



# Chapter 1: Introduction to Scaling Networks



## Scaling Networks

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# Chapter 1

1.0 Introduction

1.1 Implementing a Network Design

1.2 Selecting Network Devices

1.3 Summary



# Chapter 1: Objectives

- Describe the use of a hierarchical network for a small business.
- Describe recommendations for designing a network that is scalable.
- Describe the type of switches available for small-to-medium-sized business networks.
- Describe the type of routers available for small-to-medium-sized business networks.
- Configure and verify basic settings on a Cisco IOS device.



## 1.1 Implementing a Network Design



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## Hierarchical Network Design

# Network Scaling Needs

As they grow and expand, all enterprise networks must:

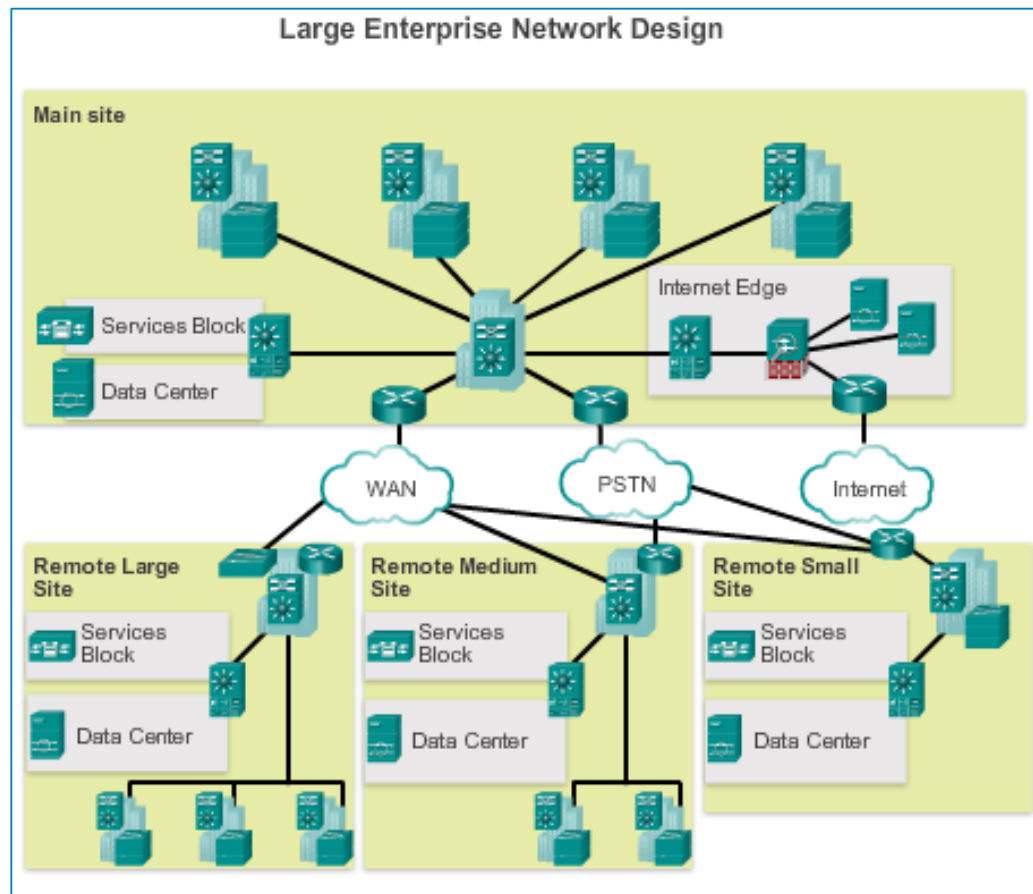
- Support critical applications
- Support converged network traffic
- Support diverse business needs
- Provide centralized administrative control



## Hierarchical Network Design

# Enterprise Business Devices

To provide a high-reliability network, enterprise class equipment is installed in the enterprise network.

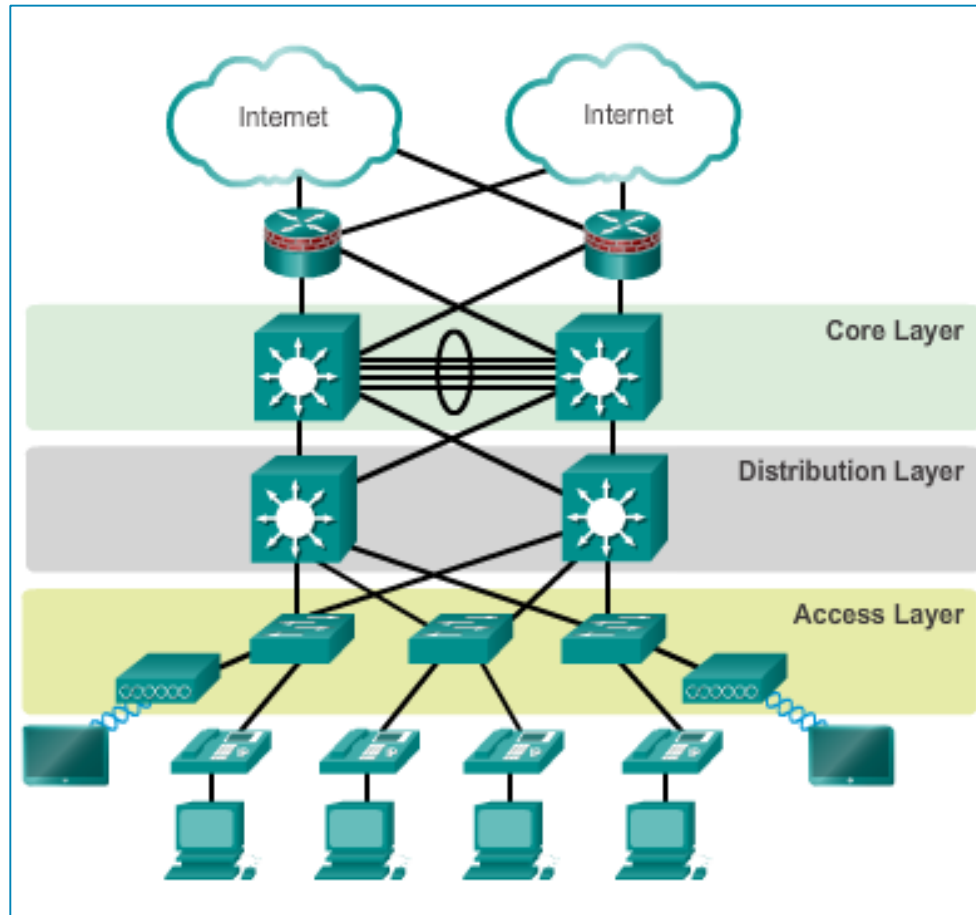




## Hierarchical Network Design

# Hierarchical Network Design

This model divides the network functionality into three distinct layers.



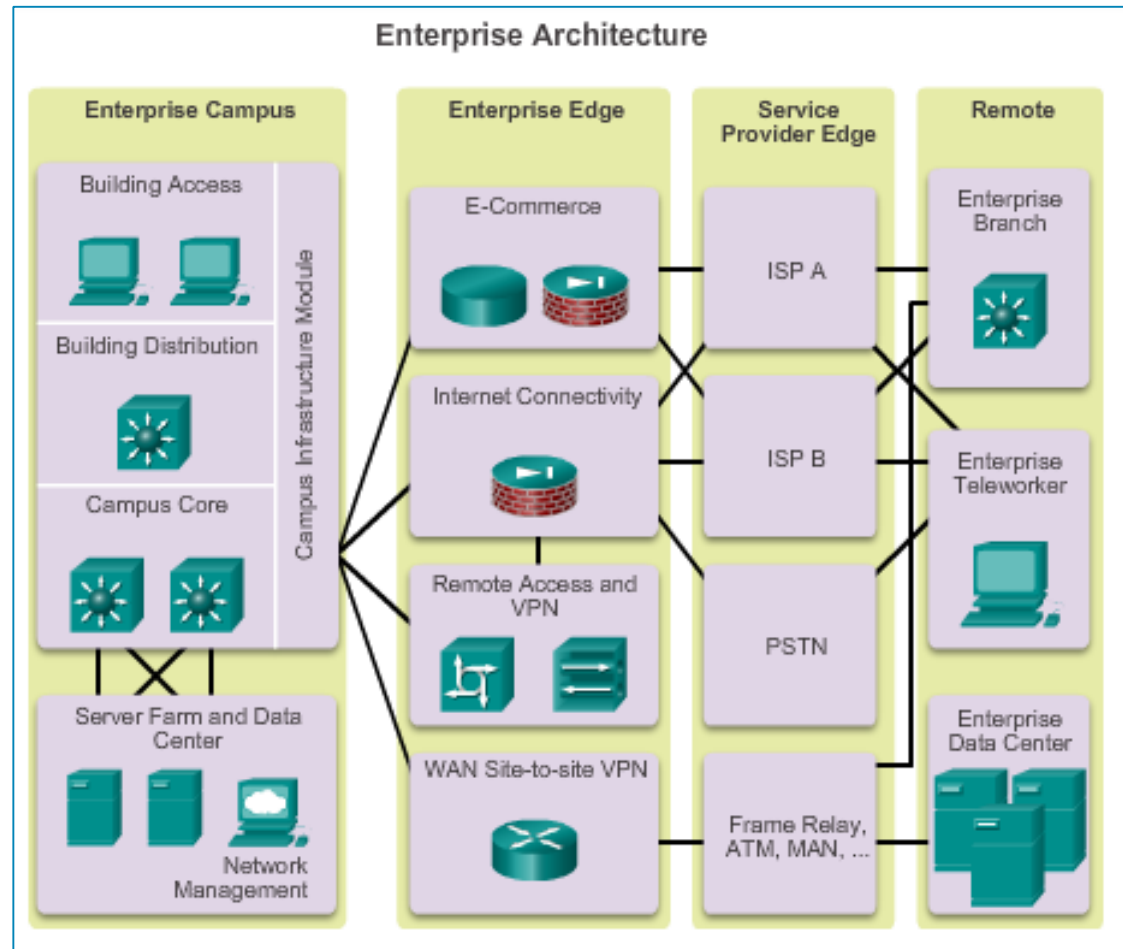


## Hierarchical Network Design

# Cisco Enterprise Architecture

The primary Cisco Enterprise Architecture modules include:

- Enterprise Campus
- Enterprise Edge
- Service Provider Edge
- Remote







## Hierarchical Network Design

# Failure Domains

- Failure Domains are areas of a network that are impacted when a critical device or network service experiences problems.
- Redundant links and enterprise class equipment minimize disruption of network.
- Smaller failure domains reduce the impact of a failure on company productivity.
- Smaller failure domains also simplify troubleshooting.
- Switch block deployment – each switch block acts independently of the others. Failure of a single device does not impact the whole network.



## Expanding the Network

# Designing for Scalability

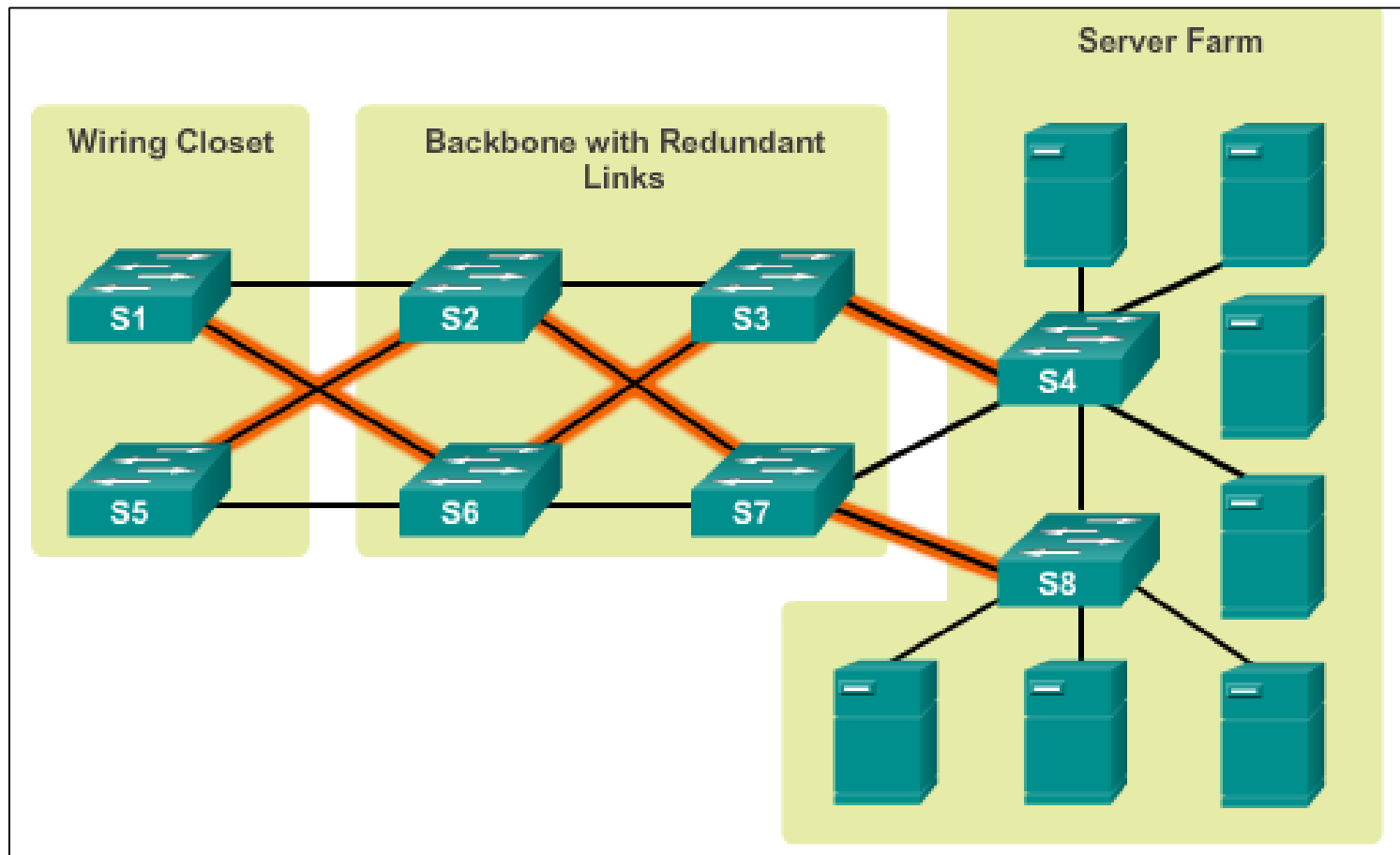
- Use expandable, modular equipment or clustered devices.
- Include design modules that can be added, upgraded, and modified, without affecting the design of the other functional areas of the network.
- Create a hierarchical addressing scheme.
- Use routers or multilayer switches to limit broadcasts and filter traffic.



## Expanding the Network

# Planning for Redundancy

- Installing duplicate equipment
- Providing redundant paths

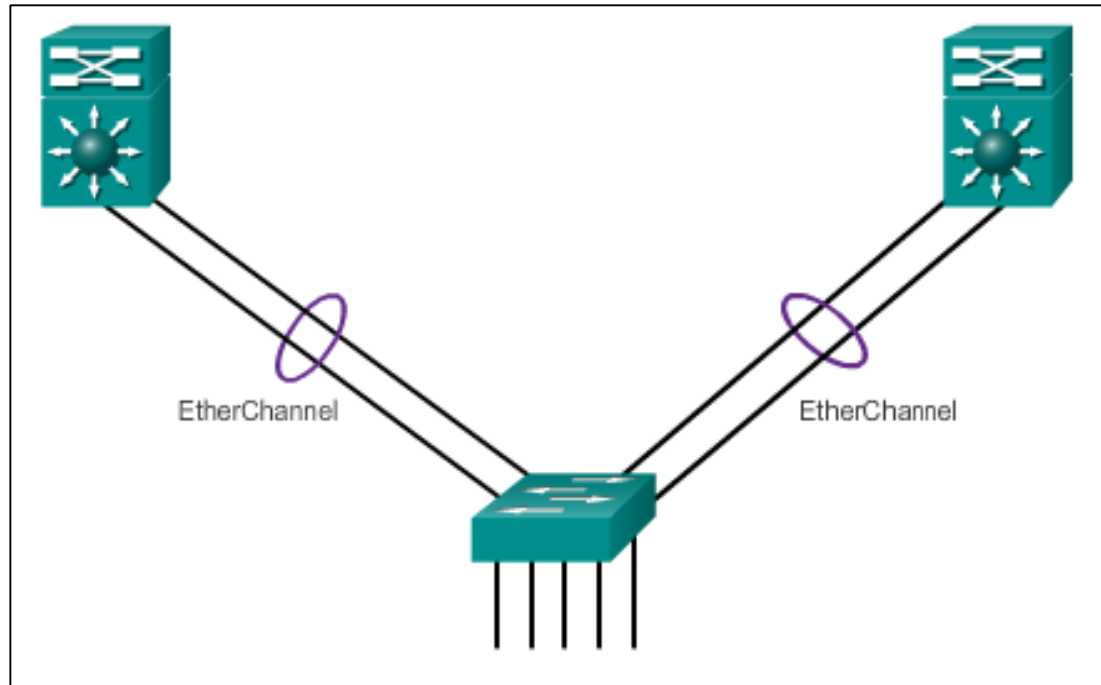




## Expanding the Network

# Increasing Bandwidth

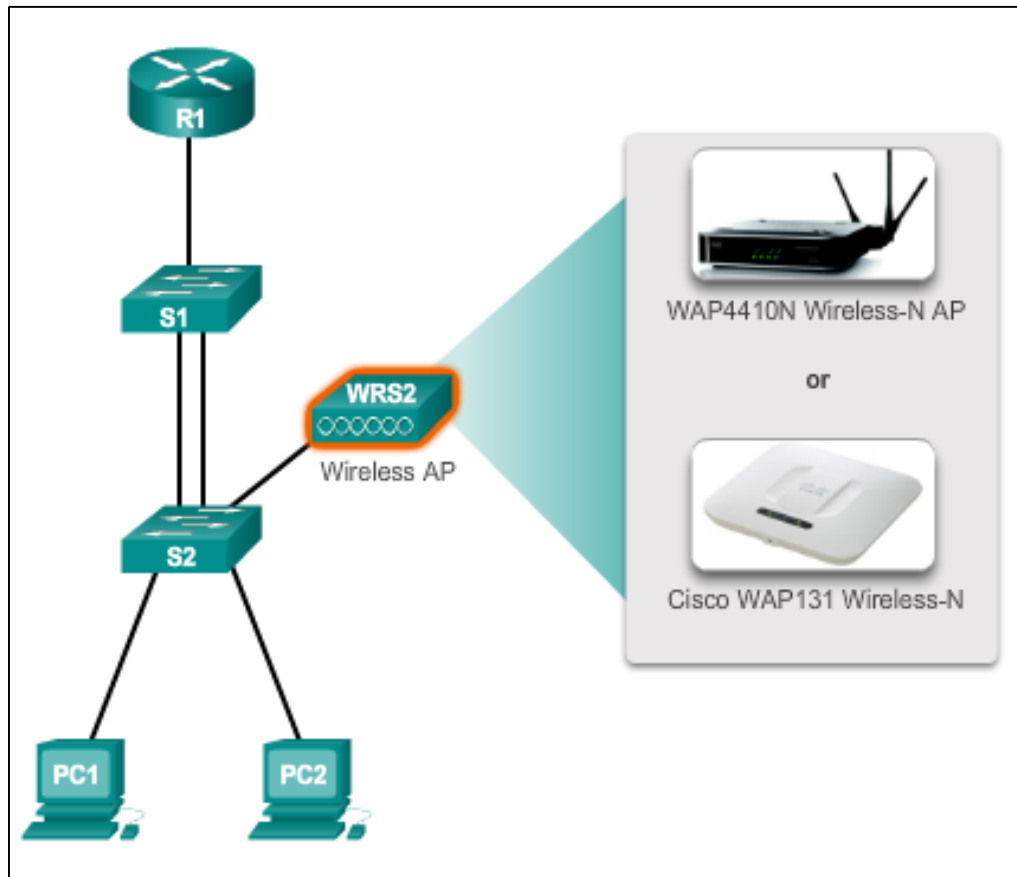
- Link aggregation increases the amount of bandwidth between devices by creating one logical link made up of several physical links.
- EtherChannel is a form of link aggregation used in switched networks.



## Expanding the Network

# Expanding the Access Layer

Access layer connectivity can be extended through wireless connectivity.

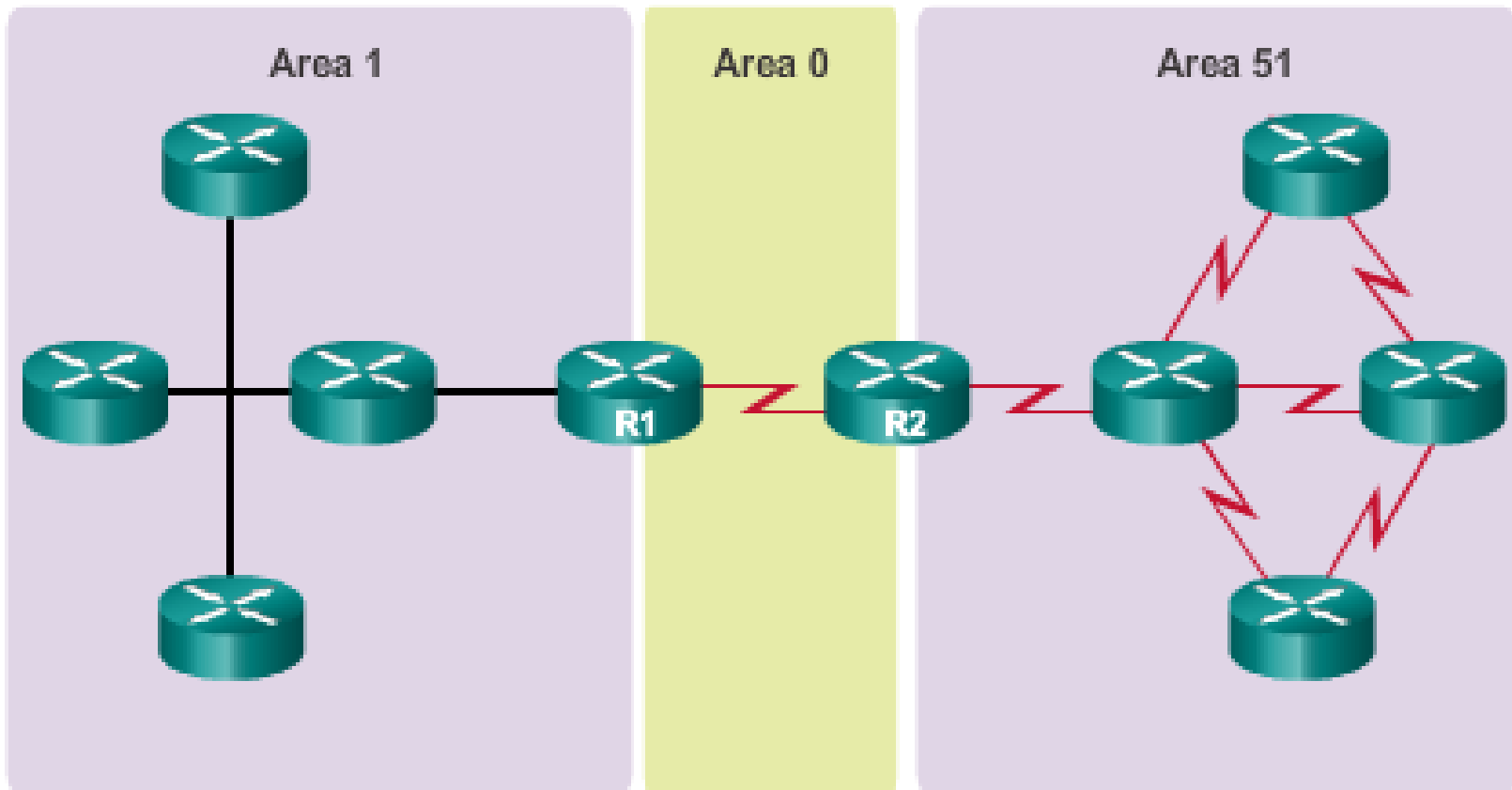




## Expanding the Network

# Fine-Tuning Routing Protocols

OSPF works well for large, hierarchical networks.





## 1.2 Selecting Network Devices



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## Switch Hardware

# Switch Platforms

Select form factor:

- Fixed
- Modular
- Stackable
- Non-stackable



Campus LAN



Data Center



Cloud-Managed



Service Provider



Virtual Networking





# Switch Hardware

## Port Density



24-port switch



48-port switch



Modular switch with up to 1000+ ports

## Switch Hardware

# Forwarding Rates

The processing capabilities of a switch are rated by how much data the switch can process per second.

24-port Gigabit Ethernet Switch



Capable of switching 24 Gb/s of traffic

48-port Gigabit Ethernet Switch

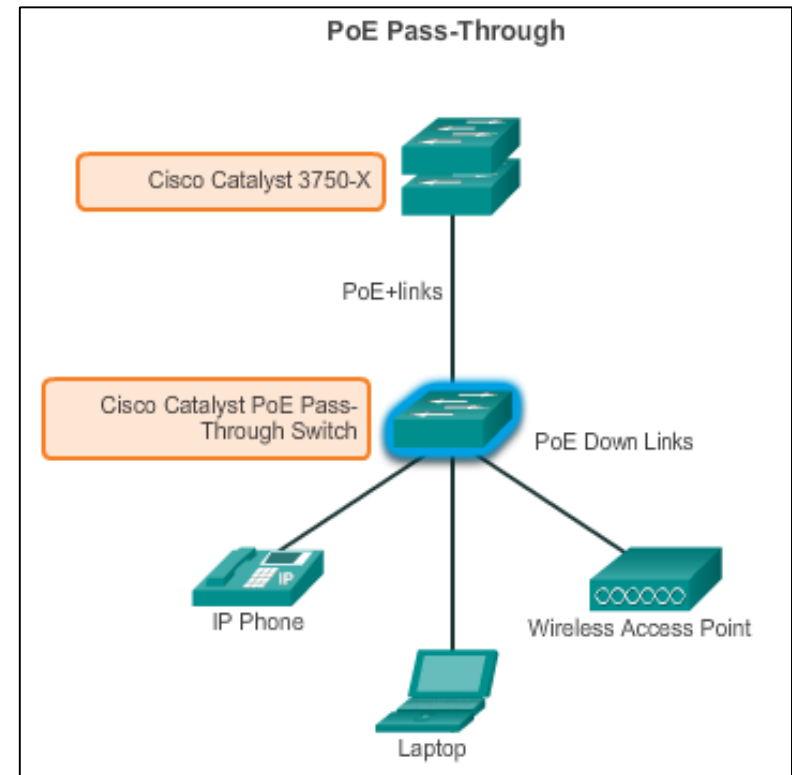
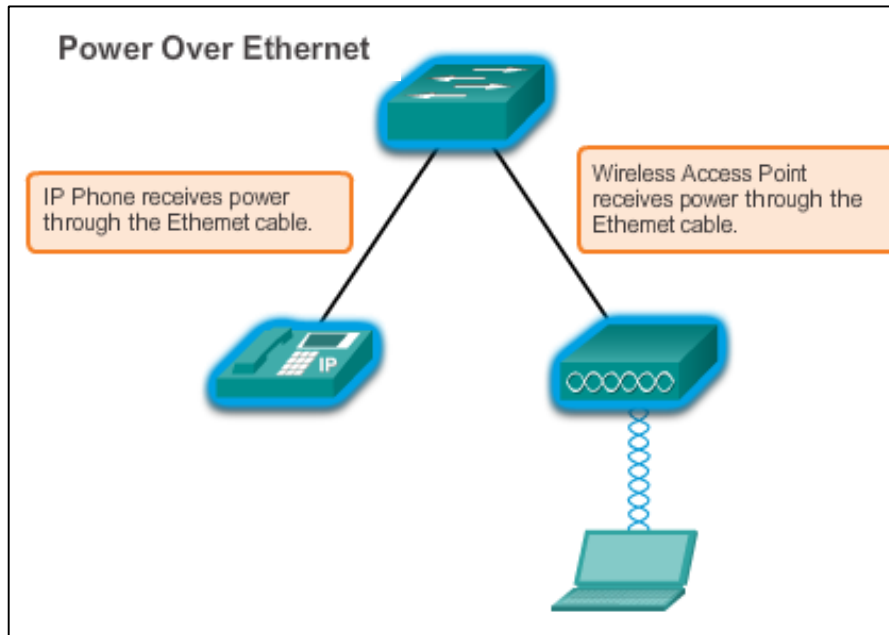


Capable of switching 48 Gb/s of traffic



# Switch Hardware

## Power over Ethernet



## Switch Hardware

# Multilayer Switching

- Deployed in the core and distribution layers of an organization's switched network.
- Can build a routing table, support a few routing protocols, and forward IP packets.

Cisco Catalyst 2960 Series Switches



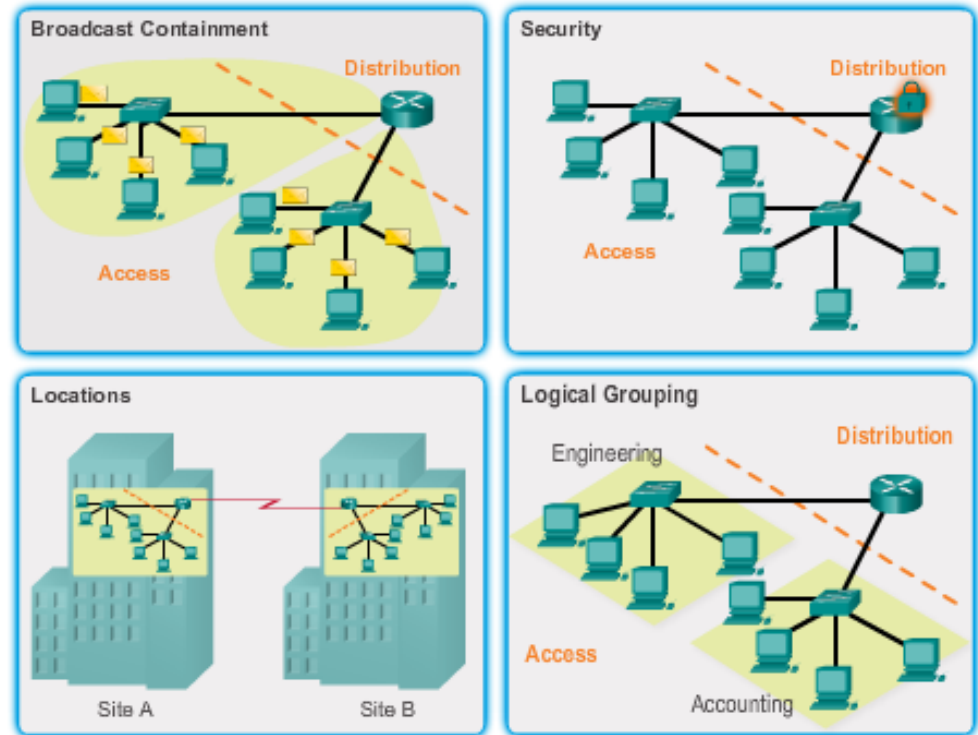


# Router Hardware

## Router Requirements

### Role of routers:

- Interconnect multiple sites
- Provide redundant paths
- Connect ISPs
- Translate between media types and protocols





## Router Hardware

# Cisco Routers

Three categories of routers:

- Branch – Highly available 24/7.
- Network Edge – High performance, high security, and reliable services. Connect campus, data center, and branch networks.
- Service provider routers



Branch



Network Edge



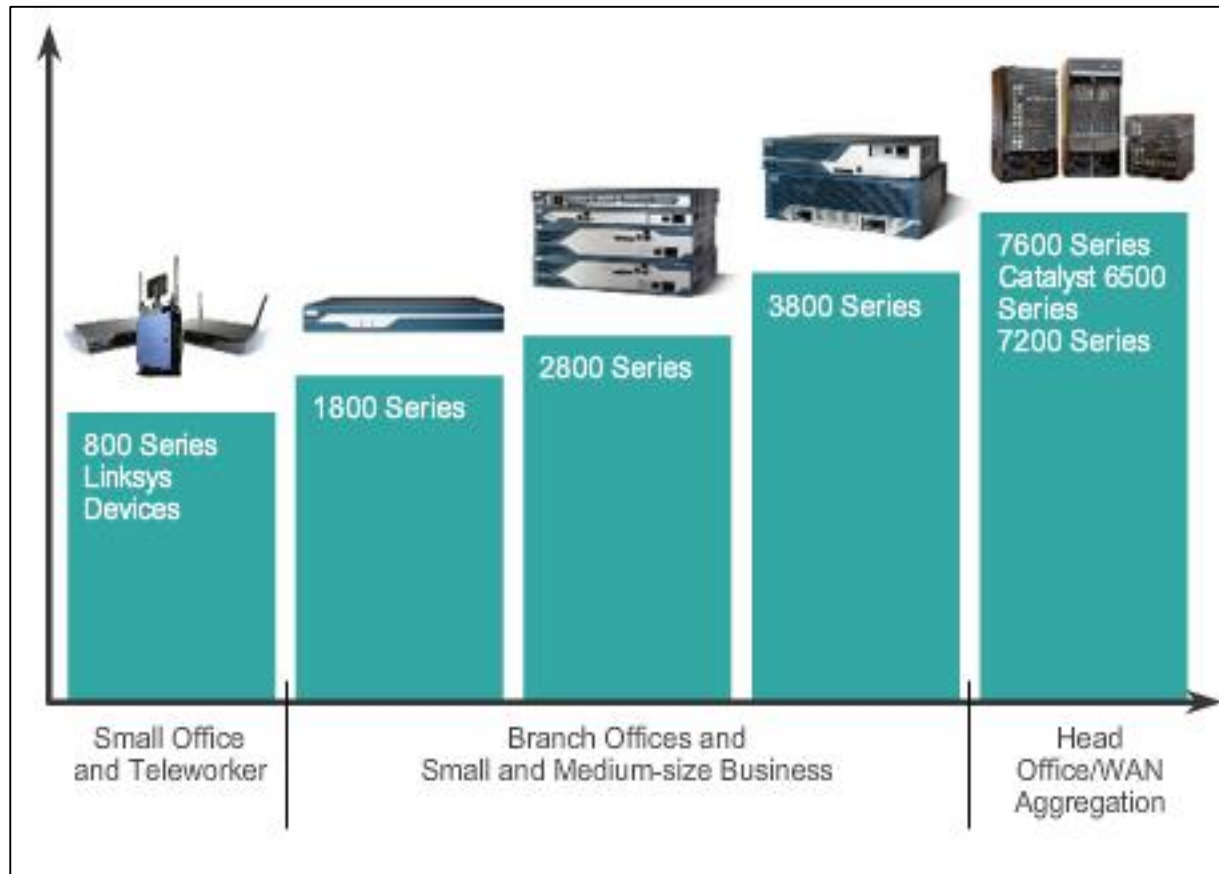
Service Provider



## Router Hardware

# Router Hardware

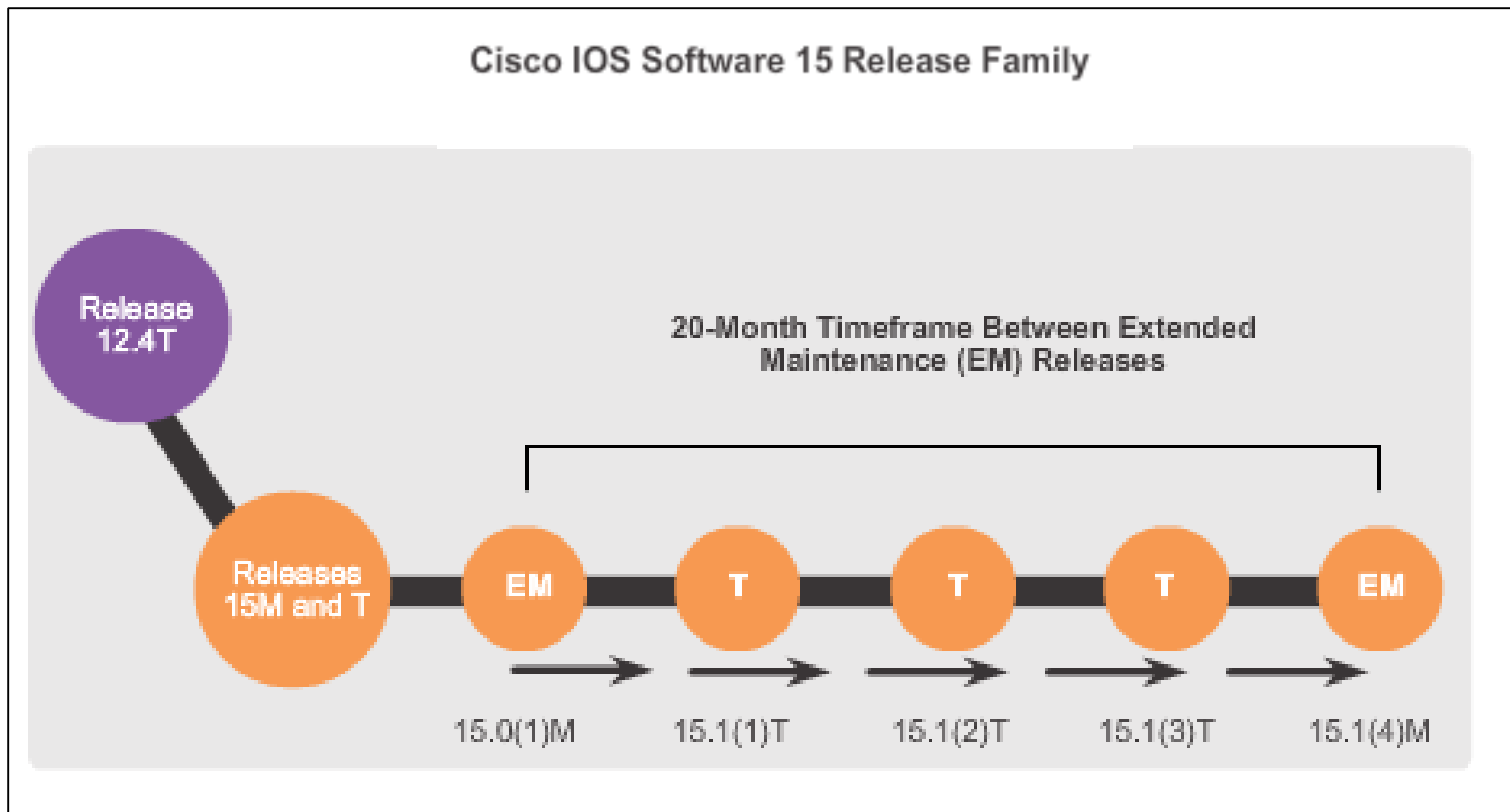
- Fixed configuration – Built-in interfaces.
- Modular – Slots allow different interfaces to be added.





## Managing Devices

# Managing IOS Files and Licensing

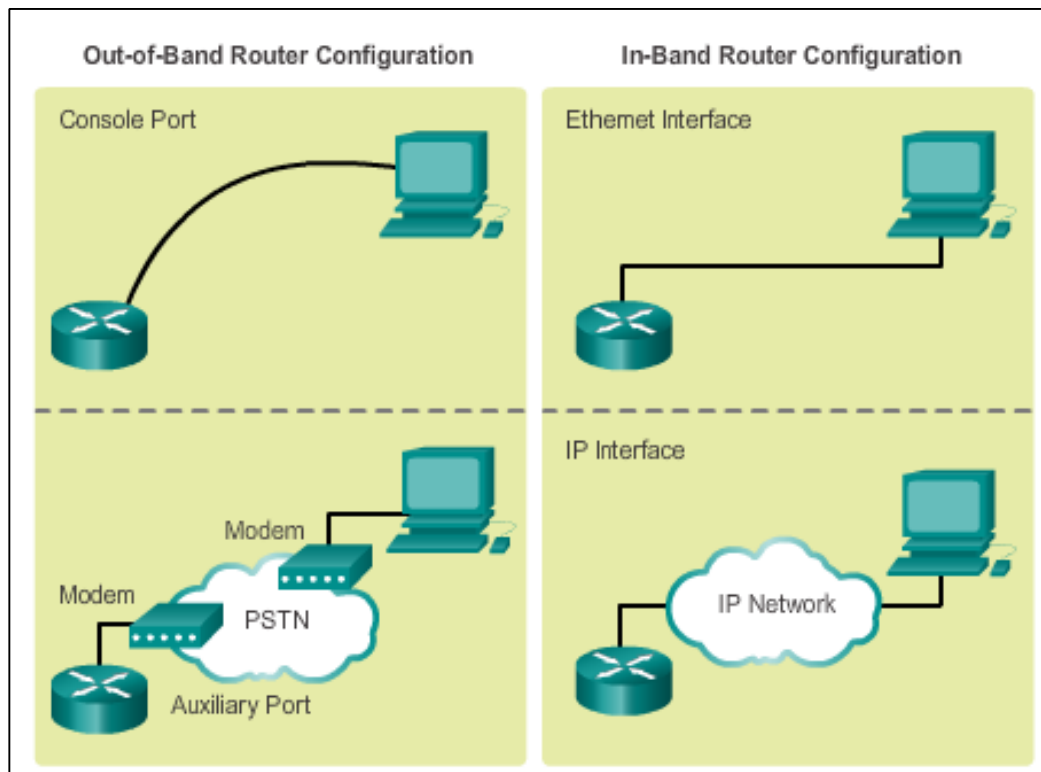




## Managing Devices

# In-Band vs. Out-of-Band Management

- **In-Band** requires, at least, one interface to be connected and operational and use of Telnet, SSH, or HTTP to access device.
- **Out-of-Band** requires direct connection to console or AUX port and Terminal Emulation client to access device.





## Managing Devices

# Basic Router CLI commands

Basic router configuration includes:

- Hostname
- Passwords (console, Telnet/SSH, and privileged mode)
- Interface IP addresses
- Enabling a routing protocol

```
Router# configure terminal
Router(config)# hostname R1
R1(config)# enable secret class
R1(config)# line console 0
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exec-timeout 0 0
R1(config-line)# line vty 0 4
R1(config-line)# password cisco
R1(config-line)# login
R1(config-line)# exit
R1(config)# service password-encryption
R1(config)# banner motd $ Authorized Access Only! $
R1(config)# interface GigabitEthernet0/0
R1(config-if)# description Link to LAN 1
R1(config-if)# ip address 172.16.1.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# interface Serial0/0/0
R1(config-if)# description Link to R2
R1(config-if)# ip address 172.16.3.1 255.255.255.252
R1(config-if)# clock rate 128000
R1(config-if)# no shut
R1(config-if)# interface Serial0/0/1
R1(config-if)# description Link to R3
R1(config-if)# ip address 192.168.10.5 255.255.255.252
```



## Managing Devices

# Basic Router show Commands

- **show ip protocols** – Displays information about routing protocol configured.
- **show ip route** – Displays routing table information.
- **show ip ospf neighbor** – Displays information about OSPF neighbors.
- **show ip interfaces** – Displays detailed information about interfaces.
- **show ip interface brief** – Displays all interfaces with IP addressing , interface, and line protocol status.
- **show cdp neighbors** – Displays information about all directly connected Cisco devices.



## Managing Devices

# Basic Switch CLI Commands

- Hostname
- Passwords
- In-Band access requires the Switch to have an IP address (assigned to VLAN 1).
- Save configuration – **copy running-config startup-config** command.
- To clear switch – **erase startup-config**, and then **reload**.
- To erase VLAN information – **delete flash:vlan.dat**.

```
Switch# enable
Switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)# hostname S1
S1(config)# banner motd %Unauthorized access prohibited%
S1(config)# enable password cisco
S1(config)# enable secret class
S1(config)# line con 0
S1(config-line)# password cisco
S1(config-line)# login
S1(config-line)# line vty 0 4
S1(config-line)# password cisco
S1(config-line)# login
S1(config-line)# interface vlan 1
S1(config-if)# ip address 192.168.1.5 255.255.255.0
S1(config-if)# no shutdown
S1(config-if)# exit
S1(config)# ip default-gateway 192.168.1.1
S1(config)# interface fa0/2
S1(config-if)# switchport mode access
S1(config-if)# switchport port-security
S1(config-if)# interface fa0/3
S1(config-if)# speed 10
S1(config-if)# duplex half
S1(config-if)# end
```



## Managing Devices

# Basic Switch Show Commands

- **show port-security** – Displays any ports with security enabled.
- **show port-security address** – Displays all secure MAC addresses.
- **show interfaces** – Displays detailed information about interfaces.
- **show mac-address-table** – Displays all MAC addresses the switch has learned.
- **show cdp neighbors** – Displays all directly connected Cisco devices.



## 1.3 Summary



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# Chapter 1: Summary

This chapter:

- Introduces the hierarchical network design model that divides network functionality into the access layer, the distribution layer, and the core layer.
- Describes how the Cisco Enterprise Architecture further divides the network into functional components called *modules*.
- Defines how routers and multilayer switches are used to limit failure domains.
- Explains that a good network design includes a scalable IP scheme, fast converging and scalable routing protocols, appropriate Layer 2 protocols and devices that are modular or easily upgraded.



# Chapter 1: Summary (cont.)

- Identifies that a mission-critical server should have a connection to two different access layer switches. It should also have redundant modules and backup power.
- Recognizes that routers and switches should be selected from the appropriate categories to meet the network's requirements.



