Introduction to Networking

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Computer Networks

What is Networking?

- When you use a computer not connected to a network, you are working in what is called a stand-alone environment.
- Computers connected over a network can make that information exchange easier and faster. The information moves directly from computer to computer rather than through a human intermediary. People can concentrate on getting their work done rather than on moving information around the company

LAN

- A local area network (LAN) is a number of computers connected to each other by cable in a single location, usually a single floor of a building or all the computers in a small company.
- While local area networks are perfect for sharing resources within a building or campus, they cannot be used to connect distant sites.

WANs

- Stated simply, wide area networks are the set of connecting links between local area networks. These links are made over telephone lines leased from the various telephone companies. WANs can be created with satellite links, packet radio, or microwave transceivers. These options are generally far more expensive than leased telephone lines.

WANs

- A WAN, spans a larger area, often a country or continent. It contains a collection of machines (call these hosts) intended for running user (i.e. ,application) programs. The hosts are connected by a communication subnet, or just subnet for short. The job of the subnet is to carry messages from host to host,
- In most WANs, the subnet consists of two distinct components: transmission lines and switching elements. Transmission lines (also called circuits, channels, or trunks) move bits between machines.

Limitation of WAN

- WANs suffer from extremely limited bandwidth. The fastest commercially feasible wide area data links are many times slower than the slowest local area links. This makes the sharing of resources over a WAN difficult. Generally, WAN links are used only for interprocess communications to route short messages, such as e-mail or HTML (World Wide Web) traffic.

Advantages of Networking

- Sharing Information
- Sharing Hardware Resources
- Sharing Software Resources
- Preserving Information
- Protecting Information

Sharing Hardware Resources

- Networked computers can also share
  - » Fax modems
  - » Floppy drives
  - » CD-ROMs
  - » Tape backup units
  - » Plotters
  - » Scanners
  - » Hard disks
  - » Almost any other device that can be attached to the computer.

Sharing Hardware Resources

- You can attach some peripherals **directly** to the network; they do not need to be attached to a computer to be shared on the network.

Clients, Servers, and Peers

- There are three roles for computer in a local area network:
  - **Clients**, which we use but do not provide network resources
  - **Peers**, which both use and provide network resources
  - **Servers**, which provide network resources.

ntages of Server-Based Networks

- Strong central security
- Central file storage, which allows all users to work from the same set of data and provides easy backup of critical data
- Ability of servers to pool available hardware and software, lowering overall costs

ntages of Server-Based Networks

- Ability to share expensive equipment, such as laser printers
- Easy manageability of a large number of users
- Central organization, which keeps data from getting lost among computers

ntages of Server-Based Networks

- Expensive dedicated hardware
- Expensive network operating system software and client licenses.
- A dedicated network administrator (usually required)

Protocol Hierarchies

- To reduce their design complexity, most networks are organized as a series of layers or levels, each one built upon the below it. The purpose of each layer is to offer certain services to the higher layers, shielding those layers from the details of how the offered services to the higher layers from the details of how the offered services are actually implemented.

Protocol Hierarchies

- Layer **n** on one machine carries on a conversation with layer **n** on another machine. The rules and conventions used in this conversation are collectively known as the layer **n** protocol. Basically, a protocol is an agreement between the communicating parties on how communication is to proceed.

Protocol Hierarchies

- In reality, no data are directly transferred from layer **n** on one machine to layer **n** on another machine. Instead, each layer passes data and control information to the layer immediately below it, until the lowest layer is reached. Below layer 1 is the physical medium through which actual communication occurs.

Design Issues for the Layers

- Rules for the data transfer
- Error control
- Preserve the order of messages sent on them.
- How to keep a fast sender from swamping a slow receiver with data.
- Inability of all processes to accept arbitrarily long messages.
- When there are multiple paths between source and destination, a route must be chosen.

tion-less/Connection-Oriented Protocols

- There are two ways that communications between computers can be arranged: Connectionless and connection oriented.
- Connectionless systems optimistically assume that all data will get through, so there's no protocol overhead for guaranteed delivery or sequential packet ordering. This makes them fast..

tion-less/Connection-Oriented Protocols

- Connection-oriented systems pessimistically presume that some data will be lost or disordered in most transmissions. Connection oriented protocols guarantee that transmitted data will reach its destination. Transmission Control Protocol (TCP/IP) is an example of a connection-oriented internet protocol.

nectionless versus Connection-Oriented Protocols

- All is not lost for connectionless transports, however, since higher level protocols will know what data has not reached its destination after some time and request retransmission. The higher level protocol must sort out the data packets.

Interfaces & Services

- The function of each layer is to provide services to the layer above it.
- The active elements in each layer are called entities. An entity can be a software entity (such as a process) or a hardware entity (such as an intelligent I/O chip).
- Entities on the same layer in different machines are called peer entities.
- The entities in **layer n** implement a service used by **layer n+1**.

es between Services and Protocols

- A service is a set of primitives (operations) that a layer provides to the layer above it. Defines what operations the layer is prepared to perform on behalf of its users, says nothing at all about how these operations are implemented.

es between Services and Protocols

- A **protocol**, in contrast, is a set of rules governing the format and meaning of the frames, packets, or messages that are exchanged by the peer entities within a layer. Entities use protocols in order to implement their service definitions.
- A protocol relates to the implementation of the service and as such is not visible to the user of the services.

T h

- The International Organization for Standardization (**ISO**) began developing the OSI reference model in 1977. It has since become the most widely accepted model for understanding network communication.
- This model is based on a proposal developed by the International Standards Organization (ISO). The model is called the **ISO OSI** (Open Systems Interconnect) Reference Model.

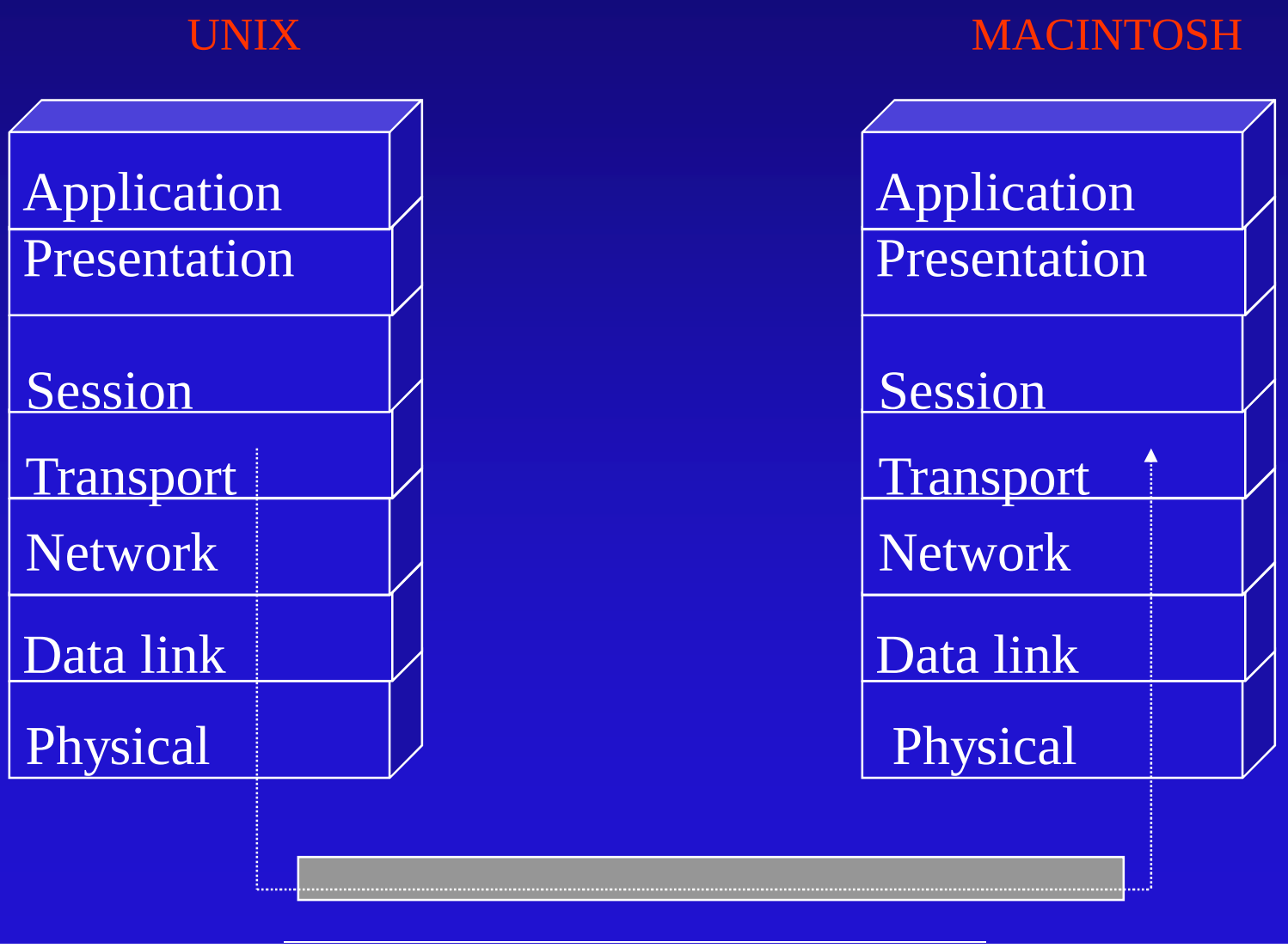
The OSI Model

- The OSI model itself is not a network architecture because it does not specify the exacts services and protocols to be used in each layer. It just tells what each layer should do.

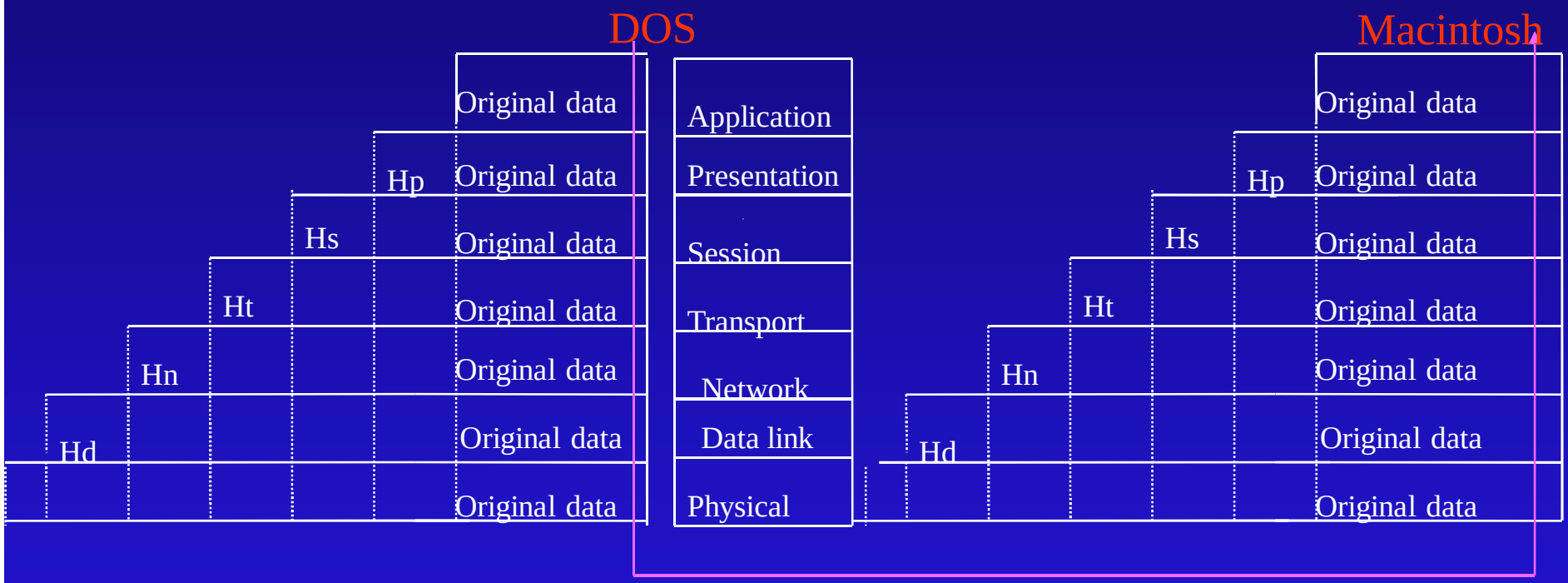
The OSI layers

- The OSI model consists of 7 layers:
  - Application
  - Presentation
  - Session
  - Transport
  - Network
  - Data Link
  - Physical

age sent from one peer layer to another



The OSI model and headers

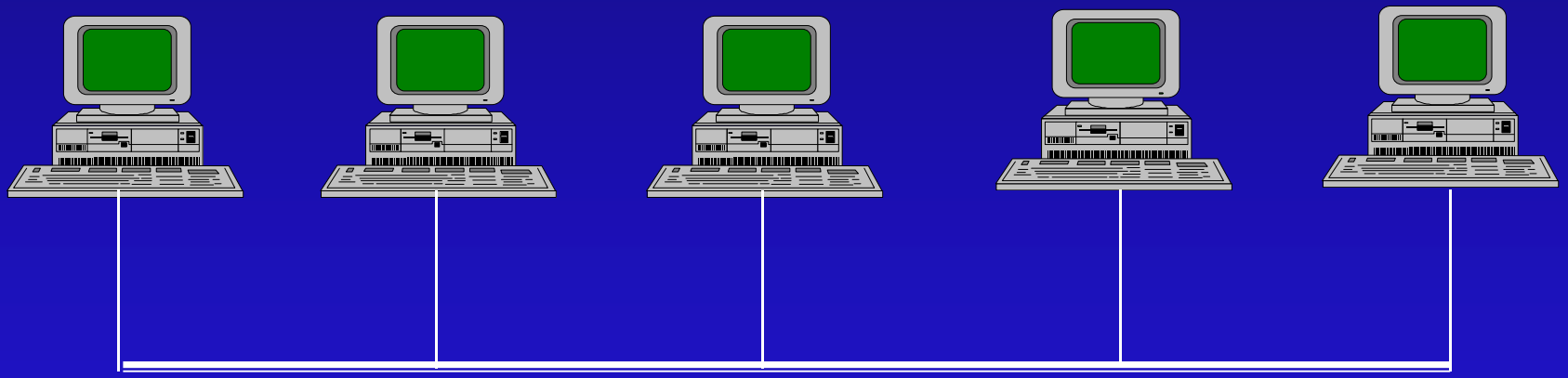


Hp -Presentation header
Ht =Transport header
Hs =Session header
Hn =Network header
Hd =Data Link header

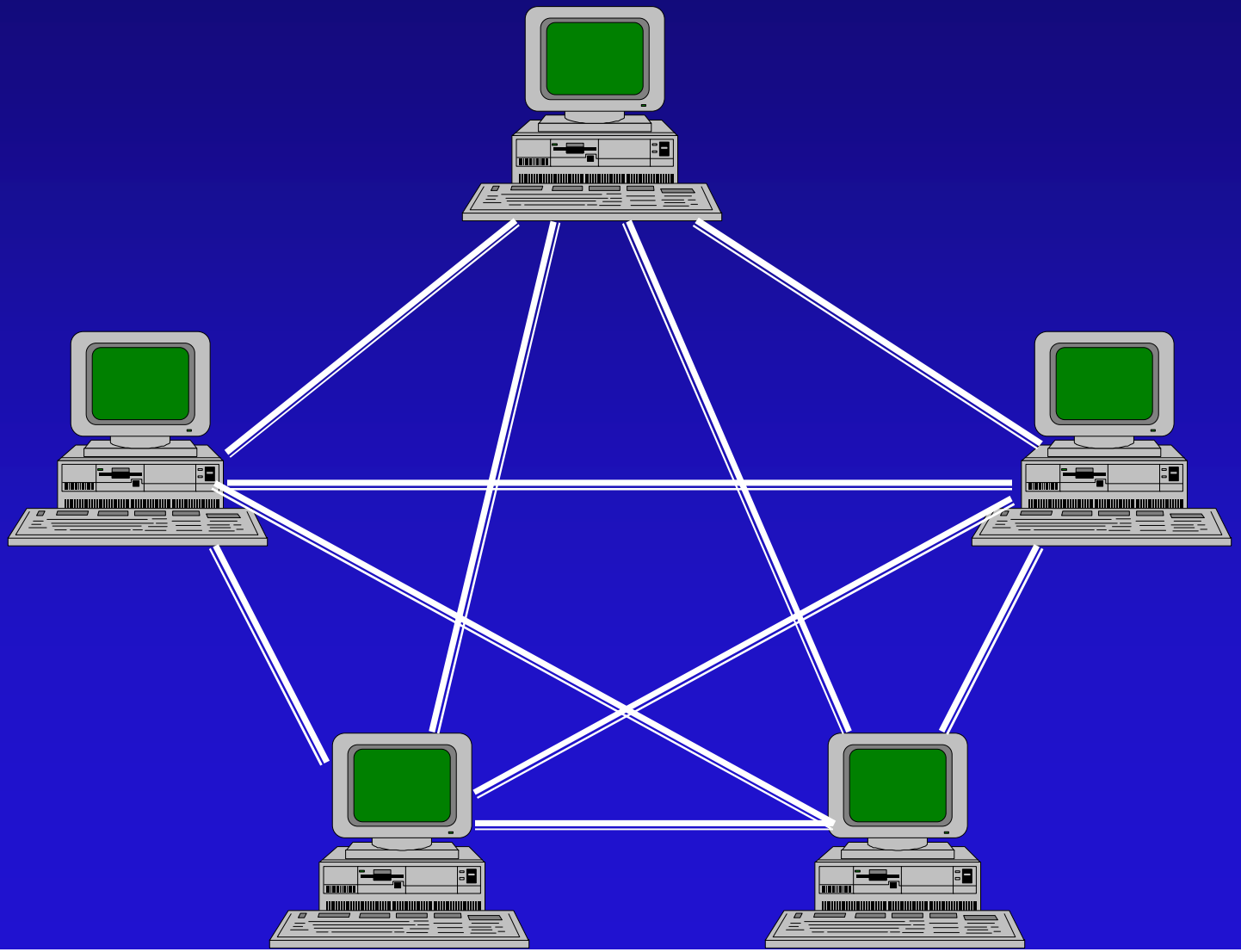
Physical Layer

- Responsible for sending bits from one computer to the another.
- Not concerned with the meaning of the bits.
- It defines physical and electrical details, such as
  - what will represent a **1** or a **0**,
  - how many pins a network connector will have,
  - how data will be synchronized,
  - when the network adapter may or may not transmit data
- Physical topologies include: **bus, star or ring**

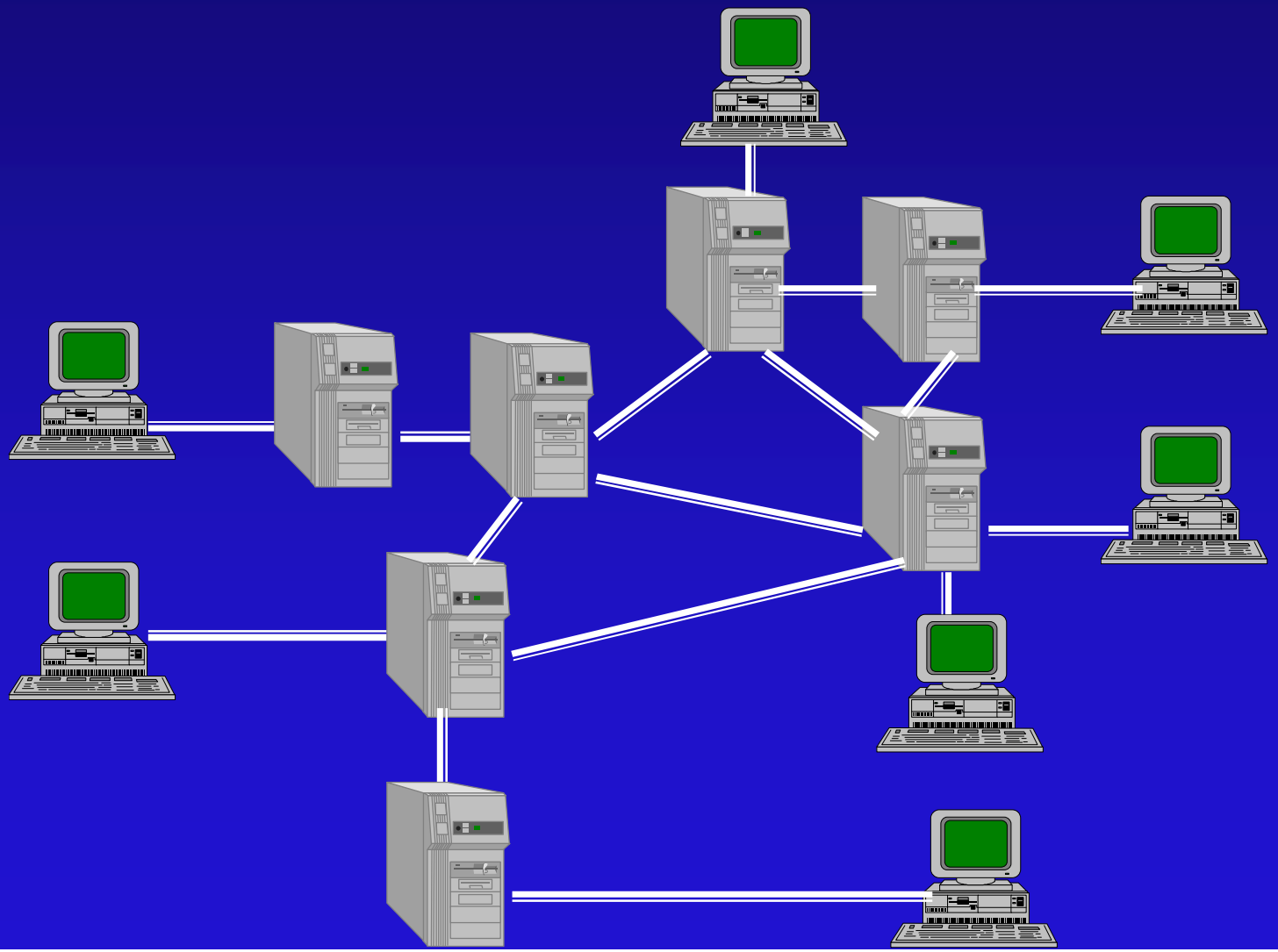
Bus Topology



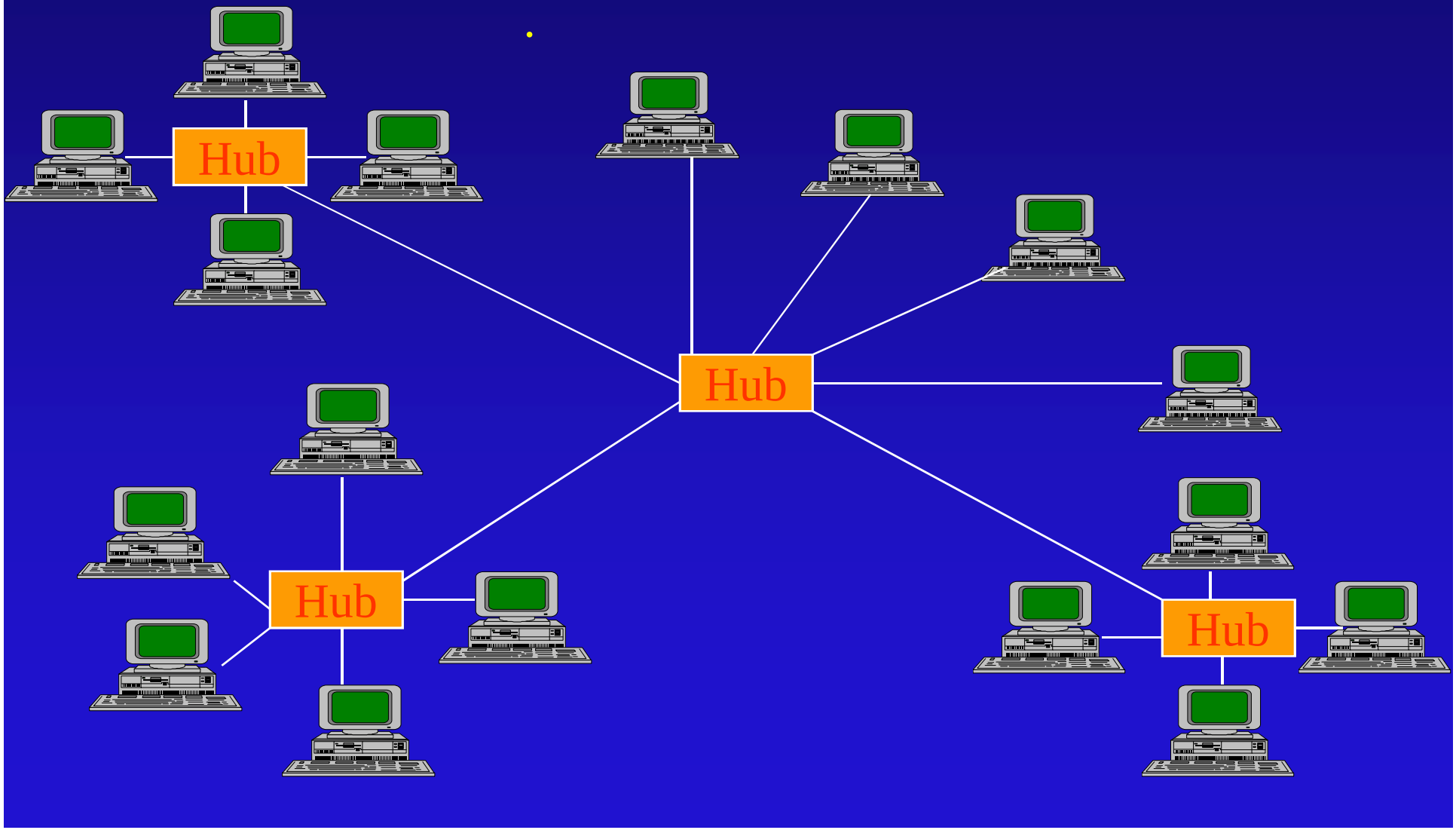
True Mesh



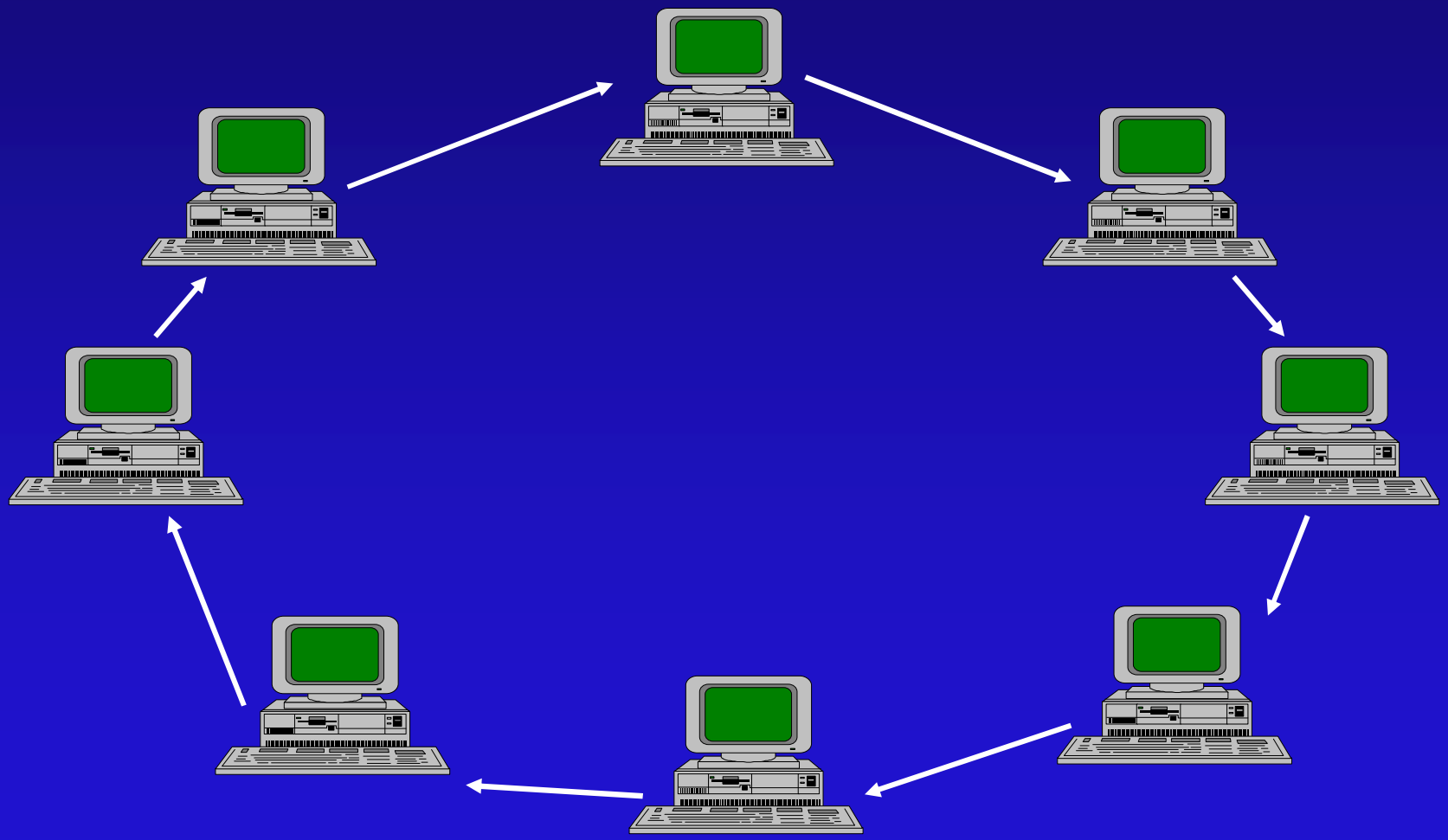
Hybrid Mesh



Hybrid Star



Ring topology



Data Link Layer

- It provides for the flow of data over a single link from one device to another.
- It accepts packets from the network layer and packages the information into data units called frames to be presented to the physical layer for transmission.
- Can detect lost/damaged frames
- Bridges, intelligent hubs, and network interface cards are devices typically associated with the data link layer.

Network Layer

- Makes routing decisions and forwards packets
- It translates logical network addresses into physical machine addresses (the numbers used as destination IDs in the physical network cards).
- It also determines the quality of service (such as the priority of the message)
- It may break large packets into smaller chunks and reassemble the chunks into packets at the receiving end.
- Routers and gateways operate in the network layer.

Transport Layer

- The transport layer ensures
  - » that packets are delivered error free,
  - » delivered in sequence, and with no losses or duplications.
  - » The transport layer also breaks large messages from the session layer (which we'll look at next) into packets to be sent to the destination computer and reassembles packets into messages to be presented to the session layer in the destination layer.

Session Layer

- The session layer allows application on separate computers to share a connection called a session.
- It provides services such as name lookup and security to allow two programs to find each other and establish the communications link.
- It also provides for data synchronization and checkpointing so that in the event of a network failure, only the data sent after the point of failure need be resent.

Presentation Layer

- The presentation layer translates data between the formats the network requires and the formats the computer accepts.
- It also does
  - protocol conversion,
  - data translation,
  - compression and encryption,
  - character set conversion, and
  - the interpretation of graphics commands.

Application Layer

- It provides services that directly support user application, such as database access, e-mail, and file transfers. It also allows applications to communicate with applications on other computers as though they were on the same computer.

Summary

- Overview of Networking
  - » WANS, LANs, MANs, etc.
- The ISO OSI Model
- Some networking topologies
- Networking in the Kingdom