CHAPTER ONE

INTRODUCTION

1.0 GENERAL OVERVIEW

Before the emergence of the Internet and other data networks, telecommunications had a clear meaning: it was an application of technology that allowed people to communicate at a distance by voice, or encoded electronic signals through the use of the telephone, and earlier the telegraph; and telephone service was provided by the public switched telephone network (PSTN).

Then in the 1960s, facsimile and data services were overlaid on the PSTN, adding the ability to communicate documents and data at a distance – applications still considered telecommunications because they enabled new kinds of communication at a distance that were also carried over the PSTN. More recently, communication at a distance has expanded to include data transport, video conferencing, e-mail, instant messaging, web browsing and various forms of distributed collaboration enabled by transmission media that have also expanded (from traditional copper wires to include microwave, terrestrial wireless, satellite, hybrid fiber / coaxial cable, and broadband fiber transport.) Today, consumers think of telecommunications in terms of both products and services. It has become permissible and increasingly common for consumers to buy applications or equipment as products as well as services.

We can now say that telecommunication is the transmission of signs, signals, messages, words, writings, images and sounds or information of any nature by wire, radio, optical or other electromagnetic systems. Telecommunication occurs when the exchange of information between communication participants includes the use of technology. It is transmitted either electrically over physical media, such as cables, or via electromagnetic radiation. Such transmission paths are often divided into communication channels which afford the advantages of multiplexing. Since the Latin term “communicatio” is considered the social process of information exchange, the term, telecommunications, is often used in its plural form because it involves many different technologies. Early means of communicating over a distance included visual signals, such as beacons, smoke signals, semaphore telegraphs, signal flags, and optical

heliographs. Other examples of pre-modern long-distance communication included audio messages such as coded drumbeats, lung-blown horns, and loud whistles. 20th and 21st century technologies for long-distance communication usually involve electrical and electromagnetic technologies, such as telegraph, telephone, and teleprinter, networks, radio, microwave transmission, fiber optics, and communications satellites.

Telecommunication has a significant social, cultural and economic impact on modern society. On the microeconomic scale, companies have used telecommunications to help build global business empires. Telecommunication has played a significant role in social relationships. In recent years, the popularity of social networking sites has increased dramatically. These sites allow users to communicate with each other as well as post photographs, events and profiles for others to see. The profiles can list a person's age, interests, sexual preference and relationship status. In this way, these sites can play important role in everything from organizing social engagements to courtship. Prior to social networking sites, technologies like short message service (SMS) and the telephone also had a significant impact on social interactions. In 2000, market research group Ipsos MORI reported that 81% of 15- to 24-year-old SMS users in the United Kingdom had used the service to coordinate social arrangements and 42% to flirt.

In cultural terms, telecommunication has increased the public's ability to access music and film. With television, people can watch films they have not seen before in their own home without having to travel to the video store or cinema. With radio and the Internet, people can listen to music they have not heard before without having to travel to the music store. Telecommunication has also transformed the way people receive their news. A 2006 survey (right table) of slightly more than 3,000 Americans by the non-profit Pew Internet and American Life Project in the United States the majority specified television or radio over newspapers.

Telecommunication has had an equally significant impact on advertising. TNS Media Intelligence reported that in 2007, 58% of advertising expenditure in the United States was spent on media that depend upon telecommunication.

There is also the example of wireless phones which are employing Electromagnetic waves to carry voice signals along with data, voice and traffic for the internet. These electromagnetic

waves and their carriers are created using computer controlled oscillators. The computers create different digital modulation techniques like BPSK, QPSK, QAM and different variations of them which make the data transmission far more manageable. Computers also compress signals and data so we could send huge volume of data without actually sending all the bits of information. They control the use of frequency among cellular zones and make reuse of frequency in adjacent cells thereby reducing cost. Now the implementation of OFDM technology is popular, making an excellent choice for broadband communication by reducing interference among adjacent frequencies. OFDM is the fuel powering up 4G/LTE. Furthermore, optical fibers have replaced copper cables as a backbone of communication, and these leads to much data transfers which cannot be handled without using a computer.

Frequency reuse, multi carrier modulation, digital data encryption for security, data compression, modulation techniques, antenna behavior, bandwidth management, all these are done with computers and special software. Things like switches, nodes, repeaters, routers, IP addresses, mac addresses are all computer and microprocessor controlled.

Also, telecommunications network organizations are mainly divided into sections and each of these has a different task in sending data or voice over the network. In these sections to perform their tasks, there are various systems developed by leading companies in the world. Each system has computers to control the system with software developed for that system. Using them, the operators can see the status of the alarm indicators and at some cases they can clear the alarm also. In new Synchronous Digital Hierarchy systems (SDH), computer software is used to patch the bit stream going around an optical ring or coming through a radio link. Furthermore, the software can be used to make cross connections, form loops and test the system at various levels. At some rural areas there are even unmanned stations that are controlled and maintained using computers. Computers are used to provide various customer services at request and to observe and control the traffic going through the exchange. The Information Technology section has no electronic systems other than computers. It handles all the billing, keeps track of billing information coming from all the exchanges and issue bills to the subscribers monthly.

There are many other ways to use computers in telecommunications and it is not limited to work only. Computer has helped telecommunication is through the Internet. The Internet is a worldwide network of computers and computer networks that communicate with each other using the Internet Protocol. Any computer on the internet has a unique IP address that can be used by other computers to route information to it. Hence, any computer on the Internet can send a message to any other computer using its IP address. These messages carry with them the originating computer's IP address allowing for a two-way communication. The Internet thus aids in exchanging messages between two computers.

Computers also help in the area of call centers, which are facilities where a company's customer service representative makes outbound calls to potential customers, receive inbound calls from prospective customers and help others with product issues all through computers. Now some call centers are facilitated online. An employee who works from house can log into his company's online system and receive calls that redirected from the company's physical location. This allows the employees to cut down on travelling costs, and the company can hire independent contractors. Therefore, the company cuts out the costs of benefits, such as retirement and insurance.

In web broadcasting, computers allow individuals to watch live streaming from one source. The source that provides the streaming cannot see or speak to any viewer, but can offer speech or tutorial on how to perform a specific task. Web broadcasts are equivalent to television broadcasts, except the streaming is done through a computer. Computers also help in video conferencing, which is a tool used for business and pleasure. A video conference allows two or more individuals to see each other and speak as though they were conversing in person. It is used to complete business deals and used by families and friends in different places.

In the file sharing aspect, an individual can send documents via a computer. This is a more common form of telecommunication because it includes email. Some companies allow a user to post files online as a storage unit for a group of users. Then any user with proper access can open the documents whenever the individual needs it.

1.1 PROBLEM STATEMENT

Globally, there has been constant change in Information Technology and telecommunication infrastructure in recent times. Computers are now used in every aspect of telecommunication. In fact, in recent times data transfer (internet) using computers and telecommunication has almost become the same thing and are often used interchangeably. There is a need to document the role computers play in reducing the stress of handling the ever growing mass of information and data in telecommunication. This would help in keeping in consonance with the ever changing technologies and needs of the people. It would also help individuals to more about the benefits of using computer in telecommunications and to adapt to the changing technology so as not to be left behind while the flow of innovation is moving forward.

1.2 AIMS AND OBJECTIVES

The Objectives of this research work is:

- To explain fully the role that computer technology has to play in furthering telecommunications.
- To create awareness about the various advantages of using computers in the telecommunication field.
- To keep up with the development and technological progress of computers used in the area of the telecommunications industry.

1.3 METHODOLOGY

This deals with the information gathering method that will be used during the course of this research. Information gathering is carried out through the following methods:

- Google search engine.
- Past researchers work.
- Internet repository.
- Portable document format (PDFs)

1.4 DEFINITION OF TERMS

- **WORLD WIDE WEB - WWW:** The web of systems and the data in them that is the Internet Presents information in a user friendly hypertext format. WWW displays pages of information, with links to other pages. Mosaic is the program that really makes Web materials come alive. Different systems display the links differently, by highlighting the link items or by putting a code (such as a number in brackets) after the item. Others put the link in boldface or in color.
- **WAN:** Wide Area Network.
- **VIRTUAL SPACE:** Refers to a type of videoconference in which each participant is assigned a separate camera and is seen on a separate monitor, large screen or assigned spatial area.
- **VIDEO TELECONFERENCE:** A meeting involving at least one uplink and a number of downlinks at different locations. It is an electronic voice and video communication between two or more locations. It can be fully interactive voice and video or two-way voice and one way video. It includes full motion, compressed, and freeze-frame video.
- **USENET:** An anarchic network of sorts composed of thousands of discussion groups on every imaginable topic.
- **USENET NEWSGROUP:** Discussion group on one topic.
- **TELEPHONY:** the use or operation of an apparatus for transmission of sounds between widely removed points with or without connecting wires.
- **TELEPORT:** A generic term referring to a facility capable of transmitting and receiving satellite signals for other users.
- **TELETEXT:** Broadcast service using several otherwise unused scanning lines (vertical blanking intervals) between frames of TV pictures to transmit information from a central data base to receiving television sets. Users of a teletext service grab pages from the transmission cycle using a keypad similar to that used in videotex systems.
- **TELEVISION:** The electronic transmission of pictures and sounds.

- **TELEWRITER:** General term for an electronic device that produces free-hand information

  that can be sent over a telecommunications channel, usually a telephone line.
- **TERMINAL:** 1. generally, connection point of equipment, power or signal. 2. Any terminating piece of equipment such as a computer terminal.
- **TEXT:** In terms of files, a file that contains only characters from the ASCII character set. In terms of FTP, a mode that assumes that files will be transferred containing only ASCII characters.
- **TERRESTRIAL CARRIER/LAND LINE:** Telecommunications transmission system using land based facilities (microwave towers, telephone lines, fiber optic cable).
- **OPTICAL CHARACTER RECOGNITION - OCR:** The machine identification of printed characters through use of light-sensitive devices; often used as a method of entering data.
- **OPTICAL FIBER:** An extremely thin, flexible thread of pure glass able to carry one thousand times the information possible with traditional copper wire. See Fiber Optics.
- **INTERNET:** A worldwide system for linking smaller computer networks together governmental institutions, military branches, educational institutions, and commercial companies. Networks connected through the Internet use a particular set of communications standards to communicate, known as TCP/IP. Internet is the name given to the overall connectivity of all its various sub-networks, including USENET, APRAnet, CSnet, BITNET, etc. There is no surcharge to send or receive messages through Internet. Only ASCII messages up to 50,000 characters can be sent through this system. With a lowercase "i", an internet is a group of connected networks.

CHAPTER TWO

LITERATURE REVIEW

2.0 TELECOMMUNICATION

Today, the information to be shared through telecommunication comes in a variety of forms. If this information is to be brought to the right people at the right time, the storage and retrieval methods must be such that it can keep in pace with the torrent of information flow. Computer is the only device that can be able to manage this work because of its high speed processing capability of large amount of information. This is way computer is highly relied on in the area of telecommunication.

Computer technologies used for telecommunications have changed greatly over the last few centuries in other to be able to meet up with the increasing flow of information. In 1837, Sir Charles Wheatstone and Sir William Fothergill Cooke invented the electric telegraph. On July 25, 1837 the first commercial electrical telegraph was demonstrated by William Fothergill Cooke, an English inventor, and Charles Wheatstone, an English scientist. Both inventors viewed their device as "an improvement to the [existing] electromagnetic telegraph" not as a new device. The first transatlantic telegraph cable was successfully completed on 27 July 1866, allowing transatlantic telecommunication for the first time.

The conventional telephone was invented independently by Alexander Bell and Elisha Gray in 1876. Antonio Meucci invented the first device that allowed the electrical transmission of voice over a line in 1849. The first commercial telephone services were set-up in 1878 and 1879 on both sides of the Atlantic in the cities of New Haven and London.

Starting in 1894, Italian inventor Guglielmo Marconi began developing a wireless communication using the then newly discovered phenomenon of radio waves, showing by 1901 that they could be transmitted across the Atlantic Ocean. This was the start of wireless telegraphy by radio. Voice and music were demonstrated in 1900 and 1906, but had little success. World War I accelerated the development of radio for military communications. After the war, commercial radio AM broadcasting began in the 1920s and became an important mass

medium for entertainment and news. World War II again accelerated development of radio for the wartime purposes of aircraft and land communication, radio navigation and radar. Development of stereo FM broadcasting of radio took place from the 1930s on-wards in the United States and displaced AM as the dominant commercial standard by the 1960s, and by the 1970s in the United Kingdom.

On 25 March 1925, John Logie Baird was able to demonstrate the transmission of moving pictures at the London department store Selfridges. Baird's device relied upon the Nipkow disk and thus became known as the mechanical television. It formed the basis of experimental broadcasts done by the British Broadcasting Corporation beginning 30 September 1929. However, for most of the twentieth century televisions depended upon the cathode ray tube invented by Karl Braun. The first version of such a television to show promise was produced by Philo Farnsworth and demonstrated to his family on 7 September 1927. After World War II, the experiments in television that had been interrupted were resumed, and it also became an important home entertainment broadcast medium.

On 11 September 1940, George Stibitz transmitted problems for his Complex Number Calculator in New York using a teletype, and received the computed results back at Dartmouth College in New Hampshire. This configuration of a centralized computer (mainframe) with remote dumb terminals remained popular well into the 1970s. However, already in the 1960s, researchers started to investigate packet switching, a technology that sends a message in portions to its destination asynchronously without passing it through a centralized mainframe. A four-node network emerged on 5 December 1969, constituting the beginnings of the ARPANET, which by 1981 had grown to 213 nodes. ARPANET eventually merged with other networks to form the Internet. While Internet development was a focus of the Internet Engineering Task Force (IETF) who published a series of Request for Comment documents, other networking advancement occurred in industrial laboratories, such as the local area network (LAN) developments of Ethernet (1983) and the token ring protocol (1984).

Empowered by research into semiconductors and digital electronics in the telecommunications industry, analog representations of voice, images and video have been supplanted by digital representations in this century. The biggest consequence has been that all types of media can

be represented in the same basic form (i.e., as a stream of bits) and therefore can be handled uniformly within a common infrastructure (most commonly called Internet Protocol, or IP, data streams). Subsequently, circuit switching was supplemented by packet switching. For example, telephony is now routinely carried at various places in the network by the Internet, using VoIP, and cable networks.

Perhaps the most fundamental change, both in terms of technology and its implications for industry structure, has occurred in the architecture of telecommunications networks. Architecture in this context refers to the functional description of the general structure of the system as a whole and how the different parts of the system relate to each other. Previously, the PSTN, cable, and data networks coexisted as separately owned and operated networks carrying different types of communications, although they often shared a common technology base i.e. point to point digital communications and some facilities such as high-speed digital pipes shared by different networks.

How are the new networks different? First, they are integrated, meaning that all media – voice, audio, video or data – are increasingly communicated over a single common network. This integration offers economies of scope and scale in both capital expenditures and operational costs, and also allows different media to be mixed within common applications. As a result, both technology suppliers and service providers are increasingly in the business of providing telecommunications in all media simultaneously rather than specializing in a particular type such as voice, video or data.

Second, the networks are built in layers, from the physical layer which is concerned with the mechanical, electrical, optical, functional and procedural means for managing network connections to the data, network, and transport layers which are concerned with transferring data, routing data across networks between addresses and ensuring end to end connections and reliability of data transfer, to the application layer which is concerned with providing a particular functionality using the network and with the interface to the user.

These changes in networks are as a result of the increasing expansion of computer technologies. Previously, telephones used copper cables to carry out communication. There were exchanges where rows of Operators manually handled all the phone calls to their

respective recipients, and as there were people handling calls, the number of calls that could be maintained at any given moment was limited. Then computers were introduced in the area of telecommunication and we saw that we could send our voice through air using radio like technology. Now there are billions of phones all over the world, making millions of simultaneous call at any given moment. This is possible through the use of specialized computers. Normally, what you send through your telephone lines are converted to digital signals and multiplexed into 2mb bit streams. Then they are transmitted to the destination using optical fibers or radio transmission links if the destination is local. Optical fibers provide cheaper bandwidth for long distance communication. If the destination is over the sea, the files would be sent through a submarine cable system or a satellite system. In a telephone network, the caller is connected to the person they want to talk to by switches at various telephone exchanges. These exchanges switch the files to the destination at the various levels. The switches form an electrical connection between the two users and the setting of these switches is determined electronically when the caller dials the number. Once the connection is made, the caller's voice is transformed to an electrical signal using a small microphone in the caller's handset. This electrical signal is then sent through the network to the user at the other end where it is transformed back into sound by a small speaker in that person's handset. That is what a telecommunication network does from the outside. At the hardware level, it is a collection of electronic systems with printed circuit boards with computers used as controllers and maintainers.

2.1 HISTORY OF TELECOMMUNICATION

"Telecommunication" is a term coming from Greek and meaning "communication at a distance" through signals and varied nature coming from a transmitter to a receiver. In order to achieve effective communication, the choice of proper means of transport for the signal has played a fundamental role. In ancient times the most common way of producing a signal would be through light (fire) and sound (drums and horns). However those kinds of communication was insecure and certainly left room for improvement as they do not permit message encrypted or a more fast transmission of information on a large scale.

The true “jump” in terms of quality came with the advent of electricity. Electromagnetic energy, is able to transport information in an extremely fast way (ideally to the speed of light), in a way that previously has no equal in terms of cost. Therefore we may also say that the starting point of all modern telecommunication was the invention of the electric cell by Alessandro Volta (1800)

It was shortly thereafter that the experiment on more advanced communication system begun. In 1809, **Thomas S. Sommering** proposed a telegraphic system composed of a battery, 35 wires (one of each letter and numbers) and a group of sensor made of gold, which was submerged into a water tank. When a signal was passed from one of those wire, electrical currency will split water molecule, and small oxygen bubbles would be visible near the sensor. Many other experiments were soon to follow. **Wheatstone**, **weber** and **Karl Friedrich Gauss** tried to further develop Sommering’s idea in a product that could be mass distributed, but their effort were without success.

In the year 1843, **Samuel Morse** proposed a way to assign each letter and number to a ternary code (point, line and space). This way turned out to be extremely convenient and more affordable than Sommering’s idea, especially in terms of reduced circuitry (you wouldn’t need any more wire for each symbol). Meanwhile technology became advanced enough to find a way to convert those signals to audible (or sometimes graphic) signals. The combination of those two factors quickly determined the success of Morse’s symbol code, which we can still find useful today. The system was later developed and improved by in the following years by **Huges** , **Baudot**, and **Gray** (1879), who theorized other possible codes (Gray's code is still in applications today in the ICT industry and in barcodes technology).

However, the telegraph could still be used just by trained personnel and in certain buildings like offices, so it could only be used by a limited amount of people. Research of the time therefore took another direction and aimed at producing a machine that could transmit sounds, rather than just signals. The first big step in this direction was the invention of transducers which could transform an acoustic signal into an electric one and vice versa (microphone and receiver) with acceptable information loss, in 1850.

Seven years later, **Antonio Meucci** and **Graham Bell** independently managed to build a prototype of an early telephone ('sound at distance') machine. Since Meucci didn't have the money to patent his invention (the cost was $250 at the time), Bell managed to register it first. Both with telegraphs and telephones, the need for a distributed and reliable communication network soon became evident. Routing issues were first solved by means of human operators and circuit commutation: the PSTN (Public Switched Telephone Network) was born. However, this system didn't guarantee the privacy and

secrecy of conversations, and efforts towards the development of an automatic circuit commutation were made.

In 1899, **Almon Strowger** invented an electro-mechanic device simply known as 'selector', which was directed by the electrical signals coming from the calling telephone device, achieved through selection based on geographical prefixes.

Many other innovations were soon to come:

In 1885, **Guglielmo Marconi** invented the 'wireless telegraph' (radio);

In 1920, valve amplifiers made their first appearance;

In 1923, the television was invented;

In 1947, the invention of transistors gave birth to the field of electronics;

In 1958, the first integrated circuit was built;

In 1969, the first microprocessor was invented.

With the last step, electronics becomes more than ever a fundamental part in the telecommunication world, at first in the transmission, and soon also in the field of circuit commutation.

Moreover, in 1946 the invention of **ENIAC** (Electronic Numerical Integrator and Computer) starts the era of informatics. Informatics and telecommunications inevitably begun to interact, as it was to be expected: the first made fast data processing possible, while thanks to second the data could then be sent to a distant location.

The development of microelectronics and informatics radically revolutionized techniques both in telecommunication networks and performance requirements for the networks. Starting from 1938, an innovative technology called PCM (Pulse Code Modulation) started to grow more and more popular. This technology could achieve the digital transmission of a voice signal by digitally encoding and decoding, rather than by means of transducers: however, PCM was first used on a large scale only in 1962 in the United States (the so-called 'T1').

During the mid-Sixties **Paul Baran**, a RAND Corporation employee working on communication problems concerning the US Air Force, first gave birth to the concept of 'packet switching network' rather than the conventional idea of circuit commutation network. According to this model, there should be no

hierarchy in the nodes of a network, but each node should rather be connected to many others and be able to decide (and, in case of need, modify) the packet routing. Each packet is a bulk of data which consist of two main parts, a 'header' containing routing information and a 'body' containing the actual data.

In this context **Vincent Cerf**, **Bob Kahn** and others developed, starting from the 70s, the TCP/IP protocol suite, which made possible communication of computers and heterogeneous machines through a series of physical and logical layers. Packet switching network and TCP/IP were later chosen by the military project ARPANET. The rest of the story is widely known: in 1983, ARPANET became available to universities and research centers, among which NSFNET (National Science Foundation + NET), which finally gave birth to the Internet.

In the latest years, the importance of the Internet has been constantly growing. The high flexibility given by the TCP/IP suite and the ISO/OSI protocols provide a strong foundation on which communication among devices of different kind -- be it a laptop or a cell phone, an iPod or a GPS navigator -- has finally been made simple and easy to achieve.

Hence Telecommunication is defined as the science and technology of communication over a distance. The ability to convey information quickly, accurately, and efficiently has always been one of the main focuses driving human innovation. From prehistoric man with their signal fires to the smartphone-wielding high-powered executives of today, communication still remains a key for survival and success. The history of telecommunication illustrates this never-ending push for progress as it steadily parallels human growth, becoming more widespread and efficient as the development of modern civilization unfolds.

Prehistoric Era: Fires, beacons, smoke signals, communication drums, horns: Man's first attempts at distance communication were extremely limited. Prehistoric man relied on fire and smoke signals as well as drum messages to encode information over a limited geographic area as they attempted to contact neighboring clans. These signals also needed to have very simple, pre-decided meanings like "safe" or "danger" or "victory" or could be used as a form of alarm system in order to alert prehistoric clans to predators or invading clans.

2.1.1 EARLY HISTORY OF THE TELEPHONE

1790: Semaphore lines (optical telegraphs): Using the maritime flag semaphore as a starting point, The *Chappe* brothers, two French inventors, created the first optical telegraph system in 1790. The optical

telegraph was a system of pendulums set up somewhere high like on a tower or the top of a town clock. The telegraph would swing its mechanical arms around and sign messages from one tower to the next. It was the first telecommunications system in Europe.

2.1.2 OPTICAL TELEGRAPHY

1838: Electrical telegraph: Samuel B. Morse had been working on the idea of a recording telegraph with friends Alfred Vail and Leonard Gale. They discovered that when connecting two model telegraphs together and running electricity through a wire, you could send messages by holding or releasing the buttons in a series of intervals. This became known as Morse code and lay the foundation for modern land-line phones.

2.1.3 HISTORY OF THE TELEGRAPH

1858: First trans-Atlantic telegraph cable: At this point, most of Britain and the United States had telegraph stations and were able to regularly communicate within their own countries, but a man named Cyrus Field from New York wanted to lay the first transatlantic telephone cable to connect England and the United States by telegraph. This project, though it was met with many setbacks, was finally completed in August of 1858.

2.1.4 TRANSATLANTIC TELEGRAPH CABLE

1867: Signal lamps: In 1867, the first dots and dashes were flashed by signal lamps at sea. The idea was that of British Admiral Phillip Colomb, who took the design of signal lamp inventor Arthur C.W. Aldis and implemented this method of communication as well as his own code in order for the ships in his fleet to easily communicate. This code was similar to Morse code, but eventually, Morse code became more widely used.

2.1.5 SIGNAL LAMPS

1876: Telephones: The year 1876 was a big one for Alexander Graham Bell. Having come to the U.S. as a teacher for the deaf, he had been trying to figure out a way to transmit speech electronically. Despite little support from his friends, he successfully invented the telephone in March of 1876.

2.1.6 THE FIRST CELL PHONE CALL

1979: INMARSAT ship-to-shore satellite communications: The year 1979 was a big leap forward for maritime communications. The International Maritime Satellite Organization (INMARSAT) was established to provide marine vessels with reliable communication for increased safety and communication for sailors and passengers who needed to speak to someone on shore.

2.1.7 MARSAT

1981: First mobile phone network: The first commercially automated cellular network was launched in Japan in 1981. The network was originally launched only in Tokyo in 1979 and then was expanded. Simultaneously, the Nordic Mobile Telephone system was also established in Denmark, Finland, Norway, and Sweden.

2.1.8 HISTORY OF MOBILE COMMUNICATIONS

1982: SMTP email: Prior to 1982, the Internet was highly secure and comprised of limited network clusters between military, corporate, and some university research facilities. In 1982, Jonathan Postel wrote the Simple Mail Transfer Protocol and shifted the focus of the Internet from security to reliability using the networks as relay stations to send electronic mail to the recipient through cooperative hosts.

2.1.9 SMTP RELAY HISTORY

1983: Internet: On January 1, 1983, the Internet was officially born. ARPANET officially switched its old network control protocols (NCP) and Transmission Control Protocol/Internet Protocol (TCP/IP) became standard.

2.1.10 HISTORY OF THE INTERNET

1998: Mobile satellite hand-held phones: The first canopy of 64 satellites was put into place by a company called Iridium in 1998. They also produced the first hand-held satellite phones, which were smaller and less cumbersome than the earlier "bag" phones. This revolutionized mobile telecommunications and would lead to the modern smartphone.

2.1.11 SATELLITE COMMUNICATION

2003: VoIP Internet telephony: In 2003, phone calls were now capable of being transmitted over a computer through Internet protocols. This meant that long-distance charges were not applicable, as callers would use already-established computer networks.

2.2 TELECOMMUNICATIONS—AN EVOLVING DEFINITION

Before the emergence of the Internet and other data networks, telecommunications had a clear meaning: the telephone (and earlier the telegraph) was an application of technology that allowed people to communicate at a distance by voice (and earlier by encoded electronic signals), and telephone service was provided by the public switched telephone network (PSTN). Much of the U.S. network was owned and operated by American Telephone & Telegraph (AT&T); the rest consisted of smaller independent companies, including some served by GTE.

Then in the 1960s, facsimile and data services were overlaid on the PSTN, adding the ability to communicate documents and data at a distance—applications still considered telecommunications because they enabled new kinds of communication at a distance that were also carried over the PSTN. More recently, of course, communication at a distance has expanded to include data transport, video conferencing, e-mail, instant messaging, Web browsing, and various forms of distributed collaboration, enabled by transmission media that have also expanded (from traditional copper wires) to include microwave, terrestrial wireless, satellite, hybrid fiber/coaxial cable, and broadband fiber transport.

Today consumers think of telecommunications in terms of both products and services. Starting with the Carter phone decision by the Federal Communications Commission in 1968, it has become permissible and increasingly common for consumers to buy telecommunications applications or equipment as products as well as services. For example, a customer-owned and customer-installed Wi-Fi local area network may be the first access link supporting a voice over Internet Protocol (VoIP) service, and a consumer may purchase a VoIP software package and install it on his or her personally owned and operated personal computer that connects to the Internet via an Internet service provider.

The technologies used for telecommunications have changed greatly over the last 50 years. Empowered by research into semiconductors and digital electronics in the telecommunications industry, analog representations of voice, images, and video have been supplanted by digital representations. The biggest consequence has been that all types of media can be represented in the same basic form (i.e., as

a stream of bits) and therefore handled uniformly within a common infrastructure (most commonly as Internet Protocol, or IP, data streams). Subsequently, circuit switching was supplemented by, and will likely ultimately be supplanted by, packet switching. For example, telephony is now routinely carried at various places in the network by the Internet (using VoIP) and cable networks. Just as the PSTN is within the scope of telecommunications, so also is an Internet or cable TV network carrying a direct substitute telephony application. Perhaps the most fundamental change, both in terms of technology and its implications for industry structure, has occurred in the architecture of telecommunications networks. Architecture in this context refers to the functional description of the general structure of the system as a whole and how the different parts of the system relate to each other. Previously the PSTN, cable, and data networks coexisted as separately owned and operated networks carrying different types of communications, although they often shared a common technology base (such as point-to-point digital communications) and some facilities (e.g., high-speed digital pipes shared by different networks).

How are the new networks different? First, they are integrated; meaning that all media— be they voice, audio, video, or data—are increasingly communicated over a single common network. This integration offers economies of scope and scale in both capital expenditures and operational costs, and also allows different media to be mixed within common applications. As a result, both technology suppliers and service providers are increasingly in the business of providing telecommunications in all media simultaneously rather than specializing in a particular type such as voice, video, or data.

Second, the networks are built in layers, from the physical layer, which is concerned with the mechanical, electrical and optical, and functional and procedural means for managing network connections to the data, network, and transport layers, which are concerned with transferring data, routing data across networks between addresses, and ensuring end-to-end connections and reliability of data transfer to the application layer, which is concerned with providing a particular functionality using the network and with the interface to the user. Both technology (equipment and software) suppliers and service providers tend to specialize in one or two of these layers, each of which seeks to serve all applications and all media. As a consequence, creating a new application may require the participation and cooperation of a set of complementary layered capabilities. This structure results in a horizontal industry structure, quite distinct from the vertically integrated industry structure of the Bell System era.

All these changes suggest a new definition of telecommunications: Telecommunications is the suite of technologies, devices, equipment, facilities, networks, and applications that support communication at a distance.

The range of telecommunications applications is broad and includes telephony and video conferencing, facsimile, broadcast and interactive television, instant messaging, e-mail, distributed collaboration, a host of Web- and Internet-based communication, and data transmission. Of course many if not most software applications communicate across the network in some fashion, even if it is for almost incidental purposes such as connecting to a license server or downloading updates. Deciding what is and is not telecommunications is always a judgment call. Applications of information technology range from those involving almost no communication at all (word processing) to simple voice communications (telephony in its purest and simplest form), with many gradations in between.

As supported by the horizontally homogeneous layered infrastructure, applications of various sorts increasingly incorporate telecommunications as only one capability among many. For example telephony, as it evolves into the Internet world, is beginning to offer a host of new data-based features and integrates other elements of collaboration (e.g., visual material or tools for collaborative authoring). Another important trend is machine-to-machine communication at a distance, and so it cannot be assumed that telecommunications applications exclusively involve people.

2.3 THE TELECOMMUNICATIONS INDUSTRY

Like telecommunications itself, the telecommunications industry is broader than it was in the past. It encompasses multiple service providers, including telephone companies, cable system operators, Internet service providers, wireless carriers, and satellite operators. The industry today includes software-based applications with a communications emphasis and intermediate layers of software incorporated into end-to-end communication services. It also includes suppliers of telecommunications equipment and software products sold directly to consumers and also to service providers, as well as the telecommunications service providers. The telecommunications industry is enabled by a complex value chain that includes vendors, service providers, and users. The telecommunications value chain begins with building blocks such as semiconductor chips and software. These components are, in turn, incorporated into equipment and facilities that are purchased by service providers and users. The service providers then, in turn, build networks in order to sell telecommunications services to end users. The end users include individuals subscribing to services like telephony (landline and cellular) and broadband Internet access, companies and organizations that contract for internal communications networks, and companies and organizations that operate their own networks. Some major end-user organizations also bypass service providers and buy, provision, and operate their own equipment and software, like a corporate local area network (LAN) or a U.S. military battlefield information system.

Software suppliers participate at multiple points in the value chain, selling directly not only to equipment vendors but also to service providers (e.g., operational support systems) and to end users (e.g., various PC-based applications for communications using the Internet).

An implication of defining telecommunications broadly is that every layer involved in communication at a distance becomes, at least partially, part of the telecommunications industry. The broad range and large number of companies that contribute to the telecommunications industry are evident in the following list of examples:

- Networking service providers across the Internet and the PSTN, wireless carriers, and cable operators. Examples include AT&T, Comcast, Verizon, and DirecTV.
- Communications equipment suppliers that are the primary suppliers to service providers. Examples include Cisco, Lucent, and Motorola.
- Networking equipment suppliers selling products to end-user organizations and individuals. Examples include Cisco's Linksys division and Hewlett-Packard (local area networking products).
- Semiconductor manufacturers, especially those supplying system-on-a-chip solutions for the telecommunications industry. Examples include Texas Instruments, Qualcomm, Broadcom, and STMicroelectronics.
- Suppliers of operating systems that include a networking stack. Microsoft is an example.
- Software suppliers, especially those selling infrastructure and applications incorporating or based on real-time media. Examples include IBM, Real Networks (streaming media), and BEA (application servers).
- Utility or on-demand service providers selling real-time communications-oriented applications. Examples include AOL and Microsoft (instant messaging) and WebEx (online meetings).
- Consumer electronics suppliers with communications-oriented customer-premises equipment and handheld appliances. Examples include Motorola and Nokia (cell phones), Research in Motion (handheld e-mail appliances), Polycom (videoconferencing terminals), Microsoft and Sony (networked video games), and Panasonic (televisions).

What is striking about this list is how broad and inclusive it is. Even though many of these firms do not specialize solely in telecommunications, it is now quite common for firms in the larger domain of information technology to offer telecommunications products or to incorporate telecommunications capability into an increasing share of their products.

2.4 THE IMPORTANCE OF TELECOMMUNICATIONS

TELECOMMUNICATIONS AND SOCIETY

The societal importance of telecommunications is well accepted and broadly understood, reflected in its near-ubiquitous penetration and use. Noted below are some of the key areas of impact:

- **Telecommunications provides a technological foundation for societal communications:** Communication plays a central role in the fundamental operations of a society—from business to government to families. In fact, communication among people is the essence of what distinguishes an organization, community, or society from a collection of individuals. Communication—from Web browsing to cell phone calling to instant messaging—has become increasingly integrated into how we work, play, and live.
- **Telecommunications enables participation and development:** Telecommunications plays an increasingly vital role in enabling the participation and development of people in communities and nations disadvantaged by geography, whether in rural areas in the United States or in developing nations in the global society and economy.
- **Telecommunications provides vital infrastructure for national security:** From natural disaster recovery, to homeland security, to communication of vital intelligence, to continued military superiority, telecommunications plays a pivotal role. When the issue is countering an adversary, it is essential not only to preserve telecommunications capability, but also to have a superior capability. There are potential risks associated with a reliance on overseas sources for innovation, technologies, applications, and services.

- **VIDEO CONFERENCING:** Video conferencing is a tool used for business and pleasure. Many companies offer free video conferencing software available to download online. A video conference allows two or more individuals to see each other and speak as though they were talking in person. It is used to complete business deals and by families and friends in different places.

- **CALL CENTERS:** Call centers are facilities where a company's customer service representatives make outbound calls to potential customers, receive inbound calls from prospective customers and help others with product issues. Now, some call centers are facilitated online. An employee who works from home can log into his company's online

system and receive calls that are redirected from the company's physical location. This allows the employees to cut down on traveling costs, and the company can hire independent contractors. Therefore, the company cuts out the costs of benefits, such as retirement and insurance.

- **WEB BROADCASTING:** Separate from video conferencing, web broadcasting allows individuals to watch live streaming from one source. The source that provides the streaming cannot see or speak to any viewer; however, she can offer a speech or tutorial on how to perform a specific task. Web broadcasts are the equivalent to television broadcasts, except the streaming is done through a computer. A culinary professor could demonstrate a cooking technique from his home, while his students watch online.

- **FILE SHARING:** File sharing is a more common form of telecommunication because it includes email. Any service that provides a user with the opportunity to send documents via electronic communication is an example of file sharing. Some video conferencing software companies offer file sharing as part of their systems. There are some companies that allow a user to post files online as a storage unit for a group of users. Then, any user with proper access can open the documents whenever she needs them. However, music file sharing is illegal without purchase.

- **INTERNET AND EMAIL:** The World Wide Web, Internet and email revolutionized the way individuals communicate with each other. Rather than waiting days or weeks to see information, we can now view all information at the speed of light. Email has fundamentally transformed how people share information and conduct business based on the speed and flexibility it offers. Computers can process data at approximately 20 million bytes per second so it is easy for them to download and instantly display almost any text email.

- **VOIP AND VIDEO CHAT:** Voice-Over-Internet Protocol -- or VOIP -- replaced the need for landline telephones in many instances. These lines can provide instant phone communication over the Internet, and often are cheaper than fixed phone lines. They also provide the ability to conduct video chats to see whom you are speaking with. VOIP platforms also store contact details for easy accessibility and dialing. The current drawback to VOIP, as of May 2011, is that 911 operators cannot trace the call back to the location.

- **SOCIAL NETWORKING:** Social networking sites including Facebook, Twitter and LinkedIn allow users to rapidly generate content for people in their network to view. Rather than sending individual notes, social networking provides a constant stream of updates and information. These computer tools have taken communication a step further than email due to their ability to instantly communicate life and status updates to an entire network of people who can respond and comment to such notes in real time. Unlike email's distribution lists -- which essentially could transfer the same information to large groups of people -- social networking's streamlined and user-friendly interface precludes information overload that occurs from attempting the same functions in an email program.

- **ROUTING:** While it not a personal computer, routers are types of computers used to direct communication traffic. They are crucial to the efficient and correct distribution of calls, emails or other Internet traffic. Routers take "packets" of electronic data and send them in the direction to connect with the intended person. They can be used in the home but are also held in central data warehouses where hubs of traffic are routed in the same place.

It is difficult to predict the future impact of telecommunications technologies, services, and applications that have not yet been invented. For example, in the early days of research and development into the Internet in the late 1960s, who could have foreseen the full impact of the Internet’s widespread use today?

CHAPTER THREE

RESEARCH METHODOLOGY AND FRAMEWORK

3.0 INTRODUCTION

The Telecommunications industry today is a key enabler of productivity across economies and societies. The Telecom industry is not only a significant contributor towards the economic activities of countries, but also towards the growth of other industries. In recent times, developing nations have witnessed significant transformation within this sector due to the impact it has had on their economies.

Telecommunications is the science of communicating over a long distance using telephone or radio technology. This involves using microelectronic (small semiconductor chip), computer, and PC technologies to transmit, receive, and switch voice, data, and video communications over different transmission media, including copper, fiber, and electromagnetic transmissions.

This definition implies that we are doing more than just voice communications. Further, it does not imply using analog transmission exclusively. Many forms of analog and digital transmission are employed in telecommunications today. Analog communication is like a dimmer switch for light because it has an almost unlimited number of brightness settings. In contrast, digital communication works like a simple light switch that has only on or off.

When people use the word “telecommunications,” most think of the classical analog telephone. That is *telephony*. Telephony is focused on voice communications. Telecommunications has evolved into much more.

The telephone network was originally designed to carry human voice and not digital information such as data, music, or video. It supported telephony (voice communications), but not telecommunications (data, image, and video). Realizing this helps us to understand some of the problems occurring as telephony (voice communications), WAN, LAN, wireless communications, and PC technologies merge to become telecommunications in the next millennium.

The scary thought is that any person born today will not know a world without portable PCs to serve them. They will have no concept of products that last and last for years.

3.1 TELECOMMUNICATIONS EVOLUTION

To understand the impact that computer and telecommunications technologies are having on your company, we need to understand the love/hate relationship between computer and telecommunications technologies. These two technologies are now combining to form balanced tele-computing (Tele-computing is Pete's word for the convergence of voice, data, and LAN communications with PC technologies. In an enterprise, it signifies the total integration of telecommunications and computing functions into a single organization-wide network) networks upon which most organizations are vitally dependent.

Tele-computing is the convergence of voice, data, and LAN communications with PC technologies. This convergence delivers to the office or home PC data, image, voice, and video information. Tele-computing makes desktop, mobile, hand-held and wearable PCs universal communication appliances. Balanced tele-computing extends this concept by simply matching computer-communications tools to job functions. Balanced tele-computing becomes even more difficult as we move into the future because our tele-computing choices are forever growing. What is a good combination of computer and communications technologies today may not be the most effective combination tomorrow. So, balancing technology to meet information and communications needs becomes a interesting problem. When you think of balancing technologies to meet user needs, effective (not necessarily cheap) solutions seem more obvious. In the home, balanced tele-computing is matching the PC tools and communications services to the information and entertainment needs of the household. The focus is on providing the computer communications tools and services that help people in their work and improve their personal lives.

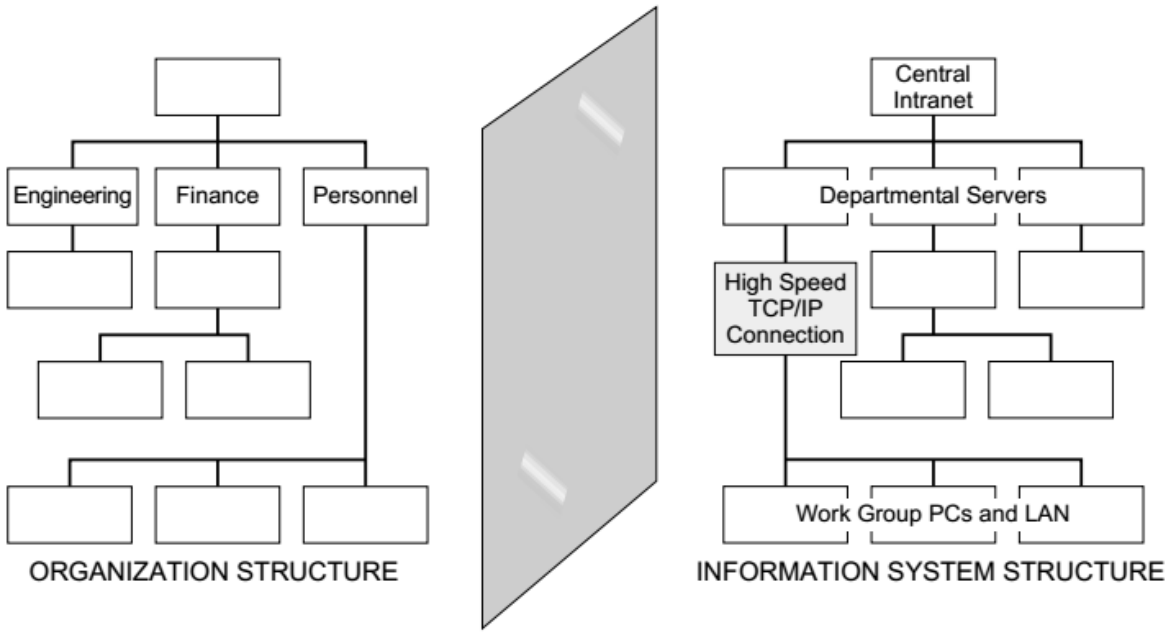

Figure 3.1 *The balanced tele-computing concept.*

How networks are built and how they work is much less important here than what they do for us. The driving force behind networks is how they make everyone more productive. This is what I call balanced tele-computing—matching the computer and communications capabilities to the work functions performed by an employee. The goal is to increase the employee's productivity. This goal is accomplished by balancing the computing done at the desktop (or in the wearable computer) with the available communications/transmission capacities and computing done in the supporting servers.

For example, the paperless office was a concept promoted in the 1980s and 1990s. Now I ask, are our offices any less paperless today? I think not! So what have all these PCs and networks done for us? They make the amount of information we digest daily increase by a factor of 50,000 or more (provided a picture is worth 1,000 words, what is a video worth? A 1,000,000 words?). Further, the information we see is filtered down to that information which is really important to us individually. So, our productivity and effectiveness is much greater than before. The information provided depends upon the PC, communications links, and servers gathering and filtering the information presented.

3.2 TECHNOLOGY AS A GROWTH FACTOR

Telecommunication basically is the transmission of signals over a distance for the purpose of communication, though the technology involved in communicating has changed significantly over the years. During ancient times smoke signal and drums were used to communicate over long distances. The advent of modern telecommunications took place during the late 18th and early 19th century. Today telecommunications is a highly technical industry, which is constantly evolving, and inventing technologies to improve the cost, coverage and quality of communication. It is one of the most R&D intensive-industries, with leading multinational corporations (MNCs) spending on average between 10 and 20% of their revenues in R&D in 2003 (MIT Technology Review, 2003).

The telecom-equipment market worldwide are growing at a rapid pace and competing globally for market share. The telecom infrastructure in both these countries has seen tremendous advancement in the past few decades. Echoing the market growth, most of the global leading telecom-equipment manufacturing firms have started their operations in China and India. This has facilitated the growth of infrastructure; however, it has a long way to go before the benefits of these technologies can reach every remote place in these countries.

3.3 DATA COMMUNICATIONS EVOLUTION

Any organization can be viewed as a large beast that performs useful functions for its customers as long as it is fed dollars of sales. Today, organizations also must be fed technology to live long and prosper. New technologies must be incorporated into business operations at a dizzying rate to assure an organization's competitive edge. The real difficulty here is that a technological edge like weaponry superiority is fleeting. Consequently, organizations must continually seek new technologies to maintain their competitive standing in their market.

One single piece of technology is driving this revolution in computing and telecommunications technologies—the microprocessor, or the computer on a chip. Its implementation into small desktop personal computers has caused a major restructuring of the computer industry. Companies that led the computer industry for years have suddenly found their major market

strength is no longer strength but rather a boat anchor. New companies created solely from PC-related products dominate American business today. Old networks were based upon providing access to mainframe computers from terminals or later PCs spread throughout an organization. IBM's System Network Architecture (SNA) and Digital Equipment Corporation's DECnet were the dominant networking architectures. These are now labeled "legacy networks." Today's networks focus on PC LANs as the building blocks for enterprise-wide communications. In less than twenty years' time, the tinker toy PCs has broken apart the traditional role of computers in organizations. Also, these PCs reshaped the telephone and entertainment industries.

In the battle between computers and telecommunications, the computer people controlled centralized mainframe computers that provided information services—accounting, inventory management, and sales monitoring—to management. The computer people were powerful because the organization believed that they understood computers and that computer were complex machines. IBM promoted this image in its vain attempt to maintain its monopoly in the computer industry. In 1987, IBM made a marketing mistake. They introduced a proprietary PC following their traditional strategy for monopolizing the computer industry. It failed. In 1995, IBM announced the demise of its micro-channel architecture PC. IBM is now the fourth-ranked PC manufacturer worldwide today.

The future of computers and telecommunications was shaped by a war between PC software rivals. It began with Microsoft and Novell. Each had technical and market strengths in different areas. Microsoft dominated PC operating environments, while Novell dominated PC LAN software. Each saw the impending battle over PC market share focused around PC communications. The war started in earnest in 1995 with the release of Windows NT servers and Windows 95 clients. The Transmission Control Protocol/Internet Protocol (TCP/IP) communications software built into these Microsoft products takes PC communications to new levels. Today, the Microsoft vs. Novell war is over before it really began, and Microsoft won.

But, a new war is developing between Linux and the legions of Linux followers and implementers, and Microsoft and Windows. Further, Microsoft is fighting on another front to dominate PC access to the Internet. The justice department monopoly litigation against Microsoft was started by Microsoft's competitive practices against Netscape, a rival Web

browser manufacturer. The winners here will play a significant role in shaping how we use communications and computers in the office and at home. Every company in the computer and communications industry understands that any company dominating the Internet and the devices that deliver the Internet to our homes and offices can become the monopoly IBM was in the computer industry of the 1960s through 1980s.

Turf wars in the telecommunications industry are continuous. The goal for every organization is to become the company that delivers one device, one network, and the information and entertainment services everyone uses. PCs today are migrating toward one universal communications application, the Web browser! Microsoft has integrated into the Windows Internet Explorer the ability to view desktop publishing files produced by Microsoft Word. The Internet Explorer also permits users to listen to music. With Windows, active desktop news and other information is delivered to the desktop in video form as well. However, regardless of how integrated Microsoft's products are, Microsoft dominance of the PC is not assured. So, computer communications turf battles continue.

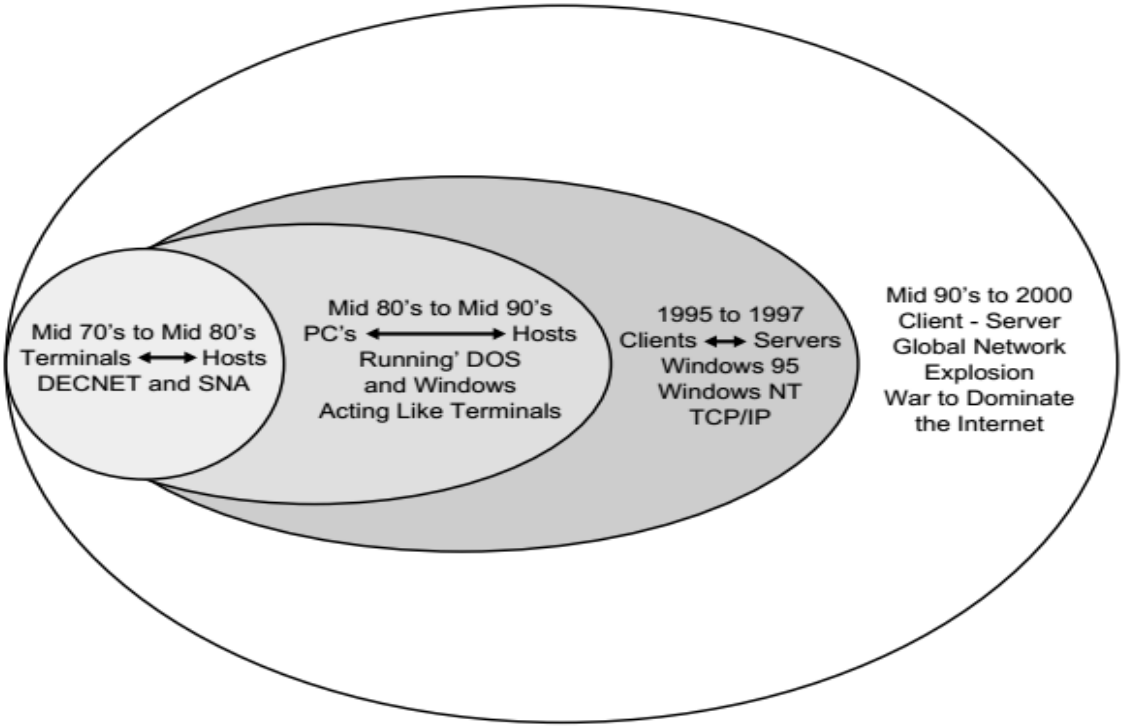

Figure 3.2 *Data communications evolution*

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3.4 LAN EVOLUTION

Local Area Networks have played a significant role in effectively integrating PCs and communications into the workplace. The need to easily and quickly share files and printers was obvious in the early days of PCs (the early 1980s).

The first LANs emerged in 1983. Most businesses began connecting their PCs together with a network to facilitate sharing of financial and administrative data and collaboration on special projects. These LANs soon provided backbone communications for businesses. Today virtually every PC is connected to a LAN or some other form of communications to permit file and printer sharing and to provide email service and more sophisticated group collaboration on business projects.

Soon LANs will play a significant role in the home. Households with an old and a new PC are networking them together. As PC prices fall lower still and the number of PCs in a household increases, more households will have a LAN. Specialized PCs will be added to perform specific functions; for example, the entertainment center-controlling PC that plays MP3 music, records video for later viewing, and gathers the news like a newspaper for us to read at our desired down time. A LAN interconnects regular workstation PCs with specialized PCs and the Internet. This makes 24/7 function possible. For example, when backing up critical household data, most PCs today use PBB (Prayer-Based Backup—praying that nothing fails). However, offsite backup using connections over the Internet are now being offered. What makes these services and technologies possible is the LAN connectivity between PCs in a single facility or campus area. Connecting these business and household LANs to the Internet with high-speed transmission links opens the door to diverse information services and capabilities.

- There are four key areas competing to provide high-speed LAN access to the Internet. They are:
- Cable modems—the first services out of the chute and being championed by AT&T and all cable television companies.
- Digital Subscriber Lines (DSLs)—A service promoted by the telephone companies. This looks to be the big, early competitor of cable modems.

- Radio Frequency (RF) broadband distribution—these services are easy to deploy via satellite or terrestrial links. We should see them in the next several years.
- Electrical power network links—these are the last dark horse competitor. Since there is good copper wire into every house, why let it go to waste?

3.5 THE INFLUENCE OF PC TECHNOLOGIES

PC CPU, RAM, and disk technologies are quickly advancing. The PC itself is rapidly becoming our home communications and entertainment appliance. For example, PCs are quickly becoming the music systems in our homes. Attach amplified speakers to a PC playing an MP3 and it rivals the music produced by the best home entertainment systems today. Soon they will exceed their capabilities. IBM's technical break-through in disk storage technology announced in March 2000 can increase disk storage capacity 100 times from current capabilities. This can have a profound impact in the amount of information retained by PCs at home and at work. It can also mean that every work of art, every movie, and every book ever written can be available on-line across the Internet.

Microcomputer technology pushes convergence because as computer speeds, storage capacities, and communications speeds to the Internet improve; they are not only used for word processing, Web surfing, and email, but also for increased voice and video communications. The common applications that we run in the future will be video/voice conferencing, voice recognition, and graphic editing. Microcomputers are simply the one-stop communications appliance of the present and the future.

3.6 TELECOMMUNICATIONS FUTURE

Tele-computing has several implications. The first is that it should be tailored to the person at work or at home. The goal is to serve employees and residential users. This means it is end-user-driven. Technology must not be cumbersome. It must be very easy to use. Further, it must be reliable. Once people count on these PC-based devices for all their information needs, the

devices and supporting networks cannot ever fail. Our PCs will become video telephones, using flat panel displays that can be hung on any wall. PCs will also become more portable and wearable. They must, however, have a more reliable operating environment than Windows 95/98/ME and even Windows 10. We will have special-use systems aimed at a primary function or two. They will be small but have big displays and make loud sounds. The most important PCs will be wearable and part of our garments, just as many cell phones are worn on the hip today.

3.7 THE FUTURE OF TECHNOLOGY AND ITS CONTRIBUTION TO THE GROWTH OF THE TELECOMMUNICATION INDUSTRY

Technological innovations in 3G mobile technology is capable of delivering broadband content that includes rich multimedia services such as video calling, video on demand, location based services and remote access / VPN applications. Also next generation technologies such as LTE (Long Term Evolution), Mobile WiMAX or 4G networks are expected to drive the wireless services in the future. Applications such as IPTV and Mobile TV will be the beneficiaries of such technological innovations.

For next generation 4G mobile phone networks in China, LTE will be the technology deployed, predicts market analyst In-Stat (Richard Wilson, 2009). Chinese telecom companies such as Huawei are investing considerable resources in the development of LTE technology and have been involved with LTE research and development since 2004 and as of July 2010 had “been awarded 14 LTE commercial contracts and more than 60 LTE trials (USCC, 2010).

Investments in Broadband by the telecom companies are growing rapidly in India. The Department of Telecom in the Indian government has formulated the Broadband Policy 2004, which envisions the creation of a framework through various access technologies such as optical fiber, digital subscriber lines (DSL) on copper loop, cable television networks, satellite media, terrestrial wireless and future technologies(Ernst and Young, FICCI, 2011).

According to Booz & Company (2010), it is estimated that a 10% increase in broadband penetration translates to a 1.5% increase in labor productivity in a country. Also, a 10% increase in broadband penetration leads to a 1.3% increase in GDP (INTUG, 2010). This shows that an

investment in technology does translate to the growth of the revenues in the telecom industry as shown in the results obtained in the previous chapter. Both China and India, irrespective of their policies and regulations benefit from technological innovations.

3.8 AREAS OF APPLICATION OF COMPUTER IN TELECOMMUNICATION

- **VIDEO CONFERENCING**

  Video conferencing is a tool used for business and pleasure. Many companies offer free video conferencing software available to download online. A video conference allows two or more individuals to see each other and speak as though they were talking in person. It is used to complete business deals and by families and friends in different places.

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- **FILE SHARING**

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- **ROUTING**

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3.9 DATA COLLECTION METHOD

The data in terms of contents used for this project were compiled from internet repository such as;

- Google search engine.
- Past researchers work.
- Internet repository.
- Portable document format (PDFs)