

Invited Talk- Next Generation Wide Area Cellular Network- 4G and beyond (5G)

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Abstract

The field of wireless mobile networking was started in early 1990's pushed by the appearance of laptops and wireless LAN (Wi-Fi). Recent improvements in computer and embedded systems have enabled portable devices with sufficiently high computing capability. Moreover, wireless technology advanced rapidly in the recent years. The major initiative was the realization of the 3G (Third Generation) cellular networks that provides high bandwidth access to digital data on the Internet. The combination of these advances triggered the notion of mobile networking which integrate high BW wireless network infrastructures with portable devices to provide varieties of new digital services such as e-mail, web access, broadband Internet, video conferencing, image transfers, and music download. The main challenge in mobile networking is to provide wireless network access, to handle mobility, and to make portable devices that is comfortable to be carried away by mobile users. Smart mobile phone uses a variety of silicon, starting with CPU, multimedia processors for audio/video, graphics, games, video codec, memory, power management, connectivity and communication.

Over the last few years, the emergence of the cellular networks standards-based solutions has dramatically changed the market perception of the technology. The 1G (First Generation) was analog FM cell phones based on AMPS Standard. The 2G was introduction of digital cellular which included GSM and CDMA. It really revolutionized the mobile business expanding the subscriber capacity and reliable calls and brought first data transmission standard GPRS and EDGE. The 3G defined 3G Partnership Project (3GPP) and International Telecom Union (ITU). The ITU brought 3G as WCDMA to provide broadband data services with video, multimedia, and high quality voice. We are right now with 3G services. The 3G also includes new standards called HSPA and Qualcomm CDMA1xEVDO with Rev. A and B. The data rate is increased by a factor of 8 from 1G to 2G (GSM 9.6kbps). The peak data rate increased by a factor of 40 from 2G to 3G for mobile users (384 kbps) and a factor of 200 for stationary users (2Mbps).

4G is next generation network beyond 3G. The 4G brings voice and data together under IP technology umbrella with download speed up to 100Mbps for mobile users and 300Mbps for stationary users and upload speed to 50Mbps. The peak bit rates increased by a factor of 260

from 3G to 4G for mobile users (100Mbps) and a factor of 150 for stationary users (300Mbps). The technology used for 4G is Long Term Evolution (LTE). LTE is based on OFDMA and MIMO. The ITU comprises advanced version of LTE (LTE-A). The LTE-A is expected to offer 1Gbps for low mobility local area coverage and 100Mbps for full mobility wide area coverage. Demand for Ultra HD video (4k resolution) and emerging IoT services is driving the need for 4.5G deployment (called LTE-A Pro) Rel 13 onwards. It will support massive MIMO (128 to 512 antennas) and have a new control plane and data plane (Software Defined Network) for achieving low latency.

The 5G is next step in the continuous innovation and evolution of the mobile industry. Within past 12 months numerous announcements were made about 5G but officially no clear definition of 5G yet available. The ITU issued vision of 5G technology that are mobile broadband, massive machine type communication (M2M), ultra low latency, and resilient communication. The 5G will use mm-wave technologies with massive-MIMO and multi-Radio network to achieve ultra low latency and 10Gbps data rate. The 5G group has formed 5GPPP (5G Public Private Partnership) research group. The 5GPPP is a joint initiative between the European IT industries and European Commission. The project includes China's Huawei and European tech. giants Alcatel-Lucent, Nokia, Ericsson. The 5G will provide 10 to 20Gbps per user data rates and 1ms or even a few hundred μ s latency from person-to-person and person-to-machine. The 5G will connect everything (IoT) and everyone: people, objects, sensors which will result in connecting 50 billion nodes by 2020. The 5G will be a complete wireless communication with no limitation and can be called as REAL wireless world (World Wide *Wireless* Web). The 5G final standard is expected in 2018. Field trials will start in 2016 by Verizon. This will gradually build up for 2018 Olympics in Korea which will be first full blown demo of pre-standard version of 5G. The 5G will be available in 2020 and mass deployment is expected by 2022.



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