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Table of Abbreviation

Abbreviation	Full Form
WAN	Wide Area Network
ATM	Automated Teller Machine
LAN	Local Area Network
TCP-IP	Transmission Control Protocol- Internet Protocol
IGRP	Interior Gateway Routing Protocol
KbPS	Kilobits Per Second
KBPS	Kilobytes Per Second
VC	Virtual Circuit
GSM	Global System for Mobiles
LTE	Long Term Evolution
WAP	Wireless Application Protocol
GPRS	General Packet Radio Service
EDGE	Enhanced Data GSM Environment
UMTS	Universal Mobile Telecommunications System
TDMA	Time-division multiple access
CDMA	Code Division Multiple Access
SMS	Short Message Service

1.1. Introduction

The coursework of Networks and Operating System is given to research and write a technical report about GSM Technologies. GSM stands for Global System for Mobiles. GSM technologies include mobile communication and cellular technologies. Here in the technical report, we are supposed to explain both the Mobile Communication and Cellular Technologies in details.

The history of mobile communication, about cellular radio and advantage and disadvantages of mobile communication is described in this task. Also the cellular technologies GSM to LTE through 1G, 2G and 3G is explained in this task with details. Also different Wireless Communications methods are described in detail. Wireless communication includes WAP, GPRS, EDGE, UMTS etc. which are all explained in this task of the coursework.

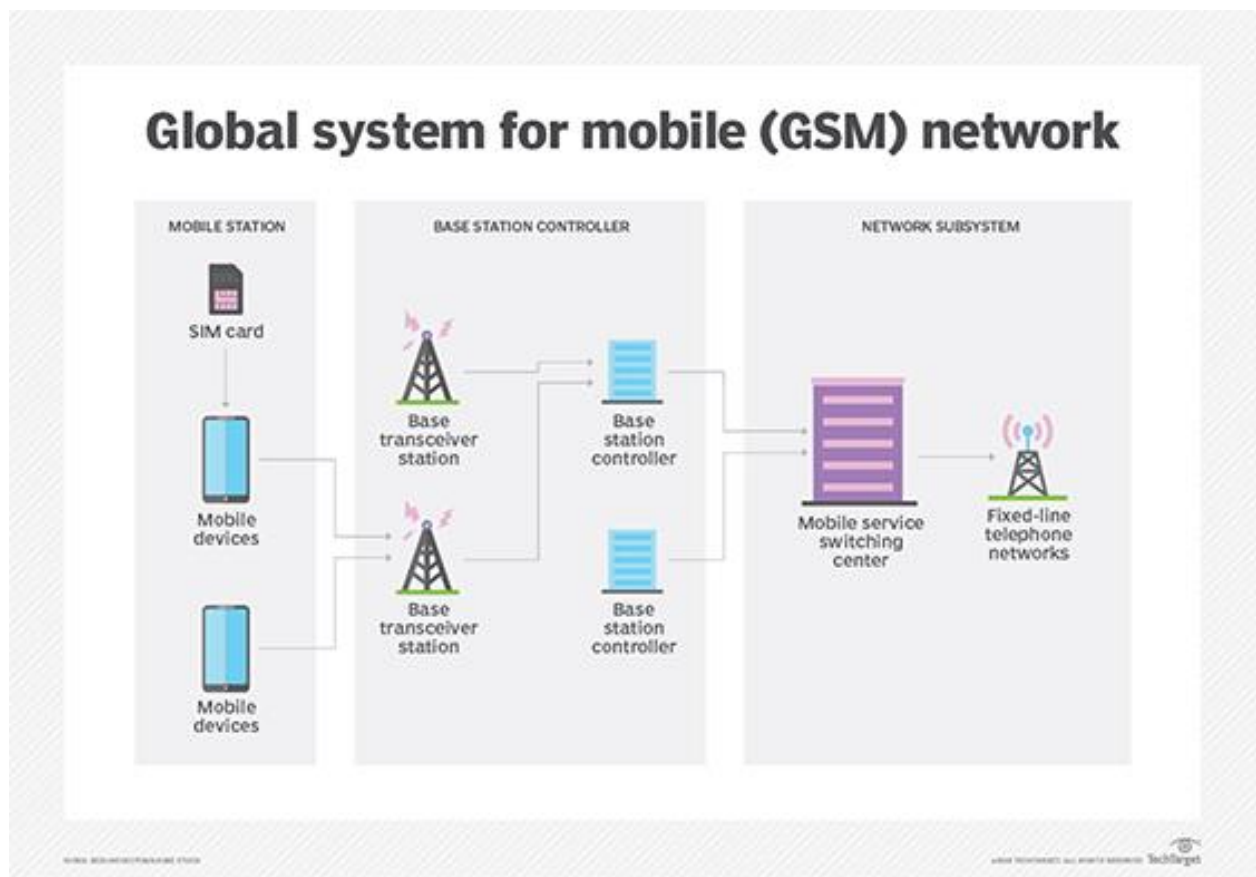


Figure 1 GSM Network (Rouse, 2019)

1.2. Background

Students are supposed to go through books, journals, industry white papers, research outputs of organisation, and web resource materials to do research and understand all the necessary terms of GSM Technologies. So that the report written by students will be genuine to study. The report has limitation of 2000 words, so students are challenged to write meaningful short and sweet report of all the terminologies used in GSM Technology.

1.2.1. Mobile Communication

Mobile communication is the technology which allows people located in different location to communicate without any physical or wired connection. It has made our life easier, one can send information from one pole of the world to another pole within minutes via mobile communication. Mobile communication is evolving day by day and has become a must have for everyone. (Macwan, 2017)

Mobile communication converts voice to electrical signal to nearest base station, then the station sends data to the nearest base station of the receiver and converts digital or analogue form to the voice. A mobile phone is an example of mobile communication. It is used for full duplex two way radio telecommunication. (Stuber, 1996)

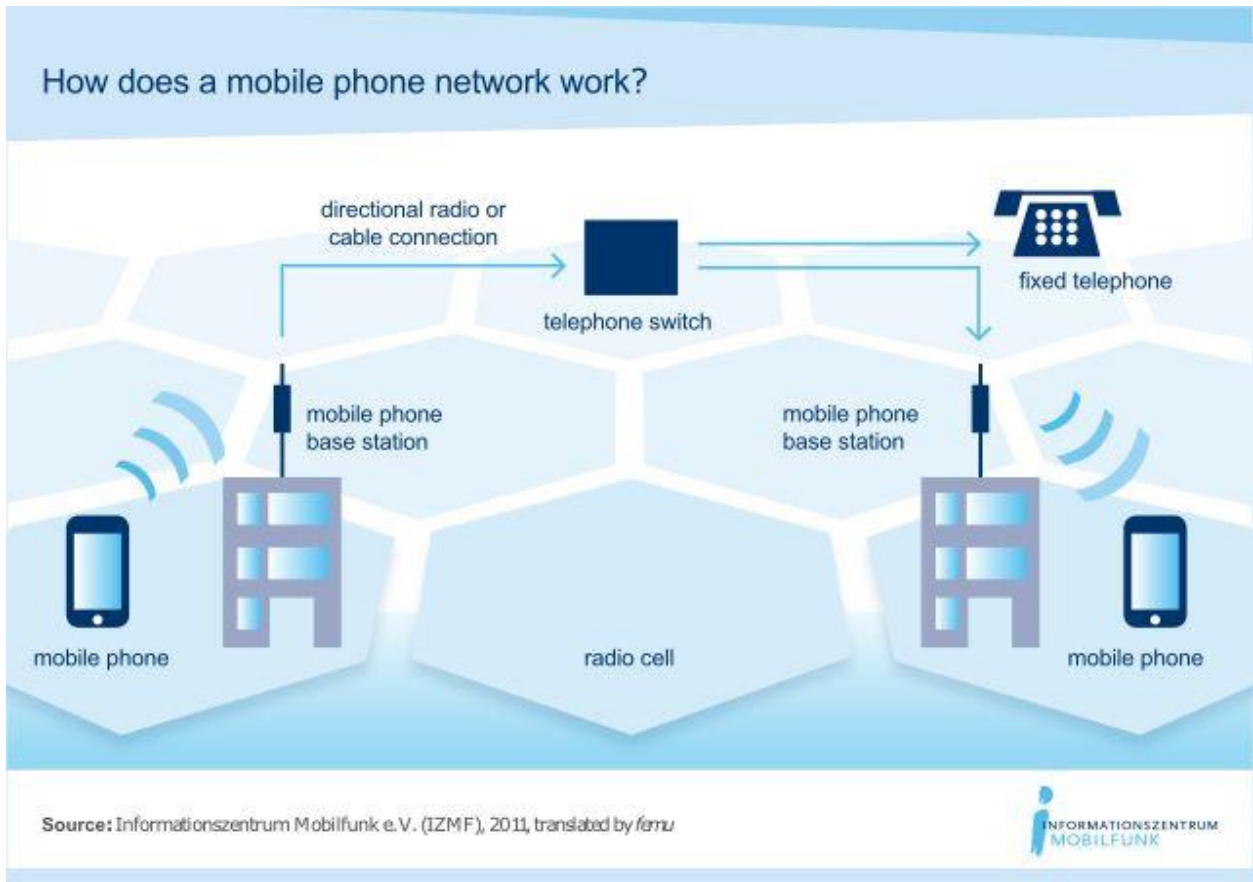


Figure 2 Schematic illustration of the principle of a cellular phone network (EMF-Portal.org, 2019)

1.2.1.1. History

The first mobile telephone system was launched in 1946 by Graham Bell in St. Louis USA. Early mobiles used to use single high power transmitters with analogue frequency modulation techniques to get coverage of up to 50 miles. So the initial telecommunication service was limited to certain area, radius.

To overcome this problem of small coverage because of bandwidth, BELL Laboratory introduced cellular concept which eventually give better coverage in large area. Even though Bell Laboratories introduced cellular services, the first commercial use of cellular services was introduced by Nordic Mobile Telephone in 1981 AD. Then after few time,

new mobile systems were developed which used FDMA technology. They are also known as First Generation System.

One of the deficiency of analogue systems was the lack of functioning with other systems. So in order to overcome this and enable cross border roaming on higher lever, the GSM technology was initiated by combining private and public companies. 1990 was the year when phase 1 of the GSM specifications was released. Then in 1991, GSM service was launched for commercial purpose. In 2004, GSM subscriptions reached 1 billion.

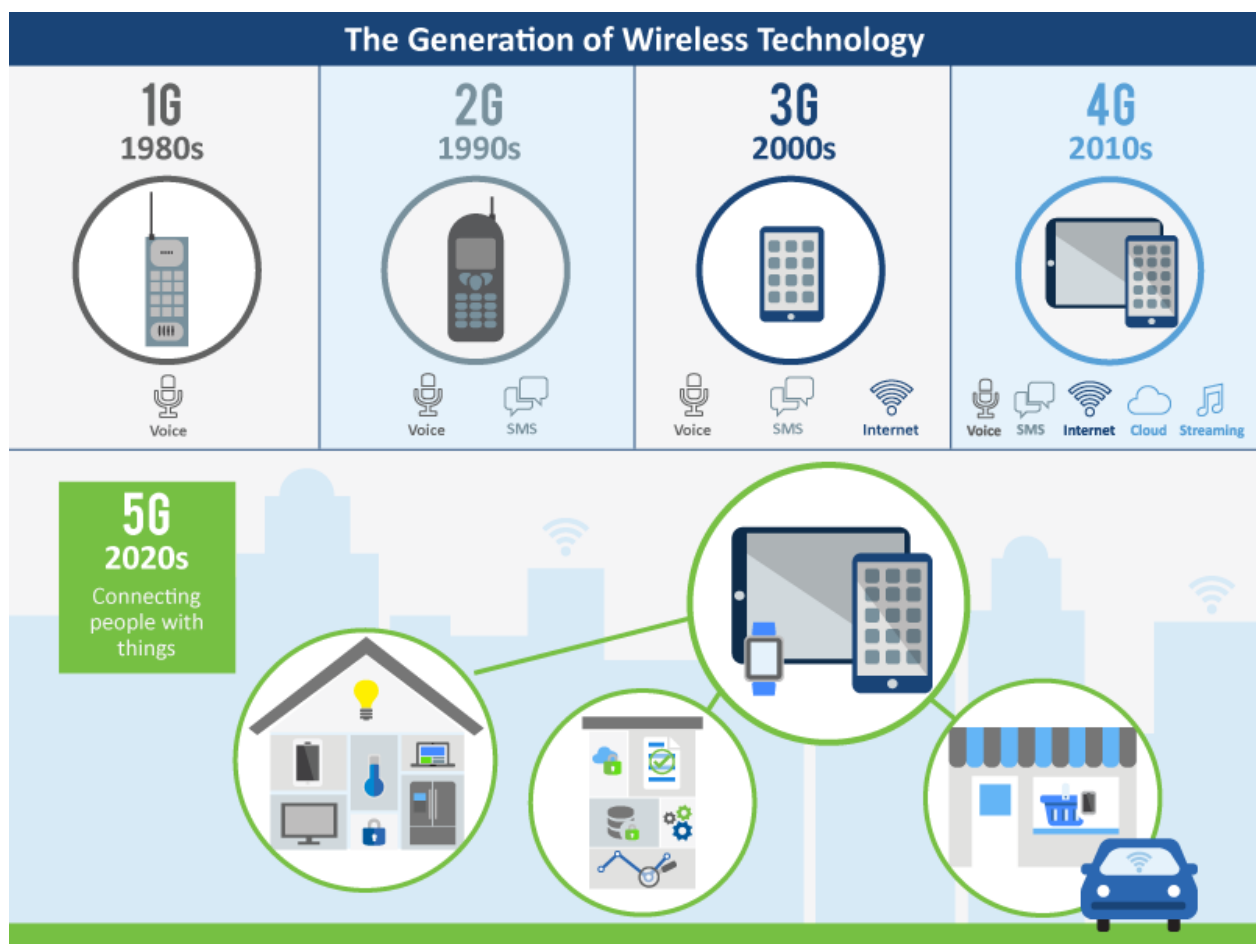


Figure 3 the history of mobile communication (Julie, 2016)

1.2.1.2. Cellular Radio

Cellular Radio is a network distributed over land areas, each served by at least one fixed location transceiver. The land areas are known as cells and transceivers are base stations. The base stations provide the network coverage to cell which can be used for the transmission of voice, data and other types of content.

Since there are many cells in different locations, when joined together, they provide the radio coverage over a large geographical area, enabling number of devices like mobile phones, tablets, laptops which are equipped with modes to communicate with each other and any device anywhere in the network.

Cellular networks provide a number of desirable features, it gives more capacity than a single large transmitter since same frequency can be used for multiple links. The devices use less power from a single base station since cell towers are closer. The cell towers can be added as much as wanted giving the network, a large coverage area.

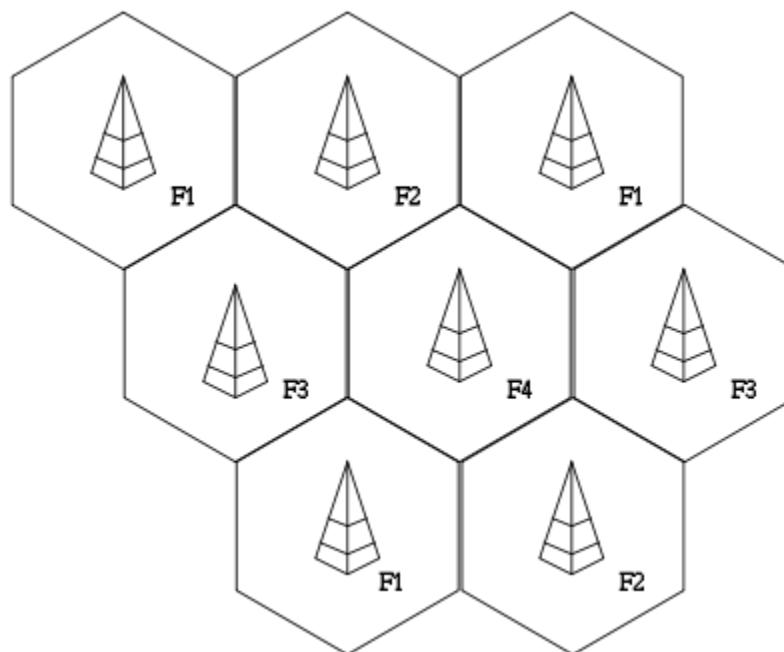


Figure 4 Cellular Radio Network Cells (Munir, 2005)

In cellular radio system, a land area where radio service should be supplied, is divided into number of cells. Cells may be of hexagonal, square, circular or

irregular cells. Each cell have radio base stations and cell is assigned with multiple frequencies. Different frequencies are used in adjacent cells. Each cell has a base transceiver. The transmission power is carefully controlled to allow communication within the cell using a given frequency. To objective of this technology is to use same frequency in other cells, allowing frequency to be used for multiple simultaneous conversations.

1.2.1.3. Advantages and Disadvantages

There are so many advantages of Mobile Communication. It helps in communicating with people all around the globe. It has brought people together. Anyone can go online with your mobile devices and reach across the world. It makes your work easy and makes you become more productive and efficient. It allows people to share resources with each other. People can send files from one device to another. Here are some advantages of Mobile communication technology in business:

- Allow us to retrieve information quickly.
- Quality and flexibility.
- Increased ability to communicate in and out of the workplace.
- Greater access to modern apps and services.
- Ability to accept and provide payments wirelessly.

Despite of advantages, there are some downsides of mobile communication too. It may pose different security difficulties like hacking, leak of data etc. Privacy issues may arrive while using services of mobile communication. So one must be very aware while using the communication technologies. Following are some disadvantages of mobile technology:

- Workplace Distractions.
- Increased IT Security issues.
- Less focus in workflow.

1.2.2. Cellular Technologies

Cellular technology refers to having many small interconnected transmitters instead of one big transmitter. It is widely used and is based upon the concept of frequency re-use by the application on a series of coverage of small interconnected transmitters. There are many different types of cellular technology.

1.2.2.1. GSM

GSM refers to Global System for Mobile Communications. It is the digital mobile network that is widely used by mobile phone users in the world. GSM uses a variation of time division multiple access and is the most widely used technology among TDMA, GSM and CDMA. GSM phones allow you to simply switch SIM cards and use another GSM device. GSM provides standard features like phone call encryption, data networking, caller ID, call forwarding, call waiting, SMS, and conferencing. (Digital Monitoring Products, 2014)

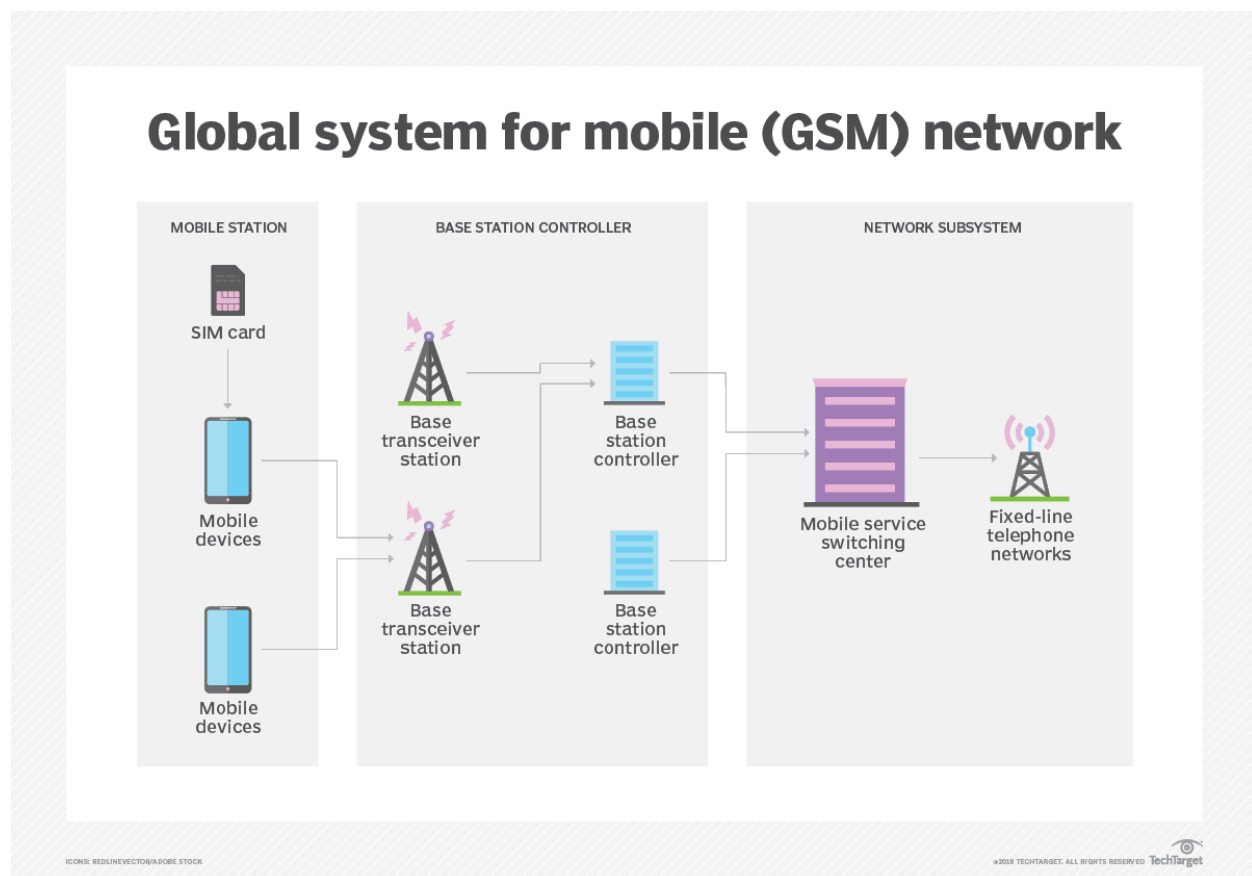


Figure 5 GSM Network

GSM operates in the 900 MHz band (890 MHz - 960 MHz) in Europe and Asia and in the 1900 MHz (sometimes referred to as 1.9 GHz) band in the United States. It is used in digital cellular and PCS-based systems. GSM makes use of TDMA technique to transmit signals. GSM uses encryption to make phone calls more secure, it provides SMS for text messaging and paging, it allows call forwarding, waiting and multi-party conferencing. GSM supports more than one billion mobile subscribers in more than 210 countries occupying the total 70 percent market share in world's digital cellular subscribers.

Years	Events
1982	Conference of European Posts and Telegraph (CEPT) establishes a GSM group to widen the standards for a pan-European cellular mobile system.
1985	A list of recommendations to be generated by the group is accepted.
1986	Executed field tests to check the different radio techniques recommended for the air interface.
1987	Time Division Multiple Access (TDMA) is chosen as the access method (with Frequency Division Multiple Access [FDMA]). The initial Memorandum of Understanding (MoU) is signed by telecommunication operators representing 12 countries.
1988	GSM system is validated.
1989	The European Telecommunications Standards Institute (ETSI) was given the responsibility of the GSM specifications.
1990	Phase 1 of the GSM specifications is delivered.
1991	Commercial launch of the GSM service occurs. The DCS1800 specifications are finalized.
1992	The addition of the countries that signed the GSM MoU takes place. Coverage spreads to larger cities and airports.
1993	Coverage of main roads GSM services starts outside Europe.
1994	Data transmission capabilities launched. The number of networks rises to 69 in 43 countries by the end of 1994.
1995	Phase 2 of the GSM specifications occurs. Coverage is extended to rural areas.
1996	June: 133 network in 81 countries operational.
1997	July: 200 network in 109 countries operational, around 44 million subscribers worldwide.
1999	Wireless Application Protocol (WAP) came into existence and became operational in 130 countries with 260 million subscribers.
2000	General Packet Radio Service(GPRS) came into existence.
2001	As of May 2001, over 550 million people were subscribers to mobile telecommunications.

Table 1 History of GSM technologies (Tutorials Point, 2019)

1.1.1.1. 1G, 2G, 3G and LTE

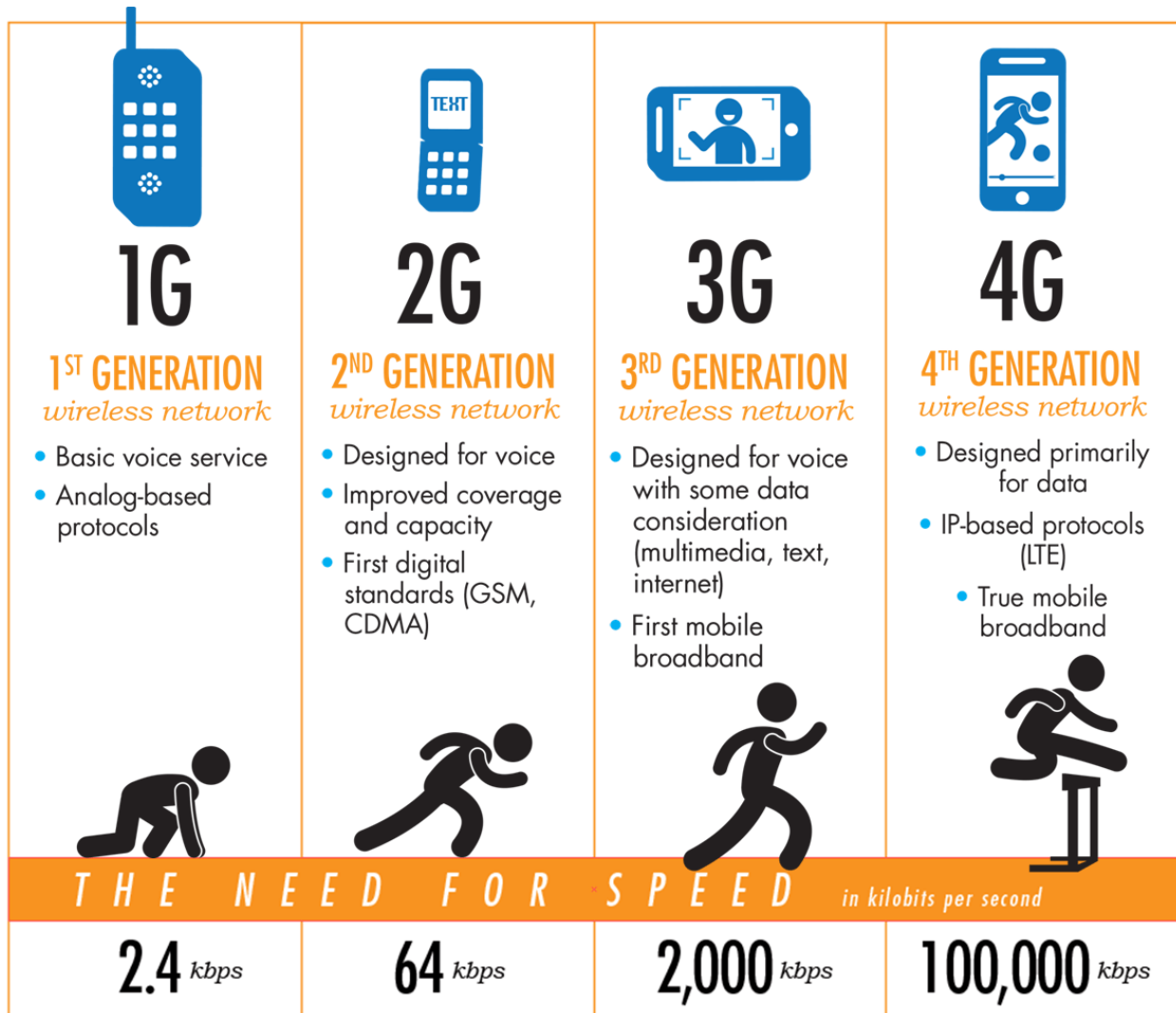


Figure 6 Comparison between 1G 2G 3G & 4G (Team, 2019)

1G is the first generation of wireless cellular technology introduced in 1980s. It is analog technology having the maximum speed of 2.4 Kbps supporting voice only. The phones using 1G used to have poor battery life and voice quality.

2G is the second generation of cellular technology introduced in around 1991. It took cell phones from analog to digital communications. 2G featured multiple users on a single channel. The maximum speed of 2G with GPRS technology is 50 Kbps.

3G is the third generation of wireless mobile telecommunications technology introduced in 2001. It is the upgrade for 2G networks, it introduced higher transfer rates up to 2Mbps.

4G is the fourth generation of networking, released in 2008. It supports mobile web access like 3G does and also gaming services, HD mobile TV, video conferencing, 3D TV, and other features that demand high speeds. The maximum speed of 4G Networks is up to 60Mbps.

LTE stands for Long Term Evolution and often called 4G LTE, introduced in 2009. LTE provides true broadband speeds in comparison to 3G offering low latency and high network capacity. The maximum speed of LTE is 50 Mbps. (Gibson, 1996)

1.1.1.2. Wireless Communications

Data communication performed and delivered wirelessly is called wireless communications. This is a broad term that incorporates all procedures and forms of connecting & communicating between two or more devices using a wireless signal through wireless communication technologies and devices. (Techopedia, 2019) The different forms/technologies of wireless communication are described below:



Figure 7 Wireless Communication technology connecting a City

1.1.1.2.1. WAP

WAP stands for Wireless Application Protocol, is a worldwide standard for providing internet communications and accessing information over a wireless network. WAP is a standardized technology for cross-platform, distributed computing very similar to the Internet's combination of Hypertext Mark-up Language (HTML) and Hypertext Transfer Protocol (HTTP).

1.1.1.2.2. GPRS

GPRS refers to General Packet Radio Services which is a packet based wireless communication service on 2G and 3G cellular communication systems. It is a non-voice, high speed and useful packet switching technology intended for GSM networks. IT provides a steady internet connection to computer and mobile users. GPRS offers maximum speed of 171.2 kbps, providing instantaneous and steady connections, which permit data to be sent wherever and whenever required. (Rahman, 2013)

1.1.1.2.3. EDGE

The EDGE network stands for Enhanced Data Rates for global Evolution. It is a third generation mobile data technology. EDGE is a faster version of GPRS and theoretically, it provides maximum speed of 473 kbps but EDGE network has an average speed of 75 to 135 kbps. In order to use EDGE network, both phone and network must support EDGE else phone will automatically connect to GPRS. EDGE is also known as 2.75G. The advantages of the EDGE network were more marked before the widespread implementation of 3G networks. It is four times as efficient as a GPRS network. (Geoff Sanders, 2003)

1.1.1.2.4. UMTS

UMTS refers to Universal Mobile Telecommunications Service and is a third generation broadband, packet based technology. UMTS is based on the Global System for Mobile communication standard. UMTS offers maximum data rate capacity of 2048 kbps. Besides voice and data, UMTS will deliver audio and video to wireless devices anywhere in the world through fixed, wireless and satellite systems.

1.2. Conclusion

Finally the research is completed after doing lots of study and research. It started by writing about GSM technology which include topics like Mobile Communication and Cellular technologies. In mobile communication, its history, about cellular radio and advantages and disadvantages were discussed. And in cellular technologies part, GSM, 1G to LTE and different wireless communication technologies are described after going through many websites, research papers and books. In wireless communications, different technologies like WAP, GPRS, EDGE and UMTS are described in detail.