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Wired Versus Wireless: A Review

Narinder Singh[1] and Rekha Kalra[2]

[1,2]Dept of Computer Science Guru Nanak College Budhlada
E-mail: [1]ns_kalra@yahoo.co.in, [2]rekha_nskalra@yahoo.co.in

Abstract—*The communication system whether it is wired or wireless has a common purpose to exchange the information between the sender and the receiver. A numerous changes have been recorded in the field of communication. With the advancement in technology, inventions of sophisticated electronic components and because of its great need the communication industry become the focus of engineers. The main aim of this paper is to show the evolution of communication system from its beginning to the present age and merits and demerits of various wired and wireless technologies.*

1. INTRODUCTION

The word communication contains common and that means common information about facts, sensations, actions etc. Usually there is an interchange of information. For that purpose the communication partners change their roles and there is therefore a form of dialogue between them [1].

Our definition includes the special case of one-sided communication (monologue). One example for one-sided information is television broadcasting, but in this case there is no interchange and thus it sometimes might be useful to restrict the term communication on dialogues or the communication between more than two persons [1].

If people communicate directly, it is referred to as face-to-face communication. This is, without any doubt, the richest and most complex form of communication because it is based not only on speech and hearing but includes gestures, touches, smell etc. But face-to-face communication is much more than these components. It generates multiple synergies and gives a feeling of presence that also exists when the persons have sensory defects (e.g. hard of hearing, blindness) [1].

The communication system means to exchange the information between the transmitter (also called as source) and receiver (also called as destination) through the channel. The transmitter and receiver may be very close to each other or may be separated by significant distance. The channel between the transmitter and receiver may a wired or wireless, the only aim is to transfer the information in such a way that it received at the receiver in the same spirit as it transmitted.

1.1 Classification of Communication system

1.1.1 As per the type of data transmission

a. Simplex communication system
b. Half duplex communication system
c. Full duplex communication system

1.1.1.1 Simplex communication system

The communication systems that can transmit the data only in one direction are called as simplex communication system for example the radio relay station. These are also called as unidirectional communication system.

1.1.1.2 Half duplex communication system

The communication systems that can transmit the data in both the directions but at a time only in one direction are called as half duplex communication system for example the walki-talky systems. These are also called as bidirectional communication system.

1.1.1.3 Full duplex communication system

A duplex communication system is a system composed of two connected parties or devices which can communicate with one another in both directions at a same time. Duplex systems are employed in nearly all communications networks, either to allow for a communication "two-way street" between two connected parties or to provide a "reverse path" for the monitoring and remote adjustment of equipment in the field. These are also the bidirectional communication system [2].

1.1.2 Depending upon the type of data

a. Analog communication system
b. Digital communication system
c. Hybrid communication system

1.1.2.1 Analog communication system

If the data which is going to be transmitted is analog in nature and the analog data is transmitted with analog modulation schemes (amplitude modulation, frequency modulation, phase modulation etc.) Then those systems are called as analog communication system.

1.1.2.2 Digital communication system

When the data is digital in nature and digital modulation techniques (Pulse code modulation, delta modulation etc.) are used to transmit the data then that systems are called as digital communication system.

1.1.2.3 Hybrid communication system

If the data is in analog form but due to the advantages of digital format, it is converted into digital shapes before transmission and then transmitted by using the digital modulation techniques and at receiver side after demodulation again reconverted into analog form that are called as hybrid communication systems.

This project is organized in such a way that Section 1 consist of introduction of general communication systems and its various categories on the basis of data and mode of communication. Section 2 is focused upon the different wired communication systems. Section 3 describes the Wireless communication systems. Section 4 discussed the history of Wire and Wireless Communication. Section 5 gives the comparison of wired and wireless communication system and Section 6 presents the conclusion.

2. WIRED COMMUNICATION SYSTEMS

Wired Communication refers to the transmission of data over a wire-based communication technology. If the channel present between the transmitter and receiver is a guided medium then the systems are called as wired communication systems and depending upon the types of medium these can be categorized as: Cable system, Optical communication system, Microwave communication system etc. Wired systems are more reliable and secure [in the sense of being more private].

Currently the three main types of wired communication are:

1. Wired telephone
2. Cable TV
3. Wired computer networks

2.1 Wired Telephone

The wired telephone made tremendous advances before the advent of the integrated circuit. Communication engineers developed the analog telephone that transmits the waveform of human voice into a worldwide system displacing the telegraph. The evolution of the phone system has been driven by providing humans the type of service they desire. Humans want their conversations over phones to be a close approximation of live conversations between two people that is with no delays in transmission [3]. Consequently, the phone system was developed as a circuit switched network where channel capacity is dedicated in a path from the initiator phone to the destination phone until the conversation is terminated.

2.2 Cable TV

Cable TV started as high capacity analog signal. Since each station needs a frequency of 6M, 50 cable channels are multiplexed into a signal of 300M Hertz. Cable systems frequently use optical fiber to junction boxes and then use coaxial cables into residences. These coaxial cables have a much higher capacity than the twisted copper wire phone system, but currently cable systems are one-way broadcast communication systems. There are a few experimental interactive systems with a limited amount of interaction. Because cable systems broadcast a fixed set of channels into each home, they have no need for exchanges found in telephone systems. Also, because each household has a fixed number of channels; cable companies do not need an elaborate billing system, such as the one for long distance telephone traffic [3].

2.3 Wired Computer Networks

Communication networks for computer communication generally connect office machines or factory machines. It is completely digital. The three aspects of this communication we need to discuss are:

1. Packets
2. Routers
3. Networks

2.3.1 Packets

Computer communication is broken down into packets, whose size in terms of bits depends on the communication protocol. One advantage of packet communication is that it provides a mechanism to correct errors, or if this cannot be accomplished, resend the packet until it is communicated without error. One of the first data protocols was X.25, which is very robust in noisy channels. With less noisy channels, the protocol, Frame Relay sends data more quickly because it spends less time checking for errors [3].

2.3.2 Routers

In computer communication networks, routers serve a similar role as exchanges in telephone networks. They direct the flow of packets through the computer communication networks. Each packet has a header that enables the router to send the packet towards its destination. Packet communication in computer networks is very different from continuous voice or video communication, which as was pointed out, requires dedicated channel capacity. In contrast, in packet communication there is no dedicated channel capacity and each packet could travel a different route through the communication network [3].

2.3.3 Computer Networks

Computer networks are discussed in order of the area covered.

1. LAN (Local Area Network)
2. WAN (Wide Area Network)
3. Internet

2.3.3.1 LAN (Local Area Network)

These small networks are now everywhere in corporations and public institutions. In large organizations like University they connect departments, such as the economics department. We

have a LAN that connects all faculty offices to servers and printers. A common type of LAN is a loop in which messages from the sender travel until they reach the receiver station. The loop is analogous to a party line of telephone. But, as the number of stations on the loop increases, the amount of traffic can greatly slow down communication. For this reason in larger organizations, networks are subdivided into LANs connected by bridges. For example, the University economics department LAN is connected to the larger University collection of networks for the various departments and colleges [3].

2.3.3.2 WAN (Wide Area Network)

These large networks for large institutions such as transnational can cover a large geographical area. Firms lease communication bandwidth from the telephone firms in capacities that can range up to Gbps (Gigabits per second). In designing WANs the designer must consider the delay caused by transmission of a message through a large number of routers, each of which must take some time processes each packet [3].

2.3.3.3 Internet

Data traffic for long distance is sent over many types of networks. For example, telephone networks and private computer networks carry great volumes of data traffic. Currently the computer network that connects almost all computer networks is known as the Internet. This network gradually connected most higher education centers. There was a great expansion in traffic as the combined network was used for all types of research [3].

2.3.3.3.1 Protocols

The protocols behind the Internet are the TCP/IP protocols. TCP covers the packets and IP covers the addresses. In 1991 the adoption of OSI, open systems interconnection made it possible to connect almost any type of computer network to the Internet even if the connecting network was not based on TCP/IP. What this means is that almost all computer networks can and have been connected to the Internet [3].

2.3.3.3.2 Email

The growth of the Internet is associated with the type of services that can be provided through the Internet Tom Truscott and Jim Ellis, two graduate students at Duke created USENET in 1979 based on the Unix UUCP program. USENET has a very large number of discussion groups on practically any topic imaginable. USENET was a separate network from ARPANET. In 1972 Ray Tomlinson created the first E-mail program. At first E-mail users were generally researchers communicating with other researchers. Currently most people who use computers use E-mail. E-mail is free, fast and generally more effective than playing voice tag. At first there were numerous unconnected E-mail systems in information utilities such as CompuServe, Prodigy and Internet. The adoption of these standards and OSI means inter institution E-mail communication has become as easy as intra institution E-mail [3].

2.3.3.3.4 WEB

The service that led to the explosive growth of the Internet was the creation of the WWW, generally called the WEB and the creation of the first WWW browser MOSAIC in 1993 that was displaced over time by Microsoft Explorer, Firefox, Safari and others. WWW browsers reduce the knowledge requirement to use the Internet to basic computer literacy in point and click operations. In addition, browsers folded services such as USENET and E-mail in the WWW browser as additional options. Thus using a modern browser the user has access to all Internet type services in an easy to use form. The fact that browsers cover all the Internet services in an easy to use form is just one aspect of the explosion in Internet use. The other is that browsers are created such that some variation of the browser runs on all types of operating systems whether Unix, Window, or MacOS. This means that WWW applications are independent of the machine or operation system. Also, the capabilities of the WEB will keep on expanding to include voice and video [3].

2.3.3.3.5 Browser Tags

Pages in browsers were first composed in a language called HTML. This language had tags that controlled the layout of a page. The number of tags was about 6000 and they resided in the browser. The limited number of tags limited what could be displayed on a page. For example, for math there were superscript and subscript tags, but little else. To overcome the limitations of HTML a new browser page representation language has been developed and deployed called XM, which is gradually replacing HTML. In XML the tags are unlimited and are communicated to the browser to interpret the page being interpreted. XML encourages groups to create special purpose collections of tags for special purposes [3].

3. WIRELESS COMMUNICATION SYSTEMS

Communication technologies that don't rely on wires to transmit data are considered wireless. In wireless communication the data is transmitted form transmitter to the receiver through open air in the form of electromagnetic waves. The data that is for transmission is converted into electromagnetic waves with the help of transmitting antennas then transmitted through the open air and at the receiving end it is again received by another antenna called as receiving antenna [4]. Functionally both the antennas are identical and both can transmit and receive the electromagnetic waves.

Various wireless communication techniques are

- Wireless Local Loop (WLL)
- Local multipoint distribution system (LMDS)
- Cellular Communication

3.1 Wireless Local Loop (WLL)

In WLL each cell includes a base station antenna, mounted on top of a tall building or tower. Individual subscribers have a fixed antenna mounted on a building or pole that has line of sight link to the base station antenna. From the base station, there is a link, which may either be wired or wireless, to a switching center (generally a telephone company) which provides connections to the local and long-distance telephone networks. The WLL is one of the solutions for high-speed two way voice and data communication [5].

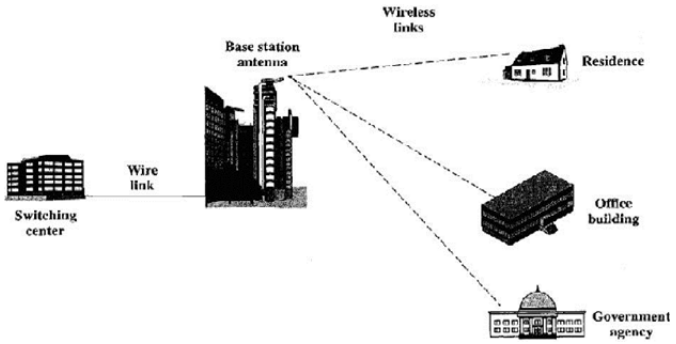

Fig. 1

For most high-speed WLL schemes, the millimeter wave regions are used. The millimeter wave range frequencies are above 10 GHz, and up to about 300 GHz. The reasons for using frequencies in this range for WLL include the following:

1. There are wide unused frequency bands available above 25 GHz.
2. At these high frequencies, wide channel bandwidths can be used to provide high data rates.
3. Small size transceivers and adaptive antenna arrays can be used.

But because of so many losses at such high frequencies (like free space losses, multi path losses, rain fall and humidity etc) limits the range of WLL to few kilometers.

3.2 Local Multipoint Distribution Service (LMDS)

LMDS is a WLL service to deliver TV signals and two-way broadband communications, operating at millimeter frequencies. In the United States, LMDS will be offered at frequencies near 30 GHz; in Europe and some other areas, frequencies near 40 GHz will be used. LMDS has relatively high data rates, that is in the Mbps range, LMDS are capable of providing video, telephony, and data transmission and these are relatively of low cost in comparison with cable alternatives. But at the same time the range of service is less from the base station, so it require relatively large number of base stations to cover the given service area. Also the LMDS's short-wavelength signals cannot pass around or penetrate objects like buildings, or walls [6].

3.3 Cellular communication

A cellular network is a wireless network which covers the wide geographical area for wireless communication. The total area is divided into small cells (hexagonal shape cells). And each cell has at least one base station. All the base stations are low power stations and providing the services in the specified area that may be of meters to few kilometers (upto 20 km). Each cell uses its own allocated set of frequencies to transmit the signals. These systems also support the mobility of user during the ongoing call [7]. When the user enters in another cell during the call then the new frequencies which are from the allocated set of new cell are assigned to user and this is called as handover and it is so fast and smooth that user don't get interrupted and call continues.

The main feature of cellular network is its ability to re-use frequencies to increase both coverage and capacity. The elements that determine frequency reuse are the reuse distance and the reuse factor. The various standards which have been adopted form the beginning to present age also called as generations of cellular communication are 1G (First Generation), 2G, 2.5G, 3G and 4G, 5G are becoming the reality in near future.

Table 1: Comparison of the features of various cellular standards

Features	NMT	GSM	UMTS	IS-95	IS-2000
Technique	FDMA	TDMA/ FDMA	W-CDMA	CDMA	CDMA
Generation	1G	2G	3G	2G	3G
Encoding	Analog	Digital	Digital	Digital	Digital
Year of First Use	1981	1991	2001	1995	2000
Global Market Share	0%	72%	12%	.06%	12%
Roaming	Nordic And Other European countries	World Wide except Japan & South Korea	World wide	Limited	Limited
Frequency Utilization/ Call Density	Very low	0.2 MHz = 8 time slots	5 MHz = 2 M bits/sec	Lower Then CDMA-2000	1.228 MHz= 3 M Bits/sec
Battery Life	low	Very good	Lower then GSM	lower	lower
Hand off	Hard	Hard	Soft	Soft	Soft
Voice And Data same time	No	Yes GPRS class A	Yes	No	Yes

4. COMPARISON OF WIRED AND WIRELESS COMMUNICATION SYSTEMS

1. Wireless communication means portability. Wired is usually stationary.

2. Because wireless systems send data through air waves they are open to anyway listening the air for signals. Wired systems are inherently secure because data is not transmitted over the air.
3. Most wired systems used what is called UTP or STP (Unshielded twisted pair and shielded twisted pair) cabling, and are generally prone to less outside interference such as EMI and interference from nature. Wireless signal however, suffer from RFI, and interference from other wireless signals, which can degrade network performance.
4. In terms on network reach, fiber (wired) is the best for a reach of up to 2000 miles depending on if it's multimode or single mode fiber; single mode is faster because the light signal is broken in the tube as it travels. Wireless systems have a limit of about 300 ft.
5. In term of carrying capacity, Wired is best as it is in the Gigabits/sec range. Wireless (N being the best) is around 108 Megabits/sec [9].

5. CONCLUSION

The purpose of wired or wireless communication is to transfer the information in faithful way that means without the loss of the identity of original message during the transmission. In both the communication systems the message is encounter noise in number of ways that degrade the quality of the transmitted signal, so the main concentration of the design engineers is on the security of data, reliability and noise free communication. Wireless communication is better in number of ways but it requires more security and sophisticated noise control mechanism for ensure faithful transmission.

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