Introduction

NETWORK SECURITY

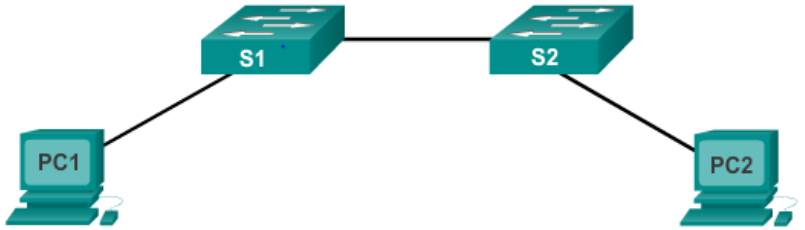
Dr. Md. Nadir Bin Ali

Lecture-2

Operating Systems

All networking equipment depend

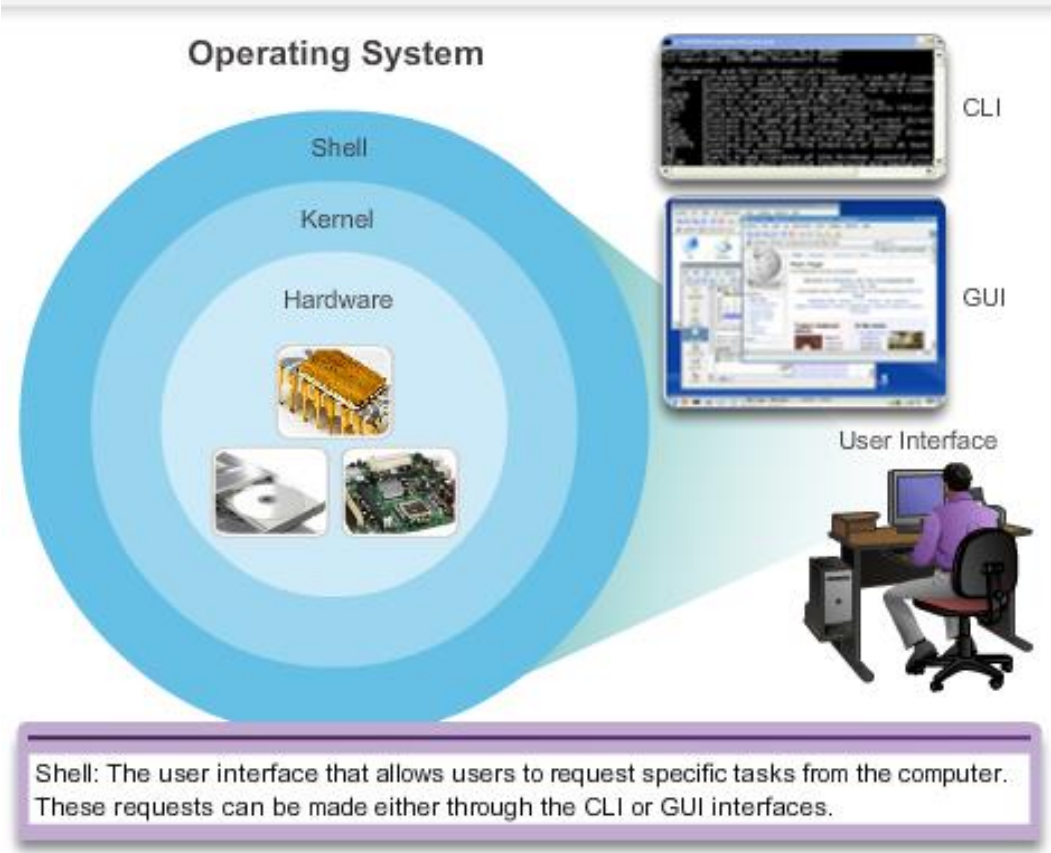
- End users (PCs, laptops, sma
- Switches
- Routers
- Wireless access points
- Firewalls



Internetwork Operating System (IOS)

- Collection of network operating systems used on devices

Operating Systems



Location of the Cisco IOS

IOS stored in **Flash**

- Non-volatile storage – not lost when power is lost
- Can be changed or overwritten as needed
- Can be used to store multiple versions of IOS
- IOS copied from flash to volatile RAM
- Quantity of flash and RAM memory determines IOS that can be used

IOS Functions

Major functions performed or enabled by Cisco routers and switches include:

Console Access Method

Most common methods to access the Command Line Interface

- Console
- Telnet or SSH
- AUX port

Console Access Method

Console port

- Device is accessible even if no networking services have been configured (out-of-band)
- Need a special console cable
- Allows configuration commands to be entered
- Should be configured with passwords to prevent unauthorized access
- Device should be located in a secure room so console port can not be easily accessed

Telnet, SSH, and AUX Access Methods

Telnet

- Method for remotely accessing the CLI over a network
- Require active networking services and one active interface that is configured

Secure Shell (SSH)

- Remote login similar to Telnet but utilizes more security
- Stronger password authentication
- Uses encryption when transporting data

Aux Port

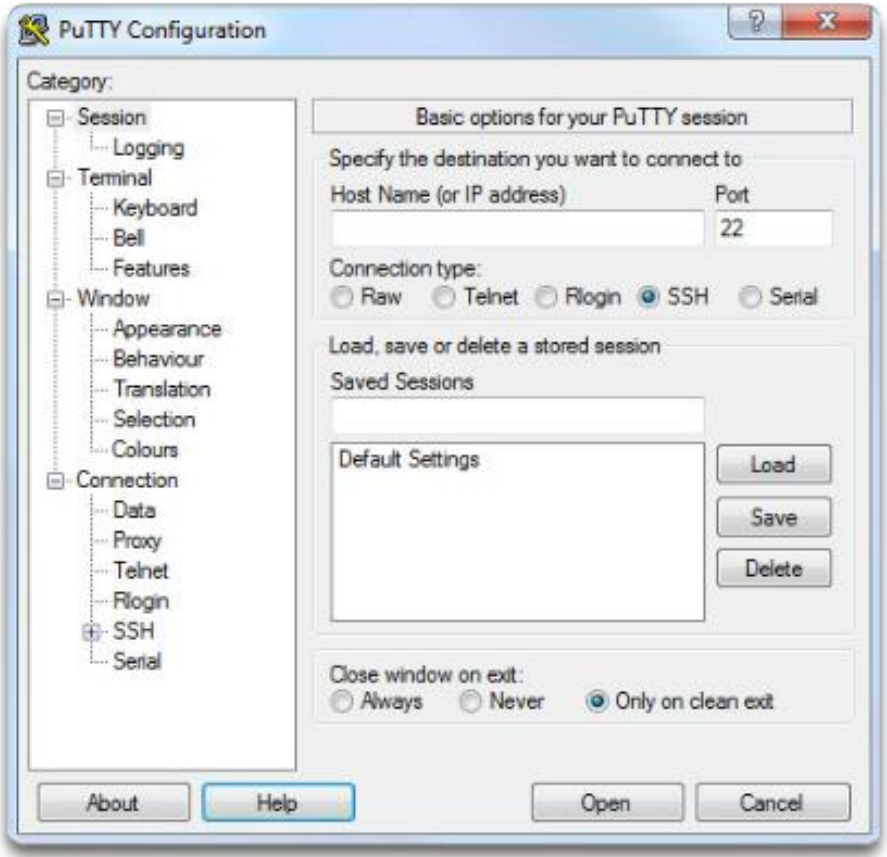
- Out-of-band connection
- Uses telephone line
- Can be used like console port

Terminal Emulation Programs

Software available for connecting to a networking device

- PuTTY
- Tera Term
- SecureCRT
- HyperTerminal
- OS X Terminal

PuTTY



Primary Modes

User EXEC Mode

Limited examination of router.
Remote access.

```
Switch>
Router>
```

The **User EXEC** mode allows only a limited number of basic monitoring commands and is often referred to as view-only mode.

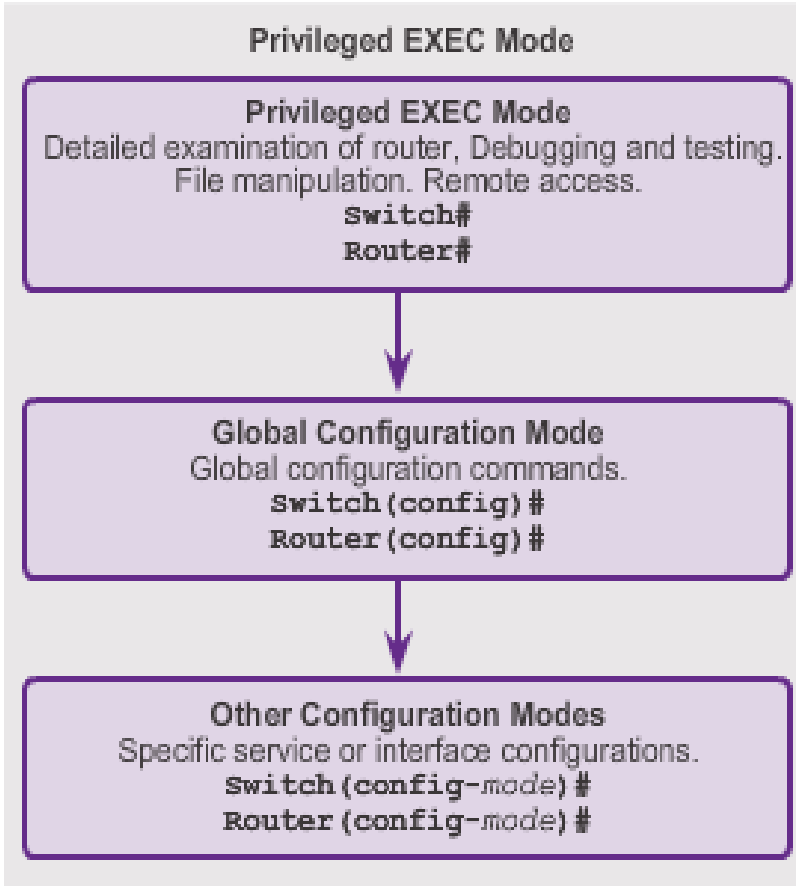
Privileged EXEC Mode

Detailed examination of router. Debugging and testing. File manipulation. Remote access.

```
Switch#
Router#
```

The **Privileged EXEC** mode, by default, allows all monitoring commands, as well as execution of configuration and management commands.

Global Configuration Mode and Submodes



IOS Prompt Structure

```
Router>ping 192.168.10.5

Router#show running-config

Router(config)#Interface FastEthernet 0/0

Router(config-if)#ip address 192.168.10.1 255.255.255.0
```

The prompt changes to denote the current CLI mode.

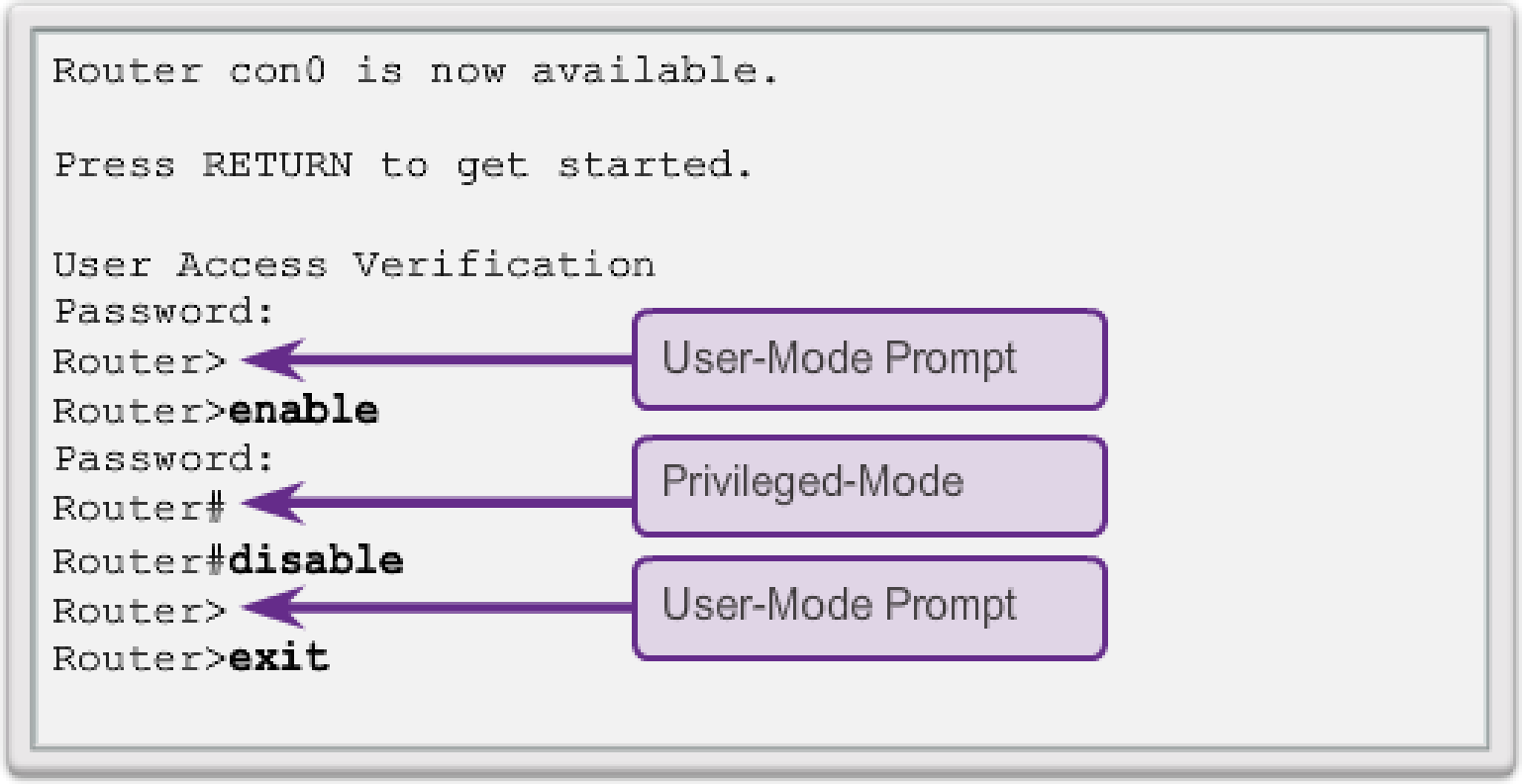
```
Switch>ping 192.168.10.9

Switch#show running-config

Switch(config)#Interface FastEthernet 0/1

Switch(config-if)#Description connection to WEST LAN4
```

Navigating between IOS Modes



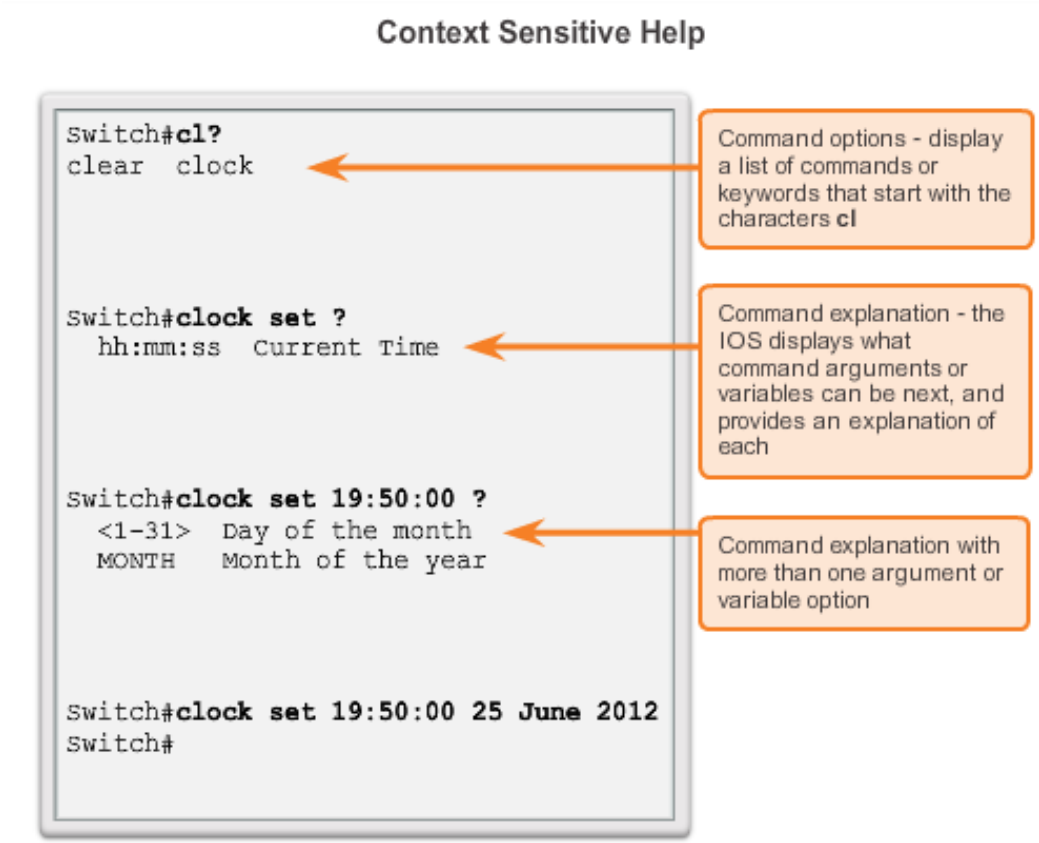
Navigating between IOS Modes (cont.)

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#interface vlan 1
Switch(config-if)#exit
Switch(config)#exit
Switch#
```

```
Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#vlan 1
Switch(config-vlan)#end
Switch#
```

```
Switch#configure terminal
Enter configuration commands, one per line.
End with CNTL/Z.
Switch(config)#line vty 0 4
Switch(config-line)#interface fastethernet 0/1
Switch(config-if)#end
Switch#
```

Context Sensitive Help



Command Syntax Check

```
Switch#>clock set
% Incomplete command.
Switch#clock set 19:50:00
% Incomplete command.
```

The IOS returns a help message indicating that required keywords or arguments were left off the end of the command.

```
Switch#c
% Ambiguous command:'c'
```

The IOS returns a help message to indicate that there were not enough characters entered for the command interpreter to recognize the command.

```
Switch#clock set 19:50:00 25 6
                          ^
% Invalid input detected at '^'
marker.
```

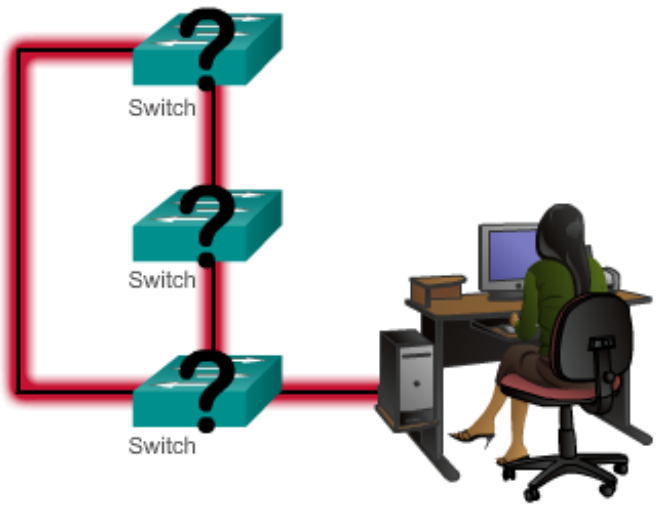
The IOS returns a "^" to indicate where the command interpreter can not decipher the command.

Device Names

Some guidelines for naming conventions are that names should:

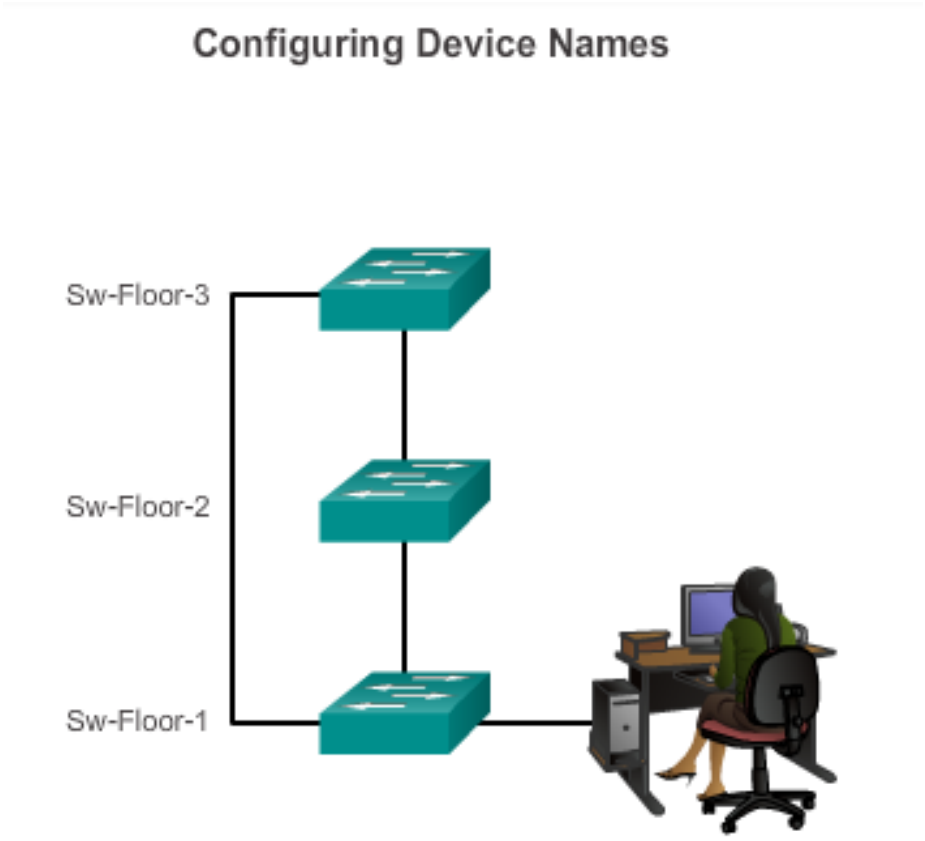
- Start with a letter
- Contain no spaces
- End with a letter or digit
- **Use only letters, digits, and dashes**
- Be less than 64 characters in length

Without names, network devices are difficult to identify for configuration purposes.



Hostnames

Hostnames allow devices to be identified by network administrators over a network or the Internet.



Securing Device Access

The passwords introduced here are:

- **Enable password** - Limits access to the privileged EXEC mode
- **Enable secret** - Encrypted, limits access to the privileged EXEC mode
- **Console password** - Limits device access using the console connection
- **VTY password** - Limits device access over Telnet

Securing Privileged EXEC Access

- use the **enable secret** command, not the older **enable** password command
- **enable secret** provides greater security because the password is encrypted

```
Sw-Floor-1>enable
Sw-Floor-1#
Sw-Floor-1#conf terminal
Sw-Floor-1(config)#enable secret class
Sw-Floor-1(config)#exit
Sw-Floor-1#
Sw-Floor-1#disable
Sw-Floor-1>enable
Password:
Sw-Floor-1#
```

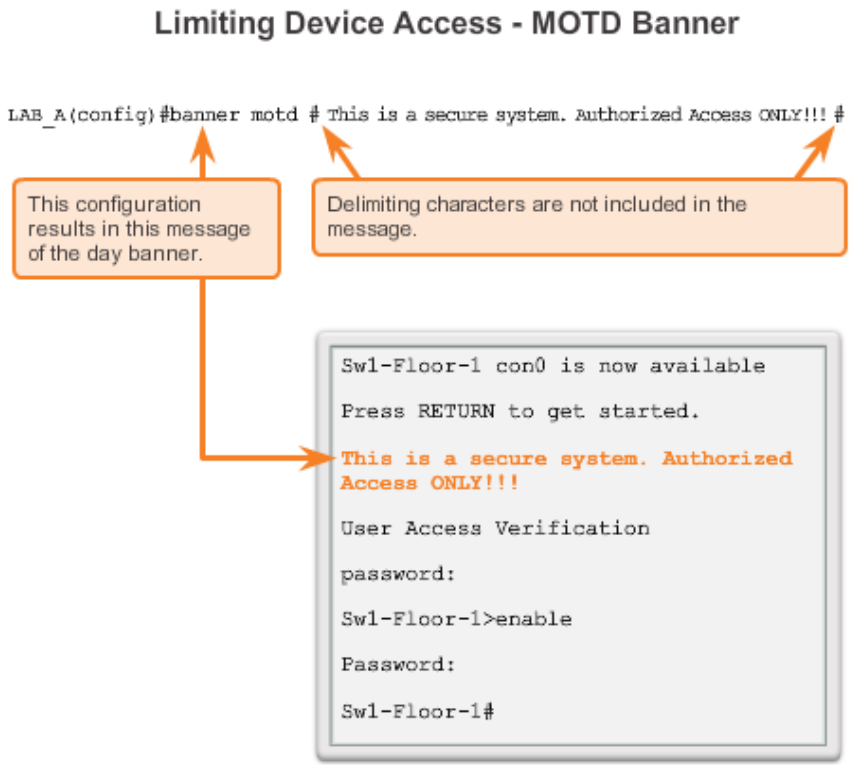
Securing User EXEC Access

```
Sw-Floor-1(config)#line console 0
Sw-Floor-1(config-line)#password cisco
Sw-Floor-1(config-line)#login
Sw-Floor-1(config-line)#exit
Sw-Floor-1(config)#
Sw-Floor-1(config)#line vty 0 15
Sw-Floor-1(config-line)#password cisco
Sw-Floor-1(config-line)#login
Sw-Floor-1(config-line)#
```

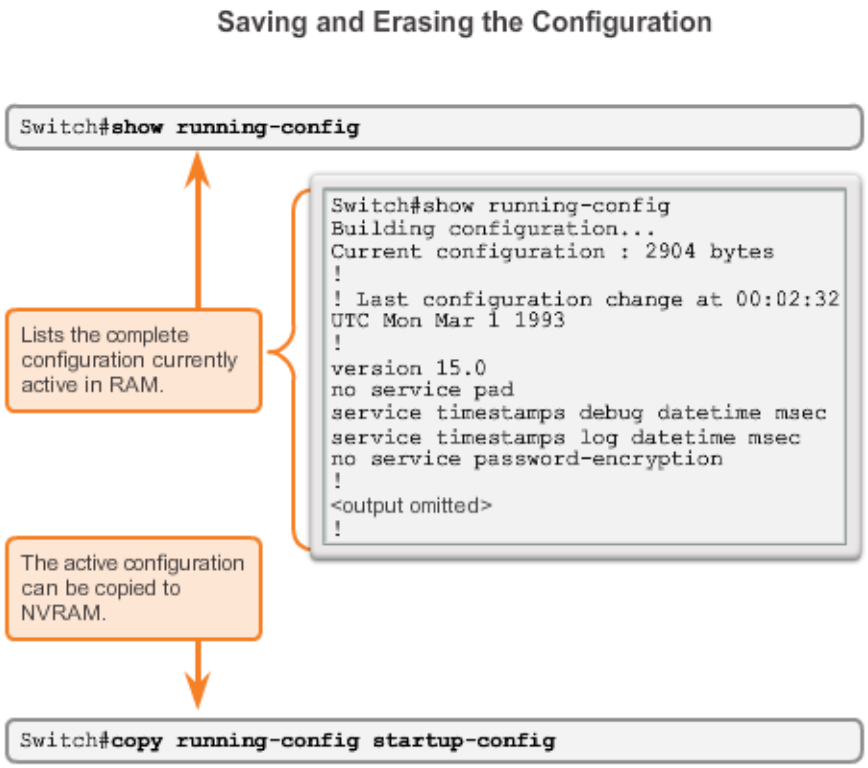
- Console port must be secured
  - reduces the chance of unauthorized personnel physically plugging a cable into the device and gaining device access
- vty lines allow access to a Cisco device via Telnet
  - number of vty lines supported varies with the type of device and the IOS version

Banner Messages

- important part of the legal process in the event that someone is prosecuted for breaking into a device
- wording that implies that a login is "welcome" or "invited" is not appropriate
- often used for legal notification because it is displayed to all connected terminals

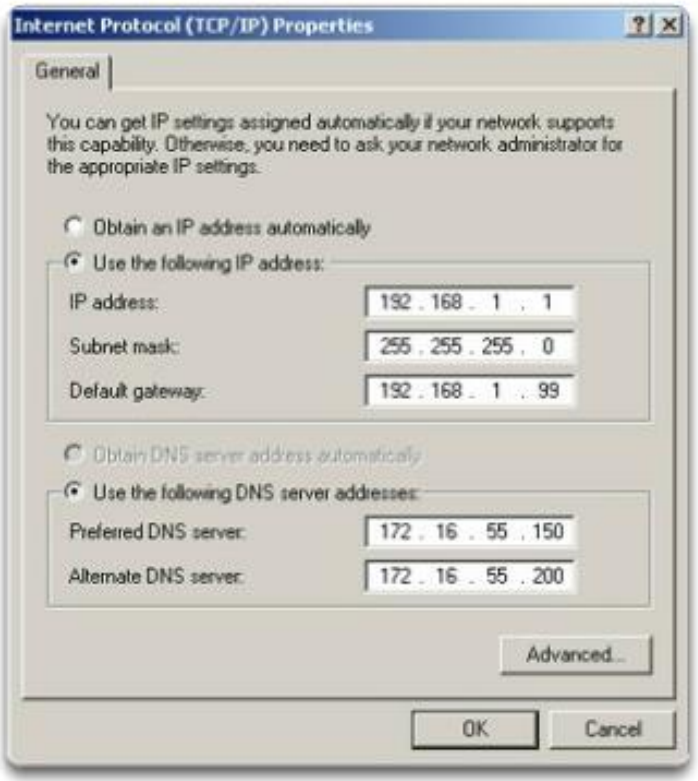


Configuration Files

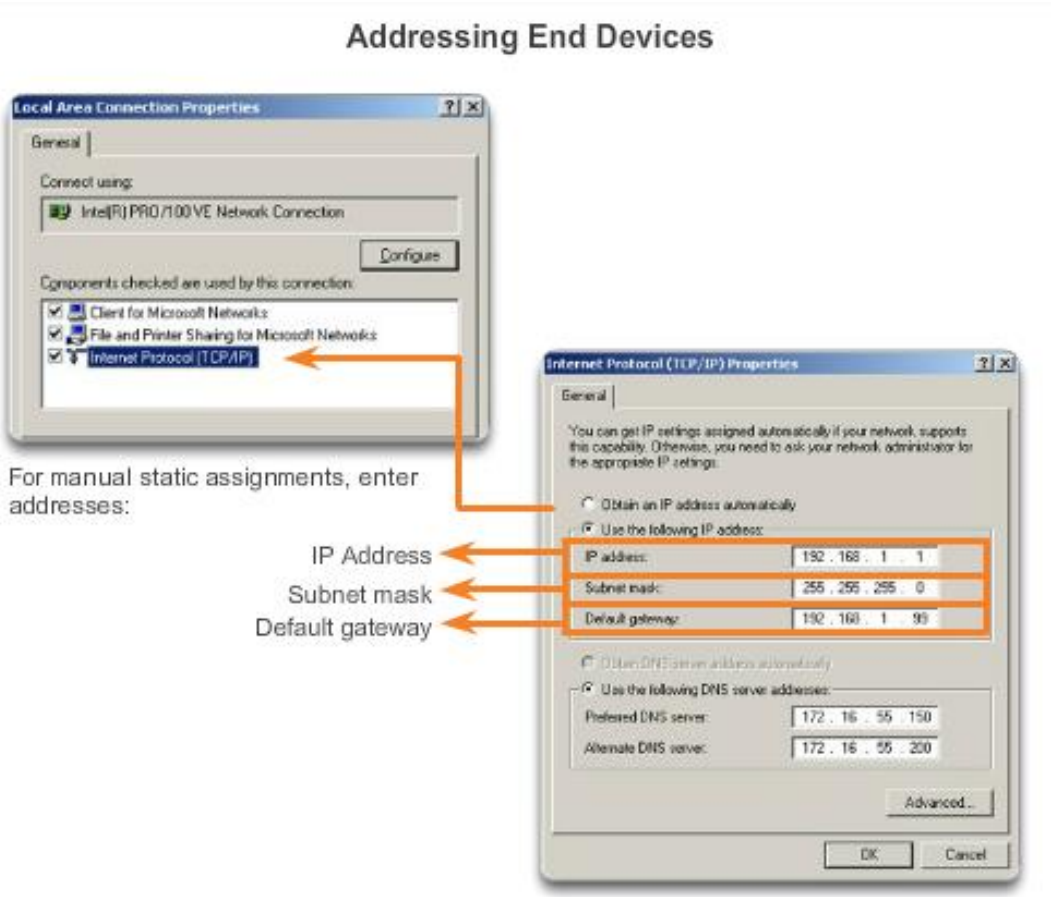


IP Addressing in the Large

- Each end device on a network must be configured with an IP address
- Structure of an IPv4 address is called *dotted decimal*
- IP address displayed in decimal notation, with four decimal numbers between 0 and 255
- With the IP address, a subnet mask is also necessary
- IP addresses can be assigned to both physical ports and virtual interfaces



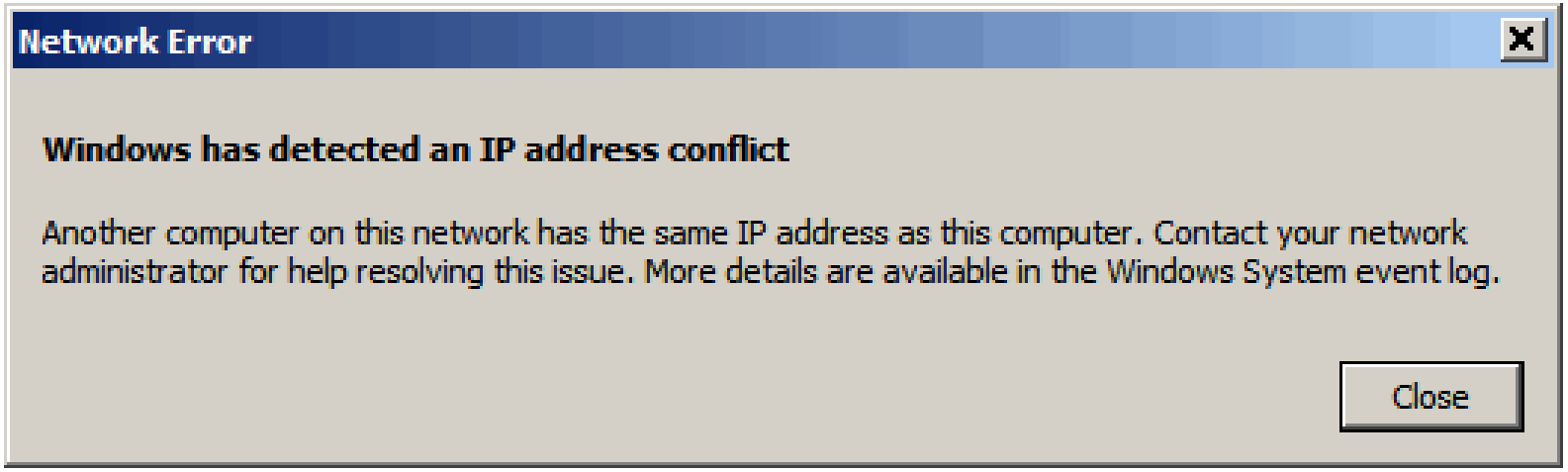
Manual IP Address Configuration for End Devices



Automatic IP Address Configuration for End Devices

Assigning Dynamic Addresses

IP Address Conflicts



Thank You