

15.020 Competition in Telecoms

Recitation #2

Othman Laraki

Agenda

- Introduction to Packet-Switched Networks

What is an Internetwork?

For this diagram, see Figure 1-1 in:
Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

Connecting different devices, using different technologies to each other and having them work together and function as a single large network.

Wide Area Networks (WANs)

- A geographically dispersed telecommunications network, more broad than a LAN
- May be privately owned or rented, but usually connotes the inclusion of public networks.
- WAN technologies function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

Metropolitan Area Networks (MANs)

- A network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network ([LAN](#)) but smaller than the area covered by a wide area network ([WAN](#)).
- Usually an interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network)
- also the interconnection of several LANs by bridging them with [backbone](#) lines (sometimes referred to as a *campus network*).

Local Area Networks (LANs)

- Interconnect individual users so that they can exchange data and share peripheral devices over small geographic area
- Computers use underlying 'protocols' to communicate across a LAN – at lowest 2 layers of OSI Model
- High-speed, fault-tolerant
- 2 main methods of accessing the physical medium:
 - Carrier sense Multiple Access with Collision Detect (CSMA/CD)
 - Ethernet
 - Token passing
 - Token Ring

LAN Architectures

4 'logical architectures':

- Bus
- Logical Ring
- Star
- Tree

3 types of data transmission

- Unicast: single source to single destination
- Multicast: single source to specific subset of nodes
- Broadcast: single source sent to all nodes

OSI Reference Model

- International Standards Organization (ISO)
- OSI (Open Systems Interconnection)
- Objective: Interoperability
 - Standard description for transmission of messages between 2 points in a telecommunication network
 - Consistent interaction of products
- Core Concept: Layering
 - Divide communication between 2 users into layers, each layer adding special, related functions: each user's computer has the 7 layers
 - Upper 4 layers used whenever a message passes from or to a user
 - Lower 3 layers used when a message passes through the host computer

OSI Reference Model

For this diagram, see: *Dell White Paper: Local Area Networks* (1997).

Encapsulation

For this diagram, see Figure 1-6 in:
Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

OSI Layer Overview

Layer	Functions	Sample Protocols
Layer 7: Application	Enable Applications to Access the Network Stack	DNS, FTP, Winsock API, SMTP
Layer 6: Presentation	Coding and conversion functions for Application Layer Data	MPEG, GIF, JPEG, TIFF
Layer 5: Session	Establishing, managing and terminating sessions	AppleTalk, SCP
Layer 4: Transport	Packetizes data from the Session layer and ensures error-free delivery	TCP, UDP
Layer 3: Network	Addressing, routing, packet switching, and data congestion	IP, IPV6
Layer 2: Data Link	Packets \leftrightarrow Bits	SLIP, PPP, Ethernet
Layer 1: Physical	Transmit bits over cable (voltage, timing, data rates, maximum distance, physical connectors)	

Layer 1 (Physical)

- Repeater
 - Interconnect LAN segments
 - Treat as single cable & retransmits all signals
 - Prevent signal degradation

For this diagram, see Figure 2-6 in Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

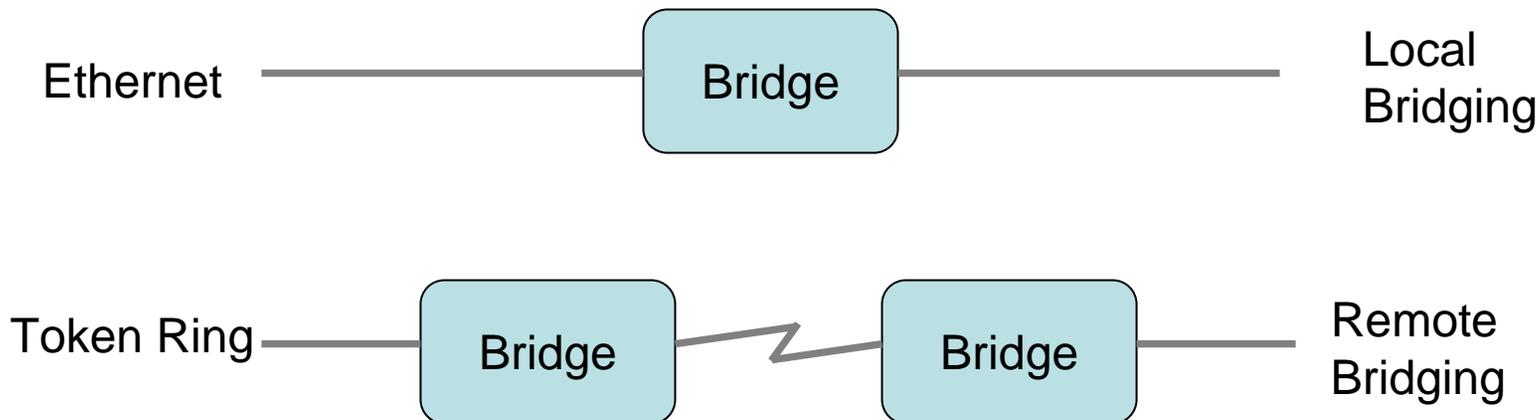
- Multiplexer
 - Multiplex: Combine multiple data streams onto 1 or more output channels
 - Demultiplex: Separate data streams at remote end

For this diagram, see Figure 1-19 in Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

Layer 2 (Data Link Layer)

Bridges

- Transparently connects LAN segments together, forwarding packets destined for the other segment
- Operate in software
- Can filter out packets that do not need forwarding



Layer 2 (Data Link Layer)

LAN Switches

- Interconnect multiple LAN segments
- Provide dedicated, collision-free communication between network devices
- Support for multiple simultaneous conversations
- Switch data frames at high speeds (in hardware)
- Example: interconnect 10-Mbps & 100-Mbps Ethernet LANs:

For this diagram, see Figure 4-4 in:
Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

Layer 3 (Network)

- Routers
 - Analyze network address to make routing decisions
 - Choose optimum route and forward packet to adjacent router
 - Use 'routing protocols' to define optimal path

For this diagram, see Figure 2-7 in:
Cisco Systems, *Internetworking Technologies Handbook*, 2002. <http://www.cisco.com/univercd/>

Where does Each Protocol Fit?

For this diagram, see the entry for “OSI Reference Model”
at SearchNetworking.com, <http://searchnetworking.techtarget.com/>