Module 2

Communication Switching

Lesson

4

Connectionless And Connection Oriented Packet Switching

LESSON OBJECTIVE

General

This lesson is intended to give the reader the understanding of two important modes of packet switching, namely, the connectionless and the connection oriented packet switching.

Specific

On completion of this lesson, the learner shall be able to

1. Differentiate between connectionless and connection oriented packet switching.
2. Understand the advantages and disadvantages of connectionless and connection oriented packet switching.
3. Perform a qualitative comparison of all the switching techniques.

2.3.1 INTRODUCTION

As explained earlier, packet switching was identified as the switching technique for computer networks. The long messages are broken into smaller optimally sized packets for transmission over network with a view to minimize the cost of communication. It is obvious from the previous lessons that circuit switching is rather costly because all the links and nodes from source to destination have to be simultaneously active and further, have to be reserved for a single communication session. But then, this cost is perhaps justified to some extent by the resulting Quality of service. This is true particularly for voice communication and long real time messages. In packet communication, the QoS is not guaranteed because some of the packets may get lost when the different packets of a single message travel through different links. Moreover there is a random delay in message transmission. The kind of packet switching which is being referred to is really connectionless packet switching where no connection is apriori decided for the packets. The packets move towards destination as and how they get forward links. Because of this lack of a defined connection between the source and the destination, this type of packet switching is called connectionless (CL). This switching is illustrated in Fig. L2.5. The packets 1, 2, 3 and 4 navigate from the source Pi to the

destination Po through different paths. The random loss of some packets and the random delay in arrival of the different packets at the destination cause degradation in QoS.

It is worth while to have a technique which is via media between the two extremes. In circuit switching the entire path is dedicated to the single communication for the whole duration whereas in CL packet switching (CLPS) no path is even selected. To take advantage of both the techniques it was suggested that let a path from source to destination be earmarked for a call but it should not be dedicated to the communicating users. The path can be shared by other users. What happens therefore is that all packets from a source to destination will travel the same chosen path as and when the links are free even though the entire path is not reserved. The packets would have to wait at the nodes till the forward link is available. Obviously all the packets will maintain their original sequence and the probability of packet loss would be loss. This switching is still packet switching but is connection oriented (CO). The CO packet switching (COPS) appears to be giving better QoS than the CL packet switching but does not give the QoS obtainable in circuit switching.

Thus in order to improve the QoS and still have better link utilization the concept of connection less and connection-oriented packet switching was developed. The conventional packet switching is connectionless where different packets of the same message travel through different paths to reach the destination in parallel. In fact every packet has the source-destination address and therefore finds its own path to the destination. Thus no connection is required to be set up before the communication takes place. On the other hand, in connection-oriented packet switching, when a call request comes the network determines the entire path from source to destination, but unlike circuit switching, the path is not simultaneously switched on. All the packets of the same message have to travel through the same path but then they may have to wait for random time when the outgoing links from a node are busy. In this scheme, the packet overhead is reduced because every packet need not be carrying the source-destination address. Rather they are assigned path numbers to maintain their identities. The COPS has therefore the features of both circuit switching and packet switching. The fixed path is the feature of circuit switching where as the ‘Store and Forward’ technique is the feature of packet switching. For very long messages the COPS is a preferred mode over CLPS.

2.3.2 CONNECTIONLESS PACKET SWITCHING

Packet switching was originally designed so that the individual packets of a single message can follow any available path improving the link utilization. Packets arrive at an intermediate node randomly and they are transmitted over any available outgoing free link. This technique is known as **Connectionless Packet switching** because no connection is established between the sender and the receiver.

Disadvantages of connectionless packet switching:

1. Extra processing power is required at the nodes for attaching source and destination addresses with every packet which also increases the required time of transmission.
2. Connectionless Packet switching requires overhead bits for indexing/numbering the packets.
3. Packets may arrive at the destination in a random manner. This requires that all the arriving packets are stored and rearranged.
4. Some packets may be lost in the network.

CAN WE RID PACKET SWITCHING OF ITS DRAWBACKS WHILE MAINTAINING ITS ADVANTAGES THUS MAKING IT MORE USEFUL ?

We know that in normal circuit switching, the two basic aspects or steps to be followed are:

1. Decide the path
2. Dedicate the path

A similar approach is adopted in packet switching to make it efficient. Only the first step is chosen and the second is left out.

Thus to get the best of both worlds

1. Decide the path.
2. **Do not** dedicate the path.
3. **Fragment the message into packets.**
4. Use store and forward mechanism at the nodes.

These four steps are followed to send the four packets 1, 2, 3 and 4 from the source Xi to the destination Xo through the same dotted path A2, B3, C1, D3 and E4 as illustrated in Fig. L2.5.

CONSIDER THE FOLLOWING SITUATION:

A SOURCE DESTINATION PAIR IS SHOWN IN FIG. L 4.1. FOR A PARTICULAR SESSION, A SINGLE PATH IS FOLLOWED FOR TRANSMITTING ALL THE PACKETS. IN ANOTHER SESSION, ANOTHER PATH MAY BE FOLLOWED. AS CAN BE SEEN IN THE FIGURE, THE RED LINE IS THE CHOSEN PATH FOR A SESSION BETWEEN S AND D. ALL THE PACKETS ARE TRANSMITTED OVER THIS PATH. THIS TECHNIQUE RESULTS IN A SITUATION WHERE REARRANGEMENT OF PACKETS IS NOT REQUIRED, AS ALL THE PACKETS ARRIVE SEQUENTIALLY. IN FACT USING THIS TECHNIQUE IT IS POSSIBLE TO REDUCE EVEN THE ADDRESSING INFORMATION BITS REQUI

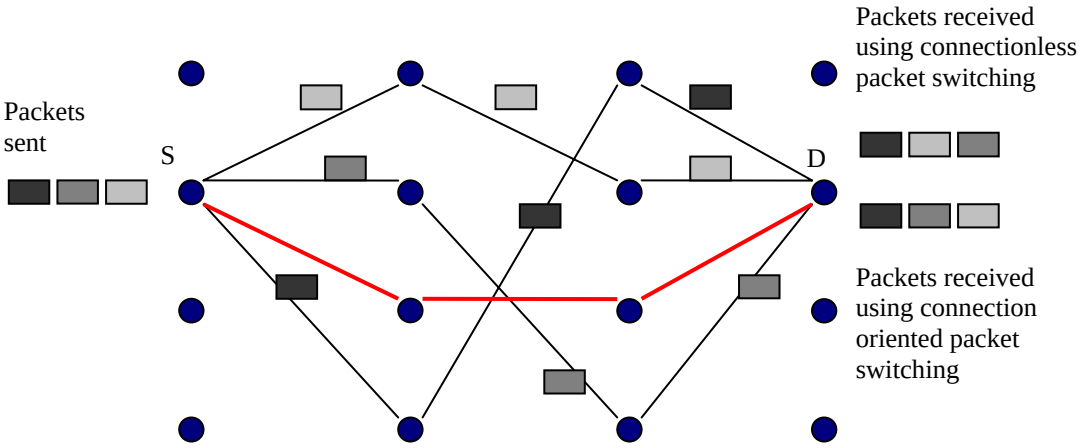

Fig. L 4.1 Connectionless and connection oriented packet switching

2.3.3 CONNECTION ORIENTED PACKET SWITCHING

As explained earlier a via media between the CL packet switching and the circuit switching would be desirable so that major disadvantage of each is taken care. The connection oriented (CO) packet switching was conceived to overcome the problems of packet loss and out of turn arrival of the packets faced in the CLPS and the problem of reserving and dedicating the full circuit to a single connection as done in circuit switching. In the

COPS, the individual packets don't travel through the network though different paths but all the packets for particular source destination pair take the same pre-selected path that is the selected connection. In a given network, there are a number of possible paths between a source and destination pair. This network may be serving a large number of users. With the possibility of any user communicating with any other user, the possible number of user source destination pair would be fairly large in fact certainly much larger than the possible number of paths. In COPS an available path is selected for the requested call and is assigned a distinct number which is then used by every packet of the call. Obviously then the source destination addresses are not required to be carried by every packet to reach the proper destination. The path number or the path address is good enough to direct the packets to the desired destination. Since the number of paths is smaller than the number of communicating user pairs, the number of bits required for addressing the path is much smaller. This reduces the packet overhead and results in saving of transmission time therefore increasing the speed/data rate. When a source has some data to transmit to a destination, it requests for a path. Now based on the source-destination (S-D) pair ID a path ID is allocated to the S-D pair for the particular session. So number of bits required for addressing is reduced. This technique is called Connection-Oriented Packet Switching (COPS). It is also known as virtual switching because the circuit is not real and dedicated to a user pair. The packets hop from node to node since there is no continuous path switched on. The CLPS has been very popular for the Internet using the Internet Protocol (IP) even though it gives the least QoS amongst the three switching techniques discussed. In fact, voice and even other communication services are likely to use the IP based on the CLPS. Efforts are on to improve QoS in CLPS to serve real time communication requirements better. For large volume of traffic between a source destination pair the COPS is certainly better than the CLPS. Circuit witching no doubt is the best in terms of QoS.

2.3.4 CONCLUDING REMARKS

Each of the different switching techniques has some merits and some drawbacks. The choice of a particular technique depends on the application. Some of the points which govern the choice are : type of traffic – real/non-real time, bursty or continuous, interactive or non-interactive; legacy, existing infra structure, technology, cost, interoperability; the QoS

parameters : throughput, delay, delay-jitter, band width required, information loss/error connection time etc.

Propagation delay through the transmission media is always there for all the switching types. But there is another delay which is called the **Processing delay**. This delay arises at the nodes generally and is different in different switching methods. In circuit switching there is an initial delay in setting up the path. In packet switching the delay is due to processes like packetization/fragmentation, addressing sequencing, reassembly and so on. In addition there is a storage delay which is caused due to non availability of onward link at a node due to congestion. The process of storage of information at the nodes is really responsible for both the advantage as well as the disadvantage of packet switching.
A general conclusion can be that the attraction of packet switching is in its ability to utilize the lines better and to support heterogeneous variable rate traffic. The circuit switching gives the best reliability.

☞ *Popular traditional applications of the different switching schemes are summarized below:*

Switching Type	Application	Traffic
Circuit switching	Telephones	Real time Interactive
Message switching	Telegraph	Non-real time Text
Packet switching Connectionless Connection Oriented	Computer Networks/Multimedia Network	Bursty traffic-email Heavy Traffic

☞ *Internet employs CLPS. This is the reason why e-mail costs much less than the telephone. Also Internet is a free network i.e. nobody controls it. For conventional telephony, circuit switching with great amount of administrative control is used.*

☞ *In message and packet switching the switches are soft, as the data has to be stored first and then read out to outgoing path.*

Objective Questions

4.01 *Video / e-mail / file transfer / trivial file transfer* require connection-oriented service. True/False.

Subjective Questions

4.11 Give a quantitative and qualitative comparison of circuit, message, connectionless and connection oriented packet switching.

4.12 Suggest what kinds of switching would you employ for different loads of traffic such as light, moderate, heavy.

4.13 Differentiate Connection Oriented and Connectionless packet Switching.

4.14 Give an example of a Connection oriented Packet switched network.

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