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Review Article

Next Generation "5G Wireless Technology"

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Abstract

5th wireless mobile multimedia networks can be completed wireless communication without limitation, which bring us perfect real world wireless – World Wide Wireless Web (WWWW). 5G is based on 4G technologies, which is to be revolt to 5G. During this processing, two kind of problem need to be solved. The first problem is "wider coverage" and the second problem is "freedom of movement" from one technology to another technology. The main contribution in definition of Fifth Generation mobile network concept, which is seen as user based concept instead of operator based as in 3G or service based concept as seen for 4G. In this proposed concept the mobile user are on the top of all. The 5G terminals will have software defined radios and intonation scheme as well as new error-control schemes can be downloaded from the Internet on the run. The development is seen toward the user terminals as a focus of the 5G mobile networks. The node will have access the different wireless technologies at the same time and the terminal should be able to combine different flows from different technologies. The intelligent Internet phone concept where the mobile phone can adopt the best connections by selected constraints and energetically change them during a single end-to-end connection.

Keywords: 5G, Mix Bandwidth Data Path

Introduction

Evolution of wireless communication

The First Generation (1G)-Analog System: Actually, the first generation wireless mobile communication system is not digital technology, but analog cellular telephone system which was used for voice service only during the early 1980s.This Advanced Mobile Phone System (AMPS) was a frequency modulated analog mobile radio system using Frequency Division Multiple Access (FDMA) with 30kHz channels occupying the 824MHz to 894MHz frequency band and a first commercial cellular system introduced until the early 1990's.

The Second Generation (2G)-Digital System: The second generation wireless mobile systems are digital cellular systems. Comparing with the first generation, the second generation wireless system used digital modulation, such as Time Division Multiple Access and Code Division Multiple Access. Based on the two techniques, there were three primary 2G mobile communication systems. TDMA (IS-136), as a completely digital system, was deployed in North America in 1993, but Operated in the AMPS frequency band of 824MHz to 894MHz. CDMA (IS-95) systems using Direct Sequence Spread Spectrum (DSSS) are working on the 1850 to 1990 MHzN frequency band to support CDMA carriers. This spectrum is commonly called Personal Communications Services (PCS). GSM is the most widely used 2G standard. Standard were developed to provide both data service, and increase the data rate in GSM networks.

The Third Generation (3G)-Internet System: The main object of 3G wireless systems was to provide wireless data service with data rates of 144kbps to 380kbps in wide coverage areas, and 2Mbps in local coverage areas. Possible applications included wireless E-mail, web-based access, as well as video teleconferencing and multimedia services consisting of mixed voice and data streams. After ten years of vast development, (International Mobile Telecommunications-2000) has accepted a new 3G standard from China, i.e. TD-SCDMA. Thus, there are three new 3G cellular network standards. These are CDMA2000 from

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America, WCDMA from Europe and TD-SCDMA from China.

The Fourth Generation (4G)-Integration System: The 4G mobile system is an IP-based network internet system. The features of 4G may be outline with one word integration. 4G technology should integrate different current existing and future wireless network technologies (e.g. MCCDMA, OFDM, LAS-CDMA and Network- LMDS) to ensure freedom of movement and seamless roaming from one technology to another technology. These will provide multimedia applications to end mobile users by accessing different technologies in a continuous and always best connection possible. 4G network can integrate several radio access network with fixed internet network. A core interface sites in between core network and radio access networks, and a group of radio interfaces is used for communication between the radio access network and mobile end users. This kind of integration combines multiple radio access interfaces into a single network to provide seamless roaming and the best connected services.

The Fifth Generation (5G)-Real Wireless World System: The 5th wireless mobile multimedia internet networks can be finished wireless communication without limitation, which bring us real world wireless – World Wide Wireless Web (WWWW). 5G technologies is based on 4G technologies, which is to be revolution to 5G technologes. The 5th wireless mobile internet networks are real wireless world which shall be supported by LAS-CDMA, MC-CDMA, UWB, OFDM, Network-LMDS and IPv6.

Item	1G	2G	3G	4G	5G
Speed	n/a	<20kbps	144 kbps to 2 mbps	100 mbps to 2 gbps	Greater then 1 gbps
Tech nology	AMPS	GSM, CDMA	WCDMA	OFDMA	OFDMA
Time	1980	1990	2000	2010	2020

Figure 1.Comparison Between Generations

5G Wireless Architecture

We are living in era of congregations. Congregation is merging of technologies, Basic of congregation lies in Digitization. Our need to feel connected anywhere, anytime and with anyone, across the globe. This phenomenon is called Ubiquitous Computing paradigm.

History of telecom Moore's law 'number of transistors that can be fit into a square inch of silicon, that will doubles every 12 months. 'Moore's law describes a long-term trend in the history of computing hardware but it also proves true for wireless technologies. From 1G technologies to 4G technologies wireless bit rate has increased from 2.4 Kbps to 100 Mbps.

5G wireless architecture will be generation will ignore the Moore law and it will be phase of integration of network technologies, rather evaluation of new wireless standard.

Ubiquitous Computing: 5G would be about "ubiquitous computing", that is, having the ability to access the applications we want from any platform, anywhere, any time. To create such type of environment, some one needs to integrate various applications, emerging from various engineering practices. Human life will be surrounded by sensors, which will bring radical change to human life's daily approaches of doing things, as:

- Any one intelligent car will send SMS to any one cell phone, if any one tries to open the door, while a person are away from your car.
- Some one home security camera is attached to secured internet. So that he/she can view your sitting room on your laptop/mobile phone screen, by accessing secure website.
- Person are receiving regular MMS from hospital about your medication need and next doctor appointment.

Key challenges

o Integration of various standards: Each engineering practice has their own standard (Telecom has 3GPP, ITU, IETF, 3GPP2 etc). To integrate these standards, requires systematic and time consuming approach.

o Common Platform: There is no common architecture for interconnecting engineering practices. One common governing body is required to this, which creates a common platform for all engineering practices to regularize the interconnectivity issues as well as knowledge sharing system.

Super core concept: Existing telecom networks are designed in hierarchical way, where subscriber traffic is aggregated at aggregation point (BSC/RNC) and then routed to gateways. Flat IP architecture will less burden on aggregation point and traffic will directly move from base station to media gateways. Vision of core concept is based on IP platform. All network operators (GSM, CDMA, Wimax, and Wireline) can be connected to one Super core with massive amount of capacity. This is realization of single network infrastructure. The concept of super core will eliminate all interconnecting charges and complexities, which is right now network operator is facing currently. It will reduce number of network channels in end to end connection, thus reducing latency considerably.

High redundancy requirement: Under this Super core concept, all network operators will be moving to single core infrastructure with high redundancy and security among core network entities is required. A failure of single channel will impact huge number of subscribers across various network operators.

Transparency among network operators, regarding Subscriber data and churn management, etc. Government regulatory framework for Super core is required.

Flatter IP concept: At regular interval of time, semiconductor manufacturers advance to a new generation with smaller feature sizes. This allows to incorporate more functions into a given area of silicon and, hence, more features or new capabilities into electronic devices like cell phones, smart phones Increased processing capacity will be allow Mobile devices cell phones, PDAs, to do more tasks (instructions per minute) then before. This will be lead to even the Flatter IP network. As Flat IP has shifted some of the BSC/RNC's radio resource functions to Base station, Flatter IP will shift some of the RR functions, to Mobile devices , smart devices from Base station. At last your cell phone will not be just access device but, it will also perform some of the Radio Resource Management functions.

Evolution of network infra sharing: As described in earlier, network operators, worldwide are opting for infrastructure sharing. Currently trend is passive infra sharing as Active infra sharing has certain limitation. But at invention and deployment of Cognitive Radios (Software Based Radios) and multi-port Base station, will promote active infra sharing at Antenna, Base station and spectrum level at access Ran. So, now network operators, offering different access technologies such LTE, VOLTE & Wimax, can have single high capacity base station and antenna.

Network Layers For 5G Wireless Communications

In 5G technologies, each network will be responsible for handling user-mobility, while the node will make the final choice among different wireless/mobile access network providers for a given service. Such choice will based on open intelligent middleware in the mobile phone devices.

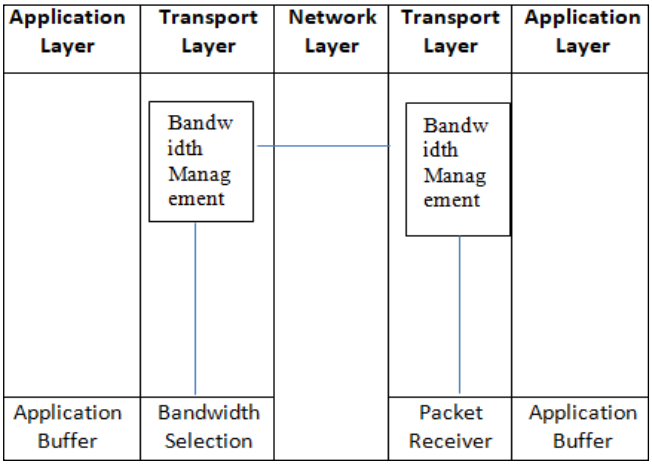

Figure 2.Mix-bandwidth Data Path

The problem is that 5G is designed for World Wide Wireless Web (WWWW) to mobile users based on network access management, but IPv6 assigns any IP address to any mobile node based on location management. This will cause 5G technologies wireless networks resources waste and the IPv6 and IPv4 is difficulty working on the World Wide Wireless Web (WWWW). In order to solve such type of problem, we have proposed the bandwidth optimization control protocol and the mix bandwidth data path for future 5G technologies real wireless world. The bandwidth optimization control protocol (BOCP) is implemented in between Medium Access Control (MAC) layer and TCP/IP layer, which is used to establish the mix-bandwidth.

Application Layer	Application (Service)
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	

Figure 3.Protocol stack for 5G mobile phones

Figure 4.5G mobile phone

Physical/MAC Layer: Physical OSI layer 1 and Medium Access Control OSI layer 2, define the wireless technology.

Network Layer: The network layer will be Internet Protocol, because there is no competition today on this level. The IPv4 is worldwide spread and IPv4 has several problems such as limited address space and has no real possibility for

QoS support per flow. These issues are solved in IPv6, but traded with significantly big packet header. Then, mobility still remains a big problem. There is Mobile IP standard on one side as well as many mobility solutions (e.g., Cellular IP, HAWAII etc.). All mobile networks will use Mobile IP in 5G technologies, and each mobile terminal will be Foreign Agent, keeping the CoA (Care of Address) mapping between its fixed IPv6 address and Care of Address for the current wireless network. However, a mobile phone can be attached to several mobile or wireless networks at the same time. In such case, it will maintain different IP addresses for each of the radio interfaces, while each of these IP addresses will be Care of address for the FA placed in the mobile Phone and Smart phone. The fixed IPv6 will be implemented in the mobile phone by 5G technologies phone manufactures.

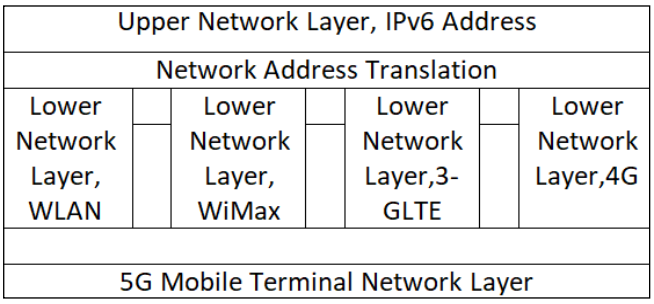

Figure 5.5G mobile phone network layer

The 5G mobile phone technologies shall maintain virtual multi-wireless network environment. For this purpose there should be separation of network layer into two sub-layers in 5G mobiles technologies i.e.: Lower network layer (for each interface) and Upper network layer (for the mobile terminal). This is due to the initial design of the Internet, where all the routing is based on IP addresses which should be different in each IP network world wide web. The middleware between the Upper network and Lower network layers shall maintain address translation from Upper network address (IPv6) to different Lower network IP addresses (IPv4 or IPv6), and vice versa.

Open Transport Protocol (OTA) Layer: The mobile phone networks differ from wired networks regarding the transport layer. In all Transport control protocol versions assumption is that lost segments are due to network congestion, while in wireless networks losses may occur due to higher bit error ratio in the radio interface.

Therefore, TCP modifications and adaptation are proposed for the wired and wireless networks, which retransmit the lost or damaged TCP segments over the wireless link only. For 5G mobile technologies terminals will be suitable to have transport layer that is possible to be downloaded and installed. Such mobiles devices shall have the possibility to download version which is targeted to a specific wireless technology installed at the base stations. This is called here Open Transport Protocol.

Application Layer: Regarding the applications, the ultimate request from the 5G mobile terminal is to provide intelligent Quality of service management over variety of networks. The 5G technologies based phone shall provide possibility for service quality testing and storage of measurement information in information databases in the mobile terminal. The Quality of service parameters, such as delay, jitter, losses, bandwidth, reliability, will be stored in a database in the 5G mobile phone devices with aim to be used by intelligent algorithms running in the mobile terminal as system processes, which at the end shall provide the best wireless connection upon required Quality of service and personal cost constraints.

Wireless Technologies used in 5G

Orthogonal Frequency Division Multiplexing: It is a form of multi-carrier modulation, works by dividing the data stream for transmission at a bandwidth B into N multiple and parallel bit streams, spaced B/N apart. Each of the parallel bit streams has a much lower bit rate than the original bit stream, but their summation can provide very high data rates. An Orthogonal Frequency Division Multiplexing transmitter accepts data from an IP network, converting and encoding the data prior to modulation. An Inverse fast Fourier transform transforms the Orthogonal Frequency Division Multiplexing signal into an IF analog signal, which is sent to the RF transceiver. The receiver circuit reconstructs the data by reversing this whole process. With orthogonal sub-carriers, the receiver can separate and process each sub-carrier without interference from other sub-carriers.

Ultra Wide Band: A Ultra Wide Band transmitter spreads its signal over a wide portion of the RF spectrum, generally 1 GHz wide or more, above 3.1GHz. The FCC has chosen Ultra Wide Band frequencies to minimize interference to other commonly used equipment, such as televisions and radios. Ultra Wide Band is “carrier-free”, since the technology works by modulating a pulse, on the order of tens of microwatts, resulting in a waveform occupying a very wide frequency domain. The wide bandwidth of a Ultra Wide Band signal is a two edged sword. The signal is secure against interference and has the potential for very high-rate wireless broadband access and speed. On the other side, the signal also has the potential to interfere with other wireless transmissions.

MC-CDMA: MC-CDMA stands for Multi-Carrier Code Division Multiple Access, which is actually Orthogonal Frequency Division Multiplexing with a CDMA overlay. The users are multiplexed with orthogonal codes to distinguish users in Multi-Carrier CDMA and single-carrier CDMA systems. It allows flexible system design between cellular system and signal cell system. However, in Multi-Carrier CDMA, each user can be allocated several codes, where the data is spread in time or high frequency.

LAS-CDMA: LAS-CDMA stands for Large Area Synchronized Code Division Multiple Access, is developed by Link Air Communication, a patented 5G wireless technology. "for Large Area Synchronized-CDMA enables highspeed data and increases voice capacity and the latest innovative solution, Code-Division Duplex (CDD), merges the highly spectral efficient for Large Area Synchronized-CDMA technology with the superior data transmission characteristics of Time-Division Duplex.This resulting combination makes Code-Division Duplex to be the most spectrally efficient, high-capacity duplex system available today. In the 5G area, for Large Area Synchronized Code Division Multiple Access is played as a global transmission protocol as showing in the following picture, Zone size .

The Network-LMDS: LMDS stands for Local Multipoint distribution system, is the broadband wireless technology used to carry voice, data, Internet and video services in 25GHz and higher spectrum. Its broadcast method consisted simultaneous voice, data, Internet, and video traffic can be the solution of signal fading issue in local area network. Therefore, Network Local Multipoint distribution system can be played as Micro Cell and Macro Cell in the 5G technology to be the main transmission protocol for the wireless devices.

Conclusions and Future Scope

5G technologies will offer even more flat architecture by using advanced semi conductor technologies as 22mN CMOS. 5G technologies will promote concept of Super Core, where all the network operators will be connected one single core and have one single infrastructure, regardless of their access technologies.

The Sixth Generation (6G)-with Satellite System: The 6th generation mobile communication networks can integrate satellite communication networks and 5G technologies to make global coverage. Satellite communications networks consist of navigation satellite networks, telecommunication satellite networks and Earth imaging satellites networks.

The Seventh Generation (7G)-Space Roaming/Handoff System: The 7G system can be supported by the global navigation satellite system, the telecommunication satellite system, the earth image satellite system and the 6G technologies cellular system. In fact, these satellites are constantly moving at speeds of roughly 8,000 miles an hour, which are making two complete orbits in less than 24*60 minutes. Thus, the handoff/roaming must happen between each satellite. Furthermore, any two different satellite systems are necessary for handoff/roaming when mobile users moving from one country to another. This kind of roaming is space hroaming.

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