Lecture 10

ATM (Asynchronous Transfer Mode)
ATM is the name given to a connection-oriented networking technology that is intended for use in both local area and wide area networks. ATM is designed to permit high speed data switching; the fastest ATM hardware can switch data at gigabit speeds. ATM networks are more expensive than other technologies.

ATM networks use fixed size frames called cells, because each cell is exactly the same size, ATM switch hardware can process cells quickly.

Each ATM cell is only 53 octets long. The cell contains 5 octets of header followed by 48 octets of data.

Connection-oriented Networking
ATM is a packet switching network, but it differs from the definition of packet switching, because ATM provides connection-oriented service. Before a computer connected to an ATM switch can send cells, a connection must be established between the source and the destination through the ATM switch.

The requesting computer specifies the remote computer's address and waits for the ATM switch to find a path through the network and establish a connection. If the remote computer rejects the request or the ATM switch between the sender and receiver cannot establish a path, the request to establish communication fails.

Once a connection succeeds, the local ATM switch chooses an identifier for the connection, called as VCI (Virtual Circuit Identifier), and make an entry in its routing table, also passes the connection identifier to the computer along with a message that informs the computer of success. For further transfer of data, source specifies the VCI and not the destination address in cells.

When any of the computer finishes using a connection, either of them communicates with the ATM switch to request that the connection be broken. The switch then disconnects the two computers.

ATM LAN or LAN Emulation over ATM
ATM was developed to support the needs of user who want real-time data communication for multimedia applications, like streaming video or songs. So ATM network started sprouting. These ATM networks satisfied the user's appetite for higher data rate. But existing LANs need to be incorporated with these ATM networks. This incorporation of existing LANs with ATM is called as **LAN emulation over ATM**.

The possible types of ATM LANs are the following
  1. **Gateway to ATM WAN**: An ATM switch acts as a router and traffic concentrator for linking a premises local network to an ATM network.
  2. **Backbone ATM switch**: Either a single ATM switch or an interconnection of ATM switch connects multiple LAN, thus a network of ATM switch acts as the backbone.

3. **Workgroup ATM**: High-performance multimedia workstations and other end systems connect directly to an ATM switch.

In practice or practically speaking, a combination of these three types of network is used, below shows such a configuration of Backbone ATM switch.
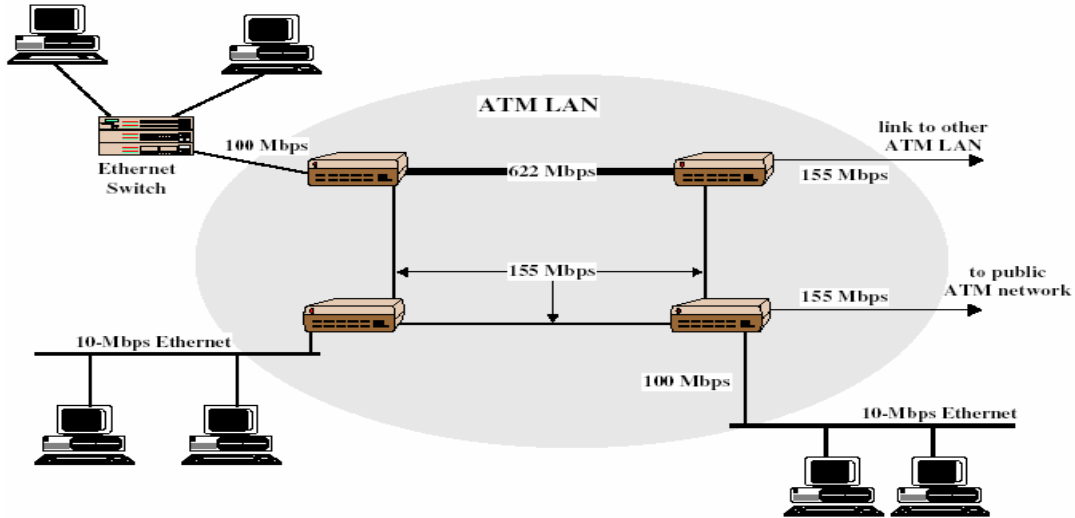
Above figure shows, how four different LANs are connected and a network of ATM switches is inserted in between which acts as the backbone for the four LANs. The disadvantage with the backbone configuration is that the end-systems remain attached to shared-media LANs with the limitations on data rate imposed by shared medium.

The solution is depicted in the figure below.
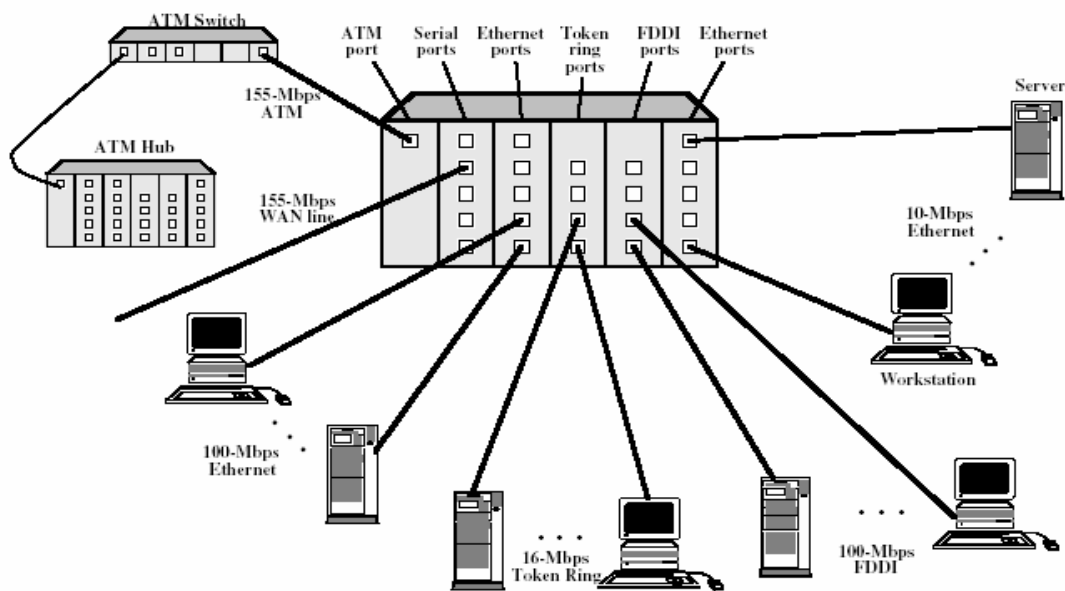
In the above figure individual end systems are attached directly to the ATM hub. Each end system has a point to point link to the hub.

But there is one thing which is actually a kind of disadvantage, and this disadvantage can be removed by imposing some overhead on the switch. There are three areas of compatibility to consider

1. Interaction between an end system on an ATM network and an end system on a legacy LAN.
2. Interaction between an end system on a legacy LAN and an end system on another legacy LAN of the same type.
3. Interaction between an end system on a legacy LAN and an end system on another different legacy LAN of a different type.

LAN Emulation in End Stations

When a standard Ethernet or Token Ring application on an end station wishes to send data frame to the network via the standard software interface, the frame contains destination MAC address which uniquely identifies the destination, and this information is sufficient for the network adapter to transmit the frame. When this standard application operates over the ATM network the following steps should be performed:

- For a specified MAC address the network adapter must determine whether a VCC to the destination in the ATM network is already established. For this purpose a table of mappings between MAC addresses and VCCs is maintained.
- If there is no VCC established then first the ATM address of the destination (which is different from the MAC address) is obtained via the address resolution process, and then a VCC to the destination is set up by the ATM network. This VCC is known as "Data Direct VCC". The mappings table is then updated.
- Once the station has established the Direct Data VCC the LANE header is appended to the frame, the frame is segmented into the 48-byte sized sells which are transmitted along the VCC.
- At the destination the sell stream is re-assembled and the original frame is re-created. The frame is then passed to the Ethernet or Token Ring application as if it LAN Emulation in Bridges and LAN Switches.

LAN Emulation in Bridges and LAN Switches

LAN Emulation is used in the intermediate systems like Bridges and LAN Switches to enable physical Ethernet or Token Ring segments to interconnect with each other and with end stations across the ATM network. These devices can be thought of as a special kind of an end station which represents a number of MAC addresses - the MAC addresses of the stations attached to the LAN segment. The Bridges and LAN Switches conceptually perform the actions of transferring the frames from one segment to the other according to the frame destination MAC address or the route information in the frame. When a physical LAN segment is to be connected to the ATM emulated LAN the Bridge with two interfaces - ATM emulation and Standard LAN Interface - is required. The Bridge then receives the frames from the physical LAN and applies standard logic to decide whether to forward the frame. If a frame is to be forwarded, then the mechanism of MAC address to VCC mapping is used and the further frame handling is identical to that described above for end stations.