DESIGN ISSUES FOR THE NETWORK LAYER AND CIRCUIT SWITCHING

Design issues for the network layer.

The network layer has been designed with the following goals:

1. The services provided should be independent of the underlying technology. Users of the service need not be aware of the physical implementation of the network - for all they know, they're messages could be transported via carrier pigeon! This design goal has great importance when we consider the great variety of networks in operation. In the area of Public networks, networks in underdeveloped countries are nowhere near the technological prowess of those in the countries like the US or Ireland. The design of the layer must not disable us from connecting to networks of different technologies.
2. The transport layer (that is the host computer) should be shielded from the number, type and different topologies of the subnets he uses. That is, all the transport layer want is a communication link, it need not know how that link is made.
3. Finally, there is a need for some uniform addressing scheme for network addresses.

With these goals in mind, two different types of service emerged: Connection oriented and connectionless. A connection-oriented service is one in which the user is given a "reliable" end to end connection. To communicate, the user requests a connection, then uses the connection to his hearts content, and then closes the connection. A telephone call is the classic example of a connection oriented service.

In a connection-less service, the user simply bundles his information together, puts an address on it, and then sends it off, in the hope that it will reach its destination. There is no guarantee that the bundle will arrive. So - a connection less service is one reminiscent of the postal system. A letter is sent, that is, put in the post box. It is then in the "postal network" where it gets bounced around and hopefully will leave the network in the correct place, that is, in the addressee's letter box. We can never be totally sure that the letter will arrive, but we know that there is a high probability that it will, and so we place our trust in the postal network.

Now, the question was - which service would the network layer provide, a connection-oriented or a connectionless one?

With a connection oriented service, the user must pay for the length (ie the duration) of his connection. Usually this will involve a fixed start up fee. Now, if the user intends to send a constant stream of data down the line, this is great - he is given a reliable service for as long as he wants. However, say the user wished to send only a packet or two of data - now the cost of setting up the connection greatly overpowers the cost of sending that one packet. Consider also the case where the user wishes to send a packet once every 3 minutes. In a connection-oriented service, the line will thus be idle for the majority of the time, thus wasting bandwidth. So, connection-oriented services seem to be useful only when the user wishes to send a constant stream of data.

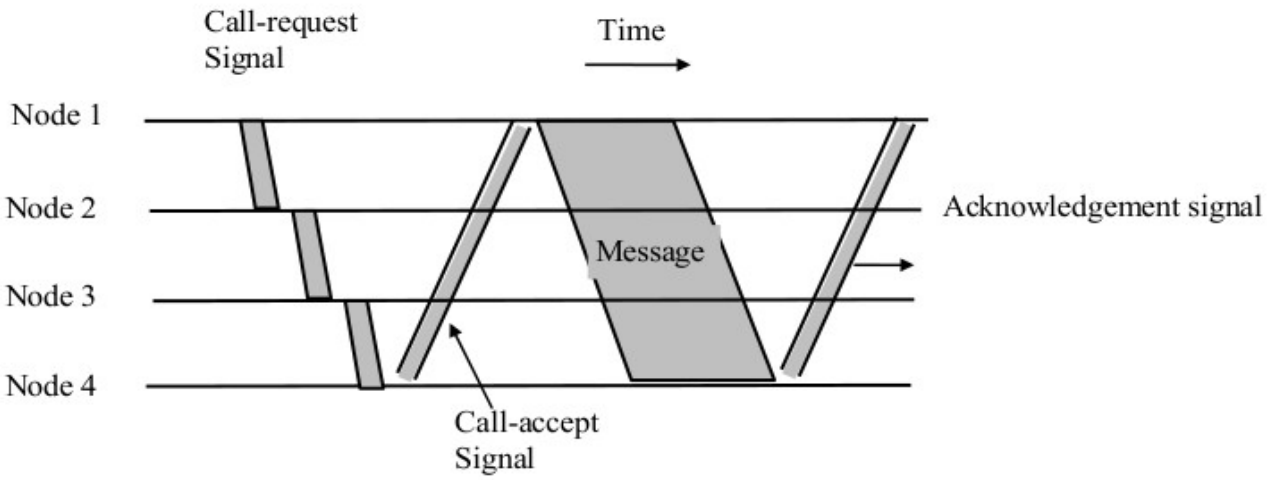
One would therefore think that the reliable nature of the connection oriented service would prompt people to choose it over the connectionless service - this is in fact not the case. One can never ensure that the network is 100% reliable, in fact for many applications we must assume that the network is not reliable at all. With this in mind, many applications perform their own error detection, flow and congestion control at a higher level in the protocol stack, that is, on their own machine, in the transport layer. So, if the sender and the receiver are going to engage in their own control mechanisms, why put this functionality into the network layer? This is the argument for the connectionless service: the network layer should provide a raw means of sending packets from a to b, and that is all. Proponents of this argument are quick to point out that the standard of our networks has increased greatly in the past years, that packets of information rarely ever do get lost, so much of the correction facilities in the network layer are redundant and serve only to complicate the layer and slow down transfer.

Its interesting to note here that it is easy to provide a connection oriented service over an inherently connectionless service, so in fact defining the service of the network layer as connectionless is the general solution. However, at the time of defining the network layer, the controversy between the two camps was (and still is) unresolved, and so instead of deciding on one service, the ISO allowed both.

Circuit Switching:

A dedicated path between the source node and the destination node is set up for the duration of communication session to transfer data. That path is a connected sequence of links between network nodes. On each physical link, a logical channel is dedicated to the connection. Communication via circuit switching involves three phases,

1. **Circuit Establishment:** Before any signals can be transmitted, an end-to-end (station-to-station) circuit must be established .
2. **Data Transfer:** The data may be analog or digital, depending on the nature of the network
3. **Circuit Disconnect:**After some period of data transfer, the connection is terminated, usually by the action of one of the two stations



Examples: PSTN, PBX etc.
circuit switching telecommunication networks was originally designed to handle voice traffic, and the majority of the traffic on these networks continues to be voice. A key characteristics of the circuit switching is that resources within the network are dedicated to a particular call. For voice communication the resulting circuit will enjoy the high percentage of utilization because most of the time one party or the other is talking.
However, as the circuit-switching network began to be used increasingly for data connections, two shortcomings became apparent:

1. In a typical userlhost data connection (e.g., personal computer user logged on to a database server), much of the time the line is idle. Thus, with data connections, a circuit-switching approach is inefficient.
2. In a circuit-switching network, the connection provides for transmission at constant data rate. Thus, each of the two devices that are connected must transmit and receive at the same data rate as the other; this limits the utility of the network in interconnecting a variety of host computers and terminals.