***Circuit and Packet Switching***

***Circuit***

In this networking method, a connection called a *circuit* is set up between two devices, which is used for the whole communication. Information about the nature of the circuit is maintained by the network. The circuit may either be a fixed one that is always present, or it may be a circuit that is created on an as-needed basis. Even if many potential paths through intermediate devices may exist between the two devices communicating, only one will be used for any given dialog.

**What is Circuit Switching?**

*Circuit switching* is defined as a mechanism applied in telecommunications (mainly in PSTN) whereby the user is allocated the full use of the communication channel for the duration of the call.

That is if two parties wish to communicate, the calling party has to first dial the numbers of the called party. Once those numbers are dialed, the originating exchange will find a path to the terminating exchange, which will in turn find the called party.

After the circuit or channel has been set up, then communication will take place, then once they are through the channel will be cleared. This mechanism is referred to as being connectionoriented.

***Advantages of Circuit Switching:***

* Once the circuit has been set up, communication is fast and without error.
*  It is highly reliable

***Disadvantages:***

* Involves a lot of overhead, during channel set up.
* Wastes a lot of bandwidth, especial in speech whereby a user is sometimes listening, and not talking.
* Channel set up may take longer.

To overcome the disadvantages of circuit switching, packet switching was introduced, and instead of dedicating a channel to only two parties for the duration of the call it routes packets individually as they are available. This mechanism is referred to as being connectionless.

In a circuit-switched network, before communication can occur between two devices, a circuit is established between them. This is shown as a thick blue line for the conduit of data from Device *A* to Device *B*, and a matching purple line from *B* back to *A*. Once set up, all communication between these devices takes place over this circuit, even though there are other possible ways that data could conceivably be passed over the network of devices between them.

The classic example of a circuit-switched network is the telephone system. When you call someone and they answer, you establish a circuit connection and can pass data between you, in a steady stream if desired. That circuit functions the same way regardless of how many intermediate devices are used to carry your voice. You use it for as long as you need it, and then terminate the circuit. The next time you call, you get a new circuit, which may (probably will) use different hardware than the first circuit did, depending on what's available at that time in the network.

# Circuit Switching vs. Packet Switching

The old telephone system (PSTN) uses circuit switching to transmit voice data whereas VoIP uses packet-switching to do so. The difference in the way these two types of switching work is the thing that made VoIP so different and successful.

To understand switching, you need to realize that the network in place between two communicating persons is a complex field of devices and machines, especially if the network is the Internet. Consider a person in Mauritius having a phone conversation with another person on the other side of the globe, say in the US. There are a large number of routers, switches and other kinds of devices that take the data transmitted during the communication from one end to the other.

# Switching and routing

Switching and routing are technically two different things, but for the sake of simplicity, let us take switches and routers (which are devices that make switching and routing respectively) as devices doing one job: make a link in the connection and forward data from the source to the destination.

# Paths or circuits

The important thing to look for in transmitting information over such a complex network is the **path** or circuit. The devices making up the path are called nodes. For instance, switches, routers and some other network devices, are nodes.

In **circuit-switching**, this path is decided upon before the data transmission starts. The system decides on which route to follow, based on a resource-optimizing algorithm, and transmission goes according to the path. For the whole length of the communication session between the two communicating bodies, the route is dedicated and exclusive, and released only when the session terminates.

# Packets

To be able to understand packet-switching, you need to know what a [packet](http://voip.about.com/od/glossary/g/PacketDef.htm) is. The Internet Protocol (IP), just like many other protocols, breaks data into chunks and wraps the chunks into structures called packets. Each packet contains, along with the data load, information about the IP address of the source and the destination nodes, sequence numbers and some other control information. A packet can also be called a segment or datagram.

# Packet switching

*Packet switching* is the dividing of messages into *packets* before they are sent, transmitting each packet individually, and then reassembling them into the original message once all of them have arrived at the intended destination.

Packets are the fundamental unit of information transport in all modern computer networks, and increasingly in other communications networks as well. Each packet, which can be of fixed or variable size depending on the protocol, consists of a *header*, body (also called a *payload*) and a *trailer*. The body contains a segment of the message being transmitted.

The header contains a set of instructions regarding the packet's data, including the sender's [IP address,](http://www.linfo.org/ip_address.html) the intended receiver's IP address, the number of packets into which the message has been divided, the identification number of the particular packet, the protocol (on networks that carry multiple types of information, such as the Internet), packet length (on networks that have variable length packets) and synchronization (several bits that help the packet match up to the network).

Packets are *switched* to various network segments by *routers* located at various points throughout the network. Routers are specialized computers that forward packets through the *best* paths, as determined by the routing algorithm being used on the network, to the destinations indicated by destination IP addresses in the packet headers. During transport from one host to another, packets may be routed out of order and across a variety of paths to get to the desired end point.

This contrasts with *circuit switching*, in which a dedicated, but temporary, circuit is established for the duration of the transmission of each message. The most familiar circuit-switching network is the telephone system when used for voice communications. Circuit-switching is ideal when data must be transmitted quickly and must arrive in the same order in which it is sent, as is the case with most real-time data, such as live audio and video.

Packet switching is used to optimize the use of the bandwidth available in a network, to minimize the transmission *latency* (i.e. the time it takes for data to pass across the network) and to increase robustness of communication. It is more efficient and robust for data that can withstand some delays in transmission, such as web pages and e-mail messages.

Most modern data communications protocols, including TCP/IP, X.25 and frame relay, are based on packet switching technologies. Moreover, packet switching is increasingly being used for voice communications as well, such as with VoIP (voice over Internet protocol), GPRS (general packet radio service) and i-mode.

Once they reach their destination, the packets are reassembled to make up the original data again. It is therefore obvious that, to transmit data in packets, it has to be digital data.

In **packet-switching**, the packets are sent towards the destination irrespective of each other. Each packet has to find its own route to the destination. There is no predetermined path; the decision as to which node to hop to in the next step is taken only when a node is reached. Each packet finds its way using the information it carries, such as the source and destination IP addresses.

As you must have figured it out already, traditional PSTN phone system uses circuit switching while VoIP uses packet switching.

# Brief comparison

* Circuit switching is old and expensive, and it is what PSTN uses. Packet switching is more modern.
* When you are making a PSTN call, you are actually renting the lines, with all it implies. See why international calls are expensive? So if you speak for, say 10 minutes, you pay for ten minutes of dedicated line. You normally speak only when your correspondent is silent, and vice versa. Taking also into consideration the amount of time no one speaks, you finally use much less than half of what you are paying for. With VoIP, you actually can use a network or circuit even if there are other people using it at the same time. There is no circuit dedication. The cost is shared.
* Circuit-switching is more reliable than packet-switching. When you have a circuit dedicated for a session, you are sure to get all information across. When you use a circuit which is open for other services, then there is a big possibility of congestion (which is for a network what a traffic jam is for the road), and hence the delays or even packet loss. This explains the relatively lower quality of VoIP voice compared to PSTN. But you actually have other protocols giving a helping hand in making packetswitching techniques to make connections more reliable. An example is the TCP protocol. Since voice is to some extent tolerant to some packet loss (unless text - since a comma lost can mean a big difference), packet-switching is finally ideal for VoIP.