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ANALYSIS OF WIRELESS COMMUNICATION NETWORK FROM 0G TO 5G WITH THE FUTURE PERSPECTIVES

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ABSTRACT

Wireless communication systems are extremely important in modern society for applications such as entertainment, industry, industrial, health, and safety. These technologies continue to evolve from one generation to the next, and fifth-generation wireless systems are now being deployed all over the world. In this article, I will discuss the development of generation for wireless communication networks, as well as importance and advantages over one another. Also highlight the application of machine learning in 5G wireless communication network. The evolution of mobile wireless technology has accelerated in recent decades. With the goal of improving quality of service, reliability, and performance, wireless communication systems have progressed from zero generation wireless network to 1st, 2nd, 3rd, 4th generation and now 5thgeneration wireless network. Machine learning is poised to play a significant part in bringing the 5thG vision to life, given the network's emerging complexity such as automatic self-driving automobiles, are being introduced, factory robotics, augmented actuality, eHealth, and a wide range of intelligent

Keywords: **Machine learning, 5G Wireless communication, eHealth**

1. INTRODUCTION

The objective of this article is to address the evolution of versatile interchanges from its origin, first generation (1G) to fifth generation 5G. The aim of this paper is to look at how flexible interchanges have evolved from 1G, 2G, 3G, and 4G to 5G. Since the early 1970s, the mobile wireless industry has been developing, revolutionizing, and evolving technology. The cellular connectivity industry has seen exponential growth since the mid-1990s. The first generation (or 1G) of mobile wireless communication networks is analogue and only used for phone calls. The second generation (2G) is a new technology that allows for instant

messages. Then came 3G, which offered multimedia capabilities as well as faster data transfer speeds and improved storage. The fourth generation (also known as 4G) combines 3G and wired broadband to provide wireless broadband internet. This is an evolution to solve the shortcomings of 3G while simultaneously improving QoS, increasing bandwidth, and lowering resource costs [1].The 5G network ushers in a true wireless future the Wireless World Wide Web (WWWW).We discuss a computational model for 5G and demonstrate how machine learning methods are used and played a part in each layer of the model. We look at supervised and unsupervised learning, Reinforcement Learning, and Deep Learning (DL).

2. ZERO GENERATION (0G) WIRELESS NETWORK

Zero generation or pre-cellular System which came after Second World War. The wireless technology was started with pre-cellular system (0G). Someone connect the calls and there were only few channels available for used. Devices was not supported other application like frequency change etc. This generation used MTS, IMPS, PTT, manual connected, AMTS, and OffentligLandmobilTelefoni were among the technologies used in the zero Generation system. They differed from older closed radio telecommunications networks in that they were available as a private service on the (PSTN) a public switched telephone network, with their personal tele-phone number. These telephones were usually connected in buses, truck or cars and called car phones. Before the invention of cellular phones, certain people had radio telephones in their vehicles in the 1970s. Radio Common Carriers, Wire line Common Carriers, AKA telecommunications providers, and two-way radio vendors were the sales channels Loggers,

building foremen, realtors, and actors were among the first consumers they were mostly used for speech communication.

3. FIRST GENERATION (1G) WIRELESS NETWORK

1G refers to the first generation wave of cell phone technologies, also called wireless telecommunications system, which was launched in the 1980s and competed in the 1990s. Japan presented Nippon Telephone &Telegraph (NTT) in Tokyo, Japan, launched world's first mobile system that time.The two most well-known analogue systems in Europe were the (N.M.T.) Nordic Mobile Telephone and the Complete access Communications System TACS in the United Kingdom was presented and in other countries like Portugal, South Africa and

West Germany was used C450, Spain – TMA, France used Radiocom 2000 and Italy RTMI. NTT (Nippon Telegraph and Telephone) established three codes, TZ-801,802,803. Other analogue networks were also adopted throughout Europe in the 1980s. speech was put into code as analog radio signals in first generation (1G) wireless systems was set up via call up. The key distinction between these two generations of mobile cellular phones is Audio transmissions on 1G networks were analogue, while audio transmissions on 2G networks were fully digital. Only higher frequencies, such as 150 MHz and above, are modulated in 1G. It had a speed of up to 2.4kbps [2]. It enables voice calls within a single region. Low bandwidth, unstable handoff, weak voice connections, and no encryption are the key drawbacks of First Generation mobile networks. Rendering them vulnerable to unwelcome. In the United States, AMPS was the first 1G norm to be introduced in 1982. The federal Communication Commission assigned the AMPS system a 40 (forty) MHz bandwidth (BW) within the 800/900 MHz frequency spectrum (FCC). AMPS was given an extra 10 MHz of bandwidth in 1988, known as extended spectrum (ES). Here figure 1 shows the development of all generation with speed and years.

The following are some of the benefits of 1G technology

(i)Analog-based framework (ii) only voice call (iii) Low speed up to 2kbps (iv) Cordless telephone

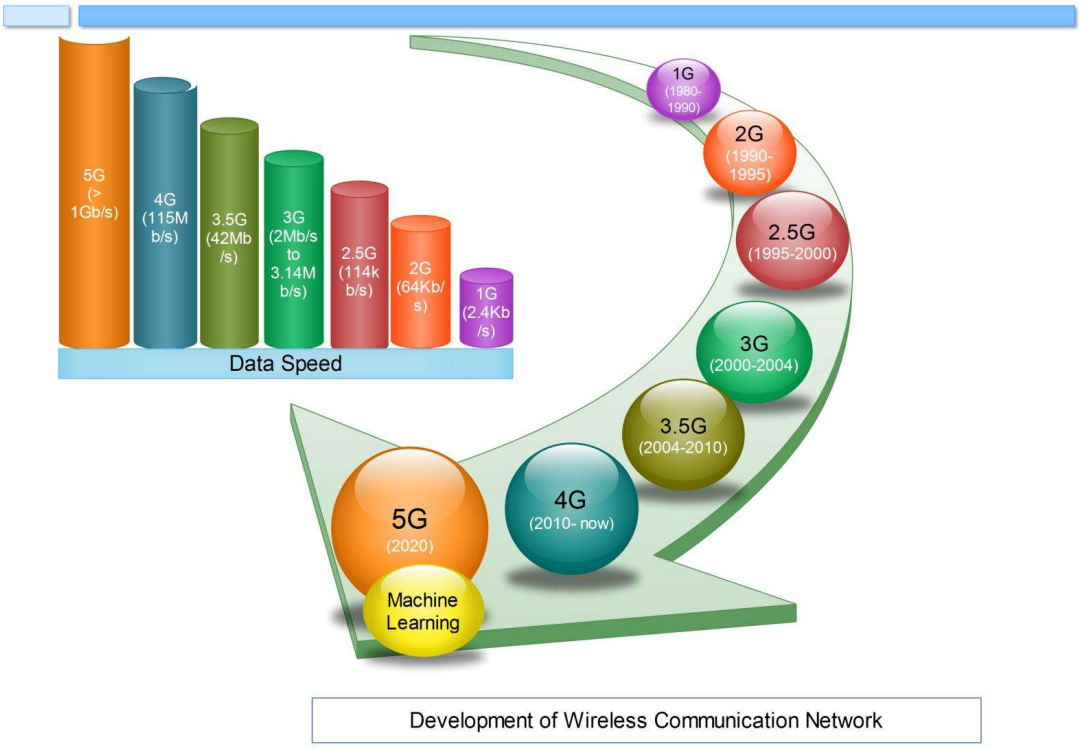

Figure 1. Development of wireless network from 1st G to 5th G with years and data speed

4. SECOND GENERATION (2G) WIRELESS NETWORK

In 1990-1995, 2G launched data communications for smartphones, starting with small Message Service plain text-based calls, and networks became far more effective on the frequency spectrum, making for much higher levels of mobile phone infiltration. Different cell phone networks are enabled by 2G technologies. In Finland, Radiolinjaor Elisa Oyj commercialized 2ndG cellular communication networks based on the group special mobile (GSM) standard in 1991. GSM, PDC, iDEN, and iS-136 are examples of TDMA technologies in 2nd G time. GSM was the first two-gigabit per second system. IS-95 is the standard for CDMA technology. Group Special Mobile (G.S.M.) is a technology that emerged in Europe. GSM is the world's most common mobile technology standard with over 212 countries using it. Universal roaming between cell phone networks is very popular due to the GSM standard, which enables customers to use their phones in a variety of locations throughout the world. In the 900 bands and 1800 MHz bands, GSM employs TDMA to multiplex up to eight calls per channel's is capable of delivering circuit switched data at

speeds of up to 14.4kbps in addition to voice . The (Digital AMPS) North American Standards IS-54 and IS-136 were 2nd generation (2G) telephone networks that used Time DMA with some time slots in each 30 kHz band, allowing for three digitally wrap calls in the same bandwidth as a single analogue call in the last AMPS standard [3]. It was once common in the Americas, especially in the US and Canada, where AT and T and Rogers mobile networks introduced the first commercial network in 1993. IS-95 techniques was the first Code-DMA based wireless cellular network system

The following are some of the benefits of 2G technology

(i) Text messages, image messages, SMS and MMS are all possible with it (ii) Signals are digitally encoded, which increases speech quality and lowers line noise (iii) Improved Spectrum Efficiency, Enhanced security, better quality and capacity (iv) Voice and data service (v) Framework cap has been increased, as well as network coverage.

(a) 2.5G: It's called GPRS, because it's a 2G system with a packet switched and a circuit switched domain (General Packet Radio Service). GPRS is an extension to the current 2G network that enables packet-based applications to be launched while also rising the traffic speeds provided by these networks. GPRS is a packet-oriented mobile data protocol that is used on GSM-based 2G and 3G cellular networks (GSM).The European Telecommunications Standards Institute (ETSI) developed GPRS in response CDPD and packet-switched cellular architectures were previously used. The Third generation partnership project is now in charge of its upkeep. HSCSD, GPRS, and EDGE technologies were used with database AUC, EIR, HLR and VLR, to have 56 kilo-bps to 384 kilo-bps data speeds for GPRS. It provides WAP connectivity, multimedia messaging service, and internet networking facilities like electronic mail and (WWWW) World Wide Wireless Web.

(b) 2.75 G (or EDGE):2.75G is also called “enhanced data rates for G.S.M. evolution”. In year 2000, E.D.G.E. is a more advanced GSM's latest edition. It enables the transmission of data and information in a clear and timely manner GPRS networks became EDGE networks with the launch of 8 phase shift keying encoding. While the symbol rate stayed the same at 270.833 samples per second, each symbol now had three bits instead of one. EDGE, also called Enhanced G.P.R.S. or IMT Single Carrier, is a wireless cell phone technology that allows for maximum data transfer speeds.

5. THIRD GENERATION (3G) WIRELESS NETWORK

The third generation (3rdG) was first released in the early 2000s. Its position is based on the work of the "International telecommunication union" (I.T.U.), which proposed a global frequency band in the 2000 MHz range to facilitate a single, standardized wireless communication protocol for all countries worldwide. 3G technology has a data rate of at minimum 144 kbit/s. after 3rd G present, often represented as 3.5 and 3.75 generation, also grant smart mobile phones and cellular modems in desktop and computers with wireless broadband access of many Mbit/s. This guarantees that it can be used for mobile speech telephony, video calls, Internet access, and TV technologies and fixed wireless Internet access. CDMA 2000 is the result of 3rdG evolution for Code division multiple access.IS-95 and IS-95B technology are used in CDMA 2000 models. GSM's 3G evolution is IS136, while the PDC System contributes to wideband Code DMA (W.C.D.M.A.). W-CDMA or Universal Mobile Telecommunication Service (U.M.T.S.) is a GSM planted technology. CDMA 2000 and W-CDMA will continue to be the most popular 3G technologies. By identifying a mobile device that follows the IMT-2000 norm, the third generation collaboration project (3-GPP) has continued this work. 3G systems provide a wider variety of more modern capabilities to customers while also increasing network capability through increased spectral performance.

(a) 3.5G or HSDPA: 3.5G is also called High-Speed Downlink Packet Access. A common term for 3rd G enhancements to have high-speed data spreading out above the basic wide-band code division multiple Access's 384 Kilo-bps downlink and 64 (sixty four) Kbps uplink (WCDMA). (H.S.D.P.A.) High speed downlink packet accessare3.5G technologies.

(b) 3.75 G or HSUPA: 3.75G is also called as high speed uplink packet access (H.S.U.P.A.). It is an enhanced form of the 3rd G network that includes high speed packet access plus. (HSPA+). This system would gradually be replaced by LTE, a more robust 3.9G system.

The following are some of the benefits of 3G technology.

(i)Streaming audio and video has been improved (ii) Several times faster data transmission. 3G networks can deliver speeds of up to 3Mbps.(iii) Multimedia applications such as video and photography are supported.(iv) Higher-speed, web WAP browsing and more security (v) Broadband with Large Capacity (vi) Global Positioning system or GSM , mobile television, phone calls, and live video conferencing are examples of value added services.

6. FORTH GENERATION (4G) WIRELESS NETWORK

4G technology is essentially an extension of 3rd G wireless network, offering more (BW) bandwidth and extra services than 3rd G. 4th G wireless communication network are emerging technologies that are chiefly in their early stages of development. L.T. E is widely marketed as 4th G -LTE, but at the time of its first listing in the 3 GPP update paper series for LTE Advanced [4] . It did not fulfil the technological specifications of a 4G wireless service. WiMax has become synonymous with 4G due to the aggressive with advanced new launches, it faces and evolves. In 2009, it was communally launched in Norway and Stockholm, and in 2011 by Verizon in their freshly acquired 700 MHz bands in the United States. The 4G technologies are expected to provide upraised attribute audio and video delivery over the Internet Protocol end-to-end. In comparison to 3G, 4G offers more services. The ambition of 4G is to add high-quality, high speed internet data services while also improving network security and internet data services over IP. MIMO (multiple inputs multiple outputs) and OFDM are the primary technologies employed (orthogonal frequency division multiplexing). 3rd G wireless technology has a peak speed of 2 Mega-bps. However, depending on your carrier, the area of the mobile base station, overpopulation, and other factors, you may receive data speeds from 500 Kilo-bps to 1.5 Mega-bps. The maximum speed of the 4G network for fast movability communication is 100Mbits/sec (like cars, bus and trains). The speed of low mobility communications (such as pedestrians or stationary) is 1Gbits/sec.

The following are some of the benefits of 4G technology

(i)High Speed, more security, high capacity (ii) Access the internet, streaming media, and video conferencing with ease. (iii) Exceptional spectral efficiency (iv) Provide any type of service to users at any time and in any place (v) High QoS and low cost per bit.

7. FIFTH GENERATION (5G) WIRELESS NETWORK

Wireless connectivity that is almost unrestricted. In 5th Generation wireless systems, Customers will benefit from ultra-fast internet and multimedia experiences thanks to 5G's innovative technology. In the future, present 4th G LTE foremost network will be upgraded to high performance 5th G network. 5G technology will transmit data using millimeter waves and unlicensed spectrum to achieve higher data rates. The rapid adoption of mobile phones and smart devices (wearable's, sensors, and actuators) is causing massive data traffic in wireless

networks. Furthermore, internet-based technologies like ultra-high-definition video communication and transmission, live cascade, enhance reality, real time video calling, live video–audio conferences, and civil networking networks are constantly increasing the amount of data available. This increase in data traffic puts a strain on the spectrum, causing spectral quality to suffer [5]. It is now a challenge for academic and industrial researchers to create new technologies that make effective use of the spectrum. Figure 2 shows the challenges of 5thgeneration wireless technology [6]. A potential alternative is the 5G wireless network, which is currently being researched and will be commercialized in 2020. TABLE 1 shows the comparison between 1G to 5G wirelesses technology with their parameters.

Table 1: Comparison between 1G to 5GTechnology.

Features	**1st G**	**2nd G**	**2.G or GPRS**	**3rd G**	**3.5 G or HSDPA**	**4th G**	**5th G**
Standards	NMT,AMPS, TACS, IMTS	FDMA, CDMA TDMA	GPRS, HSCSD	CDMA 2000, TDSCDMA, W-CDMA	HSDPA, HSUPA, HSPA+	WiMAX, LTE, Wi-Fi	SINGLE UNIFIED STANDARD
Type of Switching	Switching is circuit type	Packet Switching			All packet switching	Packet switching	All packet switching
Bandwidth	30kHz	900MHz		100MHz		100MHz	1000xBW per unit area
Channel Frequency	Analog Signal (30KHz)	1.8GHz	200KHz	1.6GHz	2GHz	2-8GHz	3-300GHz
Mechanics	Analog Signal Cellular	Digital signal Cellular (GSM)	2G with G.P.R.S.	CDMA UMTS EDGE	3G with Enhanced version	LTE, WiFi	4G+WWW MIMO, mm waves
Services	Only voice service	Digital Voice, SMS, MMS		Great Quality of Audio, video ,massage and data		Altering information access Smart devices for communication	Adjust data and information access Smart devices with Machine learning applications

The following are some of the benefits of 5G technology:

(i)Data transmission is faster than in previous generations.(ii) Global connectivity and service portability are provided by 5G technology (iii) wide broadcasting bandwidth up to Gigabit, supporting approximately 75,000 simultaneous connections (iv) Large phone memory, quick dialing, and audio/video clarity (v) 5G is a high-speed, high-capacity system that allows for large-scale data broadcasting at Gbps, Watch TV shows with the clarity of an HD quality, read multi-media newspapers.

Figure 2. Challenges of 5G wireless network

8. MACHINE LEARNING TECHNIQUES FOR FIFTH GENERATION (5G) WIRELESS COMMUNICATION NETWORK

Highly high data rates and fundamentally new technologies are anticipated in next generation wireless networks, necessitating a new wireless mobility system. The task at hand is to assist the transmission in intelligent adaptive wisdom and self-decision-making with the purpose that

the complex needs of coming generation wireless networks can be achieved. One techniques of Artificial intelligence methods for supporting smart radio terminals is machine learning. With the aid of advanced spectral efficiency learning and inference, future smart 5G mobile terminals are required to autonomously access the most meritorious spectral bands. By embracing a variety of upcoming networks with varying specifications, In the information and communication infrastructure market, 5th G is projected to be a major enabler and broadband provider. As a result of the need to keep up with today's growing smartphone traffic. With the network's increasing complexity and the emergence of upcoming use cases like self-driving vehicles, factory robots, virtual truth, eHealth, and a vast variety of intelligent technology, machine learning is expected to play a key role in bringing the 5G vision to life. Fifth Generation (5G) is a latest wireless communication technology being pursued by a number of scholars and scientists. The key claims of 5th G are that it will bring machine learning advantages to wireless communication networks and consumers. Deep Learning (DL) is main Machine learning technologies imagined as a critical technology for 5th G. For instance, in 5G, Deep Learning can choose which approach mark to attach and which property curb to use [7]. It's worth noting that, while Deep Learning (DL) can be nearly new successfully in allocate problems with promising effects, its use in wireless networks has yet to be explored. However, in this paper, I'll go through the different forms of machine learning methods, like deep learning, and how they could fit into future 5th G communication networks. Because of the recent growth in data size and use, maximum experts suggest that by upgrading the existing wireless networks from different directions, more attract should be put on reaching low-latency and goals for energy.

The Effect of Machine Learning on 5G Wireless Technology: Machine Learning is an arm of artificial intelligence that evolves algorithms and mathematical tool to meet a given work without the use of explicit commands, instead focusing on patterns and inference. Without being designed specifically for that purpose, to make forecasts or judgments, machine

learning algorithms generate mathematical established centered on data from a survey, called as training data. Learned signal processing (LSP) algorithms will inspire the future wireless network with drastic devaluation in energy burning and gains in throughput, density and precision as opposed to existing delicate and manually designed systems.

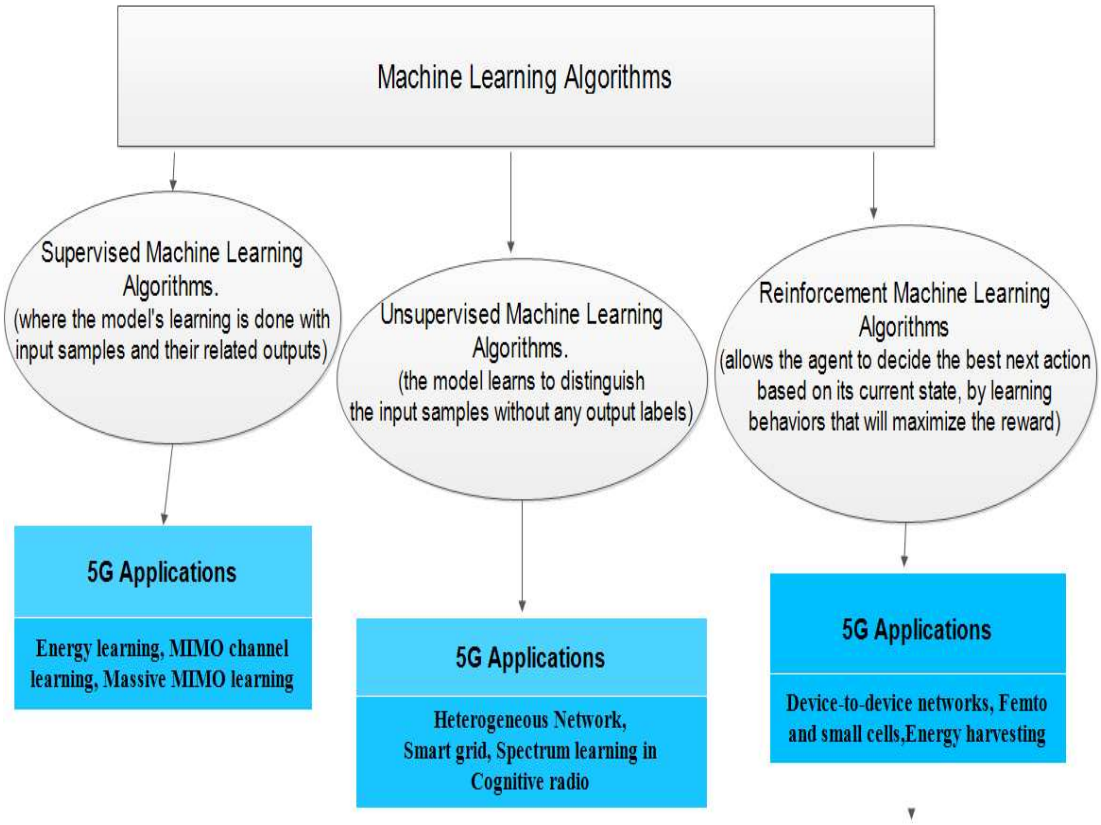

Figure 3: Machine Learning (ML) Algorithm with5G Application

Deep learning (D.L.) is a subset of machine learning where the algorithms are composed of several layers. Specific of which interprets the data differently. Artificial neural networks are the name given to the subsequent network of algorithms since it seems like the neural networks (N.N.) of the human brain. Learning neural networks (N.N.) that can efficiently connect despite their limitations are rapidly becoming a reality [8]. 5th G networks can be used to integrate machine learning and artificial intelligence into the network edge. 5th G allows many IoT (internet of things) devices to communicate at the same time, producing vast volumes of data that must be analyzed using machine learning. As machine learning (ML) and 5th G multi access edge computing (M.E.C.) are combined, and will be able to bring: (a) large levels of automation from scattered machine learning in the wireless network edges (b) directing traffic across networks depending on applications. ML has a lot of

potential for 5thG communications like enhanced—mobile- broadband (e-MBB), Massive-machine-type communications (m-MTC) and very small latency communications. Machine Learning is divided into three paradigms, which are referred to as: (a) Supervised Learning (SL) (b) Unsupervised Learning (UL) and (c) Reinforcement Learning (RL) [9]. Here Figure

3 shows the different machine learning algorithm with their application of 5th generation wireless communication network.

9. CONCLUSION

We addressed the key features, specifications, implementations, and complexities inherent in developing the 5thG of wireless mobile networking, which is intended to offer extremely fast data processing speeds and ubiquitous access through a wide range of devices. Presently, 4G networks relay data using Internet Protocol (IP) wireless access, which provide bed efficiency. To overcome the gaps in the 4th G network, we can make the 5th G network very smart by using machine leaning in the 5C network. 5G networks will also be constructive and predictive, it is essential for 5thG networks to become usable until they can be used. Because of the introduction of machine learning into 5thG wireless technology, the intelligent base stations (I. B.S.) would be capable to make their own decisions. Communication devices will be competent to create dynamically flexible clusters situated on the data collected. It would increase network application performance, latency and reliability.

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