

Connection-Oriented Networks: SONET/SDH, ATM, MPLS, and Optical Networks

Harry Perros

TOPICS

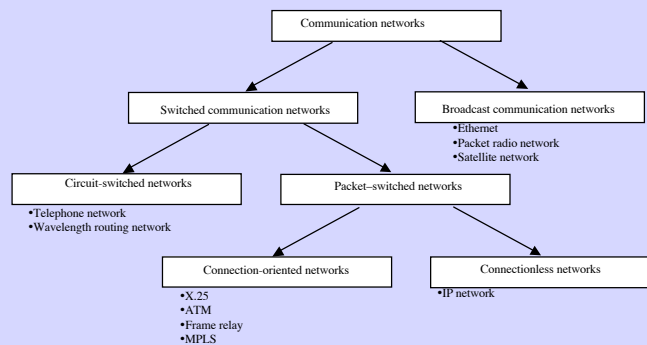
- *Chapter 1: Introduction*
- *Chapter 2: SONET/SDH*
- *Chapters 3, 4, 5: ATM networks*
- *Chapters 6 and 7: MPLS*
- *Chapters 8, 9, and 10: Optical networks*
- *Chapter 11: Access networks*
- *Chapter 12: Voice over ATM and MPLS.*

Chapter 1: Introduction

TOPICS

- Classification of communication systems
- What is a connection?
- Examples of connections

Classification of Communication Networks



Switched communication networks

– Circuit-switched networks:

- The telephone network
- Wavelength routing optical network.

– Packet-switched networks:

- IP network
- ATM
- Frame Relay
- MPLS networks

Broadcast communication networks

- Examples:
 - packet radio networks
 - satellite networks
 - multi-access Ethernet.

Packet-switched networks

- Connection-oriented networks
 - ATM
 - Frame Relay
 - MPLS
- Connectionless networks
 - IP

Circuit-switched networks

In order for two users to communicate a *circuit* or a *connection* has to be first established by the network. Specifically, the following three phases are involved:

- *circuit establishment,*
- *data transfer,*
- *circuit disconnect.*

Connection-oriented packet-switched networks

- Circuit switching is a good solution for voice, since it involves exchanging a relatively continuous flow of data.
- However, it is not a good solution for the transmission of *bursty* data

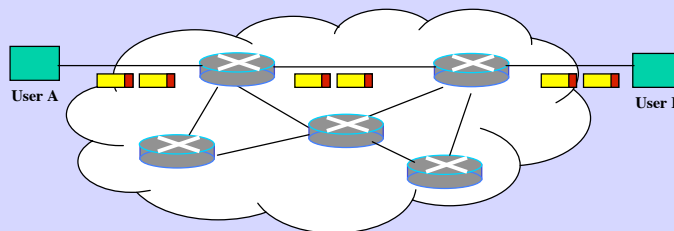
Connection-oriented packet-switched networks imitate circuit-switched network. In order for two users to communicate a *virtual circuit* or a *connection* has to be first established by the network. The following three phases are involved:

- *connection establishment,*
- *data transfer, and*
- *connection disconnect.*

Connectionless packet-switched networks

- In an IP network, a user can send packets to a destination without having to set up a connection first, i.e., without informing the network prior to transmitting them.
- This simplifies the network, as there is no need for a special signaling protocol.

Routing in IP



The routing of a packet through the network is done on a hop-per-hop basis based on the destination IP address carried in the IP packet's header.

Quality of Service (QoS) in IP

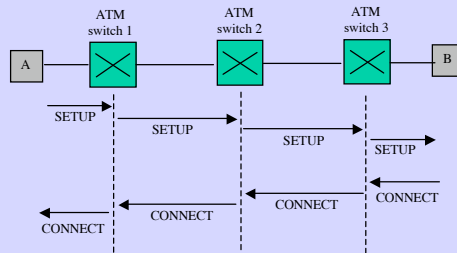
- Typically, an IP router does not offer QoS.
- It cannot distinguish packets belonging to different service classes based on their destination address.
- IP is almost ubiquitous. There has been a lot of interest in introducing QoS in the IP network, and MPLS seems to be the architecture of choice for introducing QoS.

Examples of connections

Probably the oldest connection-oriented circuit-switched network is the plain old telephone system (POTS).



An ATM connection



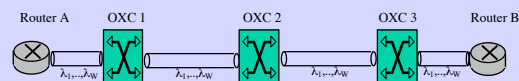
A bi-directional connection is established using signaling.
The connection is associated with an id number.

- The switching of a cell through an ATM switch is done based on its connection ID number.
- A connection is associated with a specific class of service.
- An ATM switch can distinguish cells belonging to different service classes, and serve them accordingly so that to provide them with the requested QoS.

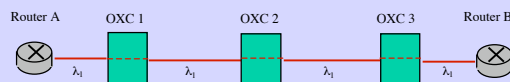
An MPLS connection

- The procedure is similar to ATM.
- An MPLS-enabled IP router switches IP packets not on a hop-by-hop basis using the packet's IP address. Rather, it forwards them using a label which identifies the connection that the packet has to follow.

A wavelength routing optical network connection



A three-node wavelength routing network



A lightpath

- An important feature of a wavelength routing optical network is that it is a circuit-switched network.
- A connection is an optical path through the optical network (called a lightpath) and it is established using a wavelength on each hop along the connection's path.

Standards Committees

- ITU-T
- ISO
- ANSI
- IEEE
- ATM Forum
- MPLS and Frame Relay Alliance
 - OIF