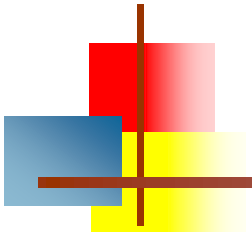
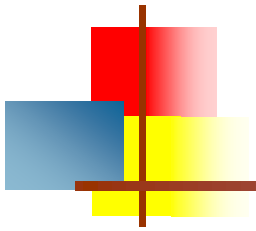


Introduction to Networks & Distributed Computing
CECS 327



Interconnection Devices

Interconnection Devices

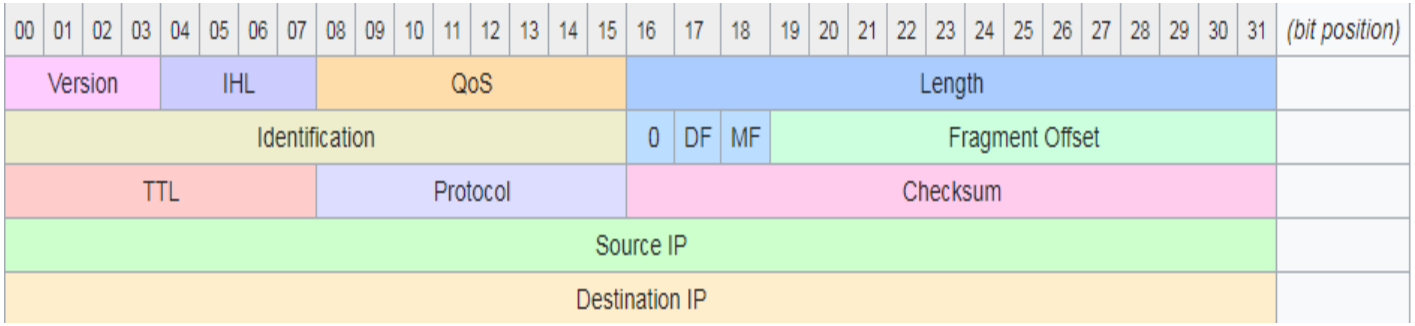
Repeaters, Hubs, Bridges, Switches & Routers

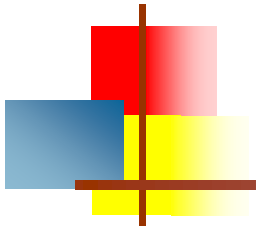
for LANs, MANs & WANs

Interconnection Devices

Network Packet:

- A network packet is a formatted unit of data carried by a packet-switched network.
- A packet consists of control information and user data which is also known as the payload.
- Control information provides data for delivering the payload, for example: source and destination network addresses, error detection codes, and sequencing information.
- Typically, control information is found in packet headers and trailers.





Interconnection Devices

Network Packet headers :

- 4 bits that contain the version, that specifies if it's an IPv4 or IPv6 packet,
- 4 bits that contain the Internet Header Length, which is the length of the header in multiples of 4 bytes (e.g., 5 means 20 bytes).
- 8 bits that contain the Type of Service, also referred to as Quality of Service (QoS), which describes what priority the packet should have,
- 16 bits that contain the length of the packet in bytes,
- 16 bits that contain an identification tag to help reconstruct the packet from several fragments,
- 3 bits. The first contains a zero, followed by a flag that says whether the packet is allowed to be fragmented or not (DF: Don't fragment), and a flag to state whether more fragments of a packet follow (MF: More Fragments)
- 13 bits that contain the fragment offset, a field to identify position of fragment within original packet
- 8 bits that contain the Time to live (TTL), which is the number of hops (router, computer or device along a network) the packet is allowed to pass before it dies (for example, a packet with a TTL of 16 will be allowed to go across 16 routers to get to its destination before it is discarded),
- 8 bits that contain the protocol (TCP, UDP, ICMP, etc.)
- 16 bits that contain the Header Checksum, a number used in error detection,
- 32 bits that contain the source IP address,
- 32 bits that contain the destination IP address.

Interconnection Devices

Frame:

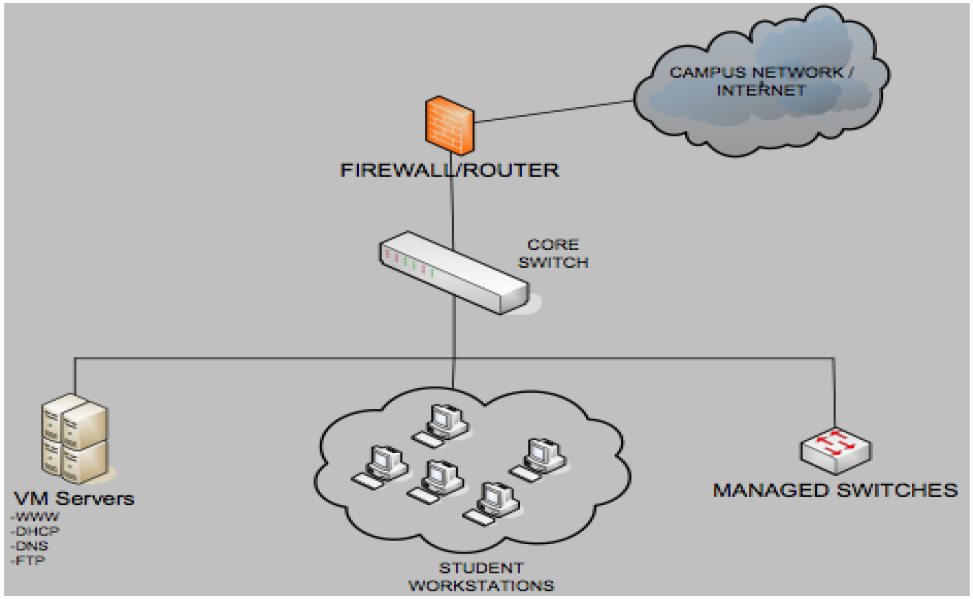
- A **frame** is a packet of data passed across the network at Layer 2 of the TCP/IP Stack.
- At Layer 2, **media access control (MAC)** addresses are used to send messages from one computer to another.
  - MAC addresses are also known as **physical addresses** or **hardware addresses**.
  - MAC addresses are not the same as IP addresses. IP addresses are software addresses that can be changed. MAC addresses are hardware addresses associated with the **network interface card (NIC)** and cannot be changed.

Frames have two MAC addresses in their header: (1) the MAC address of the source computer, and (2) the MAC address of the destination computer.

Interconnection Devices

LAN (Local Area Network)

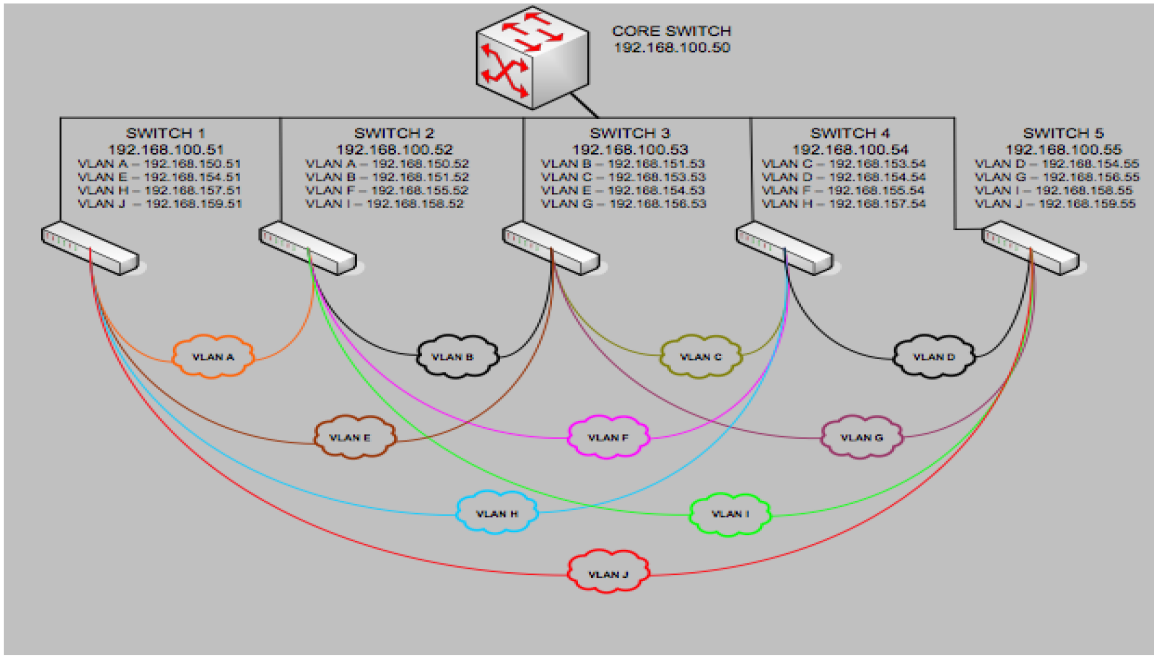
Usually, a single LAN technology with multiple segments connected via hubs or switches. One router connection to the Internet.



Interconnection Devices

MAN (Metropolitan Area Network)

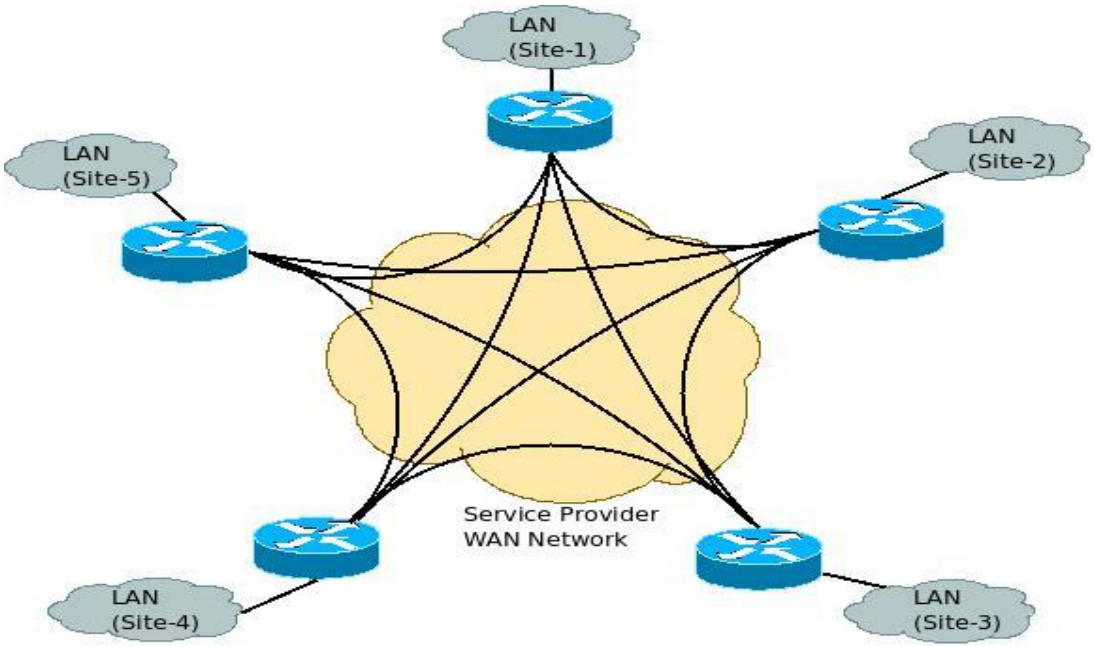
Usually, many switched LANs operating as sub-networks through VLANs (Virtual LANs) or sub-netting. Some routers used.



Interconnection Devices

WAN (Wide Area Network)

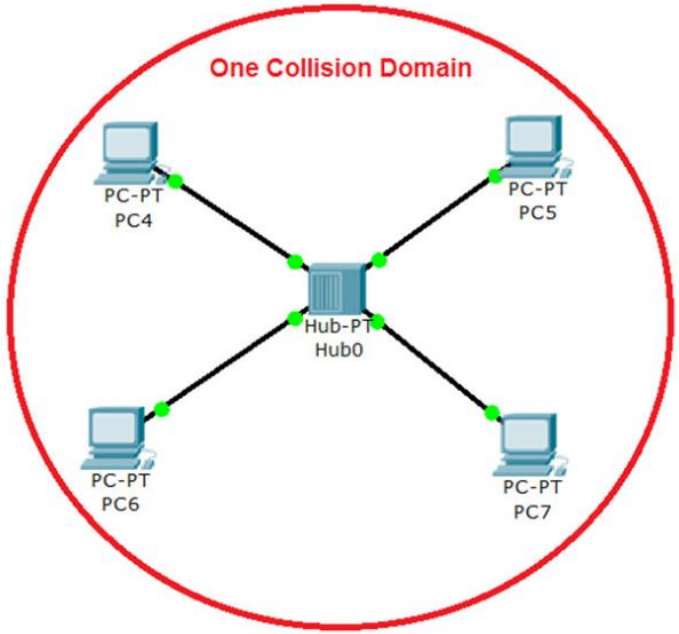
Multiple routers interconnected by point-to-point links. Routers can also connect to local MANs and LANs.



Interconnection Devices

Collision Domain:

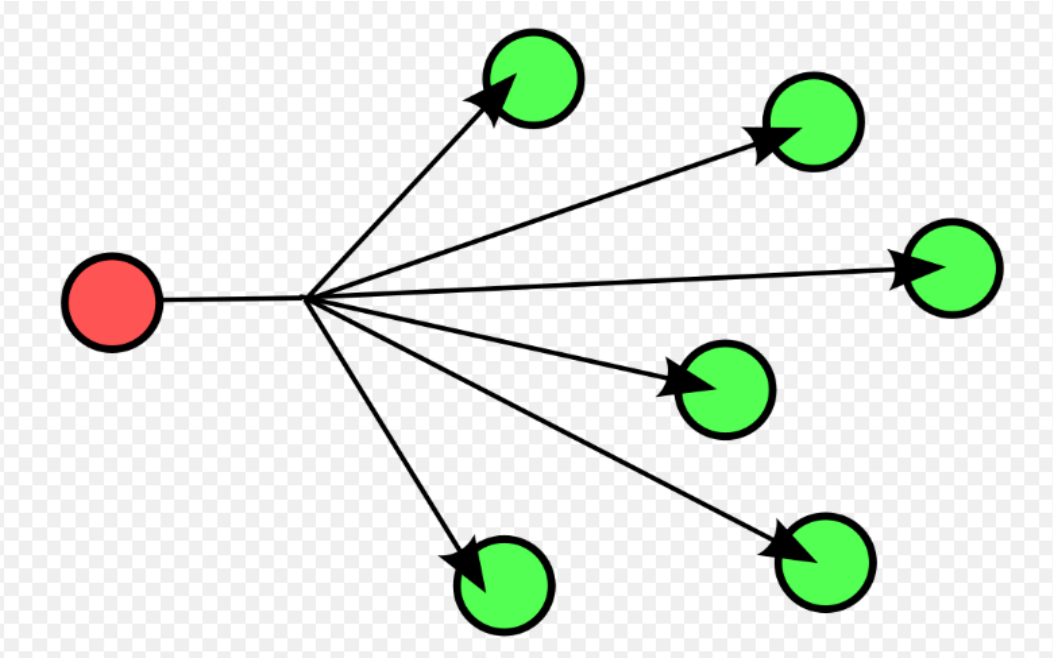
- A collision domain is, as the name implies, the part of a network where packet collisions can occur.
- A collision occurs when two devices send a packet at the same time on the shared network segment.
- The packets collide and both devices must send the packets again, which reduces network efficiency.



Interconnection Devices

Broadcasting:

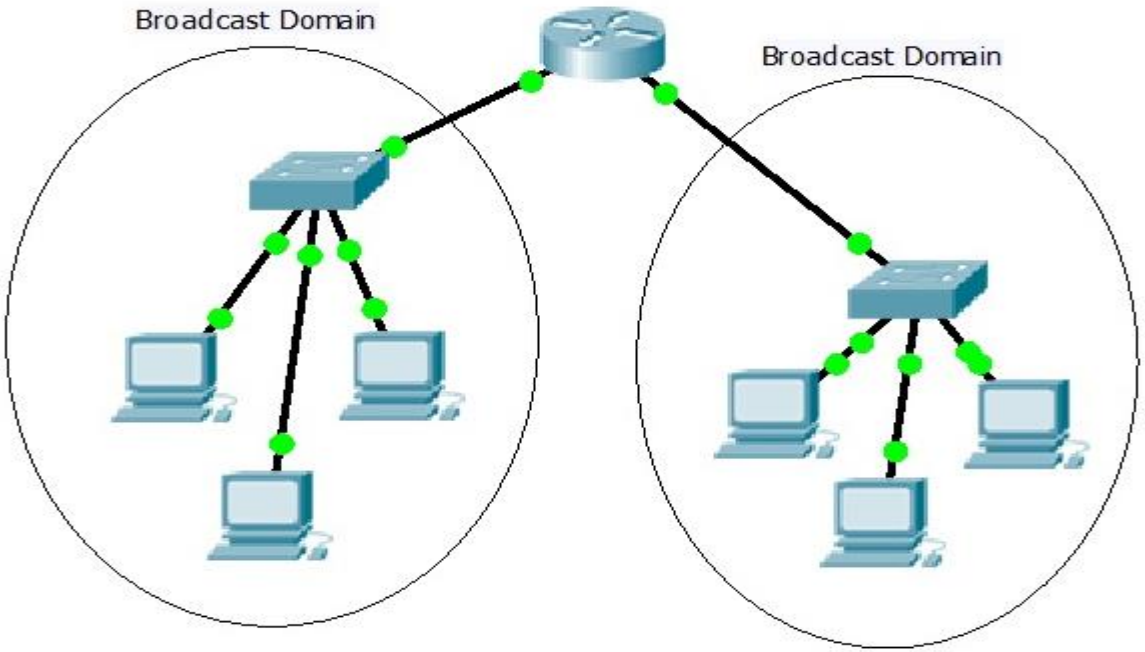
It is the process of sending data packets to multiple recipients all at once. For instance, a local area network can be configured so that any device on the network can broadcast a message to all the others.



Interconnection Devices

Broadcast Domain:

A broadcast domain is the domain in which a broadcast is forwarded. A broadcast domain contains all devices that can reach each other at the data link layer (OSI layer 2) by using broadcast message. Routers and other higher-layer devices form boundaries between broadcast domains.



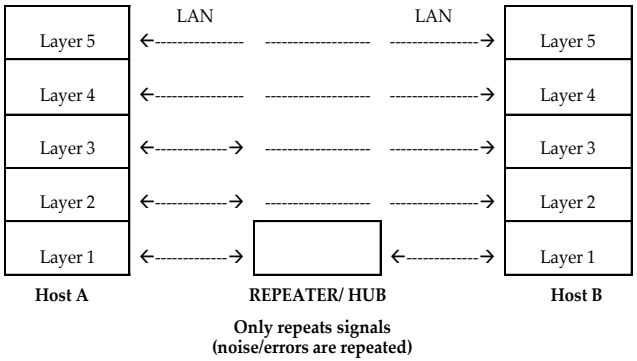
Interconnection Devices

Repeaters & Hubs:

A **repeater** is a network interconnection device with two interfaces that regenerates signals coming in one interface onto the other.

Repeaters:

- Use no logic in regenerating signals, thus data and noise are both regenerated by the repeater.
- Can be used to extend the range of a single LAN.
- Operate at Layer 1 (Physical Layer) of the TCP/IP Stack.



Interconnection Devices

Hubs:

A **hub** is a network interconnection device with multiple interfaces that accepts an incoming signal from an interface and repeats it onto all other interfaces.

Physically, hubs are:

- Small electronic devices.
- Have connections for several computers (e.g., 4, 8, or 20).

Logically, hubs:

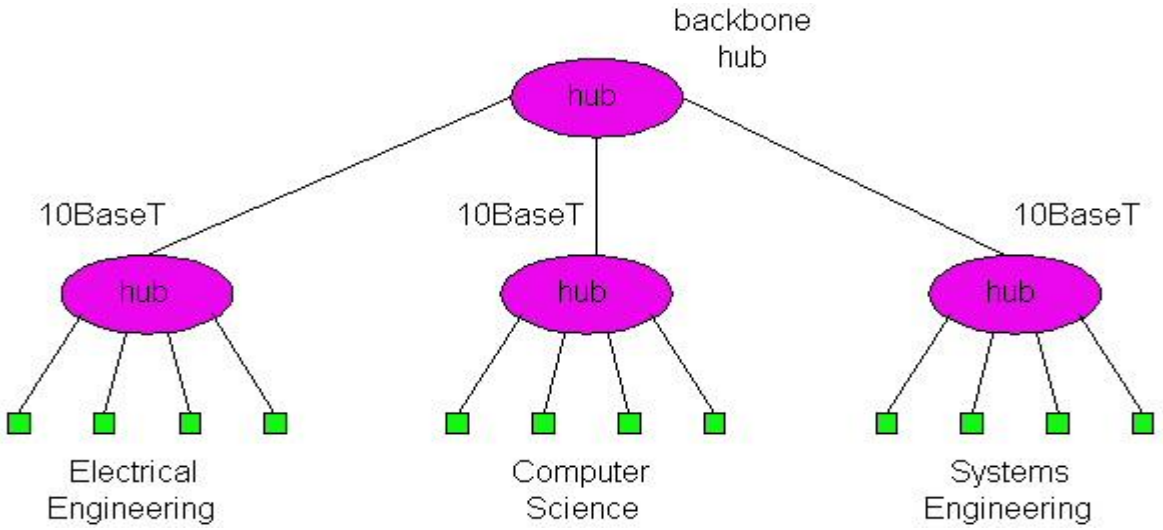
- Operate only on signals.
- Propagate each incoming signal to all connections.
- Are similar to connecting segments with repeaters.
- Do not understand frames (Layer 2 packets) so cannot filter them.

Hubs have extremely low cost and are becoming obsolete.

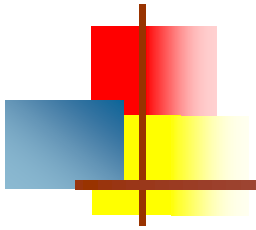
Interconnection Devices

Hub limitations:

- Single collision domain results in no increase in max throughput.
  - multi-tier throughput same as single segment throughput.
- Individual LAN restrictions pose limits on number of nodes in same collision domain and on total allowed geographical coverage.



Each connected LAN referred to as LAN **segment**



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- Computer Networks, Fifth Edition: A Systems Approach (The Morgan Kaufmann Series in Networking).
- Computer Networks and Internets (5th Edition)
- Some slides by Dr. Tracy Bradley Maples