configuration mode.
`Access2(config-if-range)#switchport mode access`	Places all interfaces in access mode.
`Access2(config-if-range)#spanning-tree portfast`	Places all ports directly into forwarding mode.
`Access2(config-if-range)#spanning-tree bpduguard enable`	Enables BPDU Guard.
`Access2(config-if-range)#exit`	Returns to global configuration mode.
`Access2(config)#exit`	Returns to privileged mode.
`Access2#copy running-config startup-config`	Saves config to NVRAM.

`ISP(config)#exit`	Returns to privileged mode.
`ISP#copy running-config startup-config`	Saves the configuration to NVRAM.

CORP Router

`Router>enable`	Moves to privileged mode.
`Router>#configure terminal`	Moves to global configuration mode.
`Router(config)#hostname CORP`	Sets the host name.
`ISP(config)#interface serial 0/0/0`	Moves to interface configuration mode.
`CORP(config-if)#description link to ISP`	Sets the locally significant interface description.
`CORP(config-if)#ip address 192.31.7.6 255.255.255.252`	Assigns IP address and netmask.
`CORP(config-if)#no shutdown`	Enables the interface.
`CORP(config)#interface fastethernet 0/1`	Moves to interface configuration mode.
`CORP(config-if)#description link to 3560 Switch`	Sets the locally significant interface description.
`CORP(config-if)#ip address 172.31.1.5 255.255.255.252`	Assigns the IP address and netmask.
`CORP(config-if)#no shutdown`	Enables the interface.
`CORP(config-if)#exit`	Returns to global configuration mode.
`CORP(config)#interface fastethernet 0/0`	Enters interface configuration mode.
`CORP(config-if)#duplex full`	Enables full-duplex operation to ensure trunking will take effect between here and L2Switch2.
`CORP(config-if)#no shutdown`	Enables the interface.

- NetBIOS name server (port 137)
- NetBIOS datagram server (port 138)
- Boot Protocol (BOOTP) client and server datagrams (ports 67 and 68)
- TACACS service (port 49)
- Host Name Service (port 42)

To close some of these ports, use the **no ip forward-protocol udp** *x* command at the global configuration prompt, where *x* is the port number you want to close. The following command stops the forwarding of broadcasts to port 49:

```
Router(config)#no ip forward-protocol udp 49
```

To open other UDP ports, use the **ip forward-helper udp** *x* command, where *x* is the port number you want to open:

```
Router(config)#ip forward-protocol udp 517
```

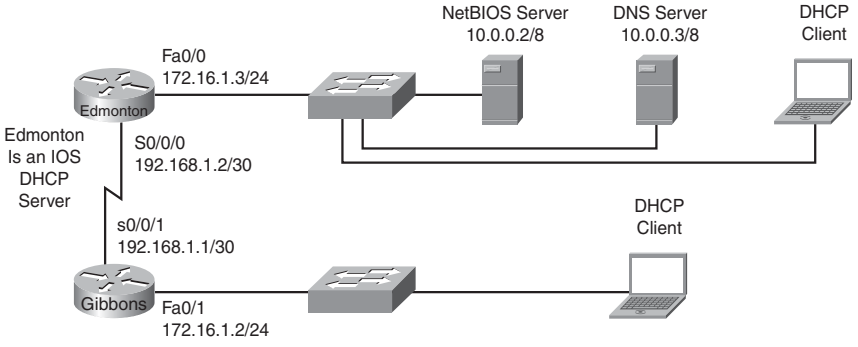

DHCP Client on a Cisco IOS Software Ethernet Interface

`Router(config)#interface fastethernet 0/0`	Moves to interface configuration mode.
`Router(config-if)#ip address dhcp`	Specifies that the interface acquire an IP address through DHCP.
	NOTE: The **ip address dhcp** command can also be applied on an L3 switch at the SVI as well as any port where the **no switchport** command has been used.

Configuration Example: DHCP

Figure 4-2 illustrates the network topology for the configuration that follows, which shows how to configure DHCP services on a Cisco IOS router using the commands covered in this chapter.

Figure 4-2 Network Topology for DHCP Configuration



`Switch#show interface gigabitethernet 1/1 | include switched`	Displays switching statistics that show statistics for each layer.
`Switch#show adjacency fastethernet 0/20 detail`	Displays the content of the information to be used during L2 encapsulation.
	NOTE: When using the **show adjacency interface xx detail** command, both the next hop-hop and local MAC addresses are displayed as well as the well-known Ethertype value of the encapsulation protocol (0x0800 for IP).
`Switch#show cef drop`	Displays packets that are dropped because adjacencies are incomplete or nonexistent.
`Switch#show ip interface vlan10`	Verifies whether CEF is enabled on an interface.

Troubleshooting CEF

`Switch#debug ip cef`	Displays debug information for CEF.
`Switch#debug ip cef drops`	Displays debug information about dropped packets.
`Switch#debug ip cef drops` *x*	Records CEF dropped packets that match access-list x.
`Switch#debug ip cef receive`	Displays packets that are not switched using information from the FIB but that are received and sent to the next switching layer.
`Switch#debug ip cef events`	Displays general CEF events.
`Switch#debug ip cef prefix-ipc`	Displays updates related to IP prefix information.
`Switch#debug ip cef table`	Produces a table showing events related to the FIB table.
`Switch#ping ip`	Performs an extended ping.

CHAPTER 5

Implementing a Highly Available Network

This chapter provides information and commands concerning the following topics:

- Implementing network logging
- Service Level Agreements (SLA)

Implementing Network Logging

Configuring Syslog

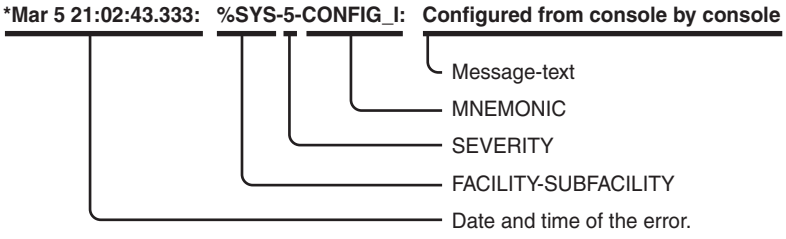
Cisco routers and switches are capable of logging information relating to a number of different kinds of events that occur—configuration changes, ACL violations, interface status, and so on. Cisco network devices can direct these log messages to several different locations: console, terminal lines, memory buffers, SNMP traps, or an external syslog server.

To get the most out of your device log messages, it is imperative that your devices display the correct time; using NTP helps facilitate your routers all having the correct time.

Messages are listed by the facility (hardware device, protocol, or a module or system software) that produces the messages. Within each facility, messages are listed by the severity level, from highest to lowest and a description mnemonic. Each message is followed by an explanation and a recommended action.

Figure 5-1 shows the message structure and format of Cisco network device System Message Log messages.

Figure 5-1 System Message Log Message Structure



There are eight levels of severity in logging messages:

Level	Name	Definition	Example
0	emergencies	System is unusable	Cisco IOS Software could not load
1	alerts	Immediate action needed	Temperature too high
2	critical	Critical conditions	Unable to allocate memory
3	errors	Error conditions	Invalid memory size
4	warnings	Warning conditions	Crypto operation failed
5	notifications	Normal but significant conditions	Interface changed state up or down
6	informational	Informational messages	Packet denied by ACL (default)
7	debugging	Debugging messages	Packet type invalid

Setting a level means you will get that level and everything below it. For example, Level 6 means you will receive Level 6 down to Level 0 messages. Level 4 means you will get messages for Levels 4–0. The default reporting level is typically Level 7 (debugging).

`Switch(config)#logging on`	Enables logging to all supported destinations.
`Switch(config)#logging buffered warnings`	Enables local logging for events that are warnings and more serious.
`Switch(config)#logging buffered 4096`	Creates a local logging buffer of 4096 bytes.
`Switch(config)#logging 192.168.10.53`	Sends logging messages to a syslog server host at address 192.168.10.53.
	NOTE: This is equivalent to the **logging host** command.
`Switch(config)#logging sysadmin`	Sends logging messages to a syslog server host named sysadmin.

`Switch(config)#logging trap x`	Sets the syslog server logging level to value *x*, where *x* = a number between 0 and 7 or a word defining the level.
`Switch(config)#logging source-interface loopback 0`	Sets the source IP address of the syslog packets, regardless of the interface where the packets actually exit the router.
`Switch(config)#service timestamps log datetime`	Includes a timestamp in all subsequent syslog messages.

CAUTION: If any debugging is enabled and the logging buffer is configured to include Level 7 (debugging) messages, the debug output will be included in the system log.

`Switch#show logging`	Displays the local logs and some current settings.

Configuring an SNMP Managed Node

`Switch#configure terminal`	Enters global configuration mode.
`Switch(config)#access-list 10 permit ip 10.1.1.0 0.0.0.255`	Configures an access list to define the managing IP segment(s).
`Switch(config)#snmp-server community CISCONET2`	Configures the community string.
`Switch(config)#snmp-server community CISCONET2 ro 10`	Optionally specifies either read-only (ro) or read-write (rw) if you want authorized management stations to retrieve and modify MIB objects. Optionally specifies an access list permitting management traffic.

`switch(config)#track 90 ip sla 10 state`	Creates an object, 90, to track the state of SLA process 10.
`switch(config)#interface vlan 10`	Moves to interface configuration mode.
`switch(config-if)#ip address 192.168.10.1 255.255.255.0`	Assigns IP address and netmask.
`switch(config-if)#standby 10 ip 192.168.10.254`	Activates HSRP group 10 on the interface and creates a virtual IP address of 192.168.10.254 for use in HSRP.
`switch(config-if)#standby 10 priority 110`	Assigns a priority value of 110 to standby group 10.
`switch(config-if)#standby 10 preempt`	Preempts, or takes control of, the active switch if the local priority is higher than the active switch.
`switch(config-if)#standby 10 track 90 decrement 20`	Tracks the state of object 90 and decrements the device priority if the object fails.

Debugging HSRP

`Switch#debug standby`	Displays all HSRP debugging information, including state changes and transmission/reception of HSRP packets.
`Switch#debug standby errors`	Displays HSRP error messages.
`Switch#debug standby events`	Displays HSRP event messages.
`Switch#debug standby events terse`	Displays all HSRP events except for hellos and advertisements.
`Switch#debug standby events track`	Displays all HSRP tracking events.
`Switch#debug standby packets`	Displays HSRP packet messages.
`Switch#debug standby terse`	Displays all HSRP errors, events, and packets, except for hellos and advertisements.

Gateway Load Balancing Protocol

Gateway Load Balancing Protocol (GLBP) protects data traffic from a failed router or circuit, like HSRP and VRRP, while allowing packet load sharing between a group of redundant routers.

Configuring GLBP

`Router(config)#interface fastethernet 0/0`	Moves to interface config mode.
`Router(config)#interface vlan 10`	Moves to interface config mode.
`Router(config-if)#ip address 172.16.100.5 255.255.255.0`	Assigns an IP address and network.
`Router(config-if)#glbp 10 ip 172.16.100.1`	Enables GLBP for group 10 on this interface with a virtual address of 172.16.100.1. The range of group numbers is from 0 to 1023.
`Router(config-if)#glbp 10 preempt`	Configures the switch to preempt, or take over, as the active virtual gateway (AVG) for group 10 if this switch has a higher priority than the current AVG.
`Router(config-if)#glbp 10 preempt delay minimum 60`	Configures the router to preempt, or take over, as AVG for group 10 if this router has a higher priority than the current active virtual forwarder (AVF) after a delay of 60 seconds.
`Router(config-if)#glbp 10 forwarder preempt`	Configures the router to preempt, or take over, as AVF for group 10 if this router has a higher priority than the current AVF. This command is enabled by default with a delay of 30 seconds.
`Router(config-if)#glbp 10 preempt delay minimum 60`	Configures the router to preempt, or take over, as AVF for group 10 if this router has a higher priority than the current AVF after a delay of 60 seconds.

Switch DLS1

`DLS1(config)#interface vlan 1`	Moves to interface configuration mode.
`DLS1(config-if)#standby 1 ip 192.168.1.254`	Activates HSRP group 1 on the interface and creates a virtual IP address of 192.168.1.254 for use in HSRP.
`DLS1(config-if)#standby 1 priority 105`	Assigns a priority value of 105 to standby group 1.
`DLS1(config-if)#standby 1 preempt`	Preempts, or takes control of, VLAN 1 forwarding if the local priority is higher than the active switch VLAN 1 priority.
`DLS1(config-if)#standby 1 track fastEthernet 0/1 20`	HSRP tracks the availability of interface FastEthernet 0/1. If FastEthernet 0/1 goes down, the priority of the switch in group 1 is decremented by 20.
`DLS1(config-if)#standby 1 track fastEthernet 0/2`	HSRP tracks the availability of interface FastEthernet 0/2. If FastEthernet 0/2 goes down, the priority of the switch in group 1 is decremented by the default value of 10.
`DLS1(config-if)#exit`	Moves to global configuration mode.
`DLS1(config)#interface vlan 10`	Moves to interface configuration mode.
`DLS1(config-if)#standby 10 ip 192.168.10.254`	Activates HSRP group 10 on the interface and creates a virtual IP address of 192.168.10.254 for use in HSRP.
`DLS1(config-if)#standby 10 priority 105`	Assigns a priority value of 105 to standby group 1.
`DLS1(config-if)#standby 10 preempt`	Preempts, or takes control of, VLAN 10 forwarding if the local priority is higher than the active switch VLAN 10 priority.

`DLS1(config-if)#standby 10 track fastEthernet 0/1 20`	HSRP tracks the availability of interface FastEthernet 0/1. If FastEthernet 0/1 goes down, the priority of the switch in group 10 is decremented by 20.
`DLS1(config-if)#standby 10 track fastEthernet 0/2`	HSRP tracks the availability of interface FastEthernet 0/2. If FastEthernet 0/2 goes down, the priority of the switch in group 10 is decremented by the default value of 10.
`DLS1(config-if)#exit`	Moves to global configuration mode.
`DLS1(config)#interface vlan 20`	Moves to interface configuration mode.
`DLS1(config-if)#standby 20 ip 192.168.20.254`	Activates HSRP group 20 on the interface and creates a virtual IP address of 192.168.20.254 for use in HSRP.
`DLS1(config-if)#standby 20 priority 100`	Assigns a priority value of 100 to standby group 20.
`DLS1(config-if)#standby 20 track fastEthernet 0/1 20`	HSRP tracks the availability of interface FastEthernet 0/1. If FastEthernet 0/1 goes down, the priority of the switch in group 20 is decremented by 20.
`DLS1(config-if)#standby 20 track fastEthernet 0/2`	HSRP tracks the availability of interface FastEthernet 0/2. If FastEthernet 0/2 goes down, the priority of the switch in group 20 is decremented by the default value of 10.
`DLS1(config-if)#exit`	Moves to global configuration mode.
`DLS1(config)#interface vlan 30`	Moves to interface configuration mode.
`DLS1(config-if)#standby 30 ip 192.168.30.254`	Activates HSRP group 30 on the interface and creates a virtual IP address of 192.168.30.254 for use in HSRP.

`DLS1(config-if)#standby 30 priority 100`	Assigns a priority value of 100 to standby group 30.
`DLS1(config-if)#standby 30 track fastEthernet 0/1 20`	HSRP tracks the availability of interface FastEthernet 0/1. If FastEthernet 0/1 goes down, the priority of the switch in group 30 is decremented by 20.
`DLS1(config-if)#standby 30 track fastEthernet 0/2`	HSRP tracks the availability of interface FastEthernet 0/2. If FastEthernet 0/2 goes down, the priority of the switch in group 30 is decremented by the default value of 10.
`DLS1(config-if)#exit`	Moves to global configuration mode.

Switch DLS2

`DLS2(config)#interface vlan 1`	Moves to interface configuration mode.
`DLS2(config-if)#standby 1 ip 192.168.1.254`	Activates HSRP group 1 on the interface and creates a virtual IP address of 192.168.1.254 for use in HSRP.
`DLS2(config-if)#standby 1 priority 100`	Assigns a priority value of 100 to standby group 1.
`DLS2(config-if)#standby 1 track fastEthernet 0/1 20`	HSRP tracks the availability of interface FastEthernet 0/1. If FastEthernet 0/1 goes down, the priority of the switch in group 1 is decremented by 20.
`DLS2(config-if)#standby 1 track fastEthernet 0/2`	HSRP tracks the availability of interface FastEthernet 0/2. If FastEthernet 0/2 goes down, the priority of the switch in group 1 is decremented by the default value of 10.
`DLS2(config-if)#exit`	Moves to global configuration mode.
`DLS2(config)#interface vlan 10`	Moves to interface configuration mode.

`Switch(config)#mac address-table static 1234.5678.90ab vlan 4 interface gigabitethernet 0/1`	Destination MAC address 1234.5678.90ab is added to the MAC address table. Packets with this address are forwarded out interface gigabitethernet 0/1.

Configuring Switch Port Security

`Switch(config)#interface fastethernet 0/1`	Moves to interface configuration mode.
`Switch(config-if)#switchport port-security`	Enables port security on the interface.
`Switch(config-if)#switchport port-security maximum 4`	Sets a maximum limit of four MAC addresses that are allowed on this port.
	NOTE: The maximum number of secure MAC addresses that you can configure on a switch is set by the maximum number of available MAC addresses allowed in the system.
`Switch(config-if)#switchport port-security mac-address 1234.5678.90ab`	Sets a specific secure MAC address 1234.5678.90ab. You can add additional secure MAC addresses up to the maximum value configured.
`Switch(config-if)#switchport port-security violation shutdown`	Configures port security to shut down the interface if a security violation occurs.
	NOTE: In shutdown mode, the port is errdisabled, a log entry is made, and manual intervention or errdisable recovery must be used to reenable the interface.
`Switch(config-if)#switchport port-security violation restrict`	Configures port security to restrict mode if a security violation occurs.
	NOTE: In restrict mode, frames from a non-allowed address are dropped and a log entry is made. The interface remains operational.

`Switch(config)#vlan access-map DROP1 5`	Creates a VLAN access map named DROP1 and moves into VLAN access map configuration mode. A sequence number of 5 is assigned to this access map. If no sequence number is given at the end of the command, a default number of 10 is assigned.
`Switch(config-access-map)#match ip address TEST1`	Defines what needs to occur for this action to continue. In this case, packets filtered out by the named ACL test1 will be acted upon.
	NOTE: You can match ACLs based on the following: IP ACL number: 1–199 and 1300–2699 IP ACL name IPX ACL number: 800–899 IPX ACL name MAC address ACL name
`Switch(config-access-map)#action drop`	Any packet that is filtered out by the ACL test1 will be dropped.
	NOTE: You can configure the following actions: Drop Forward Redirect (works only on a Catalyst 6500)
`Switch(config)#vlan access-map DROP1 10`	Creates line 10 of the VLAN access map named DROP1.
`Switch(config-map)#match mac address SERVER2`	Matches the MAC access list filter SERVER2.
`Switch(config-map)#action drop`	Drops all traffic permitted by the MAC access-list SERVER2.

`Switch(config-map)#vlan access-map DROP1 15`	Creates line 15 of the VLAN access map named DROP1.
`Switch(config-map)#action forward`	Forwards traffic not specified to be dropped in line 5 and 10 of the VLAN access-map DROP1.
`Switch(config-map)#exit`	Exits access-map configuration mode.
`Switch(config)#vlan filter DROP1 vlan-list 20-30`	Applies the VLAN map named DROP1 to VLANs 20–30.
	NOTE: The **vlan-list** argument can refer to a single VLAN (26), a consecutive list (20–30), or a string of VLAN IDs (12, 22, 32). Spaces around the comma and hyphen are optional.

Verifying VLAN Access Maps

`Switch#show vlan access-map`	Displays all VLAN access maps.
`Switch#show vlan access-map DROP1`	Displays the VLAN access map named DROP1.
`Switch#show vlan filter`	Displays what filters are applied to all VLANs.
`Switch#show vlan filter access-map DROP1`	Displays the filter for the specific VLAN access map named DROP1.

CHAPTER 8

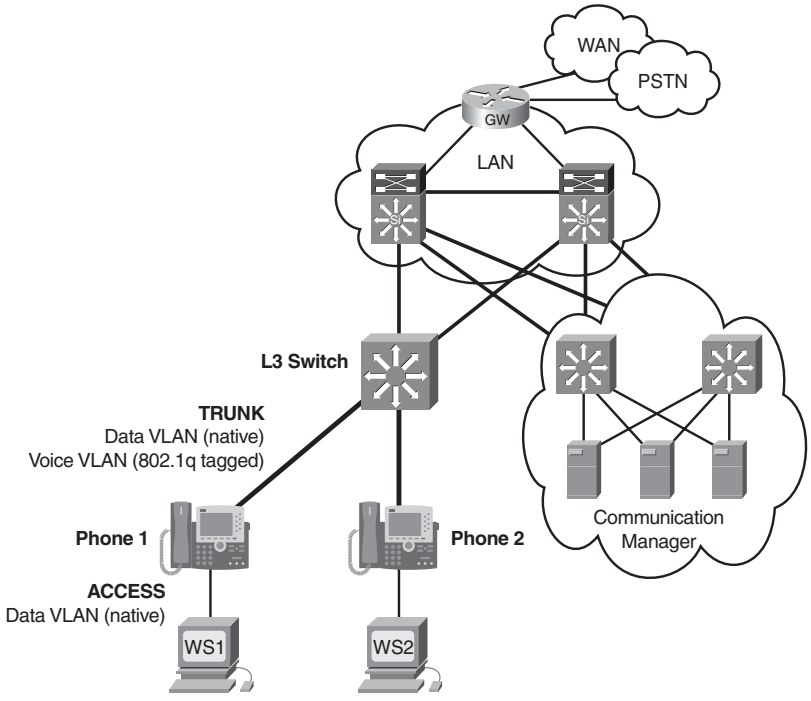
Accommodating Voice and Video in Campus Networks

This chapter provides information and commands concerning the following topics:

- Communications subsystems
- Configuring and Verifying Voice VLANs
- Power over Ethernet (PoE)
- High Availability for Voice and Video
- Configuring AutoQoS: 2960/3560/3750
  - Verifying AutoQoS information: 2960/3560/3750
- Configuring AutoQoS: 6500
  - Verifying AutoQoS information: 6500

Figure 8-1 shows the network diagram to be used as a reference for the topics covered in this chapter.

Figure 8-1 Router Switch and Phone



`Console> (enable) set qos autoqos`	Applies all global QoS settings to all ports on the switch.
`Console> (enable) set port qos 3/1 - 48 autoqos trust cos`	Applies AutoQoS to ports 3/1–48 and specifies that the ports should trust CoS markings.
`Console> (enable) set port qos 3/1 - 48 autoqos trust dscp`	Applies AutoQoS to ports 3/1–48 and specifies that the ports should trust DSCP markings.
`Console> (enable) set port qos 4/1 autoqos voip ciscoipphone`	Applies AutoQoS settings for any Cisco IP Phone on module 4, port 1.
`Console> (enable) set port qos 4/1 autoqos voip ciscosoftphone`	Applies AutoQoS settings for any Cisco IP SoftPhone on module 4, port 1.

Verifying AutoQoS Information: 6500

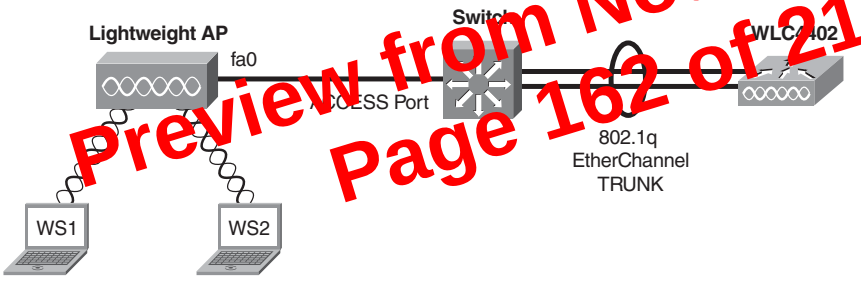
`Console> show port qos`	Displays all QoS-related information.
`Console> show port qos 3/1`	Displays all QoS-related information for module 3, port 1.

`Switch(config-if)#spanning-tree portfast trunk`	Configures the port to start forwarding immediately for every VLAN on the trunk while determining spanning-tree port status.
`Switch(config-if)#mls qos trust cos`	Classifies the inbound packet by CoS value.

Switch Configuration for 4400 Series Controllers (EtherChannel)

Figure 9-4 shows the network diagram to be used as a reference for the switch configurations for 4400 series controller using an EtherChannel.

Figure 9-4 Switch Configuration for 4400 Controller with EtherChannel



`Switch(config)#interface gigabitethernet 0/1`	Moves to interface configuration mode.
`Switch(config-if)#channel-group 1 mode on`	Assigns the gigabit Ethernet port 0/1 to EtherChannel group 1.
`Switch(config)#interface gigabitethernet 0/2`	Moves to interface configuration mode for gigabitethernet 0/2.
`Switch(config-if)#channel-group 1 mode on`	Assigns the gigabit Ethernet port 0/2 to EtherChannel group 1.
`Switch(config)#interface port-channel 1`	Creates the port-channel logical interface port-channel 1.
`Switch(config-if)#switchport trunk encapsulation dot1q`	Chooses 802.1Q as the trunking protocol for the port channel.
`Switch(config-if)#switchport trunk native vlan 99`	Defines VLAN 99 at the native VLAN for this trunk.

Figure 9-9 First Screen of the GUI Configuration Wizard

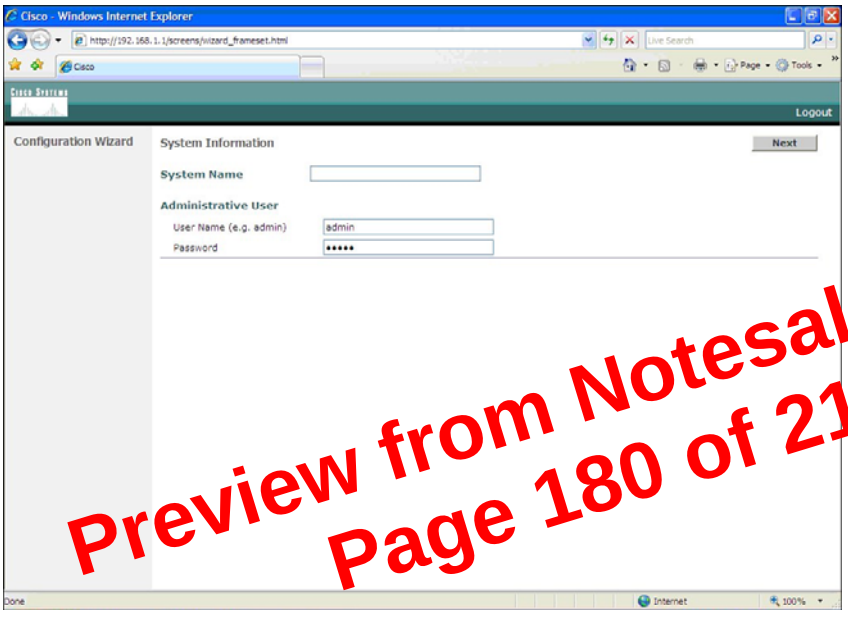
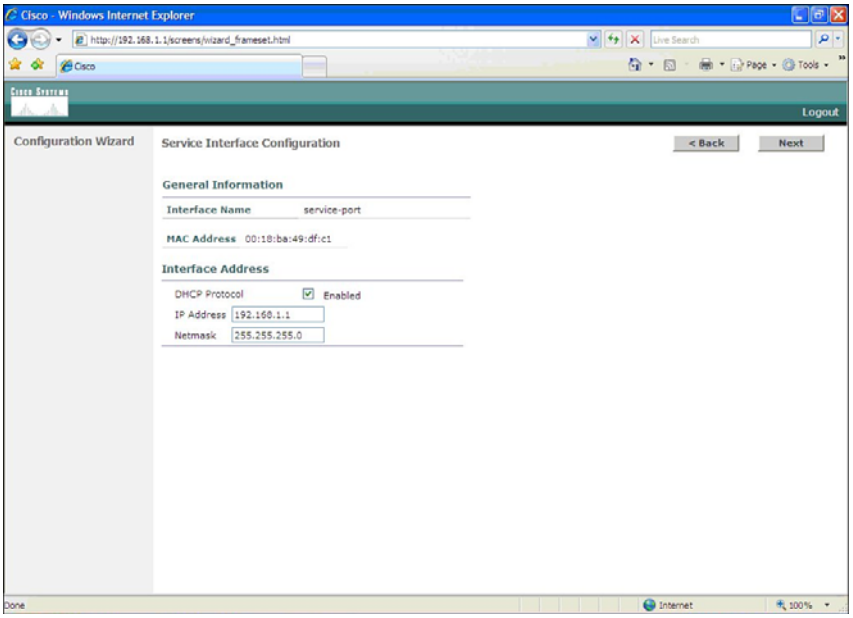


Figure 9-10 shows the second screen of the GUI Configuration Wizard. This is where you configure the IP address and netmask of the service interface and enable DHCP, if desired.

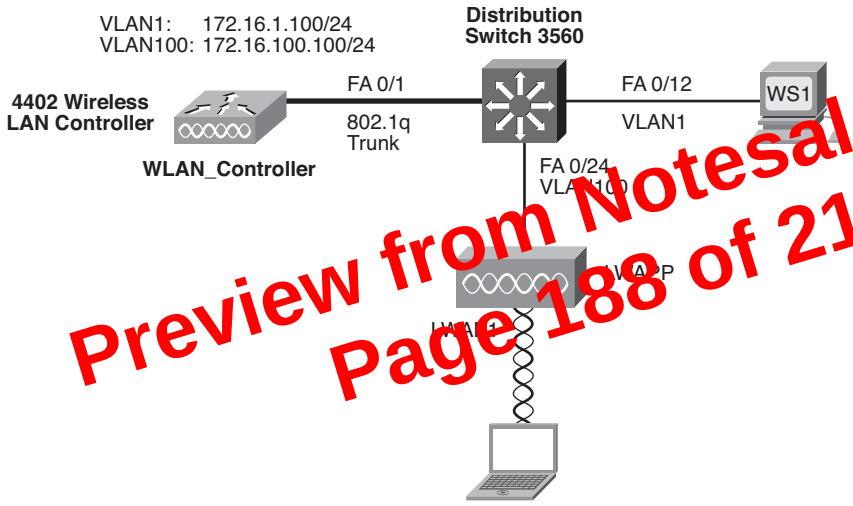
Figure 9-10 Service Interface Configuration of the GUI Configuration Wizard



Configuration Example: Configuring a 3560 Switch to Support WLANs and APs

Figure 9-23 shows the network topology for the configuration that follows, which shows how to configure a 3560 switch to support WLANs and APs.

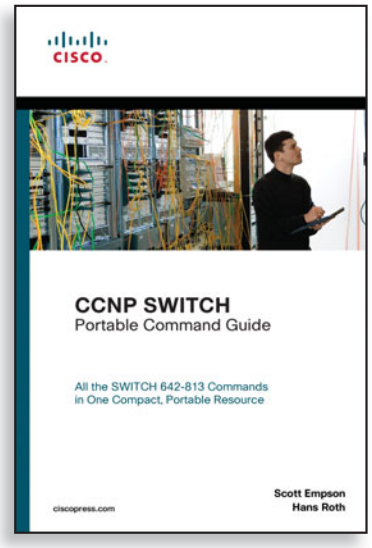
Figure 9-23 Topology for WLAN/AP Support Configuration on a 3560 Switch



`Switch>enable`	Moves to privileged mode.
`Switch#configure terminal`	Moves to global configuration mode.
`Switch(config)#hostname 3560`	Sets the host name of the switch.
`3560(config)#vlan 1`	Enters VLAN-configuration mode.
`3560(config-vlan)#name Management`	Assigns a name to VLAN 1.
`3560(config-vlan)#exit`	Returns to global configuration mode.
`3560(config)#vlan 100`	Creates VLAN 100 and enters VLAN-configuration mode.
`3560(config-vlan)#name Wireless`	Assigns a name to VLAN 100.
`3560(config-vlan)#exit`	Returns to global configuration mode.
`3560(config)#interface vlan 1`	Moves to interface configuration mode.

Table A-1 Catalyst Switch PVLAN Support Matrix (Continued)

Catalyst Platform	PVLAN Supported Minimum Software Version	Isolated VLAN	PVLAN Edge (Protected Port)	Community VLAN
Catalyst 2948G-L3/ 4908G-L3	Not Supported	Not Supported	Not Supported	Not Supported
Catalyst 1900	Not Supported	Not Supported	Not Supported	Not Supported
Catalyst 8500	Not Supported	Not Supported	Not Supported	Not Supported
Catalyst 3560	12.2(20)SE—EMI	Yes	Yes. 12.1(19)EA1 onward.	Yes
Catalyst 3750	12.2(20)SE—EMI	Yes	Yes. 12.1(11)AX onward.	Yes
Catalyst 3750 Metro	12.2(25)EY—EMI	Yes	Yes. 12.1(14)AX onward.	Yes
Catalyst 2940	Not Supported	Not Supported	Yes. 12.1(13)AY onward.	Not Supported
Catalyst 2948G/2980G	6.2	Yes	Not Supported	Yes
Catalyst 2955	Not Supported	Not Supported	Yes. 12.1(6)EA2 onward.	Not Supported
Catalyst 2970	Not Supported	Not Supported	Yes. 12.1(11)AX onward.	Not Supported
Catalyst 2960	Not Supported	Not Supported	Yes. 12.2(25)FX and later.	Not Supported
Catalyst Express 500	Not Supported	Not Supported	Not Supported	Not Supported



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