1. Interconnections

Frequently, there arises a need to link one local area network with another or to a wide area network. The linkage between two local area networks is commonly achieved using a bridge, whereas a router is typically employed for connecting a local area network to a wide area network.

Reasons for LAN Interconnections:

- To establish connections between distinct corporate divisions.
- To link two LANs employing different protocols.
- To enable a LAN to connect to the Internet.
- To segment a LAN into sections, mitigating traffic congestion.
- To create a security barrier between diverse user categories.
- To establish connectivity between WLAN and LAN.

2. Operations of bridges

- A bridge can be used to connect two similar LANs, such as two CSMA/CD LANs.
- A bridge can also be used to connect two closely similar LANs, such as a CSMA/CD LAN and a token ring LAN.
- The bridge examines the destination address in a frame and either forwards this frame onto the next LAN or does not.
- The bridge examines the source address in a frame and places this address in a routing table, to be used for future routing decisions.
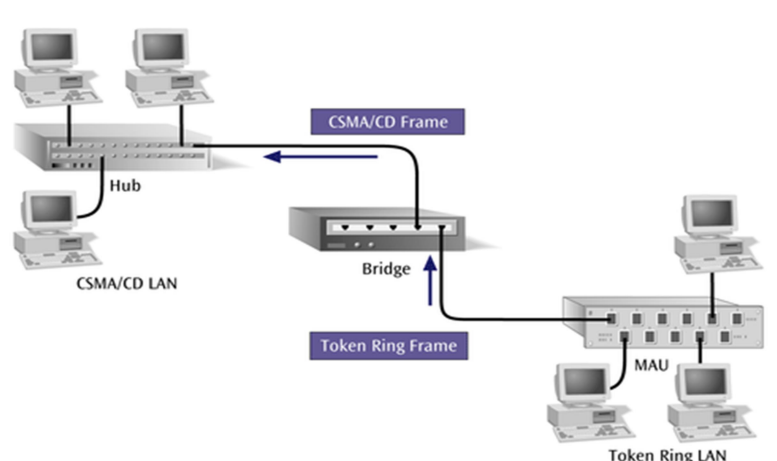

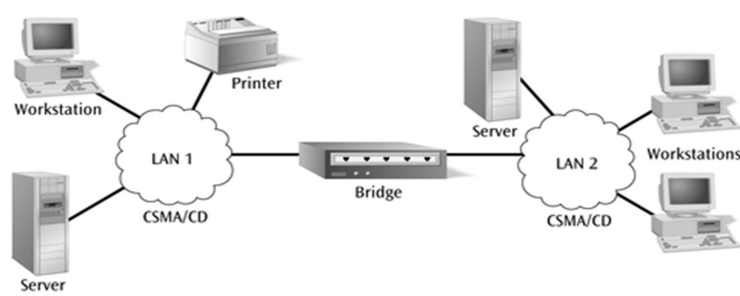**Figure 1.1**: A bridge interconnecting two dissimilar LANs

Figure 1.2: Bridge interconnecting two identical LANs

Transparent Bridges

- A transparent bridge does not need programming but observes all traffic and builds routing tables from this observation.
- This observation is called backward learning.
- Each bridge has two connections (ports) and there is a routing table associated with each port.
- A bridge observes each frame that arrives at a port, extracts the source address from the frame, and places that address in the port's routing table.
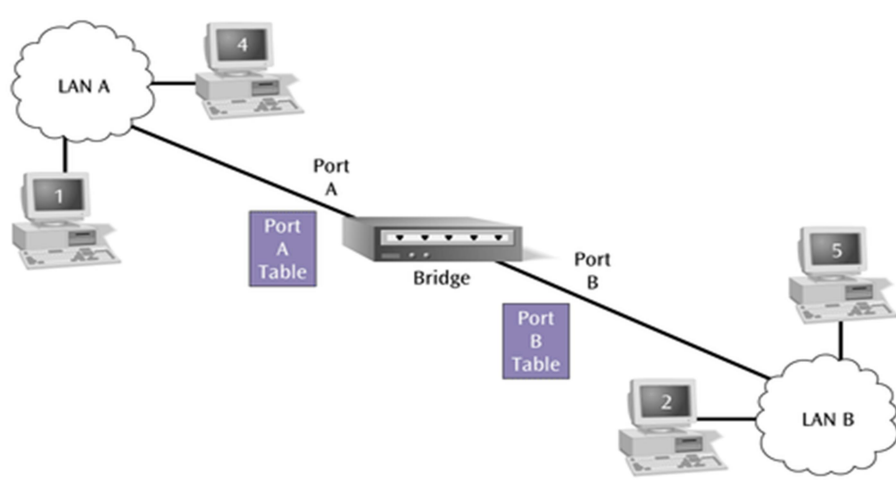- A transparent bridge is found with CSMA/CD LANs.

Figure 1.3: A bridge interconnecting two CSMA/CD networks has two internal port tables.
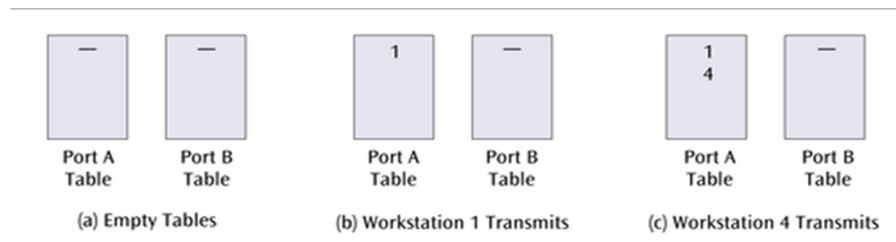
Figure 1.4: Two internal port tables and their entries

- A transparent bridge can also convert one frame format to another.
- Note that some people / manufacturers call a bridge such as this a gateway or sometimes a router.
- The bridge removes the headers and trailers from one frame format and inserts (encapsulates) the headers and trailers for the second frame format.
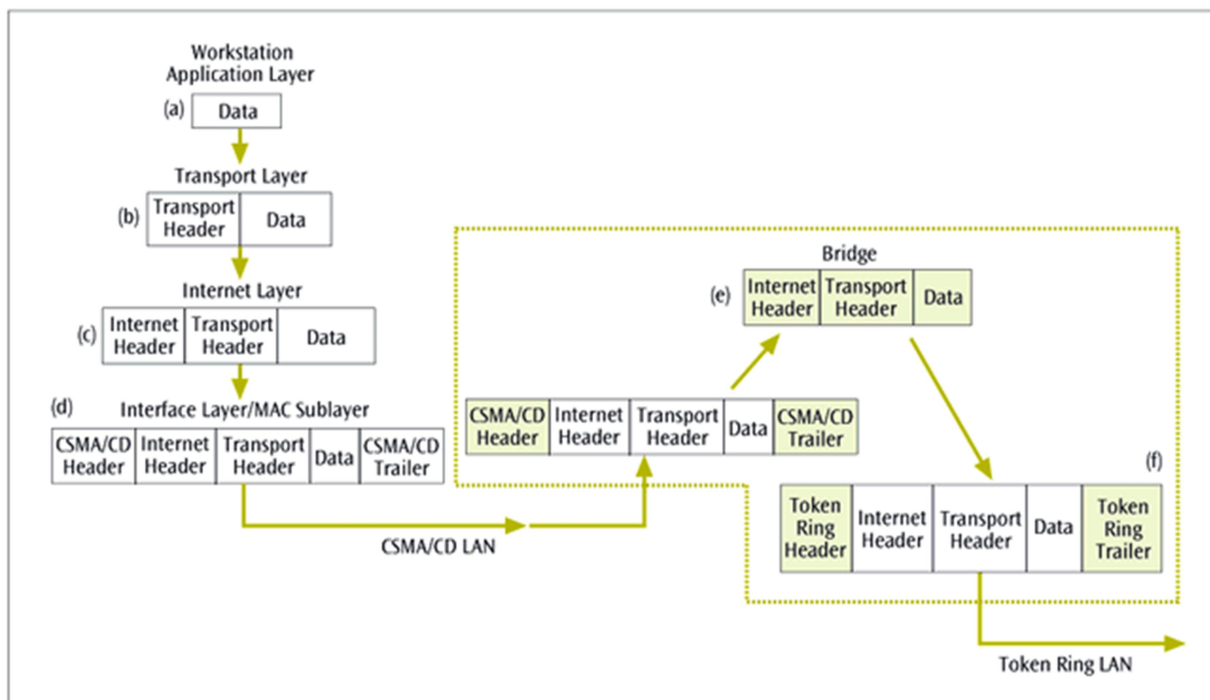

Figure 1.5: A data frames as it moves from a CSMA/CD LAN to a token ring LAN

Remote Bridges

- A remote bridge is capable of passing a data frame from one local area network to another when the two LANs are separated by a long distance and there is a wide area network connecting the two LANs.
- A remote bridge takes the frame before it leaves the first LAN and encapsulates the WAN headers and trailers.
- When the packet arrives at the destination remote bridge, that bridge removes the WAN headers and trailers leaving the original frame.
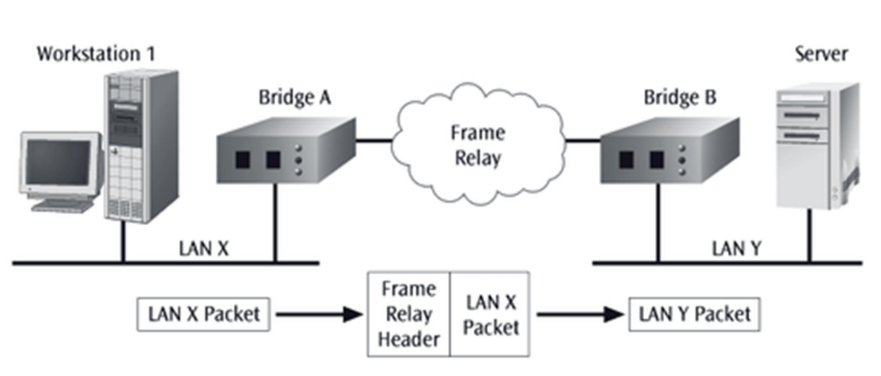

Figure 1.6: Two LANs with intervening frame relay network

3. Principle of switching in LANs

LAN stands for Local-area Network. It is a computer network that covers a relatively small area such as within a building or campus of up to a few kilometers in size. LANs are generally used to connect personal computers and workstations in company offices to share common resources, like printers, and exchange information.

LAN switching is a technology that promises to increase the efficiency of local area networks and solve the current bandwidth problems.
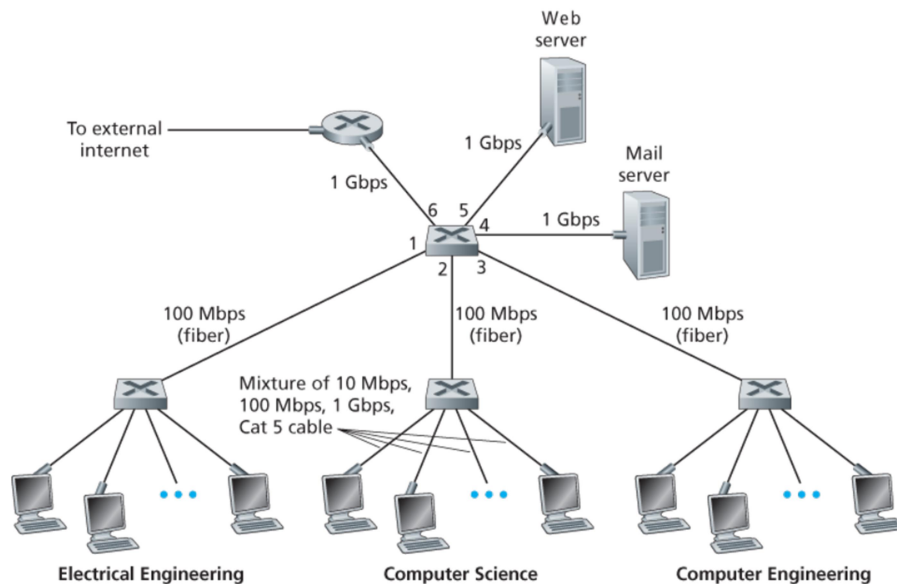
Figure 1.7: An institutional network connected together by four switches

In figure 1.7, we noted that modern institutional LANs are often configured hierarchically; with each workgroup (department) having its own switched LAN connected to the switched LANs of other groups via a switch hierarchy.

Advantages of LAN Switching:

- It can give rise to an increase in network scalability, which means that network can expand as the demand grows.
- Each network user can experience good and improved bandwidth performance.
- The setup of LAN is easy as compared to other switching techniques.

Disadvantages of LAN Switching:

- The cost of setting up a LAN network is quite high.
- Privacy violation is another disadvantage as one LAN user/administrator can check the personal files of every user present in that network.
- Since each one has the power to check other users data security is a major issue.
- LAN faces many problems mainly related to hardware problems and system failure. so a good cost of maintenance.
- Since all the computers are connected to the network a virus-infected to one of the computers may cause a spread to all the computers present in that network.

Applications of LAN Switching:

- A LAN could be used to connect printers, desktops, file servers, storage of arrays.
- LANs direct traffic between endpoints in a local area server.
4. **Switching techniques**

1) **FastForward (Cut-through)**: In this type of switching, the packet is forwarded as soon as the destination address is read. This has least latency.

2) **FragmentFree (Modified cut-through)**: This type of switching is useful when your network is experiencing large number of collisions. FragmentFree switching has a latency in between FastFoward and the Store-and -Forward.

3) **Store-and-Forward**: This method stores the entire frame and checks for errors before forwarding it on to another port. Store-and-forward has the highest latency compared with both FastForward and FragmentFree.
   The default switching method used by Catalyst 1900 series switches is FastForward.

4) **Store-and-Forward switching**: Here the LAN switch copies the entire frame into its buffers and computes the CRC. The frame is discarded if there are any CRC errors. Giant (more than 1518 bytes) and Runt (less than 64 bytes) frames are also dropped, if found.

5) **Cut-through switching**: In cut-through switching switch copies into its memory only the destination MAC address (first 6 bytes of the frame) of the frame before making a switching decision. A switch operating in cut-through switching mode reduces delay because the switch starts to forward the Ethernet frame as soon as it reads the destination MAC address and determines the outgoing switch port. Problem related with cut-through switching is that the switch may forward bad frames.

6) **Fragment-free (runtless switching)**: switching is an advanced form of cut-through switching. The switches operating in cut-through switching read only up to the destination MAC address field in the Ethernet frame before making a switching decision. The switches operating in fragment-free switching read at least 64 bytes of the Ethernet frame before switching it to avoid forwarding Ethernet runt frames (Ethernet frames smaller than 64 bytes).

Chapter 1- Test your knowledge

1. Why might you need to interconnect local area networks (LANs)?
2. What devices are commonly used to connect two LANs?
3. What are some reasons to use bridges for LAN interconnections?
4. What is the purpose of transparent bridges, and how do they build routing tables?
5. How do transparent bridges handle different frame formats, and what are they sometimes called?
6. What is the purpose of remote bridges, and when are they used?
7. What does LAN stand for, and what is its typical coverage area?
8. What is LAN switching, and what problem does it aim to solve?
9. How are modern institutional LANs often configured, and what is the purpose of this configuration?
10. What are some advantages of LAN switching?
11. What are some disadvantages of LAN switching?
12. What are some applications of LAN switching?
13. What are the three main switching techniques mentioned, and how do they differ in terms of latency and frame handling?
14. What is the default switching method used by Catalyst 1900 series switches?
15. What is the difference between Cut-through switching and Store-and-Forward switching in terms of frame handling?
16. What is Fragment-free (runtless switching), and how does it differ from Cut-through switching?