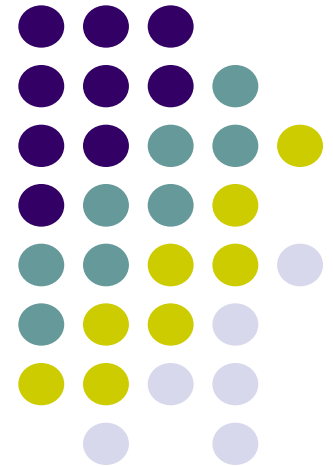


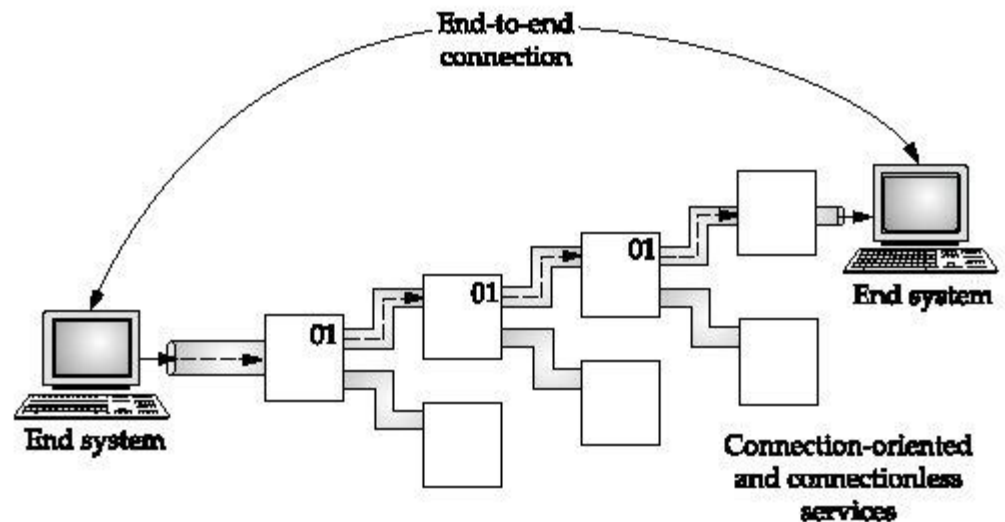
Service Paradigms (Connection-Oriented and Connectionless Services)





Connection-Oriented Service

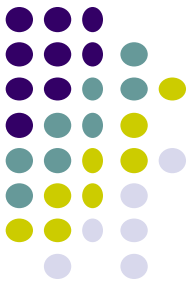
- Two distinct techniques (service paradigms) are used in data communications to transfer data: Connection-Oriented and Connectionless Services.
- **Connection-oriented Service** requires a session connection (analogous to a phone call) be established through the network before any data can be sent. One of computers requests a connection to the other, second must agree to accept the connection. After agreement, the underlying network hardware establishes a data path called a *connection*, and returns a *connection identifier* (binary value) to each two computers.
- This method is often called a **reliable network service**. It can guarantee that data will arrive in the same order. Connection-oriented services set up virtual links between end systems through a network.
- The packet on the left is assigned the virtual circuit number 01. As it moves through the network, routers quickly send it through virtual circuit 01.





Connectionless Service

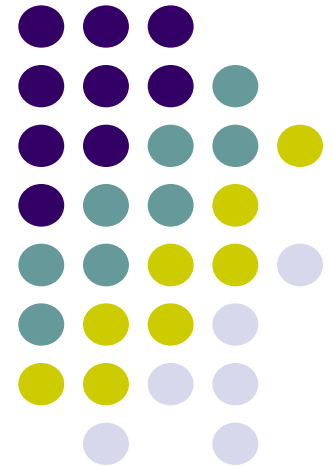
- Does not require a session connection between sender and receiver. The sender simply starts sending packets (called datagrams) to the destination.
- This service does not have the reliability of the connection-oriented method, but it is useful for periodic burst transfers. Neither system must maintain state information for the systems that they send transmission to or receive transmission from.
- A connectionless network provides minimal services.
- LANs operate as connectionless systems. A computer attached to a network can start transmitting frames as soon as it has access to the network. It does not need to set up a connection with the destination system ahead of time. However, a transport-level protocol such as TCP may set up a connection-oriented session when necessary.



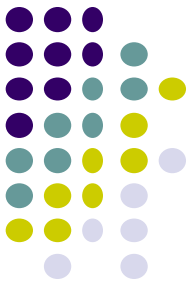
Example Usage of Services

- *The Internet* is one big connectionless packet network in which all packet deliveries are handled by IP. However, TCP adds connection-oriented services on top of IP. TCP provides all the upper-level connection-oriented session requirements to ensure that data is delivered properly.
- *MPLS* is a relatively new connection-oriented networking scheme for IP networks that sets up fast label-switched paths across routed networks.
- A WAN service that uses the connection-oriented model is *frame relay*. The service provider sets up PVCs (permanent virtual circuits) through the network as required or requested by the customer.
- *ATM* is another networking technology that uses the connection-oriented virtual circuit approach.

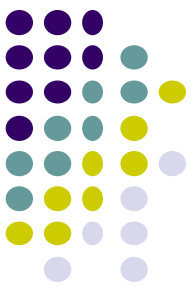
Asynchronous Transfer Mode (ATM)



Types of Networks Carrying Information

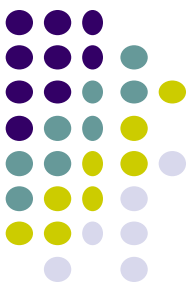


- Telephone
- TV
- Data



Single, Global Network

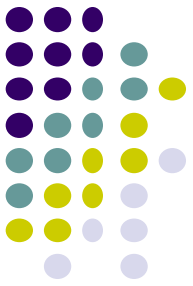
- Universal service: serve all subscribers around the world.
- Multi purpose, support for all uses: should offer subscribers voice, video and data services.
- Single, unified infrastructure: should not be formed from multiple technologies.
- Services guarantees: should perform with the same reliability and efficiency as existing networks.
- Support for low cost devices: should allow users to connect small, low cost devices such as ATM telephones.



ISDN

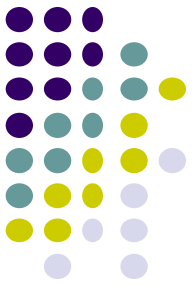
- One of the first attempts to satisfy the network goals was a system called Integrated Services Digital Network (ISDN).
- As the planning, standardization, development and deployment of ISDN proceed, data networking changed rapidly and dialup modem technology advanced.
- Relatively expensive.
- Asynchronous Transfer Mode (ATM) technology developed, handles much higher speeds and offers many more services.

ATM

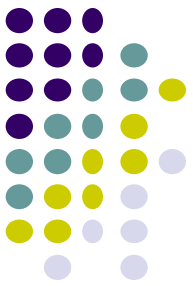


- Designed to carry voice, video and data
- Video and voice require low delay and jitter
- Video requires higher bandwidth
- Most data networks have jitter

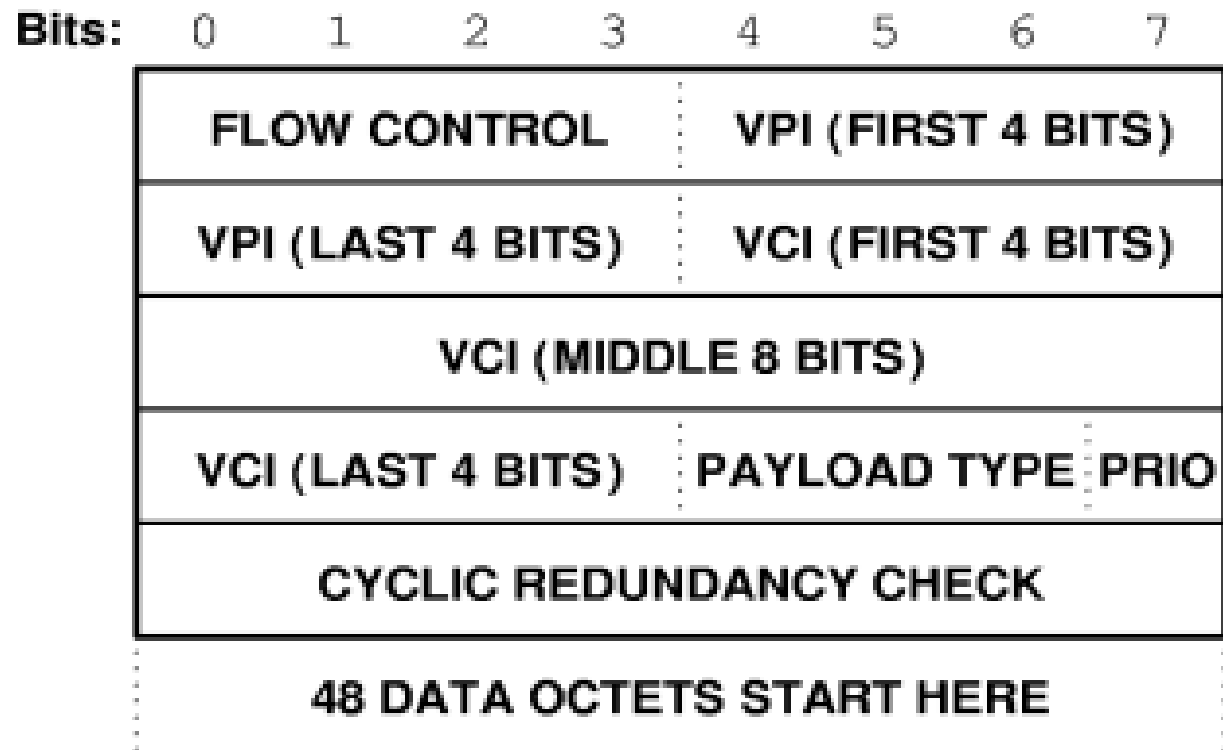
ATM



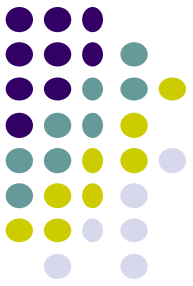
- Maximum throughput is obtained when packet size is large
- Audio transmission can not tolerate large packet sizes (delay, echo)



ATM FRAME HEADER



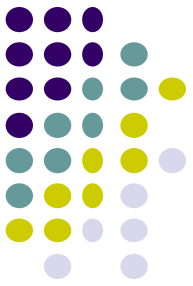
ATM



- ATM is criticized because of its small packet sizes in case of data transmission
- ATM is connection-oriented

VPI / VCI

- Virtual Path Identifier
- Virtual Channel Identifier

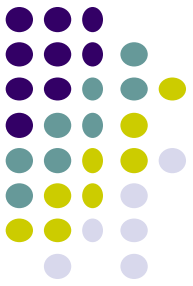




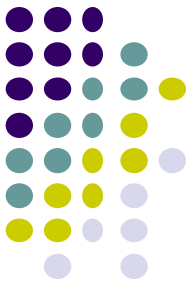
Label Switching

- ATM switch rewrites the connection identifier (VPI/VCI) in each cell it forwards.

ATM



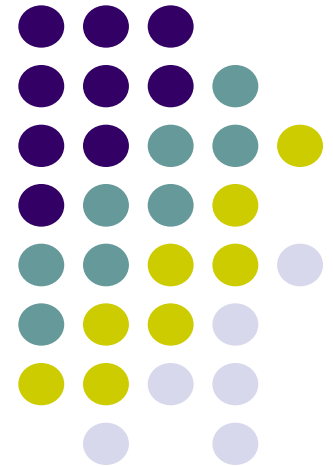
- Permanent Virtual Circuits (PVC): established as an option to provide a dedicated circuit link between two facilities
- Switched Virtual Circuits (SVC): generally set up on a per-call basis and are disconnected when the call is terminated



Quality of Service (QoS)

- Subscribers must specify their QoS requirements
- The QoS specifications must stay permanent during a connection
- CBR, VBR, ABR

Network Characteristics

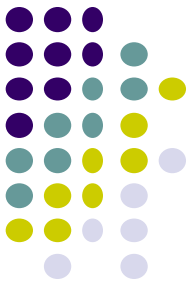




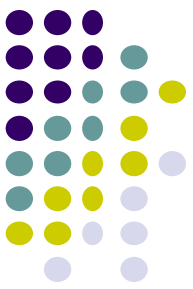
Network Ownership

- Public N/W: Owned and operated by a service provider similar to a telephone service. Any subscriber can use a public nw to communicate with any other subscriber.
- Private N/W: :Use of the network is restricted to the corporate or individual owner.
- VPN: Combines the advantages of private and public networks by allowing a company with multiple sites to have the illusion of a completely private network and to use a public network to carry between sites.
- Guaranteeing Absolute Privacy

Service Paradigm



- N/W systems offer a variety of services to attached computers.
 - Connection-oriented (CO) Service
 - Connectionless (CL) Service



Network Performance Characteristics

- Delay: How long it takes for a bit of data to travel across the network from one computer to another.
 - Propagation Delay: Signal requires a small amount of time to travel across a wire or optical fiber. PD is proportional to distance spanned.
 - Switching Delay: An electronic device waits until all bits of a packet have arrived, and takes a small amount of time to choose next hop to send packet.
 - Access Delay: Because of using a shared media, computers must delay until the medium is available.
 - Queuing Delay: If the queue already contains packets, the new packet may need to wait while CPU forwards the packets received earlier.
- Throughput: Measure of the rate at which data can be sent through the network, specified in *bits per second (bps)*. Throughput capability of the underlying hardware is called as bandwidth.
- Jitter: Represents the variance in delay.