

Review Article

5G Technology and Advancement in Telecommunication at Military Level

Anirudh Bhagwandas Rathi¹, Snehal Kalam²

¹Student, Department of EXTC, Thadomal Shahani Engineering College, Mumbai, Maharashtra, India

²Student, Department of ENTC, Maharashtra Institute of Technology, Pune, Maharashtra, India

***Corresponding author**

Anirudh Bhagwandas Rathi

Email: anirudhr3001@gmail.com

Abstract: 5G Technology (5th generation mobile technology) which denotes the next major phase of mobile telecommunication standards beyond the upcoming 4G standards. This upcoming technology will support IPv6 and flat IP. With 5G pushed over a VOIP enabled device, people will experience a level of call volume and data transmission never experienced before. Looking at the increasing demand for the speed, it has become very essential that we start investing time in 5G technology. As the customer become more and more aware of the mobile phone technology, he or she will look for a decent package all together including all the advanced features a cellular phone can have. Hence the search for new technology is always the main motive of the leading cell phone giants to out innovate their competitors. 5G technology will have it usage in field like military, smart housing, cooperate companies etc. In the present work we will be discussing the evolution of telecommunication from 1G to 5G. We will give brief information about all the generations and then focus on 5G technology. We will also discuss the problems faced by soldier due to present Telecommunication system and what recent efforts are made in order to overcome them. Due to the advantages of wireless transmission, safe wireless communication plays a significant role for safety related systems in military, industrial, medical and other safety related applications. It is said that if the planned 5G network is developed properly we won't need a 6G. Thus, giving undivided attention towards this technology can be a boon to mankind.

Keywords: 5G technology, spectrum, telecommunications, networks.

INTRODUCTION

5G is the short for fifth generation, a mobile broadband technology that is in the early stages of works and likely to be in place six to seven years from now. A 5G network will be able to handle 10,000 times more call and data traffic than the current 3G or 4G network. Data download speeds on 5G networks are likely to be several hundred times more than 4G. With 5G live gaming and real-time video streaming will be possible without any lags as data transmission happens literally in the blink of an eye. Those annoying video buffering during streaming sessions would disappear. The fifth generation wireless mobile multimedia internet networks can be completely wireless communication without limitation, which makes perfect wireless real world – World Wide Wireless Web (WWW). Fifth generation is based on 4G technologies. The 5th wireless mobile internet networks are real wireless world which shall be supported by LAS-CDMA(Large Area Synchronized Code-Division Multiple Access),OFDM(Orthogonal frequency-division multiplexing), MCCDMA(Multi-Carrier Code Division Multiple Access), UWB(Ultra-wideband), Network-LMDS(Local Multipoint Distribution Service), and IPv6 [1].

LITERATURE REVIEW

For many years exciting new developments in telecommunications have led to the success of increasing data rate and making it more users friendly.

Theodore Rappaport is the founder and director of NYU WIRELESS, one of the world's first academic research centers. He combined wireless engineering, computer science, and medicine. In his career, he founded two of the world's largest academic wireless research centers: the Wireless Networking and Communications Group (WNCG) at the University of Texas at Austin in 2002, and the Mobile and Portable Radio Research Group (MPRG), now known as Wireless@Virginia Tech, in 1990. He has advised or launched numerous high-tech companies in the wireless communications and computing fields, including Telephia (acquired by Nielsen), Motion Computing, Paratek Microwave (acquired by Research in Motion), and two university spin-out companies that developed some of the technologies now used in the wireless industry--TSR Technologies (acquired by Allen Telecom in 1993) and Wireless Valley Communications (acquired by Motorola in 2005). He has conducted pioneering research in the fields of wireless communications and smart antennas, most recently in

the field of millimeter wave wireless communication networks and 5G wireless.

XIAOHU GE is currently a professor with the Department of Electronics and Information Engineering at Huazhong University of Science and Technology (HUST), China received his Ph.D. degree in communication and information engineering. His research interests are in the area of mobile communications, traffic modeling in wireless networks, green communications, and interference modeling in wireless communications. He has published about 80 papers in refereed journals and conference proceedings, and has been granted about 15 patents in China [2]

RALF IRMER is currently leading Wireless Access Research in Vodafone Group R&D, United Kingdom. He joined Vodafone in 2005, where his major achievements were working with Verizon Wireless, China Mobile, and others to make LTE a global standard for meeting operator requirements. He defined the Wi-Fi and small cell strategies and the future wireless network blueprint for Vodafone. He was also responsible for proving key strategies in pre-commercial trials, such as LTE TDD, LTE-Advanced, and 3G/LTE/WiFi small cells including backhaul. He currently leads the 5G activities in Vodafone. He holds several patents, and has published over 30 conference and journal publications, covering coordinated multipoint, multiuser MIMO, relaying, heterogeneous networks, and quality of user experience.

Evolution from 1G to 5G

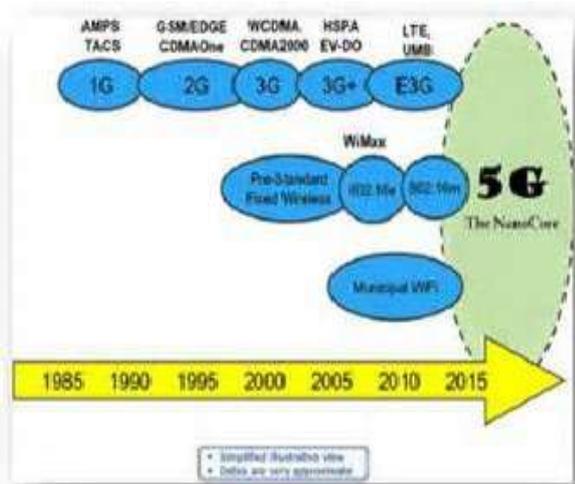


Fig. 1: Evolution from 1G to 5G

In 1945, the zero generation was introduced. Mobile Telephone Service was not officially categorized as mobile phones as they did not support the automatic change of channel frequency during calls. Then dubbed 1G, provided analog traffic channels and was designed to be an extension of the public switched telephone networks. Users with brick-sized cell phones placed and received calls in the same fashion as

landline subscribers. The most widely deployed 1G system was the Advanced Mobile Phone Service (AMPS), developed by AT&T. 1G (Time Division Multiple Access and Frequency Division Multiple Access) was the initial wireless telecom network system. In terms of overall connection quality, 1G compares unfavorably to its successors. It has low capacity, unreliable handoff, poor voice links, and no security at all since voice calls were played back in radio towers, making these calls susceptible to unwanted eavesdropping by third parties [3]. Cell phones era began with 1G. Then 2G evolved. Second-generation (2G) systems were developed to provide higher-quality signals, higher data rates for support of digital services, and greater capacity. Key differences between 1G and 2G networks include:-Digital traffic channels: The most notable difference between the two generations is that 1G systems are almost purely analog, whereas 2G systems are digital. In particular, 1G systems designed to support voice channels; digital traffic is supported only by the use of a modem that converts the digital data into analog form. 2G systems provide digital traffic channels. These systems readily support digital data; voice traffic is first encoded in digital form before transmitting. 2G and 2.5G were versions of the GSM and CDMA connections. And GSM is still the most popular technology. It is used by over 2 billion people across more than 212 countries [3]. GPRS, an additional service, is provided over GSM for the purpose of internet access. GPRS has been developed and thus, EDGE was created which is more secure and faster. Then came EDGE. It allows the clear and fast transmission of data and information. It is also termed as IMT-SC or single carrier. EDGE technology was invented and introduced by Cingular, which is now known as AT& T. EDGE is radio technology and is a part of third generation technologies. EDGE technology is preferred over GSM due to its flexibility to carry packet switch data and circuit switch data. The use of EDGE technology has augmented the use of black berry, N97 and N95 mobile phones. EDGE transfers data in fewer seconds if we compare it with GPRS Technology. For example a typical text file of 40KB is transferred in only 2 seconds as compared to the transfer from GPRS technology, which is 6 seconds. The biggest advantage of using EDGE technology is one does not need to install any additional hardware and software in order to make use of EDGE Technology. There are no additional charges for exploiting this technology. If a person is an ex GPRS Technology user he can utilize this technology without paying any additional charges.

Then came 3G, the objective of the third generation (3G) of wireless communication is to provide fairly high-speed wireless communications to support multimedia, data, and video in addition to voice. The dominant technology for 3G systems is CDMA. Although three different CDMA schemes have

been adopted, they share the following design features:—Bandwidth: An important design goal for all 3G systems is to limit channel usage to 5 MHz. There are several reasons for this goal. On the one hand, a bandwidth of 5 MHz or more improves the receiver's ability to resolve multipath when compared to narrower bandwidths. On the other hand, available spectrum is limited by competing needs, and 5 MHz is a reasonable upper limit on what can be allocated for 3G. Finally, 5 MHz is adequate for supporting data rates of 144 and 384 kbps, the main targets for 3G services.—Data rate: As mentioned, 144 and 384 kbps are the main 3G targets. Some 3G systems also provide support up to 2 Mbps for office use. A smart phone can be connected to a PC to share its internet connection and 3G and 3.5G are ideal for this. But, as this WCDMA technology is not available in all regions, it's not as popular as GSM yet.

The 4G mobile communication services are expected to provide broadband, large capacity, high speed data transmission, providing users with high quality color video images, 3D graphic animation games and audio services in 5.1 [4] channels. 4G systems provide ultra-broadband Internet access for a variety of mobile devices. 4G supports interactive multimedia services: Teleconferencing, wireless internet etc. It has wider bandwidth and higher bit rates with global mobility. 4G is entirely based on packet switching network which has digital element. It has simulation and analysis of MIMO techniques with multi element array antenna at both ends. Another way used to describe 4G is MAGIC—Mobile multimedia anytime anywhere, Global mobility support [4].

5G systems are still some years away (perhaps 2020) but likely 5G technologies are an area of active research. By 2020, the huge amounts of data traffic generated by tablets and smartphones will be augmented by an equally huge, and perhaps much larger, amount of traffic from the "Internet of things," which includes shoes, watches, appliances, cars, thermostats, door locks, and much more. With 4G, we may have reached a point of diminishing returns on network efficiency. There will be incremental improvements in the future, but significant increases in transmission efficiency seem unlikely. Instead, the focus for 5G will be on building more intelligence into the network, to meet service quality demands by dynamic use of priorities, adaptive network reconfiguration, and other network management techniques.

The gigantic array of innovative technology being built into new cell phones is stunning. 5G technologies which are on hand held phone offering more power and features than at least 1000 lunar modules. A user can also hook their 5G technology cell

phone with their Laptop to get broadband internet access.

As per the present status all over the world WCDMA is commercially launched. Some nations have planned to launch LTE within next quarter. Operator is looking ahead for wide-scale deployment of LTE in 2012. Operators will also find that the timing is right to make the switch because much of the first generation of 3G equipment will need to be upgraded soon. LTE networking equipment and handsets, already under development, will become available in 2010, and should be rolled out in large quantities in Europe by 2012 clearly shows that within 2020 LTE will become the latest trend for wireless communication all over the world. But yet our question remains unanswered. Why there is a need for 5G.

Even though LTE provides wide range of growth for present wireless telecommunication, people are not in a circumstance to make use of those benefits in an effective manner. LTE might be rigorously used in Commercial/Industrial areas. But think of a common man who utmost utilize LTE for downloading a movie or make a video call. Fact is that there is no such ground-breaking application exists in real world to be utilized by a common man. You might doubt how this verdict is applicable for current innovative world, where have enormous splendid real time applications. Concern is that our present wireless telecommunications is bottlenecked to use those applications in an effective manner.

Problems faced at military level due to current telecommunication technology

It is very necessary to have a strong network in order to stay connected during wars or disasters. The proper flow of information from one end to other has to be done flawlessly without any time delay. The current telecommunication technology has few flaws which should be rectified in order to stay aware and safe.

One of the major problems is the lack of network in forests and hilly regions. Though other means are available to communicate, nothing can replace a phone call now. It is nearly impossible for a soldier to connect to his troop from a valley or a form a middle of an ocean. Apart from this there are a few problem related to the GPS system as well. Due to current slow data rate there is a lag in the flow of information. Such lags can be accepted at domestic levels, but in order to track some missiles or any other explosive material the system has to be quick as possible.

Communication integrity is now one top challenge faced. New invention in this field still face challenges related to security and interoperability.

Message distortion is another primary concern. Due to the lack of strong networks few messages can be distorted. A slight different interpretation of those can have hazardous conclusions.

Solution and advancement in Telecommunications at Military Level

Scientists are currently working on devices which will have global connectivity. ViSat is trying to invent phone which will help soldiers to connect to their troops from any part of the world. A lot has been invented with respect to satellite phones. Iridium Communication came up with Iridium Go in order to come with signal issues in phones. Another satellite-rooted technology with down-to-earth communications potential is the Software Reconfigurable Payload (SRP), a collaborative effort between the Office of Naval Research (ONR), the Naval Research Laboratory and Marine Corps aviation. SRP plans to transform a small radio receiver designed for space applications and into a full-featured radio frequency (RF) system.

A mesh network can be a solution to many problems. Cutting-edge wireless networking technologies, potentially capable of supporting both JTRS and smart phone devices, are now arriving in the form of mesh networks, including mobile ad hoc networks (MANETs) that can provide virtually instant high-bandwidth networking capabilities for handheld radios, ground and airborne vehicle communications and security and tactical wireless sensors. The military is increasingly turning to wireless mesh networks technology for sensor-driven environmental control, yard management, and security and tactical applications. A mesh network provides continuous asset visibility from any location in the system's range.

In 2010, Camp Pendleton deployed a wireless mesh network technology developed by Mesh Dynamics for the base's Energy Management Control Systems and Automated Metering Infrastructure. The network is also used for monitoring wireless security cameras positioned around water reservoirs. The mesh network allows staff members to efficiently manage facility environmental services from a central control center instead of sending technicians into the field to perform routine management tasks. The approach saves time and money by allowing staff to fix small problems before they can grow into major crises. Wireless security video cameras set up around the 400,000-acre camp's reservoirs also save time and money by reducing the need for onsite inspections while simultaneously enhancing intruder detection.

As a tactical tool, MANETs can be used to transparently interconnect multiple mobile phones within a specified coverage area to provide greater bandwidth and better network connections. The technology can help convoys and other team-oriented

missions keep in constant communication over a wide array of terrains.

Ground Mobile Radios is another method. Ground mobile radios focuses on two basic network approaches: the Soldier Radio Waveform (SRW) and the Wideband Networking Waveform. The combined technologies allow secure networked communications among platoon, squad and team-level soldiers, as well as satellite connections back to combat commanders. Majority of the solutions and advancements requires higher bandwidth and faster data rate which can be provided by 5G technology. Such measures should be taken by military forces of every country.

CONCLUSION

The development of the mobile and wireless networks is going towards higher data rates and all-IP principle. It is expected that the initial Internet philosophy of keeping the network simple as possible, and giving more functionalities to the end nodes, will become reality in the future generation of mobile networks, here referred to as 5G.

Authors have discussed the problems faced by soldiers and what advancements are being taken in order to overcome the same. A strong 5th generation advancement can solve majority of these problem, thus it's essential we invent good chunk of research resources in this technology in order to be developed nation.

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