CSET 150
NETWORK DESIGN AND MANAGEMENT

EVENING MASTERS EDITION

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Week # 1

Modular Network Design

- **What Is Modular Design?**
  - A module is a component of a composite structure.
  - Modular network design involves creating modules that can then be put together to meet the requirements of the entire network.

Modular Network Design

- **BENEFIT: (WHY MODULAR DESIGN???)**
  - It is **easier** to **understand and design** smaller, simpler modules...
  - It is **easier** to **troubleshoot** ...
  - The **reuse** of **blocks saves** design time and effort...
  - The reuse of blocks allows ...growing ... providing **network scalability.**
  - It is easier to change modules rather than the entire network, providing **flexibility** of design.
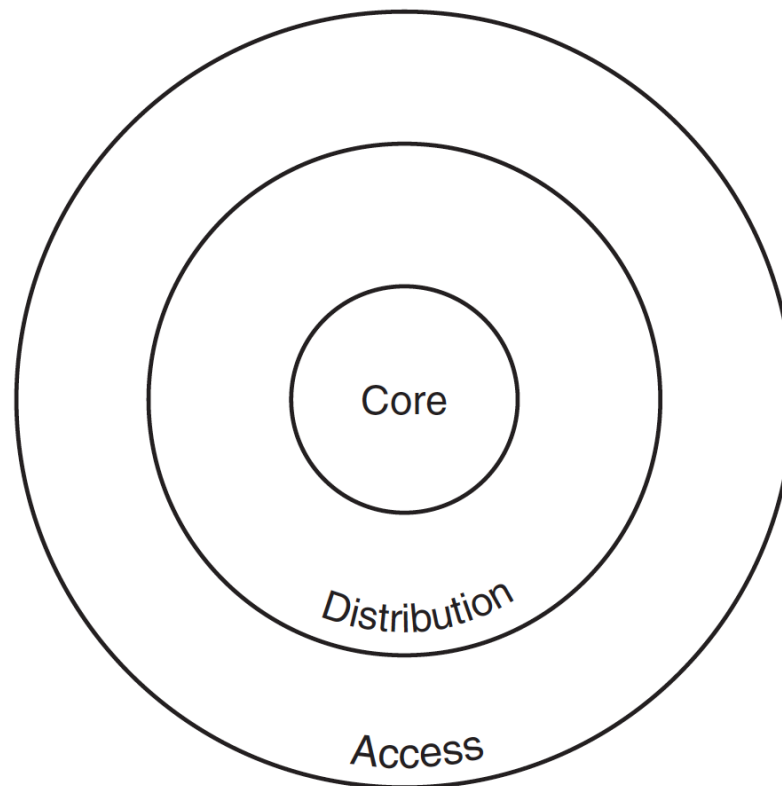
Modular Network Design

- Two models that can be used for network design:

  1. **THE HIERARCHICAL MODEL.**

  2. **THE CISCO ENTERPRISE COMPOSITE NETWORK MODEL.**

HIERARCHICAL NETWORK DESIGN

Figure 1-4   *The Hierarchical Network Design Model Separates the Network into Three Functions*
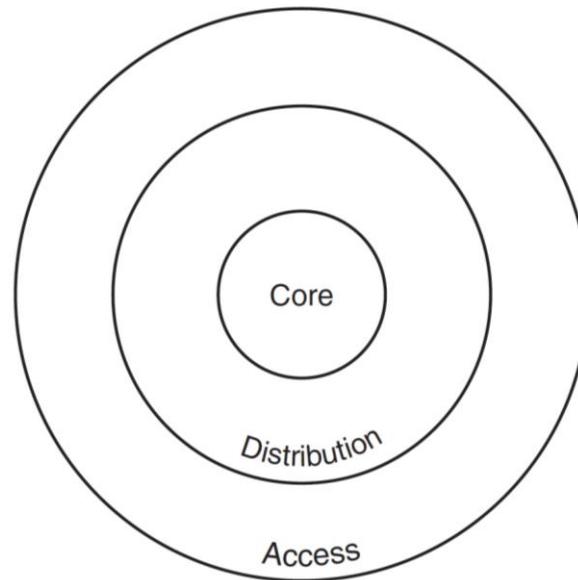
Hierarchical Network Design Model Separates the Network into Three Functions

HIERARCHICAL NETWORK DESIGN

The three functions that comprise the hierarchical network design model are as follows:

- **Access layer**—Provides user and workgroup access to the resources of the network

- **Distribution layer**—Implements the organization's policies, and provides connections between workgroups and between the workgroups and the core

- **Core layer**—Provides high-speed transport between distribution-layer devices and to core resources
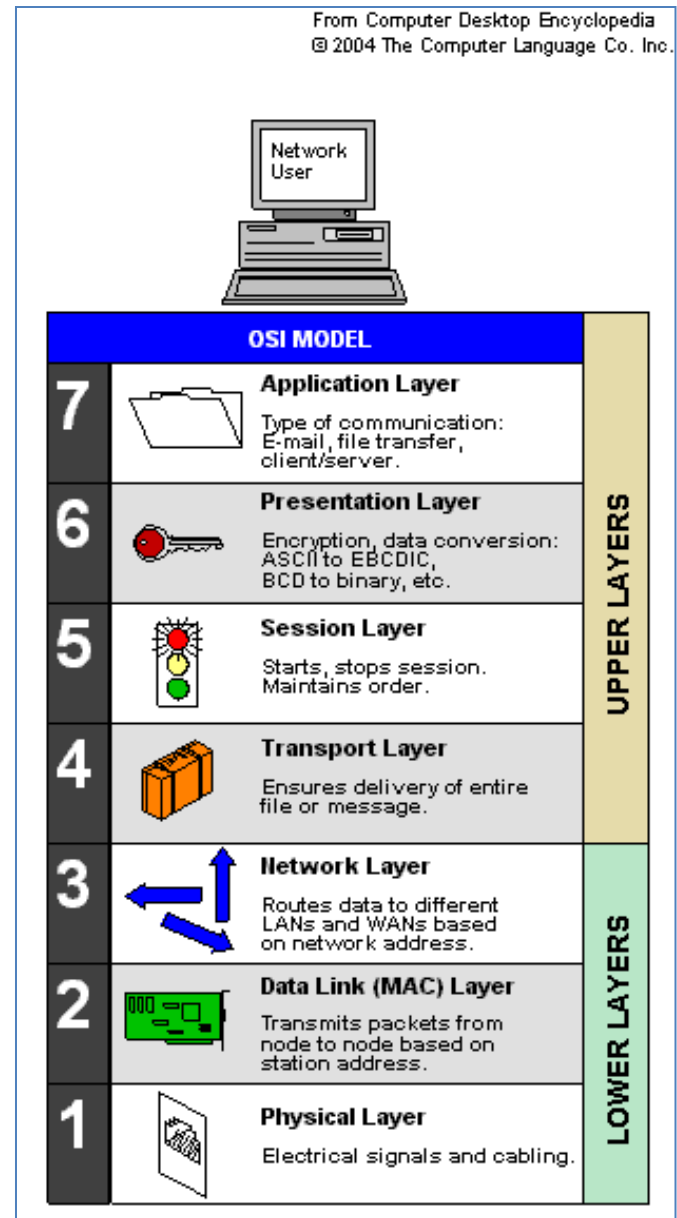
HIERARCHICAL NETWORK DESIGN

Figure 1-5 *The Hierarchical Network Design Model as Mapped to a Simple Network*

Core

Distribution

Access

Local Users   Local Users

To Branch
Office Users
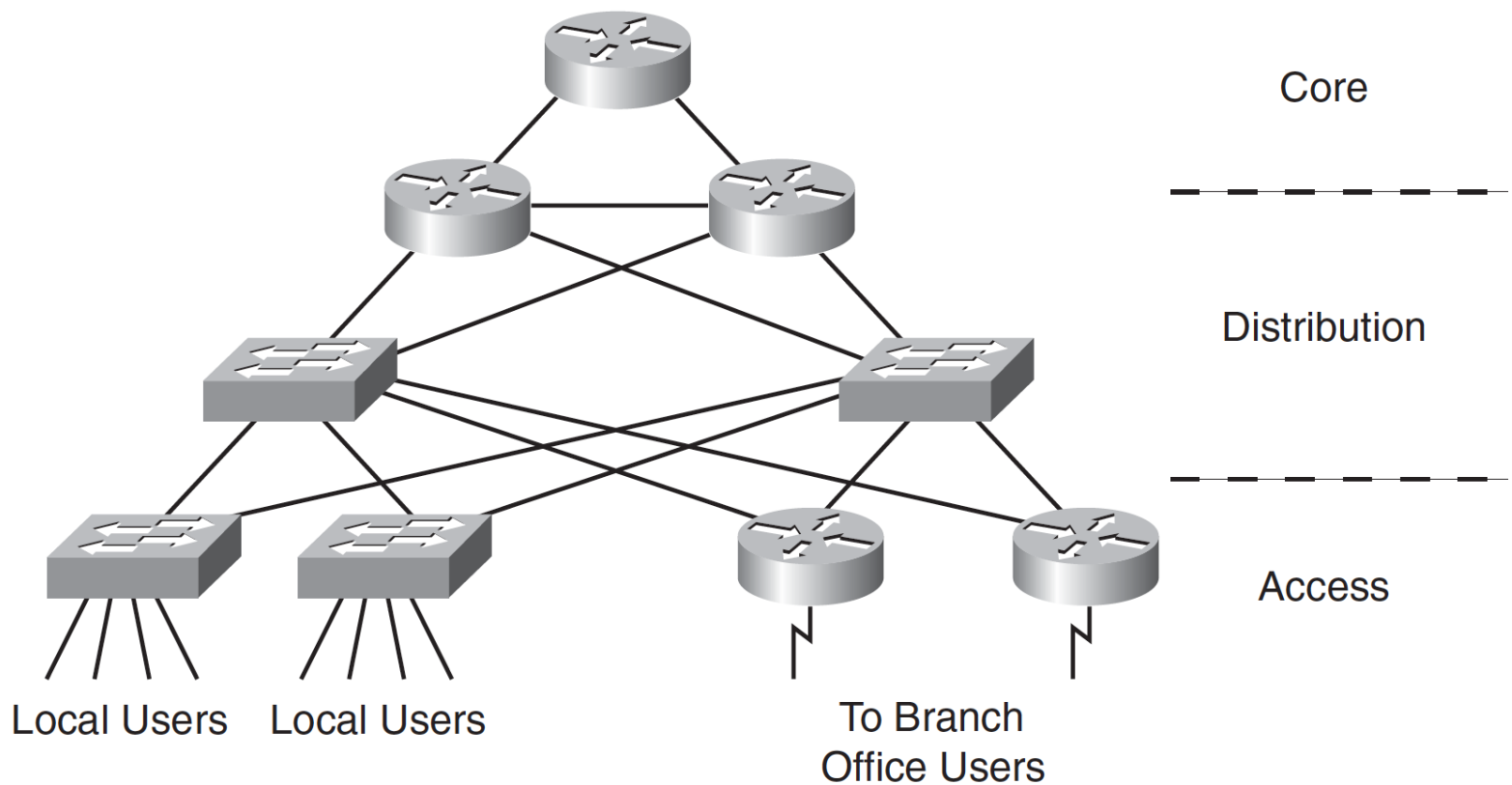
ACCESS LAYER

- The access layer is where users access the network.
  - Users can be local or remote
- Hubs operate at **OSI Layer 1**,
- All devices connected to a hub are in the same collision domain.
- Switches operate at **Layer 2**, and each port on a switch is its own collision domain

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Network User

OSI MODEL

| 7 | **Application Layer** Type of communication: E-mail, file transfer, client/server. | UPPER LAYERS |
6	**Presentation Layer** Encryption, data conversion: ASCII to EBCDIC, BCD to binary, etc.	
5	**Session Layer** Starts, stops session. Maintains order.	
4	**Transport Layer** Ensures delivery of entire file or message.	
3	**Network Layer** Routes data to different LANs and WANs based on network address.	LOWER LAYERS
2	**Data Link (MAC) Layer** Transmits packets from node to node based on station address.	
1	**Physical Layer** Electrical signals and cabling.	

ACCESS LAYER

- Using a LAN switch rather than a hub has a performance advantage:
  - A LAN **switch** forwards unicast traffic only out of the port through which the traffic's destination is considered reachable.
  - However, a hub forwards all traffic out of all its ports.

- The access layer must also ensure that only users who are authorized to access the network are admitted.

DISTRIBUTION LAYER

Core

Distribution

Access

Local Users   Local Users

To Branch
Office Users

- The distribution layer interfaces
  - between the **core** and **access** layers, and
  - between **access layer workgroups**

- **Functions and characteristics include the following:**
  - Implementing policies by **filtering,** and **prioritizing** and **queuing** traffic.
  - Routing between the access and core layers.
    - If **different routing protocols** are implemented at these other two layers, the distribution layer is responsible for redistributing (sharing) among the routing protocols, and filtering if necessary
  - Performing route summarization

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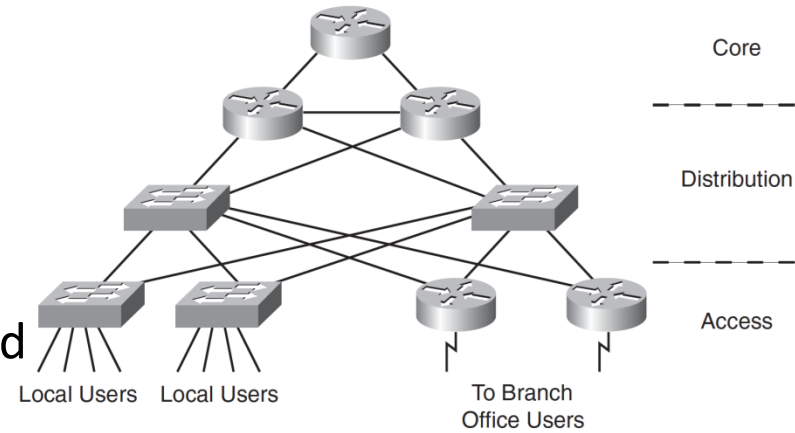
Distribution Layer

- Providing **redundant** connections, both to access devices and to core devices.

- Aggregating **multiple lower-speed** access connections into **higher-speed** core connections and converting between different media types, if necessary.

CORE LAYER

- The core layer provides a high-speed backbone.
- Functions and attributes of the core layer include the following:
  - Providing **high-speed**, **low- latency** links and **devices** for quick transport of data across the backbone.
  - Providing a **highly reliable** and **available backbone**.
  - **Adapting to network changes** quickly by implementing a quick-converging routing protocol.
    - The routing protocol can also be configured to load-balance over redundant links so that the extra capacity can be used when no failures exist.
  - Filtering is not performed at this layer, because it would slow processing.
   - Filtering is done at the distribution layer.

LIMITATION OF HIERARCHICAL MODEL

- The hierarchical model is useful for smaller networks, but it does not scale well to larger, more complex networks.

- With only three layers, the model does not allow the modularity required to efficiently design networks with many devices and features.

- The Enterprise Composite Network Model, provides additional modularity and functions

The Cisco Enterprise Composite Network Model

- Cisco has developed a **SAFE blueprint**, the **principle goal** of which is to provide **best practices information** on designing and implementing secure networks.

- The SAFE architecture uses a modular approach, providing the advantages previously discussed.

- The **Cisco Enterprise Composite Network Model** is the name given to the architecture used by the **SAFE blueprint**.

- This model supports larger networks than those designed with only the hierarchical model and clarifies the functional boundaries within the network.

The Cisco Enterprise Composite Network Model
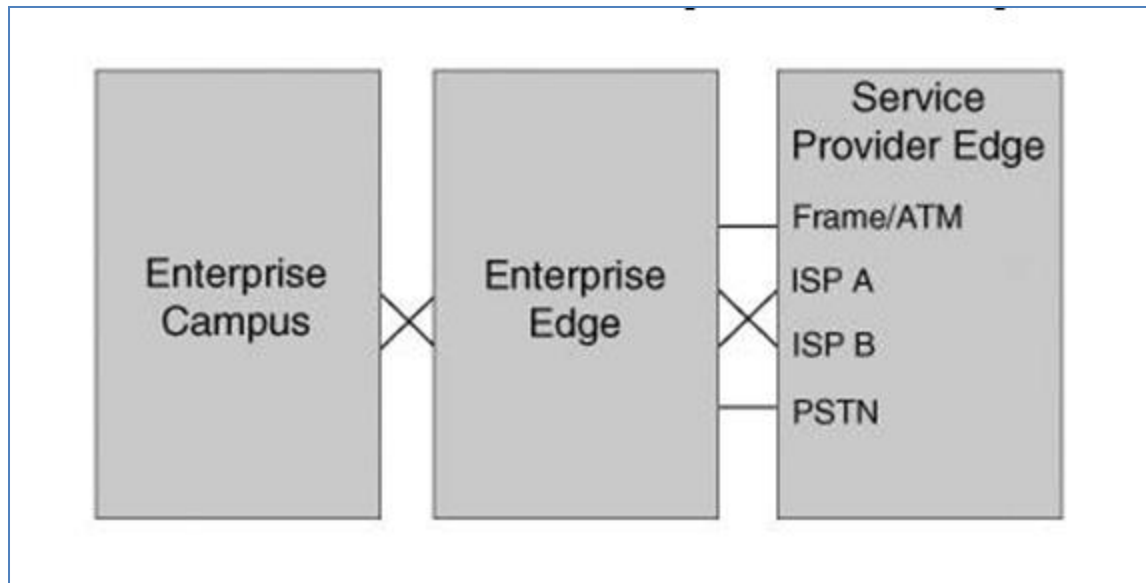
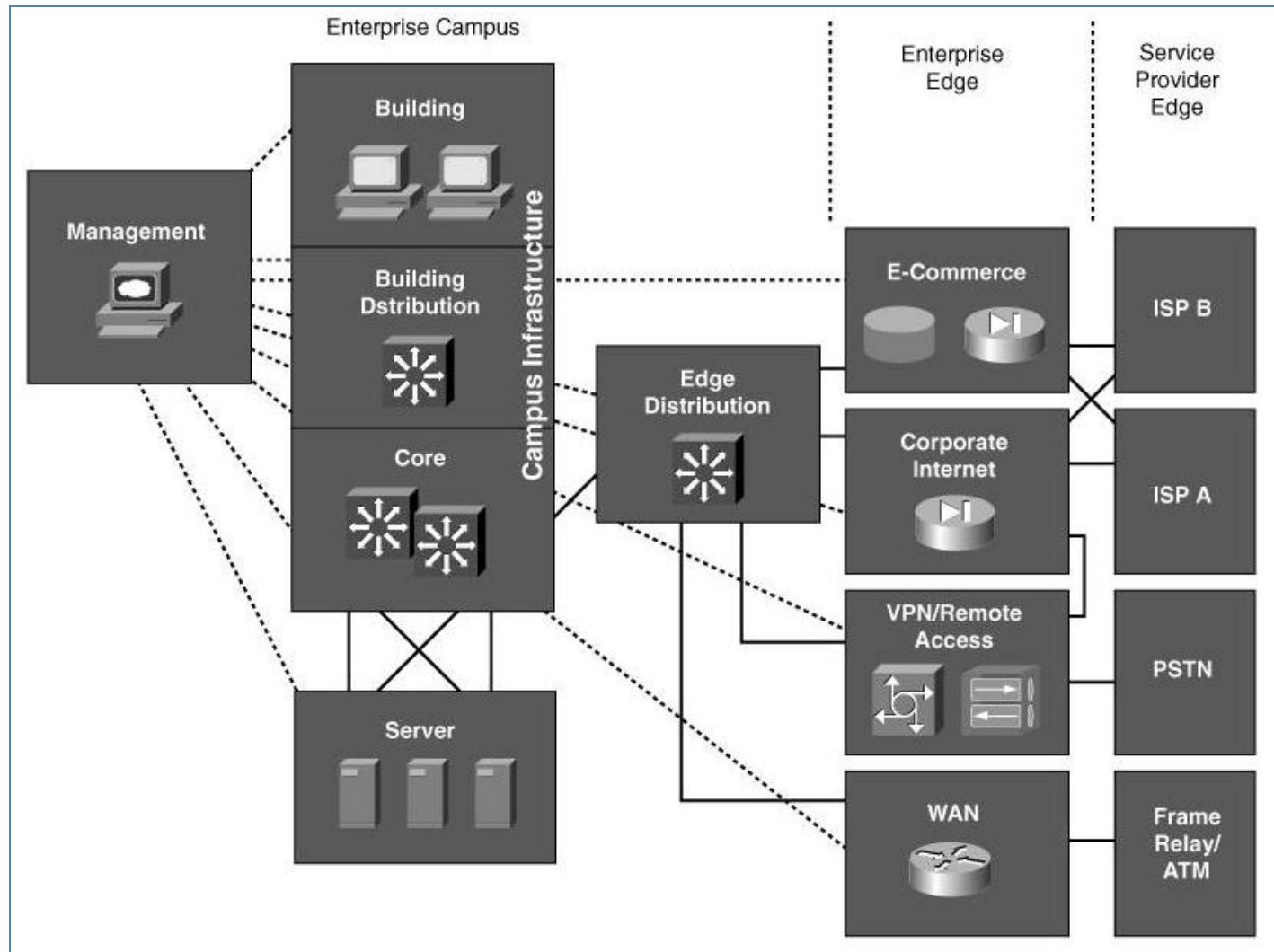- Functional Areas of the Enterprise Composite Network Model

The Cisco Enterprise Composite Network Model

The three functional areas are as follows:

- **Enterprise Campus** This area contains all the functions required for independent operation within one campus location; it does not provide remote connections. You can have multiple campuses.

- **Enterprise Edge** This area contains all the functions required for communication between the Enterprise Campus and remote locations, including the Internet, remote employees, other campuses, partners, and so forth.

- **Service Provider Edge** This functional area is not implemented by the organization; rather, it is included to represent WANs and Internet connections provided by service providers.

# The Cisco Enterprise Composite Network Model

Enterprise Campus Functional Area

- The modules within the ENTERPRISE CAMPUS FUNCTIONAL AREA are as follows:

  1. Campus Infrastructure module
  2. Management module
  3. Server module
  4. Edge Distribution module

Campus Infrastructure module

- The Campus Infrastructure module represents:

  - **one or more buildings connected to a backbone**.

  - This module is comprised of three sub-modules:

  - **Building, Building Distribution, and Core**.

- These sub-modules map directly onto the hierarchical model's

 - access, distribution, and core layers.
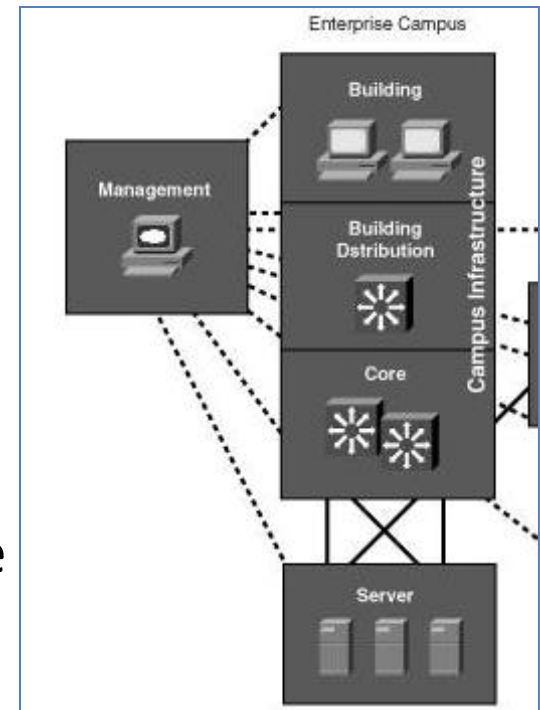
Management Module

- The Management module houses monitoring, logging, security, and other management features within an enterprise

- Some of the management security :
  - An authentication, authorization, and accounting (**AAA**) server to provide security checks of users.
    - Authentication determines **who** the user is and whether he is allowed on the network.
    - Authorization determines **what** the user can do on the network.
    - Accounting **records** the time of day and time spent,
      - The AAA server can also record a user's location.

Management Module

- Some of the management security :
  - Intrusion (interruption) detection system (**IDS**) and intrusion prevention system (**IPS**) management.
    - IDSs scan network traffic for **malicious** (Harmful) activity, while IPSs can protect the network if an attack is detected.
    - An IDS and IPS management server logs suspicious activities that are detected by IDS and IPS sensors deployed throughout the network.
  - System logging, for example, using a syslog server to log events and traps
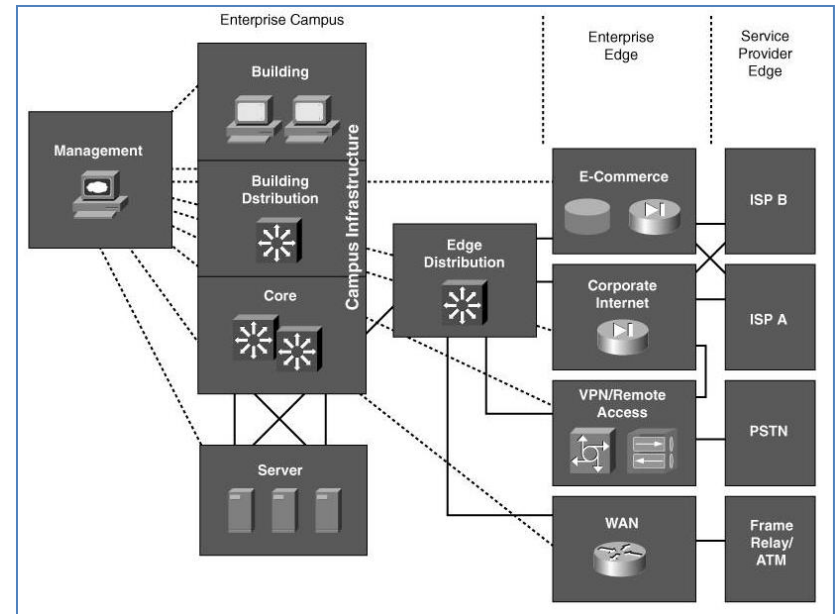
Server Module

- The centralized Server module contains internal campus servers.

- These servers can include
  - e-mail, file, and print servers, or any other servers that are necessary for the network solutions

- Layer 3 switches are typically used in this module to provide both
  - the high performance of Layer 2 switching and
  - the Layer 3 routing and filtering capabilities

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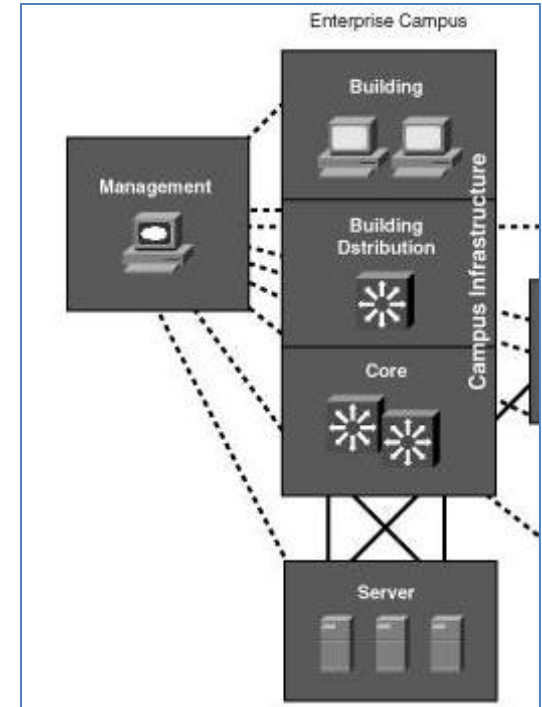
Edge Distribution Module

- The Edge Distribution module is the interface between the Enterprise Campus (through the Core sub-module) and the Enterprise Edge functional areas.

- This module typically uses **Layer 3 switching** to provide high-performance routing, similar to the Server module.

- Redundancy is again implemented in this module to ensure that the campus users always have access to the Enterprise Edge.

Enterprise Edge Functional Area

- The Enterprise Edge functional area is the interface between the Enterprise Campus functional area (through the Edge Distribution module) and the Service Provider Edge functional area.

- It is comprised of the following four modules:
  - E-commerce module
  - Corporate Internet module
  - VPN/Remote Access module
  - WAN module

E-commerce module

- The E-commerce module includes the **devices** and **services necessary** for an organization to support e-commerce applications, such as online ordering.

- The devices in this module usually include
  - web servers, application servers, and security devices such as firewalls and IDS appliances.

Corporate Internet Module

- The Corporate Internet module provides Internet access for the users and passes VPN traffic from remote users to the VPN/Remote Access module.

- Typical servers in this module include e-mail, File Transfer Protocol (FTP), and Domain Name System (DNS) servers.

- Security systems, such as firewalls and IDSs/IPSs, are also present here to ensure that only legitimate Internet traffic is allowed into the enterprise.

VPN/Remote Access module

- The VPN/Remote Access module terminates VPN traffic and dial-in connections from external users.

- Typical devices in this module include dial-in access and VPN concentrators to terminate the remote user connections, and firewalls and IDS appliances to provide security.

WAN module

- The WAN module provides connectivity between remote sites and the main site over various WAN technologies.

- This module does not include the WAN connections; rather, it provides the interfaces to the WANs.

- The WAN connections themselves are supplied by the service providers, which are represented in the Service Provider Edge modules.

- Example WAN interfaces provided by this module are Frame Relay, Asynchronous Transfer Mode (ATM), cable, and leased lines.

Service Provider Edge Functional Area

- The three modules within the Service Provider Edge functional area are as follows:
  - Internet Service Provider (ISP) module
  - Public Switched Telephone Network (PSTN) module
  - Frame Relay/ATM module