5G Mobile Wireless Technology

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Abstract: 5G Technology stands for the 5th Generation Mobile technology. 5G is a next major phase of mobile telecommunications standards beyond the 4G standards.5G is expected to provide speed upto 10Gbit/s, wider frequency band, high increased peak bit rate, high system spectral efficiency, ubiquitous connectivity and significant increase in QoS as compared to current 4G technology. Evolution of mobile communication technology to 5G is discussed in this review, followed by protocol stack and 5G architecture. A wide comparison is given between the various generations so as to compare why 5G technology is better and needed.

Keywords: MAC Layer; Network Layer; OTA; Cloud Computing.

I. INTRODUCTION

Mobile and wireless networks have made remarkable development in the last few years. At the present time, many mobile phones have also a WLAN adapter. One may expect that near soon many mobile phones will have Wax adapters. Here we are discussing the evolution of the different generations of communications their flaws and hence need for 5G technology, its architecture, advantages, and disadvantages.

II. EVOLUTION OF MOBILE COMMUNICATION

A)Classical 0G :
Wireless telephone started with 0G.Technologies used included MTS (Mobile Telephone System), PTT (Push to Talk), IMTS (Improved Mobile Telephone Service), AMTS (Advanced Mobile Telephone System), and OLT (Norwegian for Offending Landmobil Telefoni).

B. 1G: GSM
It replaced 0G technology. Data bandwidth up to 2kbps was provided. The technology used was analog cellular technology. Advance mobile phone system (AMPS) was first launched by the US and is a 1G mobile system. It allows users to make voice calls in one country. It featured mobile radiotelephones and such technologies as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT).

C. 2G:
2G cellular telecom networks were commercially launched on the GSM standard in Finland by Radio linja in 1991. It enabled the various mobile phone networks to provide the services such as text messages, picture messages, and MMS. It provided data bandwidth up to 64 kbps. This generation used Digital Cellular Technology.It is more efficient. 2G provided services like - Short Message Services (SMS), Digital voice, Higher capacity packetized data, Email. 2 types of modulation used in 2G are TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access). Now GSM is used in more than 212 countries in the world. GSM technology was the first one to help establish international roaming. The frequency band of 2G ranges from 850MHz-1900 MHz 2G includes 2G, 2.5G, 2.75G.

D. 3G (2004-2010)
Data bandwidth is up to 2Mbps. The technology used by this generation is EDGE, CDMA 2000. In this technology, clarity is increased due to the use of Wide Brand Wireless Network. Packet Switching technology is used for sending the data.

Access to Global Roaming and Clarity in voice calls. Fast Communication, Internet, Mobile T.V, Video Conferencing, Video Calls, Multi-Media Messaging Service (MMS), 3D gaming, Multi-Gaming etc. are also available with 3G phones.

E. 4G:

The basic feature of 3G Technology is fast data transfer rates. However, this feature is not currently working properly because ITU 200 is still making the decision to fix the data rates. 4G is in current use and is quite efficient. The technology used by 4G is WiMax LTE Wi-Fi. It provides data bandwidth of up to 1Gbps. Facilities provided by 4G are downloading speed up to 100 mbps, Multi-Media Newspapers, sending data faster than the previous generations, provide HD streaming, Global Roaming, Multimedia Messaging Service (MMS), Video calling, Digital Video Broadcasting (DVB), Location-based services, Mobile ultra-broadband (gigabit speed) access and
Multi-carrier transmission.

F. 5G:

It provides data bandwidth higher than 1Gbps. The technology used by this generation is WWWW (World Wide Wireless Web). The frequency band for this technology ranges from 3GHz-300GHz. 5G technologies include all type of advanced features that make 5G technology most powerful and in huge demand in near future. There is currently no standard for 5G deployments.

III. 5G NETWORKS

5th generation mobile networks or 5th generation wireless systems, abbreviated 5G, are the proposed next telecommunications standards beyond the current 4G/IMT-Advanced standards. 5G planning aims at a higher capacity than current 4G, allowing a higher density of mobile broadband users, and supporting device-to-device, ultra reliable, and massive machine communications. 5G research and development also aim at lower latency than 4G equipment and lower battery consumption, for better implementation of the Internet of things.

COMPARISION OF ALL GENERATIONS OF MOBILE TECHNOLOGIES

Technology → Features ↓	1G	2G	3G	4G	5G
Start/ Deployment	1970 – 1980	1990 - 2004	2004-2010	Now	Soon (probably 2020)
Data Bandwidth	2kbps	64kbps	2Mbps	1 Gbps	Higher than 1Gbps
Technology	Analog Cellular Technology	Digital Cellular Technology	CDMA 2000 (1xRTT, EVDO) UMTS, EDGE	WiMax LTE Wi-Fi	WWWW(coming soon)
Service	Mobile Telephony (Voice)	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 Packet	All Packet
Core Network	PSTN	PSTN	Packet N/W	Internet	Internet

IV. THEORETICAL FRAMEWORK
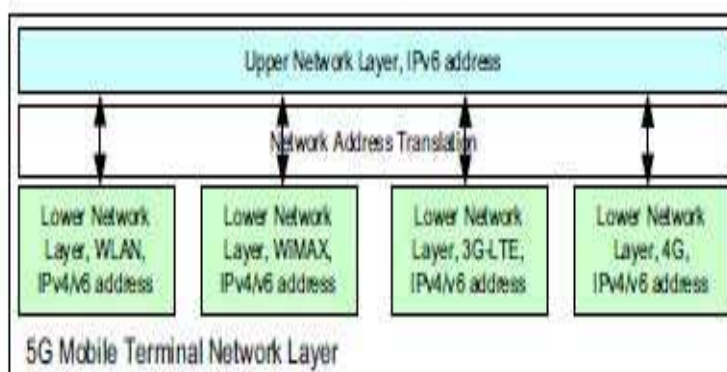## CONCEPT OF 5G TECHNOLOGY:

Protocol stack for 5G

Application Layer	Application (Services)
Presentation Layer	
Session layer	Open Transport Protocol (OTP)
Transport Layer	
Network layer	Upper network layer
	Lower network Layer
Data link Layer(MAC)	Open Wireless Architecture (OWA)
Physical Layer	

A. Physical/MAC layers
Physical and Medium Access Control define the wireless technology.For these two layers, the 5G mobile networks are likely to be based on Open Wireless Architecture.

B. *Network layer*
The network layer will be Internet Protocol (IP), as there is no competition today in this level. The IPv4 (version 4) is spread worldwide and has several problems like limited address space, has no real possibility for QoS support per flow. These issues are solved in IPv6 but traded with the significantly bigger packet header. Mobility still remains a problem. There is Mobile IP standard on one side as well as many micro-mobility solutions (e.g., Cellular IP, HAWAII etc.). All mobile networks are supposed to use Mobile IP in 5G, and each mobile terminal will be Foreign Agent (FA), keeping the CoA (Care of Address) mapping between its fixed IPv6 address and CoA address for the current wireless network. A mobile can be attached to several mobiles or wireless networks at the same time. In such case, it will maintain different IP addresses for each of the radio interfaces.

Upper Network Layer, IPv6 address	
Network Address Translation	
Lower Network Layer, WLAN, IPv4/v6 address	Lower Network Layer, WiMAX, IPv4/v6 address	Lower Network Layer, 3G-LTE, IPv4/v6 address	Lower Network Layer, 4G, IPv4/v6 address

5G Mobile Terminal Network Layer

C. Open Transport Protocol (OTA) layer

The mobile and wireless networks differ from wired networks with respect to the transport layer.
In all the TCP versions, the assumption is that lost segments are due to network congestion, while in a wireless network, losses can occur due to higher bit error ratio in radio interface. Hence, TCP modification and adaptations are suggested for mobile and wireless networks that retransmit the damaged or lost TCP segments over wireless link only. 5G mobile terminals will be suitable to have transport layer, which is possible to download and install. Such mobiles shall have the possibility to download (e.g., TCP, RTP etc.) version which is targeted to a specific wireless technology installed at the base stations.

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This is called Open Transport Protocol - OTP.

D. Application layer

Regarding the applications, the ultimate aim of the 5G mobile terminal is to provide intelligent QoS management over a variety of networks. Today, in mobile phones, the users manually select the wireless interface for particular Internet service without having the possibility to use QoS history, to select the best wireless connection for a given service.

V. 5G ARCHITECTURE –THE NANOCORE

THE 5G NANCORE IS A CONVERGENCE OF BELOW MENTION TECHNOLOGIES.

☐ Nanotechnology.
☐ Cloud Computing.
☐ All IP Platform

- NE - Nano Equipment (UE)
- AIPN –All IP Network
- NanoCore - Server

a.

b.
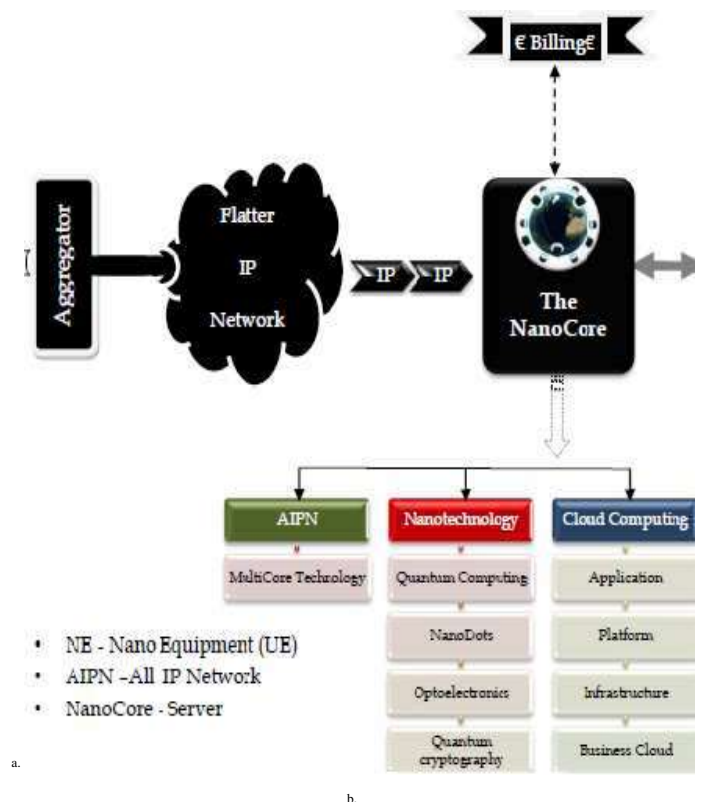
1) Nano Equipment (NE):

The mobile phone has become more than a communication device in the modern world and has turned into the identity of an individual. In 5G Nanocore, these mobile are referred as NanoEquipment as they are geared up with nanotechnology. One of the central visions of the wireless industry aims at ambient intelligence: computation and communication always available and ready to serve the user, in an intelligent way. This requires that the devices should be mobile. Mobile devices, together with the intelligence that will be embedded in the human environments – home, office, public places. It will create a new platform that enables ubiquitous sensing, computing, and communication Specs of NanoEquipments given as follow:

☐ Self-Cleaning: the phone cleans by itself

☐ Self-powered: the phone derives its energy/power from the sun, water, or air.

☐ Sense the environment: the phone will tell you the weather, the amount of air pollution present, etc.

☐ Flexible: bend but not break

☐ Transparent: "see through" phones

2) Cloud Computing

Cloud computing is a technology which uses the internet and central remote server to maintain data and applications. In a 5G network, this central remote server will be a content provider. Cloud computing allows consumers and business to use applications without installation, and access their personal files from any computer with internet access.

The same concept is going to be used in Nanocore, where the user tries to access his private account form a global content provider through Nanocore in form of cloud. It relies on the networks, requiring secure and reliable service providers. Operators can enter the cloud computing market, and create new value-added services and experiences by integrating industry content and applications in the digital supermarket model. This provides user's much more real-time application to utilize his 5G network efficiently. Secure and reliable service can be provided with quantum cryptography.

3) All IP Network
For converging different technologies to form a single 5G Nanocore we require a common platform to interact. Flat IP architecture act as an essential part of the 5G network. The All-IP Network is an evolution of the 3GPP system to meet the increasing demands of the mobile telecommunications market. To meet the customer demand for real-time data applications delivered over mobile broadband networks, wireless operators are turning to flat IP network architectures.

The key benefits of flat IP architectures are:
● Lower cost
● Universal access
● Improved user experience
● Reduced system latency
● Decoupled radio access and core network evolution.

CONCLUSION
As we expect an increasing pace of technological change, we need mobile communication system to increase in an accelerating rate. 5G is expected to provide high speed, higher connectivity, high system spectral efficiency, virtually 0 latency, more software option to upgrade, less battery consumption and highly reliable. The 5G technologies include all type of advanced features that makes 5G mobile technology most powerful and in huge demand in near future. I conclude that nanotechnology, Cloud computing, all IP are the next great technology wave.

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