

CSIS 625 Week 2

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Overview

- **Basic Concepts of Communications**
 - Categories of Networks
 - Point-to-point vs Multi-point
 - Different Transmission modes
 - Different Topologies
- **OSI Model**
 - The 7 Layers
 - Contrast to TCP/IP
 - Why it is a “Model”

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Categories of Networks

- LAN - Local Area Network
- MAN - Metropolitan Area Network
- WAN - Wide Area Network
- Only difference is area that they cover
- Gray boundaries between these categories.

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Internetworks

- internetwork or ineternet - Any time two networks are connected together.
- Internet - uppercase I - a specific ineternet.
 - The global TCP/IP based network that everyone talks about.

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Line Configurations

- Point to Point - a dedicated link between two devices
- Multipoint - More than 2 devices on a link

Transmission Modes

- Simplex
 - Unidirectional communication.
 - One node can only receive and one node can only transmit
- Half-Duplex
 - Each node can receive and transmit, but only one at a time
- Full-Duplex
 - Each node can receive and transmit at the same time.

Topologies

- How Nodes are connected to one another.
- May be logical or physical
 - Some

Topologies - Bus

- Bus
 - A multipoint media link connects all nodes together.
 - The media link called the backbone
 - Very efficient for adding additional nodes
 - Just tap onto the cable
 - Difficult to rearrange or debug.
 - Any fault on the cable may interrupt all communications

Topologies - Mesh

- Mesh
 - Every node has a point to point connection with several other nodes
 - Pure Mesh - every node connects with every other node directly.
 - With a pure mesh network, a network of n nodes, every node has $n-1$ connections.
 - Does not scale well.
 - Very robust & secure

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Topologies - Star & Tree

- Star
 - Every Node has a connection to a central point.
 - Central point often called a hub.
 - Scales much better than pure mesh, but the hub must support a lot of connections.
- Tree - two kinds
 - Multiple star networks combined.
 - Allows Star network to scale better.
 - Multiple branches from a bus network
 - Allows more flexible topology of the bus network

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Topologies - Hubs

- Hubs
 - A single point of failure.
 - A single debugging point
 - Passive hubs provide simple electrical or optical connections.
 - Simple, Cheap, don't break often
 - Active hubs regenerate the signal between nodes.
 - Allows greater distances between nodes

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Topologies - Linear

- Linear
 - Each node has a point-to-point connection with each of its neighbors.
 - Any break causes some nodes to be unable to communicate
 - Protection lines help solve reliability
 - Simple to build and extend

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Topologies - Ring

- Ring
 - Each node has a point-to-point connection with each of its neighbors to form a ring of connections
 - Like linear, but with ends connected.
 - May have all traffic going in one direction, or traffic may go in both directions.
 - Any fault will still allow nodes to talk in the opposite direction.

Topologies - Hybrid

- Combinations of the previous methods.
- Very common when linking different subnetworks together
 - One office has a 10Base2 bus Ethernet network, and another has 10BaseT star Ethernet network

Protection modes

- Rings
 - Path switched
 - Line switched
 - Packet switched
- 1+1
- 1:n

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OSI Model

- OSI - Open Systems Interconnection
- A set of standards to allow any computer to speak with any other computer
- Developed by ISO
 - Started in 1977, basically outlined by 1978
 - Formally accepted in 1983
 - GOSIP - Government OSI Profile
 - 1988 - 1994 - RIP
- Layered approach - 7 Layers

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OSI Layers

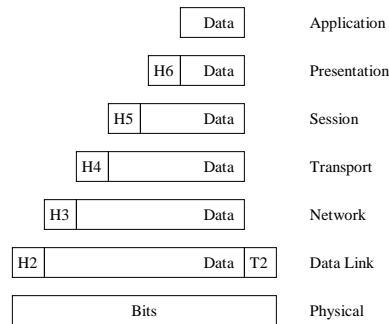
- Layer 7 - Application
- Layer 6 - Presentation
- Layer 5 - Session
- Layer 4 - Transport
- Layer 3 - Network
- Layer 2 - Data Link
- Layer 1 - Physical

OSI - Interfaces Between Layers

- Each layer has to provide services to the layer above it, and rely on the layer below it.
- Strict definition of these interfaces allows for different protocols to be easily swapped out

Layer processing

- Model says each layer adds headers, and data link layer may add trailer as well.



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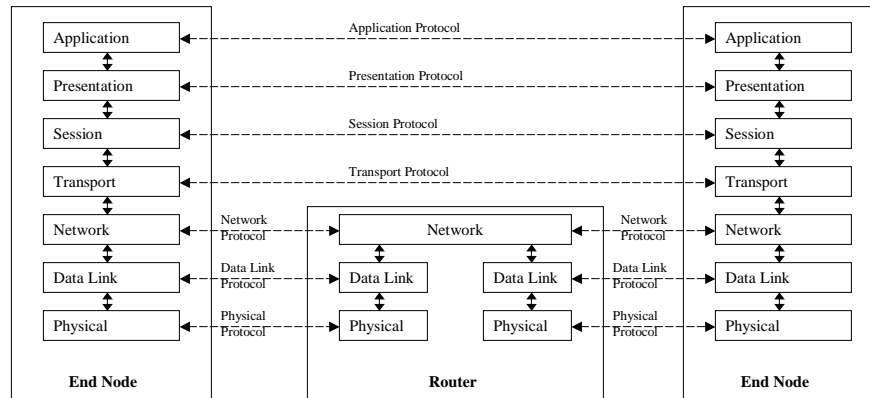
OSI Model - Peer layers

- Between nodes, layer n communicates with layer n on the other system
- The same layer implements the same functions
- The same function may not be provided in the exact same way.
- All communications is defined by a set of protocols that must be the same between two peer nodes.

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Internetworking & OSI



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Physical Layer

- Medium
- How bits are physically present on the line
 - voltage for a 1/0, light pulse, etc
- Transmission mode
 - full-duplex, half-duplex or simplex
- Physical topology
- Data rate
- Synchronization of bits & symbols (bytes)

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Data Link Layer

- Node to node delivery of frames
 - create & recognize boundaries
- Physical Addressing (multiple nodes in the physical network)
- Flow Control
- Error Control
 - Detect errors and prevent duplication
- MAC - Media Access Control
 - When can different nodes transmit

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Network Layer

- End to end delivery of packets
- Logical Addressing
- Routing - path a packet takes
- Address Translation
 - Resolving logical addresses to physical addresses
- Fragmenting packets
 - One data link layer supports bigger packets than another.

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Transport Layer

- End to end delivery of a message
 - multiple packets make up a message
- Service Port addressing
- Segmentation and reassembly of a message.
- Flow control
- Error Control
- Connection Control

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Session Layer

- Session management
 - May use many transport layer sessions to accomplish one overall session
- Synchronization
 - checkpoint a big file transfer
- Token Management
- Dialog control

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Presentation Layer

- Translation
 - Syntax and semantics of information
- Encryption
- Compression
- Authentication

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Application Layer

- Network Virtual Terminal
 - aka telnet
- File transfer, access, management (FTAM)
 - aka FTP
- Mail services
- Directory services
 - aka DNS, NIS, etc.

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OSI compared to TCP/IP

- OSI developed model, then protocols then implementations
- TCP/IP developed implementations, then protocols ratified, then a model.

Why OSI is a model

- There actually are OSI protocols BUT nobody uses them
- The library of OSI protocols is so large that it can't be understood by mere mortals
- Those implementations that actually exist are rarely interoperable.
- Session and presentation layers are ignored in everything but textbooks and bureaucracies.

OSI problems

- Protocols came out too late compared to TCP/IP protocols
- Error control, addressing, and flow control re-appear in multiple layers.
- Original pass ignored connectionless services and protocols.
 - Too many telco people on the committees
- Too much of the terminology is telco oriented which doesn't make software implementers comfortable.

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TCP/IP critique

- Ignores data link & physical
 - built on top of existing standards
- Some application protocols are grad student projects
 - Not always polished
- Actual transport & network layer protocols have been very robust.
- Not really a “model”

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