

Usage of Mobile Telecommunication Technologies in Communication

Cosmina-Georgiana Iorgoni

Abstract: *In this paper, I will discuss the topic of the evolution of mobile telecommunication technologies and its remarkable impact in communication. It is impossible not to observe the evolution of mobile telecommunication technologies and the way they evolved throughout the time. From the first demonstrated radio telecommunication of Guglielmo Marconi who marketed the first recognized long-distance wireless telegraph and in 1901 broadcasted the first transatlantic radio signal, to nowadays communication in space and wireless technology, I will pass through each generation of mobile telecommunication. They are called Generations, starting from Zero Generation to 5G, and this paper will show the advantages and improvements from one Generation to another. Mobility is the most crucial aspect in all forms of communication. It has become a necessity in private life or at work to communicate virtually and to facilitate the access to information and sharing.*

Keywords: *Mobility, Telecommunication Technologies, Generations, Wireless, Communication, Internet, Speed.*

1. Introduction

The main objective of this paper is to show the significant connection between technology and communication gained with the help of mobility in telecommunication throughout the years. The paper deals with the evolution of mobile generation technologies in the wireless communication, starting from Zero Generation to what is foreseen in the future with 5G. Mobility has become one important aspect in all types of communication, therefore mobile phone have become the most used tool in communication in recent years. The challenge is to find the right and appropriate technology for different applications and to continuously identify features that might influence the overall performance of them. Zero Generation known also as Mobile Radio Telephone System represents the generation prior to cellular phones. Last Generation, 5G, has not been officially communicated, but implies more features and development towards the user and not the operator, as opposed to what 4G brought into play.

2. Research method

2.1. Comparative analysis

The object of the research involves the analysis of the wireless technology of Zero Generation, 1G, 2G, 3G, 4G, and 5G, how everything developed throughout the years and the significant improvements seen in the mobile technology, using an analysis table to support the comparison. In this analysis, I will compare different features of each generation with the support of the companies who developed these technologies. Using exact examples, such as Nokia, Motorola, Samsung, and Apple, I will show how these companies have adapted up to today.

Analyzing the generations' development during time, I will highlight the important aspect of mobility and why the rapid worldwide growth in cellular phone users has increased over the years. For this purpose, I will use technical characteristics to show the major differences based on the research and bibliography that is included in

the paper. Mobile telecommunication technologies represent a continuous area under construction where newer wireless systems and standards will become better and better with the years. In communication, mobility came along with better and faster channels of communication, applications used at home or at work, where you now have the possibility of creating an internal platform for the employees, without external access and specific adaptations.

Wireless technology benefits are: increased efficiency, rarely out of touch, greater flexibility for users, and reduced costs.

2.1.1. The Zero Generation – 0G

The Zero Generation or 0G is named this way because it was released prior to the mobile phones and the phones were usually mounted in cars or trucks. They were called mobile radio telephones systems. It operates on 160 MHz VHF band using frequency modulation on 160-162 MHz for the mobile unit and 168-170 MHz for base stations, and used different types of technologies that I will present in the table.

2.1.2. The 1st Generation – 1G

The first Generation represents the wireless telephone technology from 1980s-1990s. The improvements are significant from the previous generation, higher frequency of 150 MHz and above transmitted between radio towers, increased speed up to 2.4 kbps using Analog Signal and allowed the voice calls in 1 country. The disadvantages were the interfered distortions and that it was not secured. It was introduced firstly in North America, being known as Analog Mobile Phone System (AMPS) and in the rest of the world as Total Access Communication System (TACS).

2.1.3. The 2nd Generation – 2G

The second Generation used digital signal and was based on GSM (Global System for mobile communications) which is the international standard for mobile phones. The data speed was not up to 64kbps, with an improved time to download a 3min MP3 song: 31-41 min. It allowed digital voice calling and SMS. The improvements were voice quality

and secrecy and safety of the calls. Between 2G and 3G there was a 2.5 Generation, which is the General Packet Radio Service (GPRS) which supported services such as SMS mobile games.

2.1.4. The 3rd Generation – 3 G

The third Generation had a data transmission speed increased from 144 kbps – 2 Mbps and was also introduced together with Smart Phones. It fastened the data transfer rate and bandwidth for web-based applications and audio/ video files, video-conferencing, TV through internet support. With 2G there was no possibility for handling video. The target for this Generation was to allow more coverage and growth with minimum investment. With 3G the download time of a 3min MP3 song is 11sec-1.5min. For this generation there was also a middle generation called 3.5 G which involved High-Speed Downlink Packet Access (HSDPA).

2.1.5. The 4th Generation – 4G

There was a need for new adaptations in order to make 4G system functional: design of new terminals, location management (tracking of the device, authentication and information), handoff management – due to mobile client moving between its GSM networks to Wireless Fidelity. LTE was developed as part of 4G. This generation had the speed of up to 100 Mbps – 1Gbps. Fourth Generation applications includes: gaming, Internet of Things, Broadband access in Remote locations.

2.1.6. The 5th Generation – 5G

The fifth Generation is not yet in place and there is not yet an official statement related to it, but as a result of my research for this paper and what I have compared and learned so far from each Generation, I can present it in several sentences. As for the predecessors of 5G, the connection is built wirelessly and will ensure a faster and a more reliable connection. For this next generation higher speed and greater coverage are foreseen; for the download speed at 40 times faster than 4G is envisioned. All this features and improvements of 5G will be

extremely helpful for everything related to the Internet of Things, smart homes, self-driving cars. To support this new generation, several companies are involved: Nokia, Vodafone and for Romania, Digi Mobil.

2.2. Analysis of the Generations from a technical point of view

This analysis is intended to highlight both the advantages and the disadvantages of each generation of mobile telecommunication and its characteristics. As a starting point, I have used the generation Zero as presented in this paper, up to 5G, which represents the next Generation. The following table shows the results of a research on what already exists on the Market and which gathers all the important aspects of a successful analysis.

Technology Features	0G	1G	2G	3G	4G	5G
Developed	1950-1970	1970-1980	1990-2004	2004-2010	Now	Next generation - testing
Speed	Raw signaling rate 19.2 kbps	14 kbps	9.6/ 14.4 kbps	3.1Mbps 500-700 kbps	100-300Mbps. 3-5 Mbps 100Mbps Wi-fi)	Probably gigabits
Data Bandwidth	160 MHz VHF using frequency modulation 160-162 MHz for the mobile unit 168-170 MHz for base stations	2kbps	64kbps	2Mbps	1Gbps	Higher than 1Gbps

Frequency	160 MHz	Kbps800-900 MHz	850-1900 MHz (GSM) 825-849 MHz (CDMA)	1.8-2.5GHz	2-8GHz	testing
Technology	PTT, MTS, IMTS, AMTS, OLT, MTD	AMPS, NMT, TACS	TDMA, CDMA	CDMA 200 (1xRTT, EVDO) UMTS, EDGE	WiMax, LTE, Wi-fi	testing
Service	Public switched telephone network	Voice calls in 1 country	Digital Voice SMS Higher Capacity Packetized Data	Integrated high quality audio, video, and data	Dynamic information access, Wearable Devices	Dynamic information access, Wearable Devices with AI capabilities
Multiplexing	-	FDMA	TDMA, CDMA	CDMA	CDMA	CDMA
Switching	-	Circuit	Circuit, packet	Packet	All Packets	All packets
Main Network	-	PSTN	PSTN	Packet N/W	Internet	Internet
Features		Voice only	Allows multiple users on a single channel	Multimedia service support	HD, higher speed, worldwide roaming	Testing
Download and upload	-	-	Download : 31-41 min	5.8 Mbps	14 Mbps	Testing
Hand off	-	Horizontal	Horizontal	Horizontal	Horizontal & Vertical	Horizontal & Vertical
Mobile TV Resolution	-	-	-	Low	High	Ultra High

3. Results

The next example represents an analysis of the evolution of a mobile company which was developed during the generations of mobile telephones. In this paper I will present Motorola's evolution phones,

according to the characteristics presented in the table above and their important model in the development process of mobile phones worldwide. They were the first ones that presented a mobile phone on the market.

- It all started with Motorola DynaTAC – 1983, it was the first portable phone, but that weighed more than 2 pounds, with a screen type LED, using technology AMPS.
- First mobile phone for Europe using GSM – International 3200 with screen type: monochrome and using GSM technology.
- Motorola 4500X – 1986 had the characteristic of being transportable and using AMPS technology.
- Motorola MicroTAC – 1989 represents the next generation, lighter and smaller, Motorola MicroTAC 9800x had plastic antenna, form factor: clamshell
- Motorola International – 1992: first digital mobile phone.
- In the evolution of mobile phones there was a break for Motorola, but in which lots of series were developed such as: A series, C series, E series, Eagle, Condor, Falcon series which brought the Android.
- Noticeable in the evolution of mobile phones is Motorola Razer – 2004, thinnest smartphone, only 7.1mm thick.
- Motorola Flipout – 2010: the completion was already on the market and the development of the new normal smartphones.

As a conclusion, it can be said that for the development of Motorola there were products which innovated the world, their new functionalities were seen as a big improvement for the industry of mobile phones, but looking at this industry nowadays we can see that the leaders on the market are no longer Motorola, but Apple, Samsung, LG or HTC, and others. They existed for some periods of time, but the adaptation to changes was not seen by the user useful, while other companies came with adaptations and offered better support in the development of mobile generations and how mobility is seen now.

4. Expert sources consulted

The topic presented in this paper is part of the digital media field, highlighting the tremendous evolution of the usage of mobile telecommunication technologies in communication. Consolidating this point of view, the bibliographic sources I have used are mostly electronic sources, but also printed documentation received from engineers specialized in telecommunication and GSM. In the dissertation paper there will also be included some theoretical aspects and official statements related to the communication field.

5. Conclusion

Based on the theoretical elements from the sources I have consulted, on my research and studies made together with some engineers and with the help and support of the theoretical points I have learned during my course on Telecommunication Technologies, I have analysed the Generations, starting from Zero to what is envisioned and is currently testing with 5G. While current technologies are being rolled out, other researches have already started for the next generation. Always one step ahead.

In communication, mobility is a key factor to the end user. In this paper, the main focus was on mobile phones, but without a doubt, tablets or other gadgets are from the same category of mobility in telecommunication. The most visible impact can be seen in our daily life, in the way we communicate and in the applications developed throughout the time to help us ease the communication. Now the latest mobile phones allows an employee to work from everywhere and anytime with an easy access to the servers and to be in constant contact with urgent decisions that needs to be made.

Bibliography

1. Furniyuki, Adachi, *Wireless past and Future: Evolving Mobile Communication Systems*, IEICE Trans. Fundamental, Vol.E84-A, 2001.

2. Haard Mehta, Darpit Patel, Bhaumik Joshi, Hardik Modi, *0G to 5G Mobile Technology: A Survey*, Journal of Basis and Applied Engineering Research, 2014.
3. Mishra, Ajay R., *Fundamentals of Cellular Network Planning and Optimization*, John Wiley & Sons, Ltd, 2004.
4. Pereira, Vasco, Sousa, Tiago, *Evolution of Mobile Communications: from 1G to 4G*, Department of Informatics Engineering of the University of Coimbra, Portugal, 2004.
5. Stuber, Gordon L., *Principles of Mobile Communication*, 3rd edition, Springer, 2012.

Webography

1. <http://ijcsit.com/docs/Volume%206/vol6issue03/ijcsit20150603123.pdf>, accessed at 24.03.2018.
2. <http://www.clear doubts.com/technology/technologies-used-in-0g-zero-generation-or-mobile-radio-telephone-system/>, accessed at 24.03.2018.
3. <https://networks.nokia.com/5g>, accessed at 24.03.2018.
4. <https://www.thesun.co.uk/tech/3050992/5g-next-generation-mobile-network-technology/>, accessed on 01.04.2018.
5. <https://www.slideshare.net/jincy-a/generation-of-mobile-communication-systems>, accessed at 24.03.2018.
6. <https://www.slideshare.net/shocking393/wireless-technology-10-68253268>, , accessed on 25.03.2018.
7. <https://www.uswitch.com/mobiles/guides/history-of-mobile-phones/>, accessed at 24.03.2018.
8. <http://www.clear doubts.com/technology/what-is-mobile-radio-telephone-system-or-0g-and-what-is-0-5g/>, accessed at 24.03.2018.
9. chrome-extension://laookkfknpbbblfpciffpaejjkokdgcga/dashboard.html, accessed at 24.03.2018.
10. <https://www.history.com/topics/inventions/guglielmo-marconi>, accessed at 24.03.2018.

Glossary

PTT = Push to talk

MTS = Mobile Telephone System

IMTS = Improved Mobile Telephone Service

AMTS = Advanced Mobile Telephone System

OLT = Norwegian for Offentlig Landmobil Telefoni "Public Land Mobile Telephony"

MTD = Swedish abbreviation for Mobile Telephony system D

AMPS = Advanced Mobile Phone System

NMT = Nordic Mobile Telephone

TACS = Total Access Communication System

FDMA = Frequency Division Multiple Access

TDMA = Time Division Multiple Access

CDMA = Code Division Multiple Access

PSTN = Public Switched Telephone Network