LAN Design

SWITCHING BASICS & INTERMEDIATE ROUTING (H2015)

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Objectives

- What are the functions of each of the three layers of the hierarchical network design model?
- What devices are recommended at each layer of the hierarchical design model?
- How does a hierarchical network support the voice, video and data needs of a small or medium sized business?
- What are common examples of the effect of voice and video over IP on network design?

Agenda

- The Hierarchical Network Model
- Principles of Hierarchical Network Design
- What is a converged Network
- Considerations for Hierarchical Network Switches
- Switch Features
- Switch Features in a Hierarchical Network
- Summary

Overview

For small and medium sized businesses, digital communications with data, voice and video is critical to performing day to day business functions. Consequently, a properly designed LAN is a fundamental requirement for doing business.

You must understand what a well designed LAN is and be able to select appropriate devices to support the network specifications of a small or medium sized business.

Vocabulary

- Access Layer:
- Distribution Layer:
- Core Layer:
- Scalability:
- Redundancy:
- Performance:
- Security:
- Manageability:
- Maintainability:
- Voice over IP (VoIP):
- Convergence:
- Quality of Service (QoS):
- Private Branch Exchange (PBX):
- Enterprise Network:
- Power over Ethernet (PoE):
- Multilayer Switch:

The Hierarchical Network Model

- When building a switched LAN, your plan is more likely to be successful if a hierarchical design model is used

- Compared to other network designs, a hierarchical network is easier to manage and expand, and problems are solved more quickly

The Hierarchical Network Model

The typical hierarchical design model is broken into three layers:

- Access Layer
- Distribution Layer
- Core Layer

The Hierarchical Network Model

The Access Layer:

- Interfaces with end devices such as PC's , printers and IP phones
- The access layer can include routers, switches, hubs, bridges and wireless access points.
- It's main purpose is to provide a means of connecting devices to the network and controlling which devices are allowed to communicate on the network

The Hierarchical Network Model

The Distribution Layer:

- Controls the flow of network traffic using policies and delineates broadcast domains by performing routing functions between virtual LANs defined at the access layer.

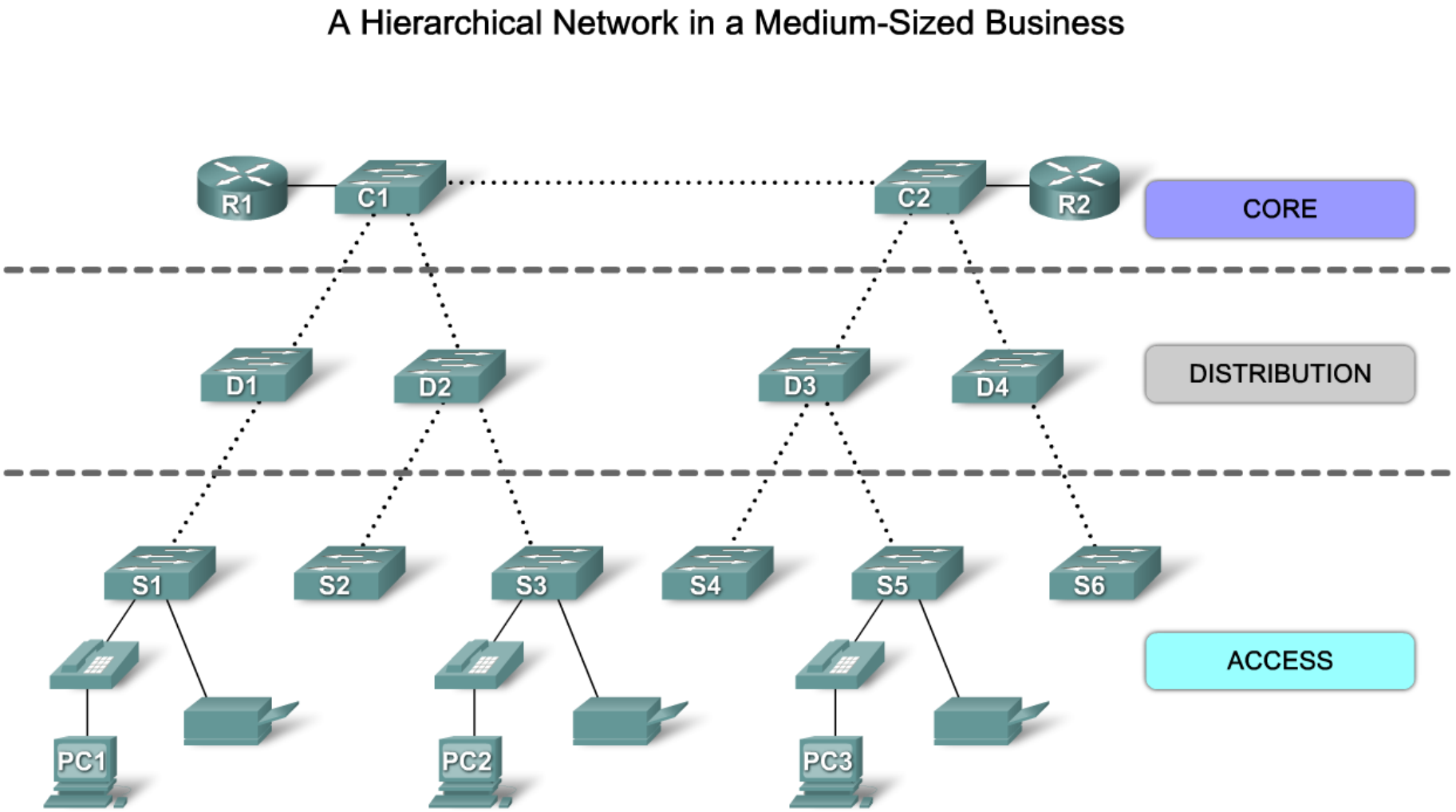
- Basically the distribution layer aggregates data from the access layer before it is transmitted to the core layer for routing to its final destination

The Hierarchical Network Model

The Core Layer:

- Is the high speed back bone of the internetwork
- It is critical for the connection between distribution layer devices
- It can also access internet resources

The Hierarchical Network Model



The Hierarchical Network Model

In small networks its is not unusual to implement a collapsed core model where the distribution layer and core layer are combined into one layer.

The Hierarchical Network Model

Benefits of a hierarchical Network

- Scalability
  - Hierarchical networks can be expanded easily
- Redundancy
  - Redundancy at the core and distribution level ensure path availability
- Performance
  - Link aggregation between levels and high performance core and distribution level switches allow for near wire-speed throughout the network

The Hierarchical Network Model

Benefits of a hierarchical Network

- Security
  - Port security at the access level and policies at the distibution level ensure path availability
- Manageability
  - Consistency between switches at each level makes management more simple
- Maintainability
  - The modularity of the hierarchical design allows for the network to scale without becoming overly complicated

Principles of Hierarchical Network Design

- Just because a network seems to have a hierarchical design does not mean that it is well designed.

- These simple guidelines with help you differentiate between well designed and poorly designed hierarchical networks.

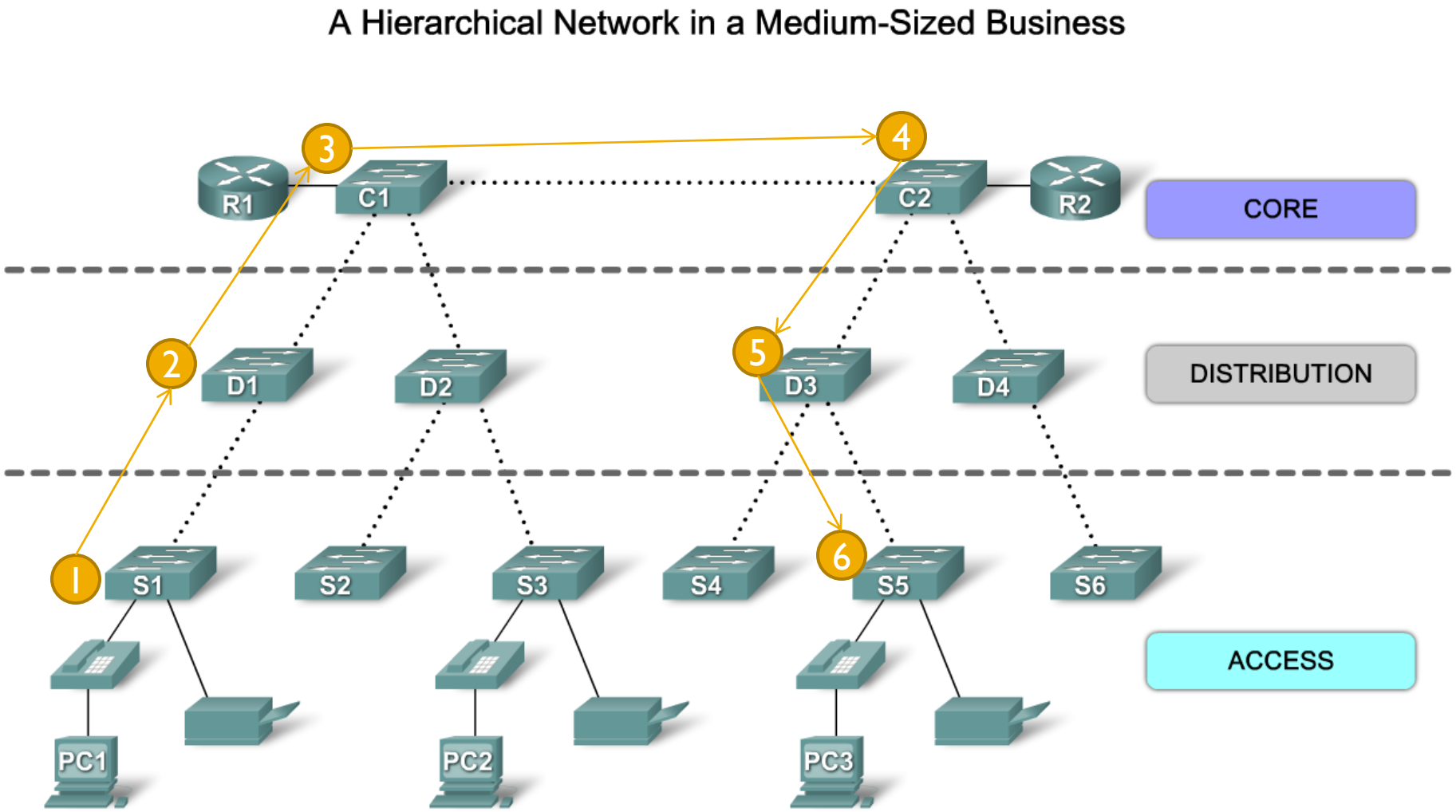
Principles of Hierarchical Network Design

Network Diameter

- Is the number of devices that a packet has to cross before it reaches its destination.

- Keeping the network diameter low ensures low and predictable latency between devices.

What's the Network Diameter PC1–PC3?



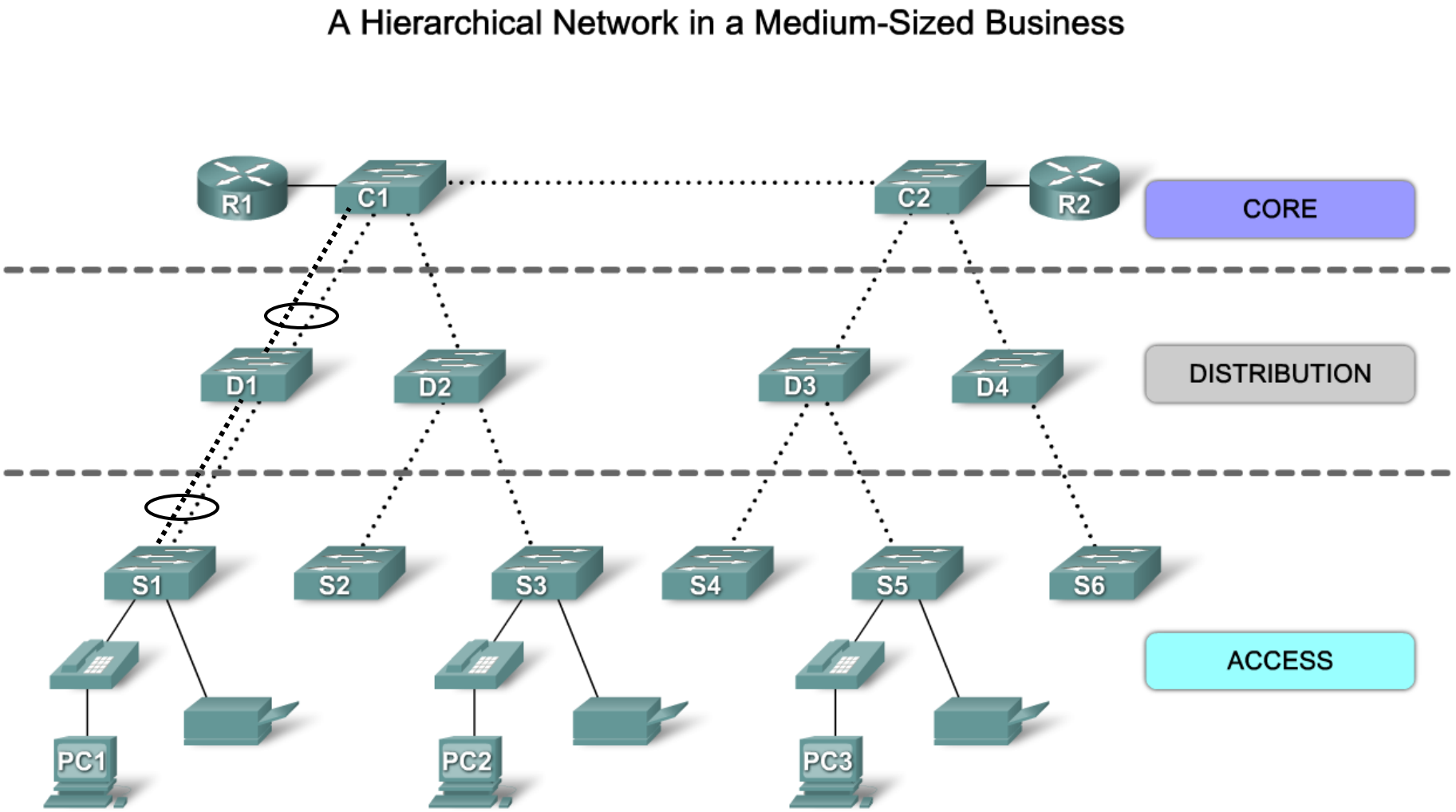
Principles of Hierarchical Network Design

Bandwidth Aggregation (Link aggregation)

- Is the combining of two or more connections to create a logically singular higher bandwidth connection.

- Cisco has its own proprietary link aggregation technology called EtherChannel.

Bandwidth Aggregation shown with ovals



Principles of Hierarchical Network Design

Redundancy

- Is not usually built into the access layer because of the difficultly and cost involved, but it is almost always present at both distribution and core layers.

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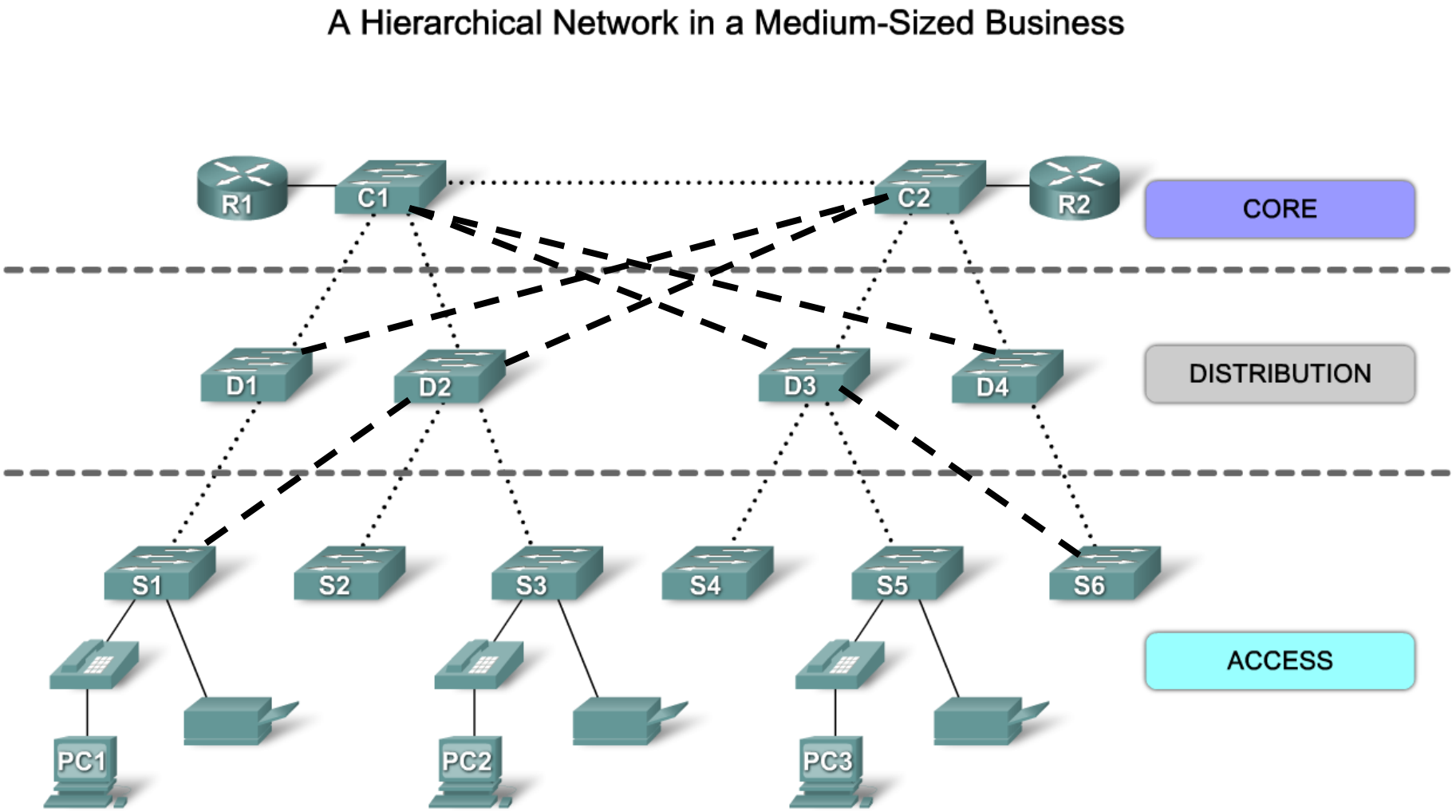
Some redundant links shown



Network Convergence

- We will talk about a different form of network convergence, to what we'd normal refer to (i.e. when the routing tables and link data is in sync across the network)

- Small and medium companies are embracing the idea of running video services on their networks together. This convergence of separate voice, data and video networks over the same single network is what we are talking about in this section.

Network Convergence

- Convergence is the process of combining voice, and video communications on a data network.

- Up until recently the cost of network equipment (and the cost of expert staff), that could handle the high quality of service (QoS) needed to have a converged network meant that only a few big companies could afford it.

Network Convergence

- Recent advances in technology have made converged networks much easier to implement and cheaper.
  - The equipment needed is now much cheaper
  - It is easier to set up than before, so no need to pay big bucks to some consultant with the expertise needed
- So converged networks (and applications) are now hugely popular and gaining popularity.

Network Convergence

- New converged networks work out cheaper than the traditional separate network for each model.
  - No need to install three physically separate networks.
  - No need to have three different groups of support personal to manage each individual system

Considerations for Hierarchical Network switches

- When selecting switch hardware, determine which switches are need in the core, distribution and access layers to accommodate the total bandwidth requirements of your network.
- Your plan should take into account future bandwidth requirements.
- To help you more accurately choose appropriate switches, perform traffic flow analysis on a regular basis.

Traffic Flow Analysis

- Traffic flow analysis is the process of measuring the bandwidth usage on a network and analyzing the data for the purpose of performance tuning, capacity planning, and making hardware improvement decisions.

- Traffic flow analysis is done using traffic flow analysis software.

User Community Analysis

- User community analysis is the process of identifying various groupings of users and their impact on network performance.

- The way users are grouped affects issues related to port density and traffic flow, which in turn, influence the selection of network switches.

Data Stores and Data Servers Analysis

- When analysing traffic on a network, consider where the data stores and servers are located so that you can determine the impact on the network.

Switch Features

- When you look up the specs for a switch, you need to understand what all the acronyms and word phases mean

Switch Features

- Form Factors:
  - Refers to the size and shape of a switch
  - Fixed configuration or modular configuration
  - Stackable (Cisco: Stackwise) or non stackable
  - Thickness, express as rack units

Switch Features

- Performance:
  - Port Density
  - Small form factor devices
  - Forwarding rates (per port and per unit)
  - Link aggregation
  - Power over Ethernet (PoE)
  - Layer 3 functionality (Multilayer switches)

Summary

- We discussed the hierarchical design model.
- Implementing this model improves the performance, scalability, availability, manageability and maintainability of the network.
- Hierarchical network topologies facilitate network convergence by enhancing the performance necessary for voice and video data to be combined onto the existing data network.

Summary

- The traffic flow, user community, data store and data server locations and topology diagram analysis are used to help identify network bottlenecks.
- The bottlenecks can then be addressed to improve the performance of the network and accurately determine appropriate hardware requirements to satisfy the desired performance of the network
- We surveyed the different switch features, such as form factor, performance, PoE and Layer 3 support, and how thye relate to the different layers of the hierarchical network design.

More Information

- List other training sessions
- List books, articles, and electronic sources
- List consulting services, other sources

Glossary

- Access Layer: The access layer in the three layer hierarchical network model describes the portion of the network where devices connect to the network and includes controls for allowing devices to communicate on the network

- Distribution Layer: In the three layer hierarchical network design model, the distribution layer is the layer that invokes policy and routing control. Typically, VLANs are defined at this layer.

- Core Layer: The backbone of a switched LAN. All traffic to and from peripheral networks must pass through the core layer. It includes high speed switching devices that can handle relatively large amounts of traffic

Glossary

- **Scalability:** A desirable property of a network to handle growing amounts of traffic in a graceful manner. A scalable network is readily enlarged.

- **Redundancy:** The duplication of devices, services, or connections so that, in the event of a failure, the redundant devices, services or connections can perform the work of those that failed.

- **Performance:** A loosely defined networking measure based on throughput and error rates.

Glossary

- **Security:** An encompassing term describing the prevention and means of prevention of unauthorised access to an entity, location or system.

- **Manageability:** A measure of the lack of difficulty in managing network devices using network management software and protocols.

- **Maintainability:** A measure of the lack of difficulty in keeping network devices and associated software in working order.

Glossary

- Voice over IP (VoIP): The capability to carry voice traffic over an IP based network with POTS like functionality, reliability and voice quality. VoIP enables a router to carry voice traffic (for example telephone calls and faxes) over an IP network. Voice packets are transported using IP in compliance with ITU-T specification H.323

- Convergence: The Speed and capability of a group of switches running STP to agree on a loop free layer 2 topology for a switched LAN.

- Quality of Service (QoS): A measure of performance for a transmission system that reflects its transmission quality and service available.

Glossary

- Private Branch Exchange (PBX): A digital or analog telephone switchboard located on the subscriber premises and used to connect private and public telephone networks.

- Enterprise Network: A large and diverse network connecting major sites within a company or other organisation. An enterprise network differs from a WAN in that it is privately owned and maintained.

Glossary

- **Power over Ethernet (PoE):** The powering of network devices over Ethernet cable. IEEE802.3af and Cisco specify two different PoE methods. Cisco power sourcing equipment(PSE) and powered devices (PDs) support both PoE methods

- **Multilayer Switch:** A multilayer switch filters and forwards packets based on OSI layer 2 through Layer 7 information at wire speed by utilizing dedicated hardware that stores data structures mirroring routing tables, ARP table, and ACL information.