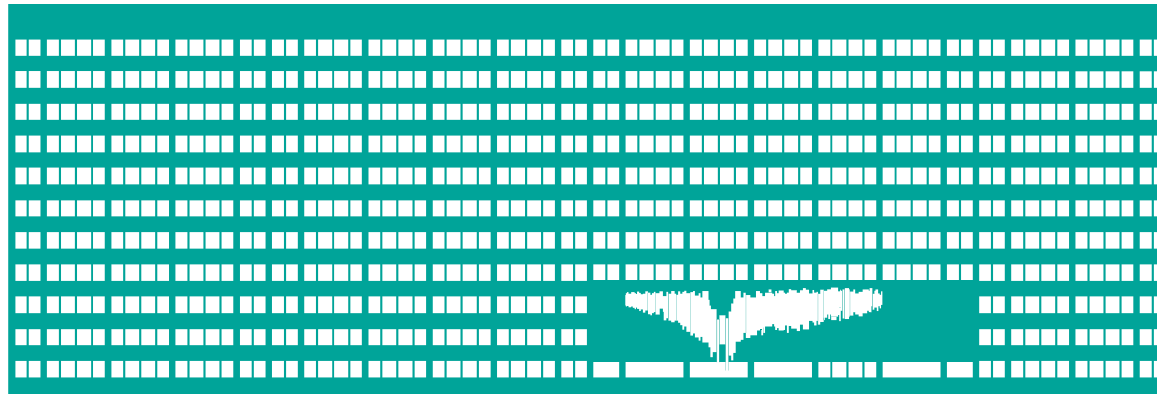


Local Area Networks vs. Wide Area Networks



Computer Networks
Lecture 1

LANs and WANs

A Traditional View

- LAN (Local Area Networks)
 - Common shared channel (various topologies)
 - High transfer rates (Mbps → Gbps)
 - Only one packet on a medium at the same time
- WAN (Wide Area Networks)
 - Partially meshed topology created mostly by P2P links
 - Lower transfer rates (kbps)
 - Multiple packets may be present on a medium at the same time
 - if the transfer rate and signal propagation delay are high

Classification Criterion

$$a = \frac{\text{End-to-end signal delay}}{\text{Time interval to transmit 1 packet}}$$

- $a > 1$: there may be multiple packets on the medium at the same time => WAN
- $a < 1$: there may be at most one packet on the medium at the same time => LAN

A Problem with the LAN/WAN Classification

- Switched LANs
 - There are multiple packets in the tree structure at the same time
- High-speed WAN links (Gbps, 10Gbps)
 - while hundreds of Mbps are typical in today's LANs

Today, we commonly differentiate LANs and WANs according to other criteria such as the geographical area they cover or a purpose and entity that administers them

(no standard criteria are defined)

Network Topologies

What is a Network Topology ?

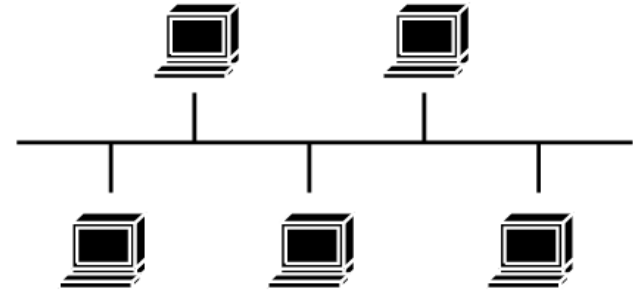
- The physical or logical arrangement and interconnections of the network elements (nodes)
 - computers and network devices
- The particular network technology is commonly bound with a particular topology
 - Token Ring=ring, Ethernet=tree or bus

Desired Characteristics of Network Topologies

- Extensibility
 - Topological and distance restrictions
- Resiliency
 - level of resiliency against failures of nodes and medium
- Reconfigurability (in case of failure)
 - possibility of automatic topology reconfiguration using an alternate link
 - (e.g the double ring in FDDI)
- Overall throughput
 - Influenced by signal propagation delay, ability to transfer multiple packets between different pairs of nodes in parallel etc.

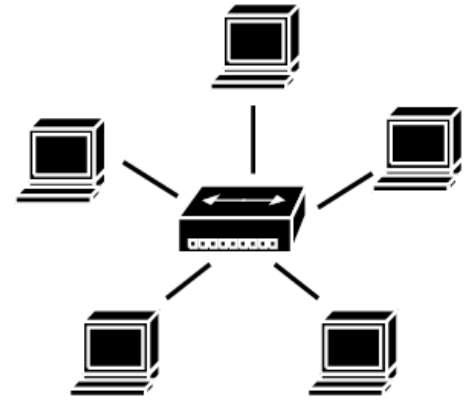
LAN Topologies

Bus



- Passive medium
- Low signal propagation delay
 - No delays are introduced by network devices
- The signal is received by all nodes
 - various media access methods may be applied
 - any pair of communicating nodes shares the medium with others
 - limited by overall capacity of the shared channel
 - limited security
- Poor resiliency against media failures (BNC T Connectors, terminators)
 - Cumbersome troubleshooting
 - A single failed NIC may negatively influence the whole segment

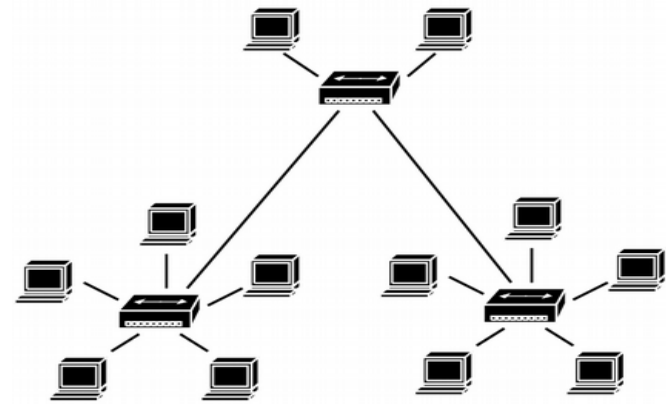
Star



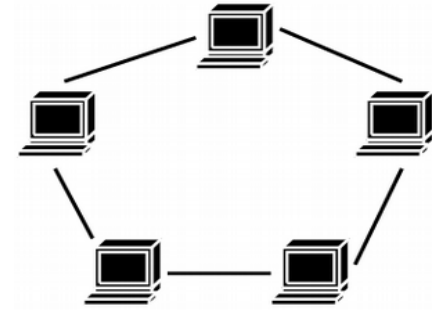
- Each node is connected to a central hub
 - either active or passive hub
- Resilient against failures of stations, the failure of the hub is critical
- P2P links may be implemented rather easily
 - and also allow usage of fiber optic cables

Tree (distributed star)

- Generalization of star
- Most used in today's LANs
- Characteristics are similar to star topology
- Hierarchical control of media access may be applied
- Implementation of redundancy:
 - redundant lines may physically exist, but have to be intentionally blocked, so that the topology remains to behave as the tree all the time



Ring (1)



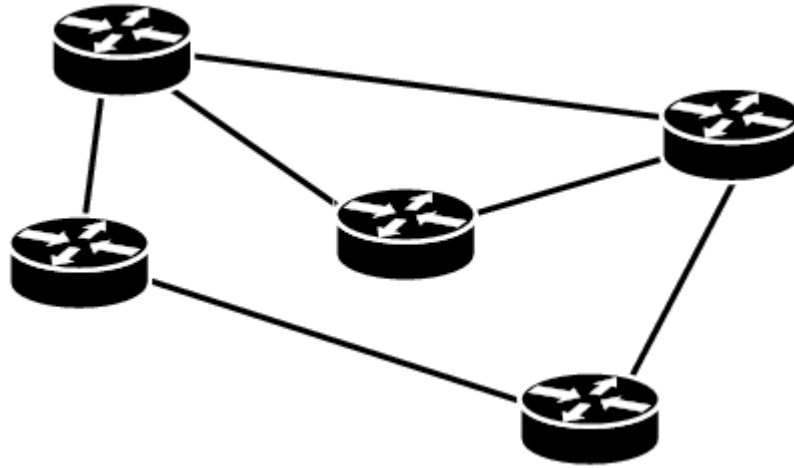
- A ring of unidirectional P2P links
 - we may combine various media types
- The data circulate around the ring and through the shift registers in each node
- Susceptible to failures of both nodes and links
 - The medium may be physically arranged as a star with Multi Station Access Unit (MSAU) in the center
 - The MSAU may bridge the signal over inactive lobes
 - The topology may be protected using dual rings and routing the signal around the failed link or node

Ring (2)

- The transmitted packet is received only by the single downstream neighbor that may consume it, modify it and/or forward it to the next neighbor
 - it may be advantageous for some media access methods

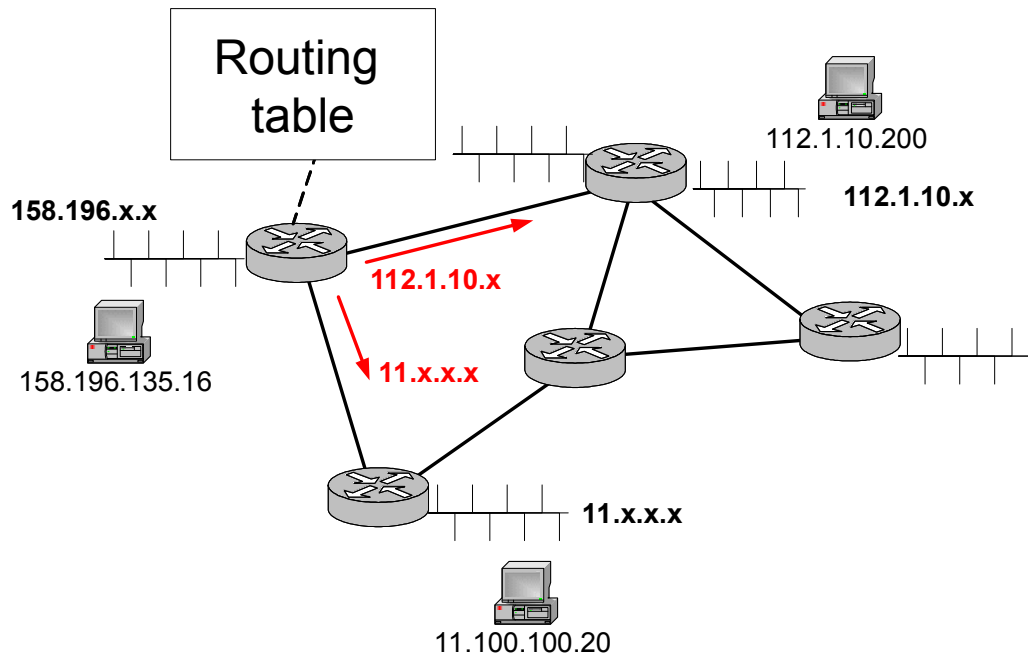
WAN Topologies

Mesh



- Point-to-point links between routers
- Alternate paths may exist
- Hub-and-spoke and full-mesh are the most favorite examples

A Topology of the Internet



- Internet is a mixture of networks with various topologies
- LANs with various topologies are interconnected by routers