1   Circuit Switching

The first attempts at communications used a physical wire between the two end points. The signal, in the form of electricity, would travel over the wire. Having a wire from every person to ever other person is impractical—there needs to be some switching station to establish the circuit between any two end points.

Early telephone system had a wire from the telephone to the switching station, with physical human operators. A user would pickup the phone, and tells the operator to which other user they'd like to be connected, and the operator would then physically (via a wire) close the circuit between the two end points.

Eventually, this switching became an automated process. A person would 'dial' a number, which would instruct a mechanical device to close the circuit between source and destination. Once established, there would be a physical copper link between the end points.

With the invention of transistors it became practical to do switching electronically (as opposed to mechanically). It then became practical to emulate circuit switching with a packet switching network.

Unlike with packet switched networks, we cannot just send a 'packet' to the destination. We need to establish and later terminate the connection.

We need to have some way of transmitting control information, we can either do this in band (in the same channel we use for data) or out of band (on a separate dedicated channel). Phone networks used in band signaling a while ago (you could control switching and other functionality by playing tones into the telephone). Today in band signaling is considered unsecure and is not used except for compatibility with old systems.

2   Packet Switching

Once computer networks became more common, it became evident that switching packets is much simpler than dealing with circuits, especially for many users that don't always occupy their channels.

There are two ways of doing packet switching. One can emulate circuits: upon the initial connection, the packets establish a 'path'—which every packet for that connection will follow. Another approach is to have each packet follow its own path.

The users of the packet switched network can see the network as either a packet switched network or as a virtual circuit. In packet switched networks, users communicate by sending packets to each other. In a virtual circuit, users establish a connection (which is done via packets), and then transmit data at a certain rate. The packet switched network ensures that the data gets to where it is going at the needed rate.

A few packet switching schemes were developed, X.25, Frame Relay, ATM, each one being more efficient. X.25 is an early attempt at doing virtual circuits, with due to media unreliability required a lot of overhead. Frame Relay eliminates some of the control information. ATM does essentially the same—very little control information, with fixed size data units. The main theme is that as physical hardware becomes more robust, less and less is needed on the protocol side to keep track of things that may go wrong.