

NETWORK DESIGN CONCEPTS

- Network designers ensure that our communications networks can adjust and scale to the demands for new services.
- To support our network-based economy, designers must work to create networks that are available nearly 100 percent of the time.
- Network users generally do not think in terms of the complexity of the underlying network. They think of the network as a way to access the applications they need, when they need them.

Network Requirements

- The network should stay up all the time, even in the event of failed links, equipment failure, and overloaded conditions.
- The network should reliably deliver applications and provide reasonable response times from any host to any host.
- The network should be secure. It should protect the data that is transmitted over it and data stored on the devices that connect to it.
- The network should be easy to modify to adapt to network growth and general business changes.
- Because failures occasionally occur, troubleshooting should be easy. Finding and fixing a problem should not be too time-consuming.

Network Design Goals

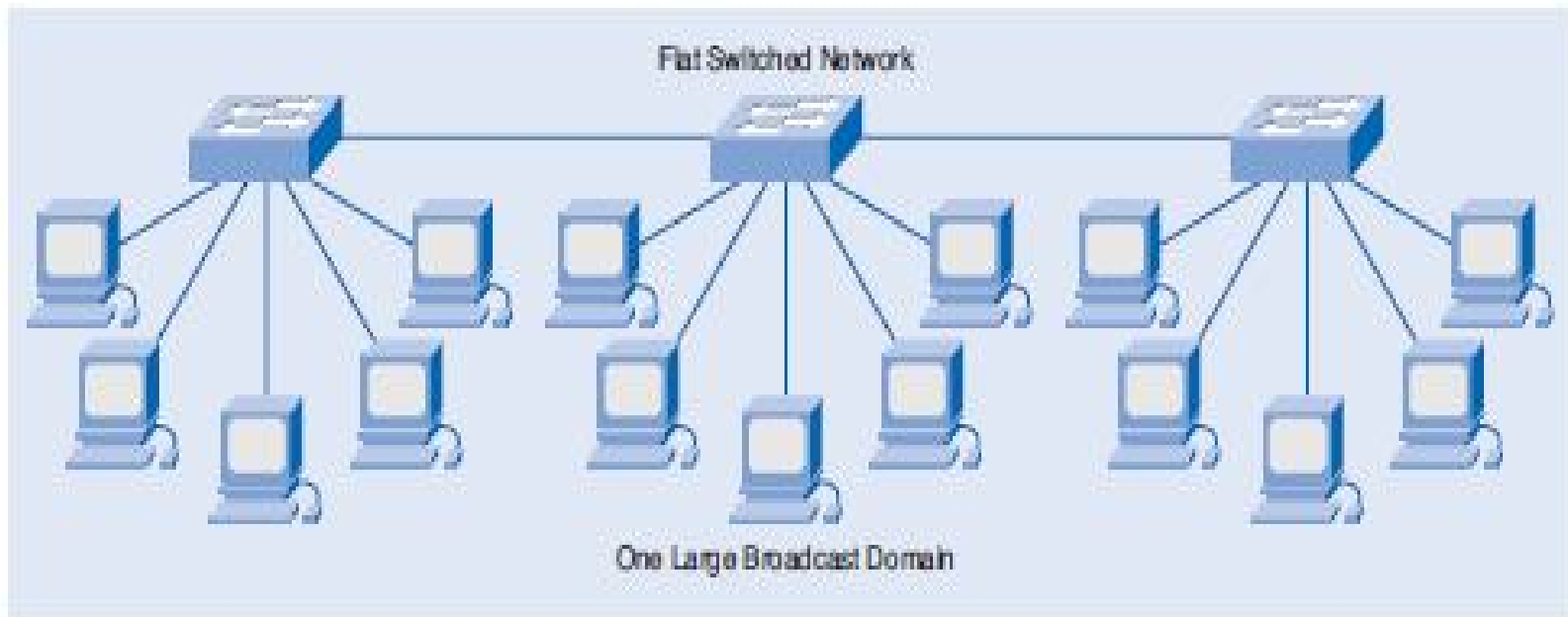
- **Scalability:** Scalable network designs can grow to include new user groups and remote sites and can support new applications without impacting the level of service delivered to existing users.
- **Availability:** A network designed for availability is one that delivers consistent, reliable performance, 24 hours a day, 7 days a week. In addition, the failure of a single link or piece of equipment should not significantly impact network performance.
- **Security:** Security is a feature that must be designed into the network, not added on after the network is complete. Planning the location of security devices, filters, and firewall features is critical to safeguarding network resources.
- **Manageability:** No matter how good the initial network design is, the available network staff must be able to manage and support the network. A network that is too complex or difficult to maintain cannot function effectively and efficiently.

Network Designs

- Network designs are classified as:
 - Mesh/Flat Network
 - Enterprise Network Design Model /Hierarchical Network
- An enterprise network contains a number of internetworking devices (e.g., switches, routers, gateways, etc) and is under the control of one big organization.

Flat Network

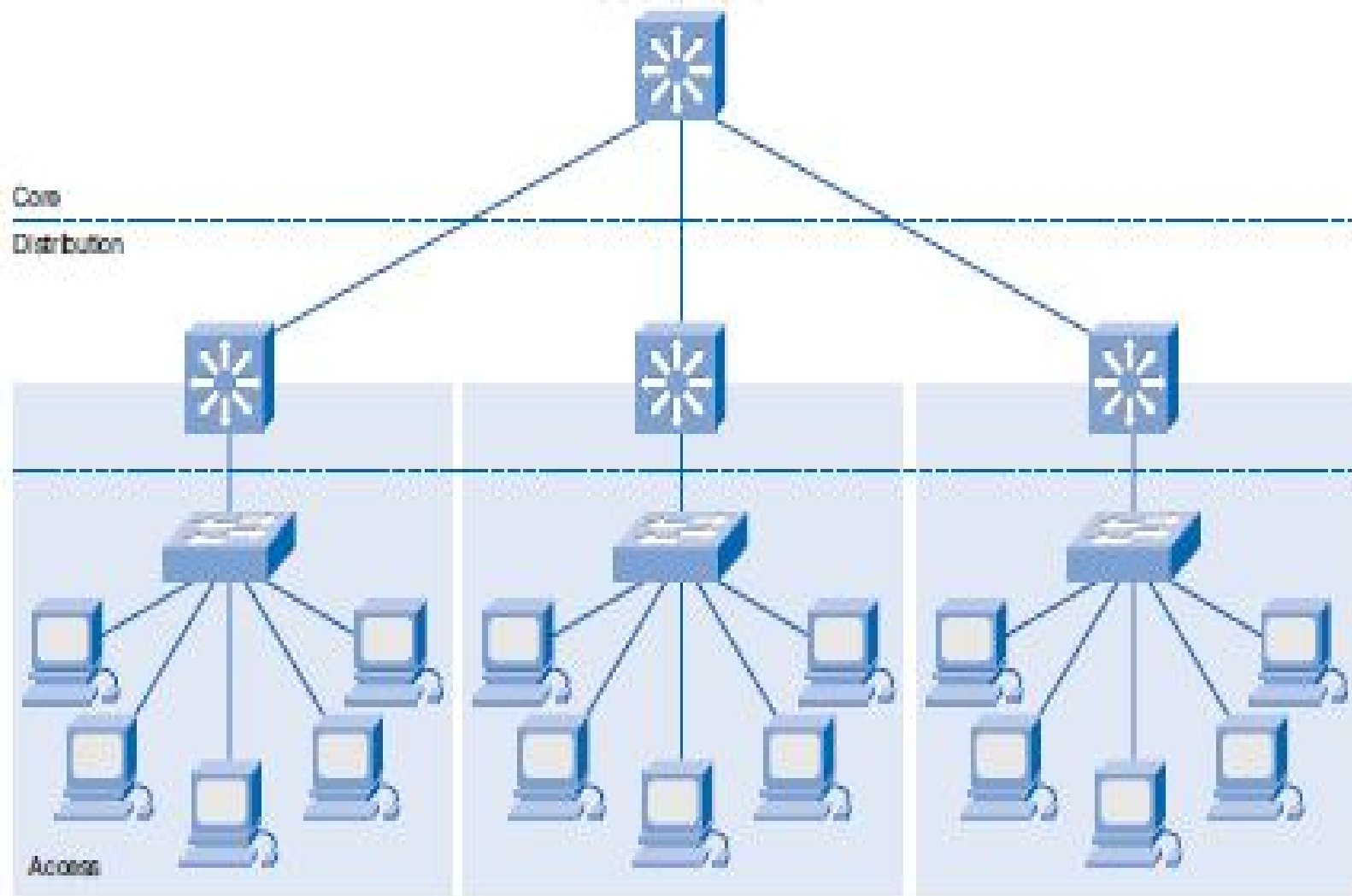
- Layer 2 devices in a flat network provide little opportunity to control broadcasts or to filter undesirable traffic.
- As more devices and applications are added to a flat network, response times degrade until the network becomes unusable



Hierarchical Network Design

- In networking, a hierarchical design is used to group devices into multiple networks.
- There are two design options:
 - Design a network infrastructure from the ground up.
 - Meld the new technologies into an existing infrastructure
- The networks are organized in a layered approach. The hierarchical design model has three basic layers:
 - **Core layer:** Connects distribution layer devices
 - **Distribution layer:** Interconnects the smaller local networks
 - **Access layer:** Provides connectivity for network hosts and end devices

Hierarchical Network



- **Core tier**

- Provides optimal wide-area transport between geographically remote sites.
- Connects campus networks in a corporate or enterprise WAN
- Services are typically leased from a telecom service provider
- May use the public Internet as enterprise backbone.
- Need to efficiently use bandwidth because of provider tariffs.

- **Distribution tier**

- Connects multiple networks (departments) within a campus network environment (one or more buildings).
- Includes campus backbone network, based on FDDI, Fast Ethernet, Gigabit Ethernet, or ATM.
- Acts as a concentrator points for many of its access tier sites.
- Links usually owned and/or controlled by the organization.
- Network policy is often implemented in this tier. E.g., security, firewall, encryption, address translation.

- **Access tier**

- Usually a LAN or a group of LANs.
- Typically uses Ethernet, Token Ring, or FDDI.
- Can be divided into two levels (workgroup level & desktop level)
 - Workgroup level: e.g., departmental level
 - Desktop level: where end-user devices are attached.
- Where hosts are attached to the network (e.g., labs)
- Connects workgroups (e.g., marketing, administration)
- Usually within a single building (or single floor)
- Provides logical network segmentation, traffic isolation and distributed environment

Advantages of a hierarchical design model :

Scalability

Design rule: Build hierarchical networks for maximum scalability.

Ease of implementation

Phased approach is more effective due to cost of resources i.e efficient allocation of resources in each phase of network deployment.

Ease of troubleshooting

- Easy to isolate problems in the network
- Use “divide-and-conquer” approach i.e Temporarily segment the network.
- Does not affect core tier network

Predictability

Makes capacity planning for growth easier.

Protocol support

- Mixing new protocol is easier.
- Merger of companies using different protocol is easier

Manageability

- Easy to implement network management instrumentation by placing probes at different levels of hierarchy