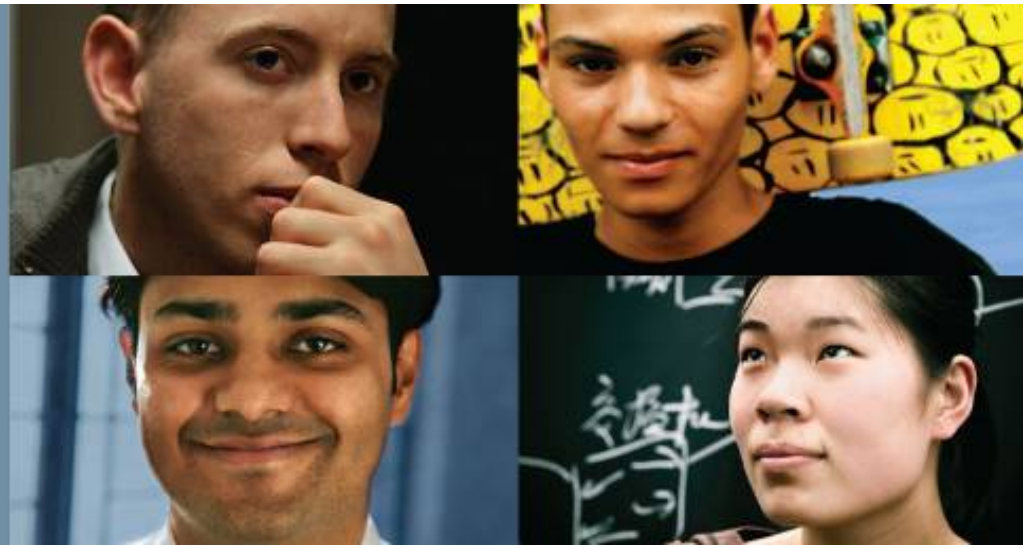
TNE10006/TNE60006: Networks and Switching



LAN Design

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Outline

- Hierarchical Network Model
- Converged Networks
- Network Design Considerations
- Switch Performance Characteristics
- Switch Features

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Hierarchical Network Model

- To satisfy the needs of a small or medium-sized business, your network is more likely to be successful if a hierarchical design model is used:
  - This involves dividing the network into discrete layers
  - Each layer provides specific functions that define its role within the overall network
  - By separating the various functions that exist on a network, the network design becomes modular, which facilitates scalability and performance

- The typical hierarchical design model is broken up in to three layers:
  - Access
  - Distribution
  - Core

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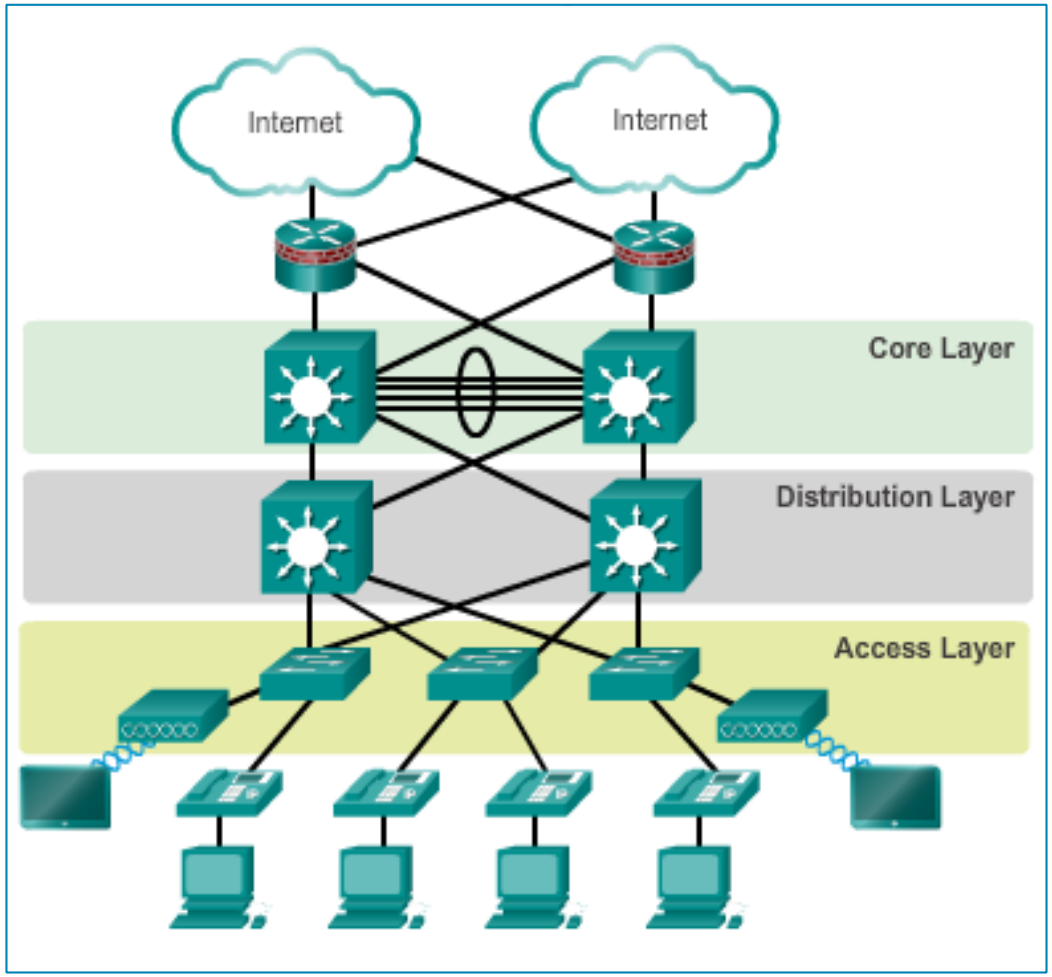
Hierarchical Network Design

This model divides the network functionality into three distinct layers.



Access Layer

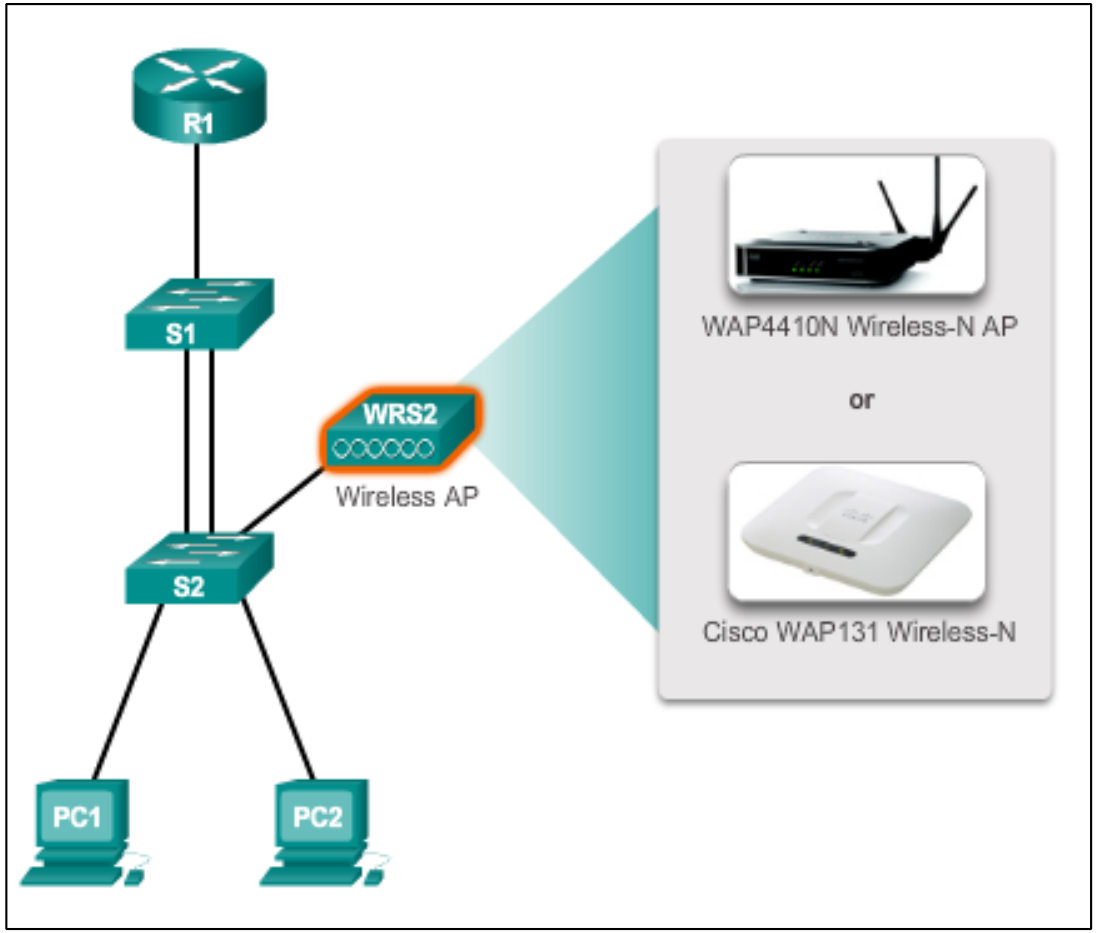
- Interfaces with end devices, such as PCs, printers, and IP phones, to provide access (2960 layer 2 switch) to the rest of the network
- Typically includes switches and wireless access points.
- The main purpose of this layer is to:

  Provide a means of connecting devices to the network

  Control which devices are allowed (eg port security) to communicate on the network

Expanding the Access Layer

Access layer connectivity can be extended through wireless connectivity.



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Distribution Layer

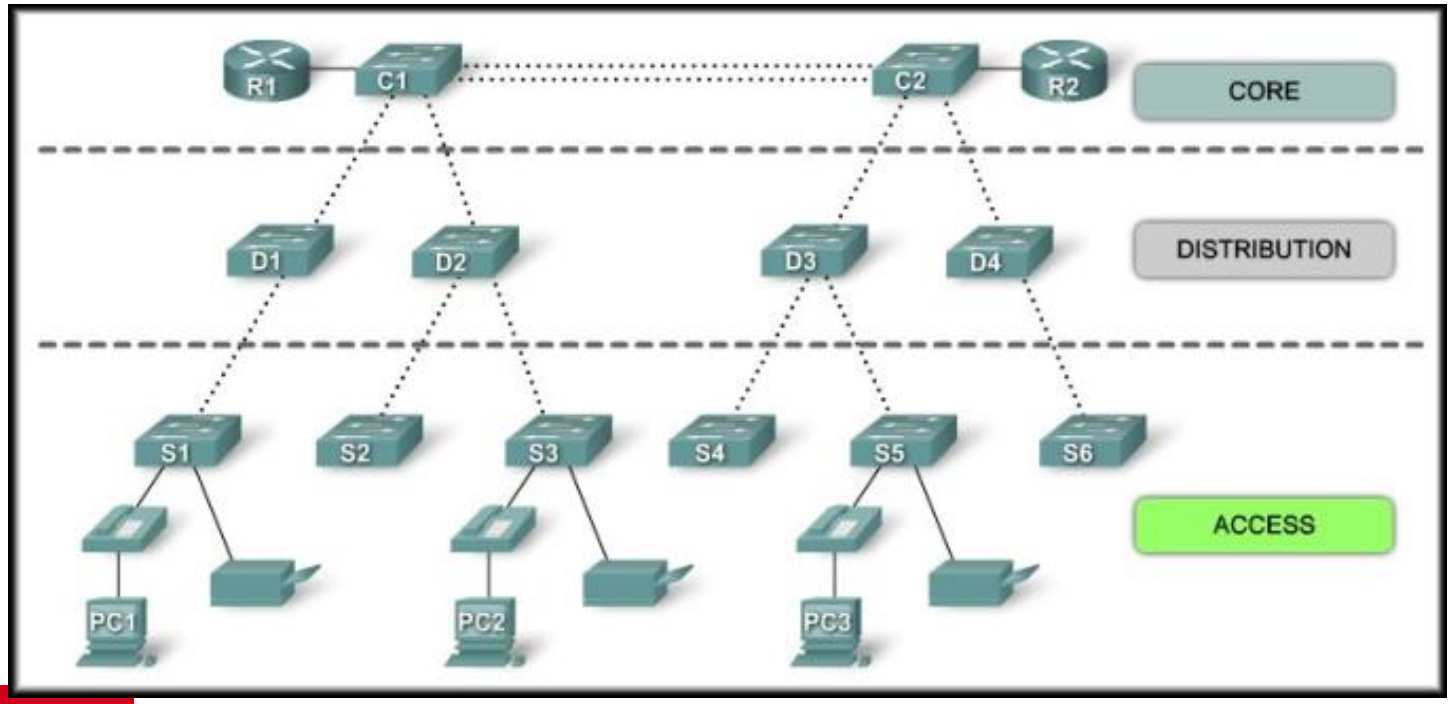
- Aggregates the data received from the access layer switches before it is transmitted to the core layer for routing to its final destination
- Controls the flow of networktraffic using policies (ACLs) and delineates broadcast domains by performing routing functions (3560 layer 3 switch) between virtual LANs (VLANs) defined at the access layer
- VLANs allow you to segment the traffic on a switch into separate subnetworks
- Distribution layer switches are typically high-performance devices that have high availability and redundancy to ensure reliability

Core Layer

- High-speed backbone of the internetwork
- Critical for interconnectivity between distribution layer devices, so it is important for the core to be highly available and redundant
- The core layer can also connect to Internet resources
- Aggregates the traffic from all the distribution layer devices, so it must be capable of forwarding large amounts of data quickly
- In smaller networks, it is not unusual to implement a **collapsed model**, where the distribution layer and core layer are combined into one layer

Logical Layout

- Layers separated into well-defined hierarchy
- Easy to see which switches perform which function
- More difficult to see in a physical/installed hierarchy
- NO intra-Layer connections



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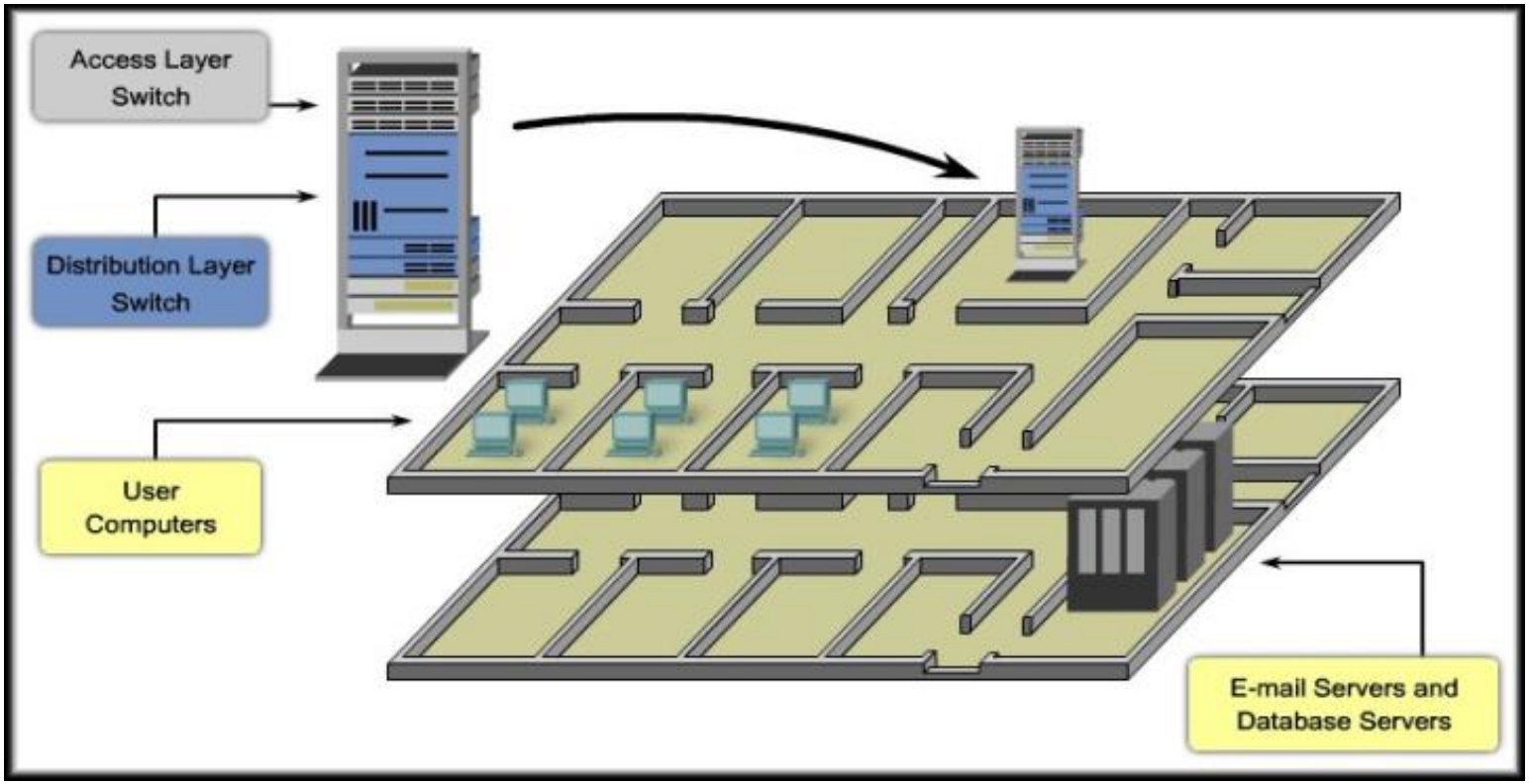
Physical Layout

- Try to maintain visibility into network design
- Often access layer and distribution switches are installed in the wiring closets of each floor and connected to each of the devices needing network access
- Logical layer switches often stacked one on top of each other in the wiring closet

Physical Layout



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Benefits

- Scalability
- Redundancy
- Performance

  Link aggregation between levels can allow for near wire-speed transfers throughout the network

- Security

  How and where to implement security make installation simpler

- Manageability

  Consistency between switch roles at each level simplifies management

- Maintainability

  Modularity allows network to scale without extra complexity

Design Principles

Network Diameter

- Number of devices a packet has to cross before reaching its destination
- A low diameter ensures low and predictable latency between devices

Bandwidth Aggregation

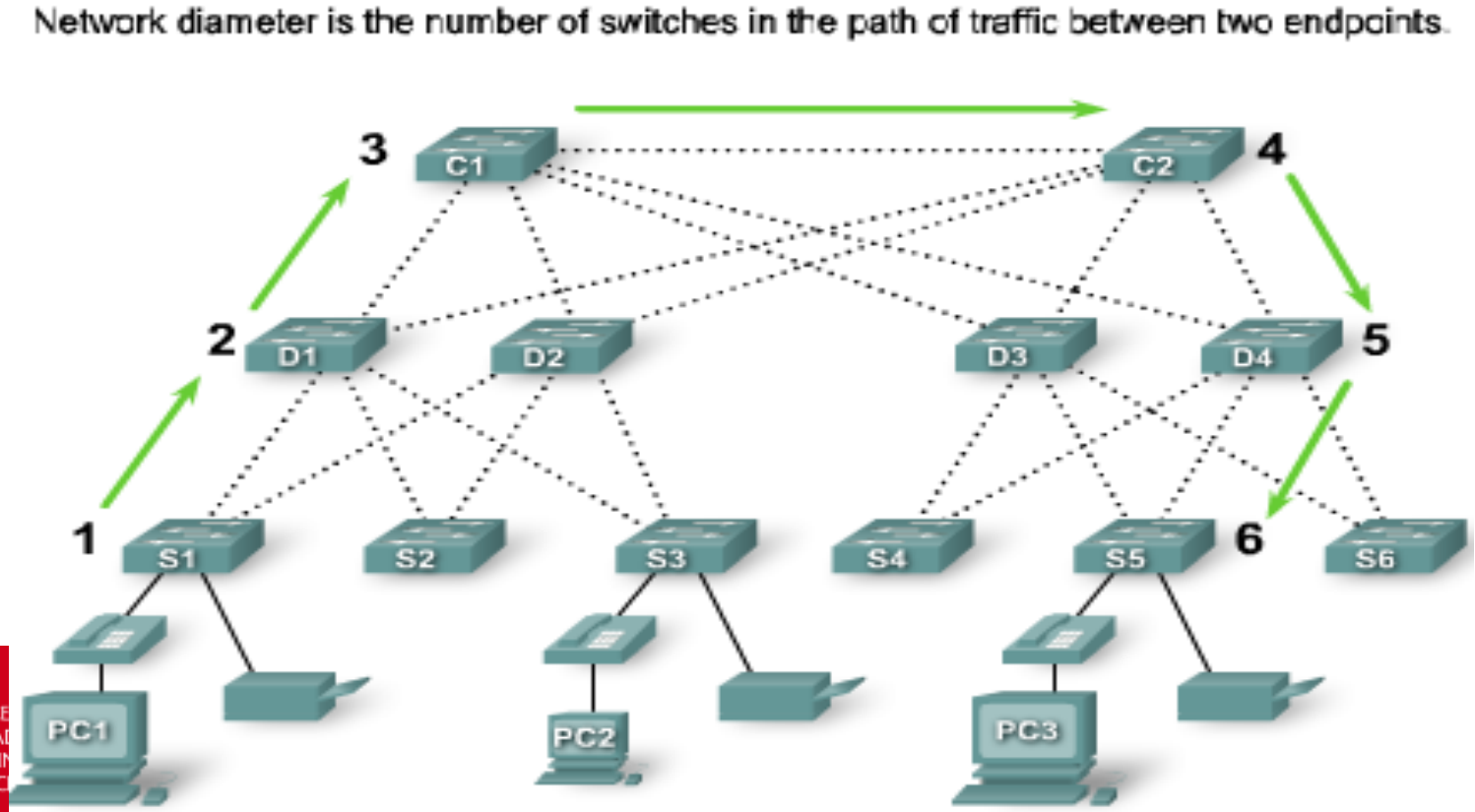
- Practice of considering the specific bandwidth requirements of each part of the hierarchy.
- After bandwidth requirements of the network are known, links between specific switches can be aggregated, which is called link aggregation

Redundancy

- Redundancy is one part of creating a highly available network.

Network Diameter

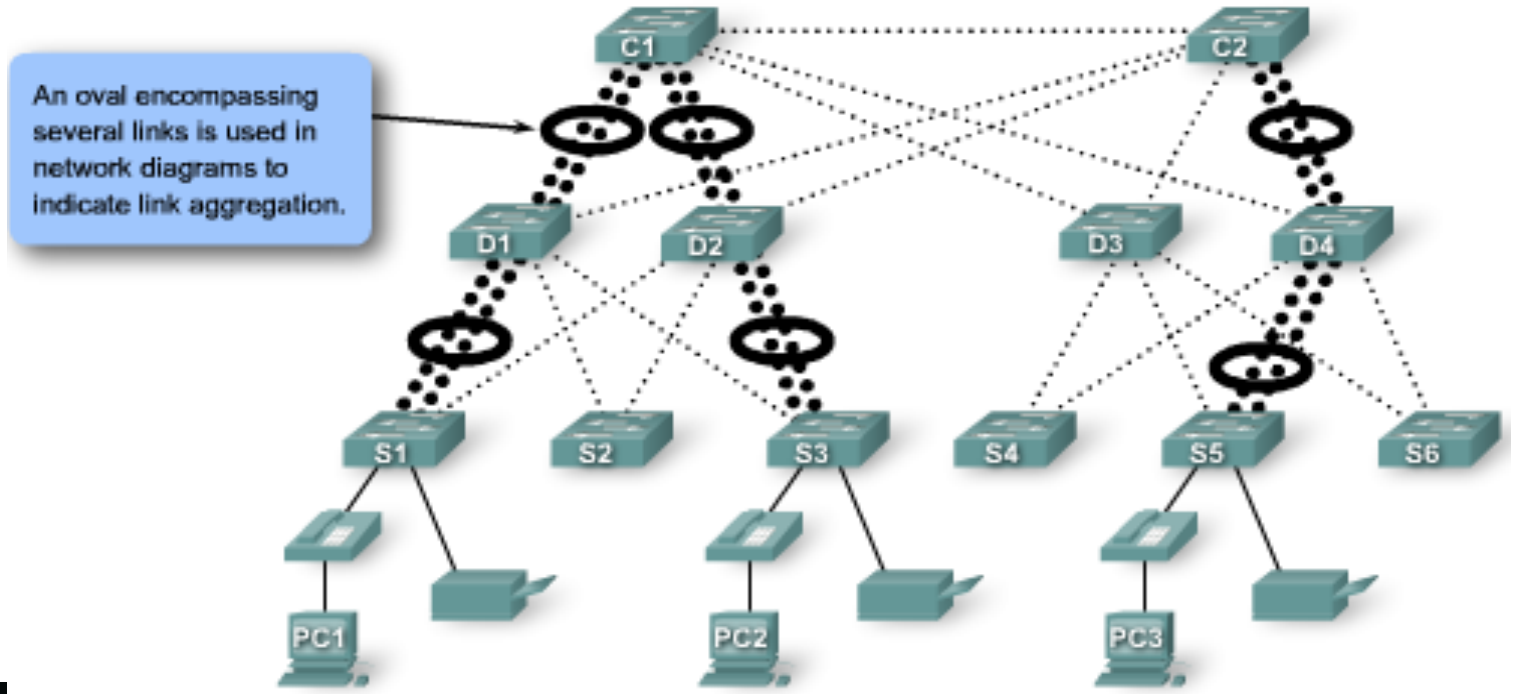
- In the figure, PC1 communicates with PC3. There could be up to six interconnected switches between PC1 and PC3. In this case, the network diameter is 6
- Each switch in the path introduces some latency
  Each switch has to examine the destination MAC address, check its MAC address table, and forward the frame
  Even though this happens in a fraction of a second, the time adds up when the frame has to cross many switches.
- In a hierarchical network, network diameter is always going to be a predictable number



Bandwidth Aggregation

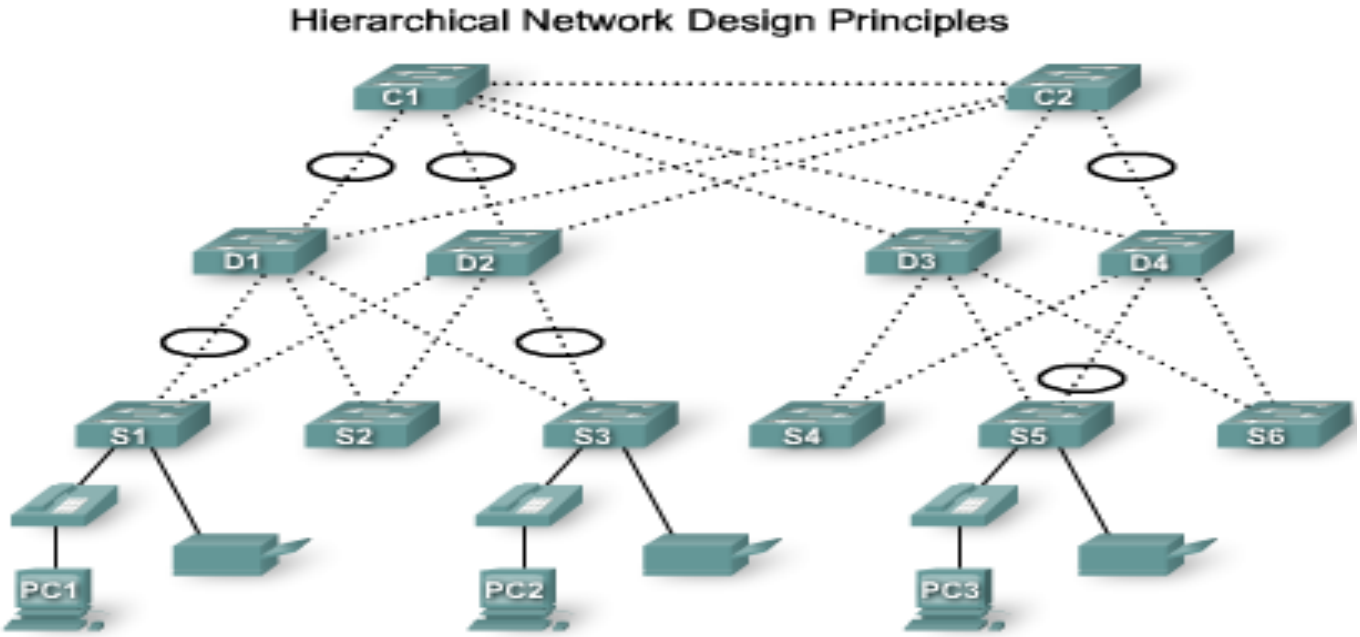
- Cisco EtherChannel allows multiple Ethernet links to be aggregated
- Specific links on specific ports in each switch are aggregated, increasing bandwidth to targeted parts of the network

Bandwidth aggregation is normally implemented by combining several parallel links between two switches into one logical link.



Redundancy

- Redundancy can be provided in a number of ways:
  - Double the network connections between devices
  - Double the devices
- Implementing redundant links can be expensive
  - Unlikely to implement redundancy at the access layer

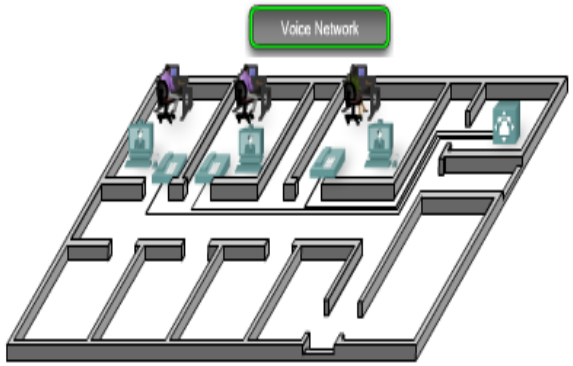


Separate vs Converged Networks

Separate Voice, Video and Data Networks

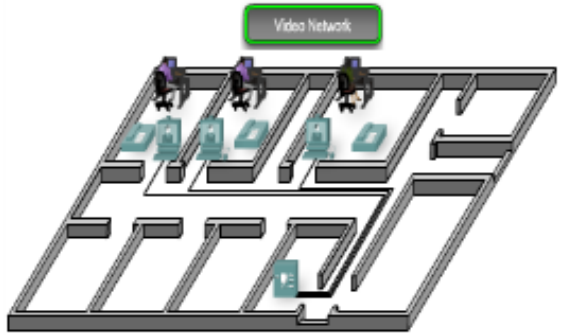
Voice network

- A voice network contains isolated phone lines running to a PBX switch to allow phone connectivity to the PSTN
- For each new phone, a new line has to be run to the PBX



Video network

- Videoconferencing data can consume significant bandwidth
- Video networks maintained separately to allow operation without bandwidth competiton



Data network

- Interconnects the workstations and servers on a network

Converged Network

- Using a properly designed hierarchical network, and implementing QoS policies that can prioritize the audio and video, means they be converged onto the data network with little to no impact on quality of service.

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Port Density

- Port density is the number of ports available on a single switch

Very high density.
Catalyst 6500 - 1,000 Ports

Forwarding Rate

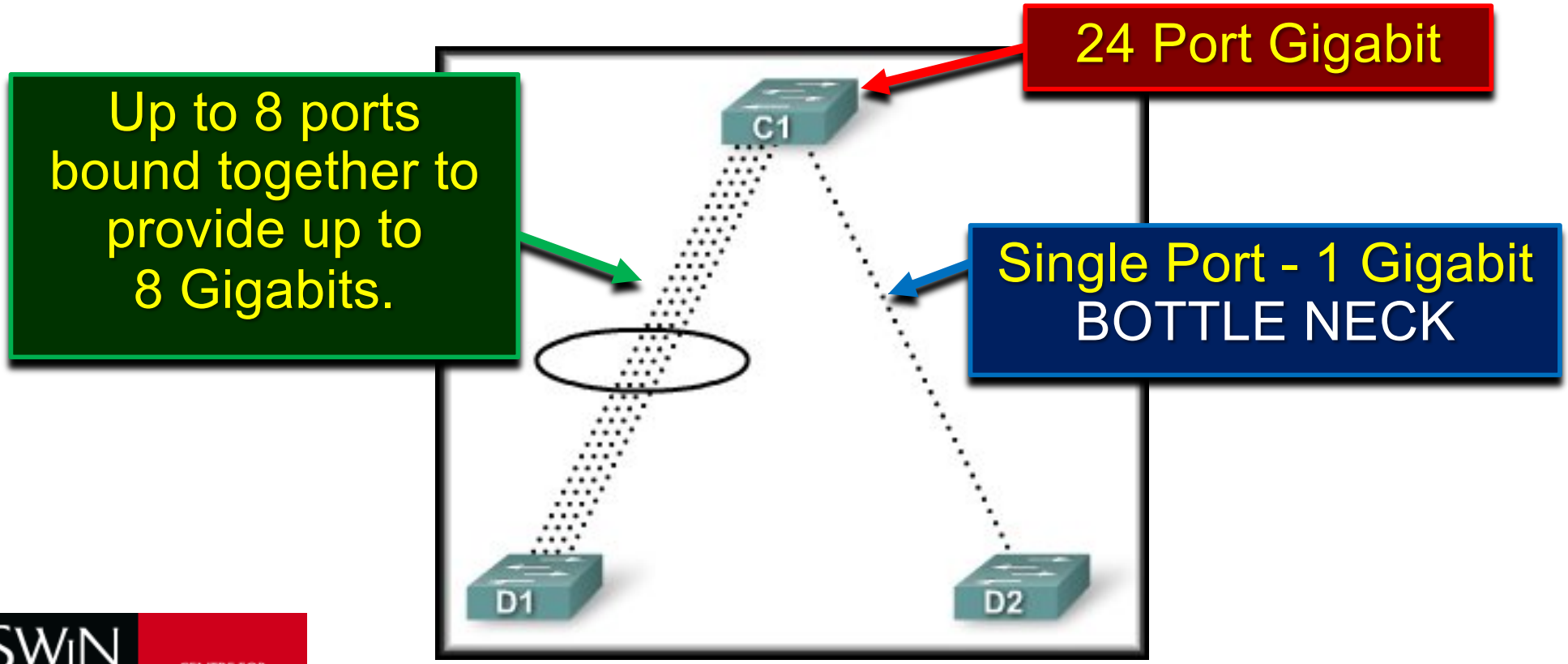
- Defines the processing capabilities of a switch by rating how much data the switch can process per second.
- If the switch forwarding rate is too low, it cannot accommodate full wire-speed communication across all of its switch ports
- Access layer switches typically do not need to operate at full wire speed
- Allows the use of:

  Less expensive, lower performing switches at the access layer

  More expensive, higher performing switches at the distribution and core layers, where the forwarding rate makes a bigger difference

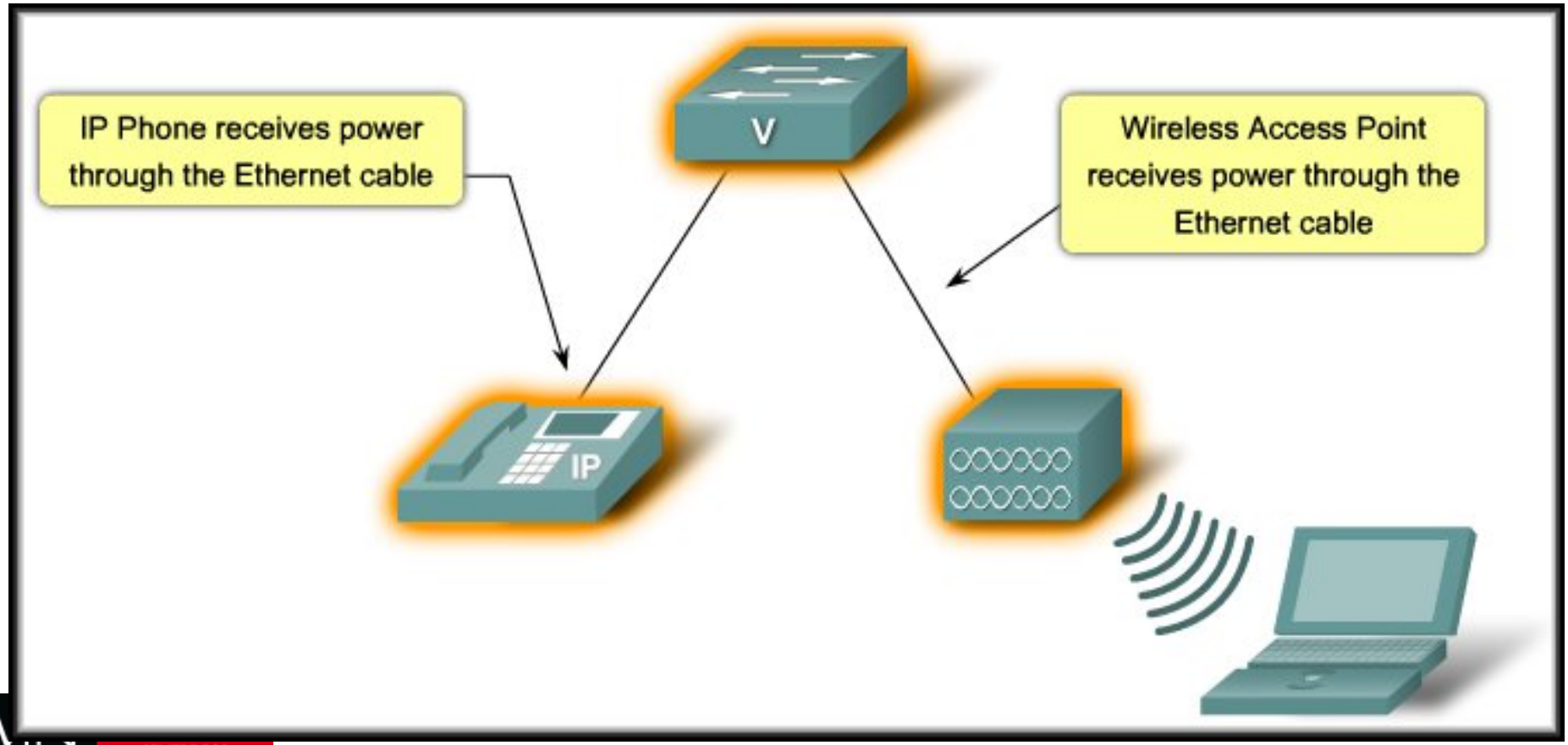
Link Aggregation

- As part of bandwidth aggregation, you should determine if there are enough ports on a switch to aggregate to support the required bandwidth.



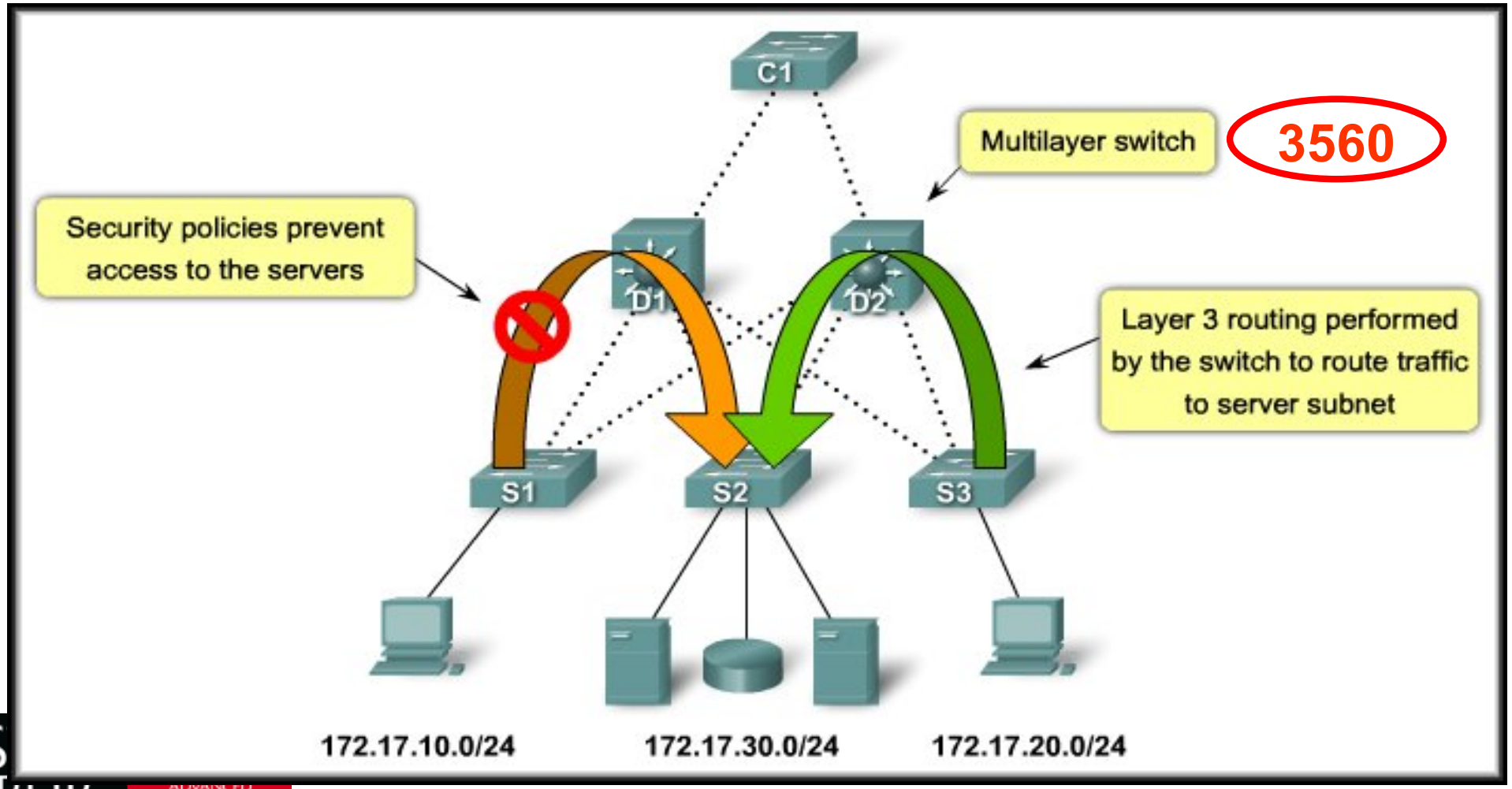
Power over Ethernet (PoE)

- Allows the switch to deliver power to a device over the existing Ethernet cabling.



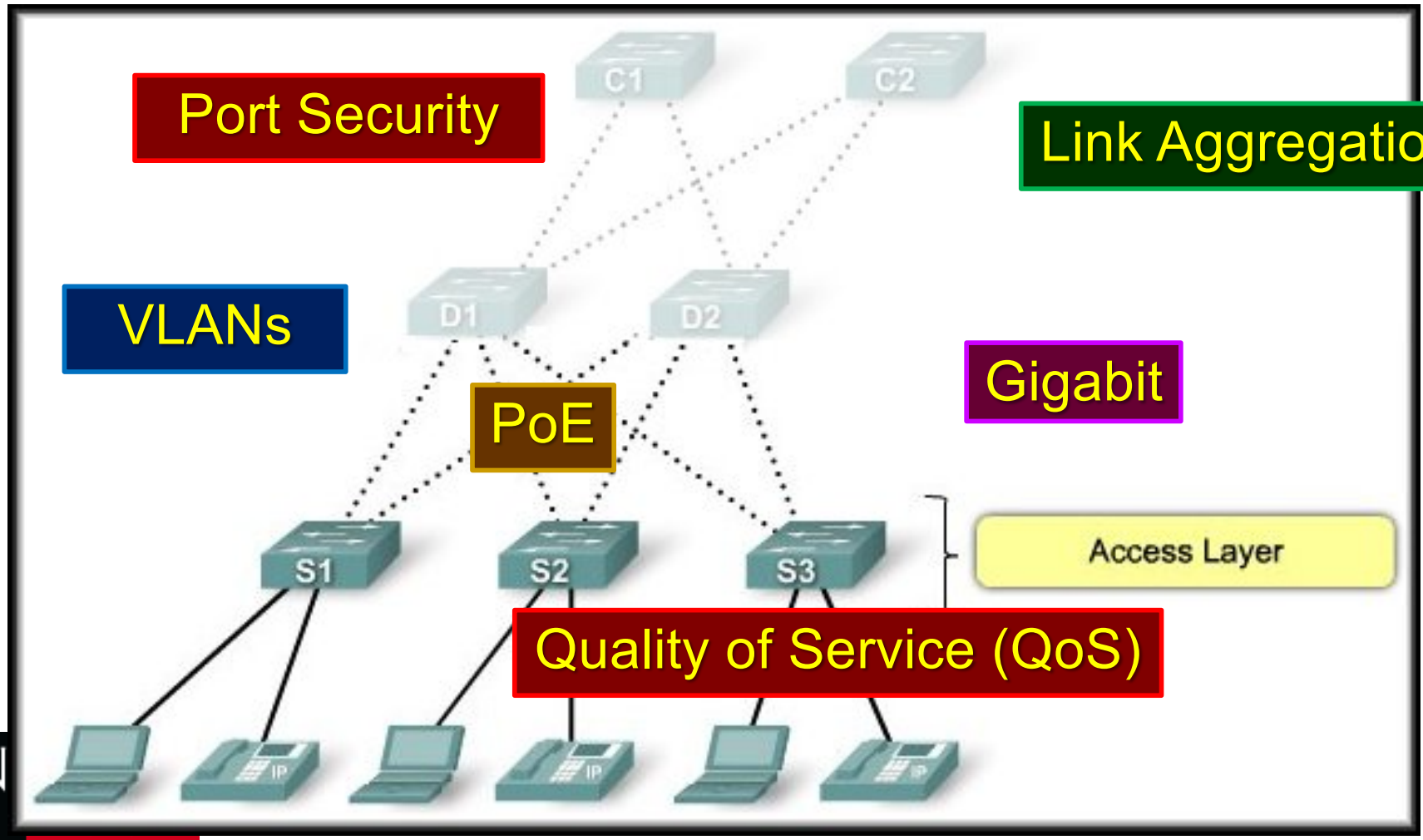
Layer 3 Functionality

Switches typically operate at Layer 2 of the OSI Model.



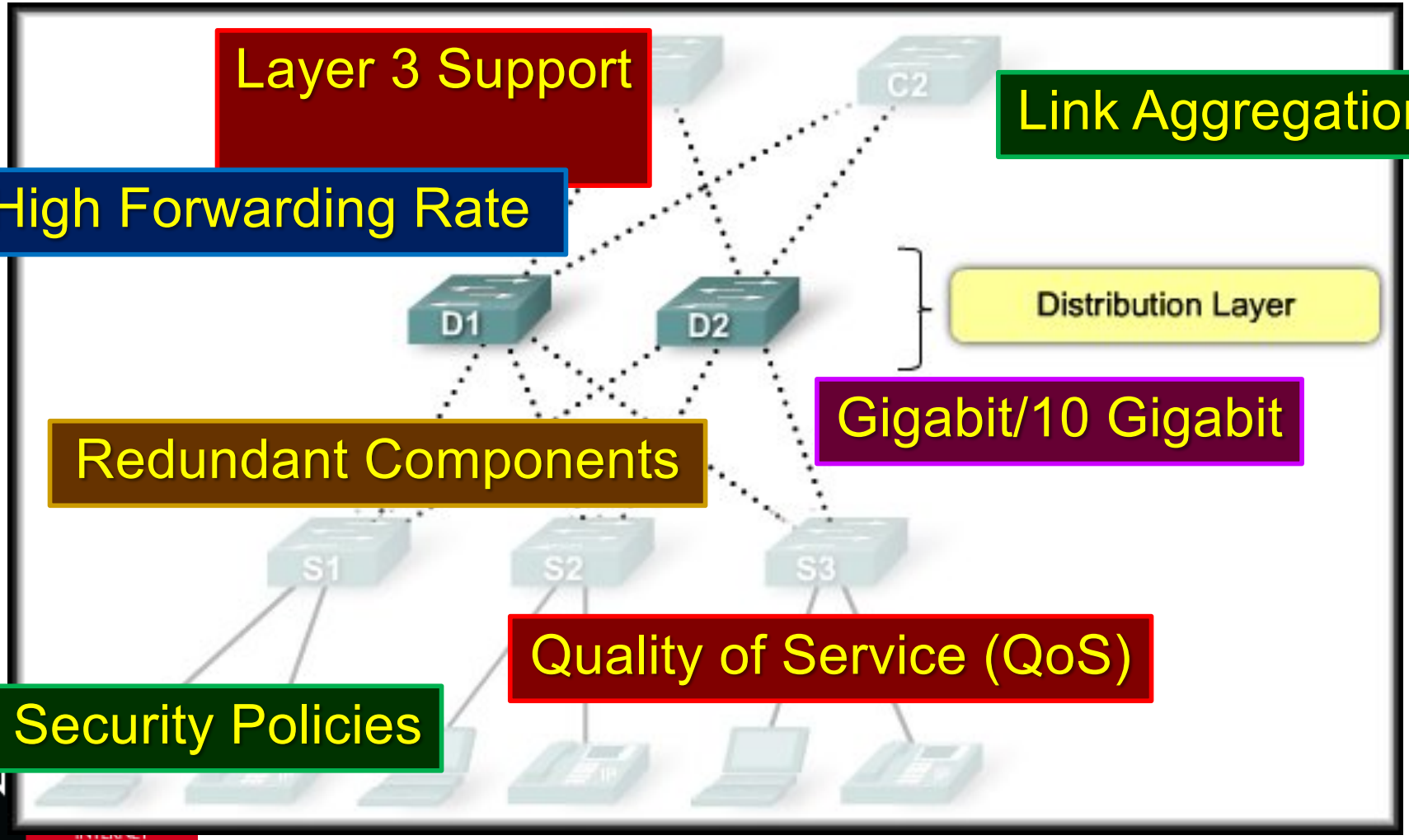
Hierarchical Network

- Access Layer Switch Features:



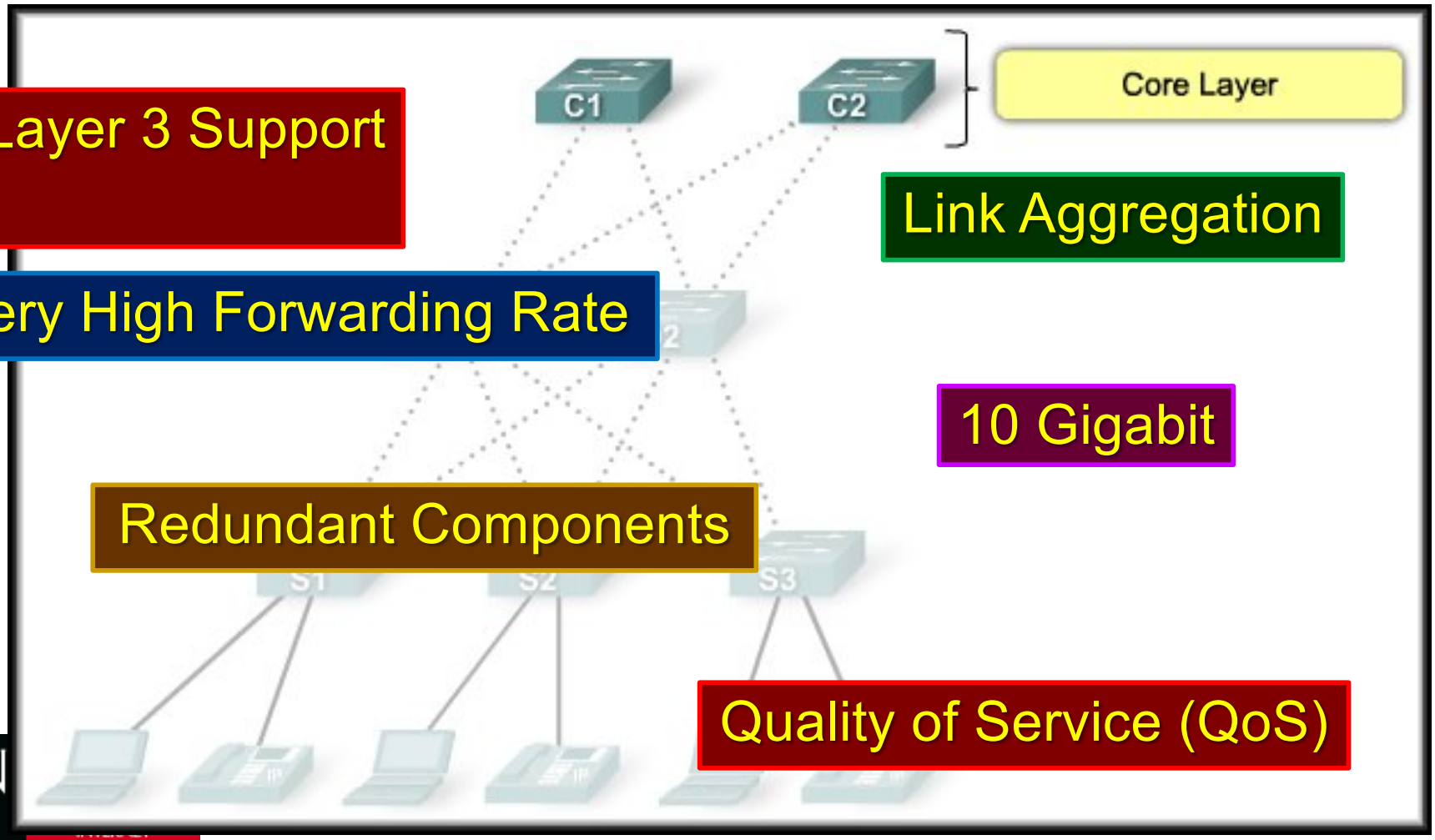
Hierarchical Network

- Distribution Layer Switch Features:



Hierarchical Network

- Core Layer Switch Features:



Summary

In this lecture, we covered:

- Hierarchical Network Model
- Converged Networks
- Network Design Considerations
- Switch Performance Characteristics
- Switch Features