TECHNOLOGY BEGETS TECHNOLOGY: A STRATUM OF FUTURE WIRELESS COMMUNICATION TECHNOLOGY BEYOND 4G

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Abstract: The evolution of wireless communication technologies can be discretely grouped into various generations based on the level of maturity of the underlying technology. In telecommunication systems, 4G is the fourth generation of mobile phonemobile communication technology standards. It is a successor to the third generation (3G) standards. A 4G system provides wireless ultra-broadband Internet access, for example to laptops with USBwireless modems, to smart phones, and to other mobile devices. Conceivable applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, 3D television, and cloud computing.

The current and future trends in wireless communication systems are considered which include the evolutionary path starting from the First Generation Technology enroute 4G Technology leading to the development of Fifth Generation 5G Technologies in the near future latest by 2020. The first whisperings of 5G began during a press event at Mobile World Congress in 2012, when executives from Telefónica, Alcatel-Lucent and Bell Labs discussed the nascent technology. Additionally, baked into the idea of fifth-generation wireless is customer experience. While previous technology Generations have seemed focused on network abilities, 5G's goal is always to offer the right ability for the right service.

It is because technology begets technology. The circle of technology just goes on and on in a loop that never ends! The concern of this paper attempts to offer a picturesque view of a stratum of future wireless communication technology beyond 4G.

International Telecommunications Union in November 2010 and IMT-A, i.e. the fourth generation (4G), wireless communication systems being deployed in the world, the fifth generation (5G) mobile and wireless communication technologies are emerging into research fields. Based on the Internet Protocol architecture of 4G communication systems, unprecedented numbers of smart and heterogeneous wireless devices will be accessing future 5G mobile and wireless communication systems with a continuing growth of Internet traffic. Therefore, compared with 4G communication systems, significantly higher wireless transmission rates are expected in 5G communication systems, such as 10 Gbps peak data rates with 8~10 bps/Hz/cell. Moreover, energy efficiency concepts will be fully integrated into future wireless communication systems to protect the environment.

To meet the above challenges, 5G mobile and wireless communication systems will require a mix of new system concepts to boost spectral efficiency, energy efficiency and the network design, such as massive MIMO technologies, green communications, cooperative communications and heterogeneous wireless networks. We expect to explore the prospects and challenges of 5G mobile and wireless communication systems combining all of the above new designs and technologies sooner than our expectations in the near future.

Key words: 1G, 2G, 3G, 4G, 5G, 10Gbps peak data rate, MIMO technologies

Introduction: Today's science is tomorrow's technology. Technology feeds on itself. Technology is ruled by two kinds of people: those who manage what they do not understand and those who understand what they do not manage. To say, the crucial most and urgent problems of the technology of today are no longer the contentment of primary needs or of archetypal wishes, but the reparation of the evils and damages by technology of the existing times. Technology makes it possible for people to gain control over everything, except over technology.

Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. Wireless communication has brought in an unparallel revolution in the field of communication during the past two decades.

The mobile communication industry growth has surpassed growth of all other fields. It applies to one and all countries across the globe. With the advent of the 4G technology, talks have started even about 5G and next generation. It is because technology begets technology. The circle of technology just goes on and on in a loop that never ends! The concern of this paper attempts to offer a picturesque view of a stratum of future wireless communication technology beyond 4G.

Fourth-Generation (4G) is a term used to describe the next complete evolution in wireless communications.A 4G system will be able to provide a comprehensive IP solution where voice, data and streamed multimedia can be given to users on an "*Anytime, Anywhere*" basis, and at higher data rates than previous generations.One of the objectives of 4G includes that 4G is a fully IP-based integrated system. 4G will be capable of providing between 100 Mbps and 1 Gbps speeds both indoors and outdoors with premium quality and high security. The infrastructure and the terminals of 4G will have almost all the standards from 2G to 4G implemented.Although legacy systems are in place to adopt existing users, the infrastructure for 4G is only packet-based.

Evolution of Data Standards:

Zero Generation Technology (Zero G):

Zero Generation (Zero G): The radio telephone system preceded modern cellular mobile telephony technology (1G). The radio telephone system contained one central antenna tower per region. The central antenna required radio phones to have a powerful transmitter, capable of transmitting up to 50 miles. The number of radio telephones per region was limited by the number of available channels. Unlike closed radio systems, radio telephones were connected to the public telephone network and were typically mounted in cars, trucks, and briefcases.

First Generation (1G) Technology:

First Generation (**1G**): They were analog based and evolved in early 1980's. They were called AMPS (*Advanced Mobile Phone System*) released in 1983 and employed in North and South America, China, Australia and so forth.

Features of 1G Systems	
Base station TxBand	869 – 894 M Hz
M U TxBand	824 – 849 M Hz
Channel Bandwidth	30 KHz
No of Voice Channels	790
No of Control Channels	42
M U max power	3 W
Cell Size Radius	2 –20 Km
Modulation Voice Channels	FM
Modulation Control Channels	FSK

Limitations of 1G Technology

- Limited Capacity and Poor Handoff Reliability
- Frequent Call Drops
- No room for spectrum growth
- Poor data communications
- Minimal privacy
- Poor Voice Quality
- Poor Battery Life
- Large Phone Size
- No Security

Second Generation (2G) Technology:

Second Generation (2G): They are based on digital technology. They are either TDMA or CDMA based. TDMA is used in GSM (Global System of Mobile Communication).

Features of 2G Systems

- Make use of CODEC (compression and multiplex algorithm) to compress and multiplex digital voice data.
- Can handle more calls per amount of bandwidth in comparison with 1G systems
- Hand sets are usually smaller, lighter and more robust
- Emit less radio power
- Safer for consumers to use
- Battery life of hand-sets lasts longer
- Offer additional services like SMS, and e-mails
- Error checking has improved sound quality
- Reduction in noise levels
- Digital voice encoding has made calls less susceptible to eavesdropping from third parties due to use of radio scanner
- Ensure rapid call set up
- Enable talking to number of parties simultaneously
- Enables to place a call on hold while one accesses another call
- Notifies one of another call whilst on a call Encrypted conversation that cannot be easily tapped
- Provides ability to use same phone in number of countries
- In GSM:

- Carrier bit rate is 270.8 kbps & speech coding bit rate is 13kbps
- Channel Bandwidth 200 k Hz in GSM
- 8 users per channel
- Mobile Unit max power is 20 W

Limitations of 2G Technology:

- The GSM is switch circuited, connection oriented technology where the end systems are dedicated for the entire call session.
- This causes insufficiency in usage of bandwidth and resources.
- The GSM enabled systems do not support high data rates.
- They are unable to handle complex data such as videos.
- Reduce range of sound.
- Weaker digital signal.

Interim Stage (2.5 G) Technology:

2.5 Generation (2.5 G): An interim stage that is between 2G and 3G is considered to be 2.5 G.

Features of 2.5 G Systems

- Phone Calls / Fax
- Voice Mail
- Send and Receive e-mail messages
- Web Browsing
- Camera Phones
- Speed: 64–144 kbps
- Time to download an MP3 song: 6-9 minutes

Third Generation (3G) Technology: Third Generation (3G): The 3G system represents convergence of 2G wireless systems into a single global system. It was first adopted in Japan and South Korea in 2001 and in USA in 2003. It was launched in India in 2008.

Features of 3G Systems:

- Enhanced multimedia (voice, data, video and remote control)
- Usability on all popular models (cellular phones, e-mails, pagers, fax, video conferencing and web browsing)
- Broad bandwidth and high speeds (upwards of 2 MBPS)
- Bandwidth 5 – 20 Mbps
- Access WCDMA / CDMA 2000
- Frequency Band 16 – 25 G Hz
- Component Design -- Optimized antenna multiband adapters
- Has both circuit / packet switching
- Routing flexibility (repeater, satellite and LAN)
- International roaming capability
- Excellent quality of voice
- Applications include:
- Still photography
- Video
- Data transmission service
- File transfer from internet
- Multimedia e-mail
- Web Browsing
- On-line services
- Time schedules
- Global positioning services / geographical information system
- Benefits in education include:
- Live video lectures can be cast to the learner
- Two way video conferencing becomes possible
- Faster downloads of assignments

Limitations of 3G Technology:

- Expensive input fee for the 3G licenses.
- Numerous differences in the licensing terms.
- It is a challenge to build the necessary infrastructure for 3G
- Expense of 3G phones.
- Lack of buy-in by 2G mobile users for the new 3G wireless services
- Large cell phones

Fourth Generation (4G) Technology: Due to sustained attempts undertaken by DoCoMo (a Japanese Company), Samsung and Apple Inc. 4G has becomeoperational in number of countries during last three months (which was expected to be operational by 2012). It has been launched in China, USA, Norway and Sweden. 4G is described as MAGIC which means...

M: Mobile Multimedia
A: Anytime Anywhere
G: Global Mobility
I: Integrated Wireless Solution
C:Customized personal Service

Objectives of 4G Technology :

- Inexpensive wireless broadband access for cost-conscious consumers and businesses will be a complete replacement for current networks and be able to provide a comprehensive and secure IP solution where voice, data, and streamed multimedia can be given to user on an “Anytime, Anywhere” basis, and at much higher data rates than previous generation.
- Flexible channel bandwidth
- A nominal data rate of 100 Mbit/s while the client physically moves at high speeds relative to the station, and 1 Gbit/s while client and station are in relatively fixed positions as defined by the ITU-R,
- A data rate of at least 100 Mbit/s between any two points in the world
- Smooth handoff access
- Seamless connectivity and global roaming
- High QoS (quality of service)
- IP, packet switched based network
- Compatibility with all existing network types
- Peak link spectral efficiency of 15bit/s/Hz in down link and 6.75bit/s/Hz in uplink
- System spectral efficiency of up to 3bit/s/Hz/cell in downlink and 2.25bit/s/Hz/cell for indoor usage
- Adaptive processing and smart antennas will be used
- To make use of OFDM (orthogonal frequency division multiplexing). This will not only enhance spectral efficiency but also result in high resiliency to RF interference and lower multi- path distortion.

Advantages of 4G :

- Virtual presence is possible on connection with live telecast events.
- Visualized virtual navigation - a remote database will contain graphical representation of streets, buildings and physical characteristics of a large

metropolis. Blocks of databases will be transmitted in rapid sequence to the vehicle.

- Teleprocessing --- Queries dependent on location information of several users in addition to temporal aspects have applications like:
- crises management
- life saving telemedicine
- VoIP for Ipv6.
- Watch HDTV
- Will provide comprehensive and secure all IP based solution involving facilities such as IP telephony, ultra-broadband internet access, gaming services.

Limitations of 4G Technology:

- The equipment required to implement a next generation network is still very expensive
- Carriers and providers have to plan carefully to make sure that expenses are kept realistic.

Here is a quick note of predictable future generation systems duly following the existing the 4G.

Fifth Generation (5G) Technology:

Fifth Generation (5G):5G is a name used in some research papers and projects to specify the next major phase of wireless communications standards beyond the 4G / IMT – Advanced standards effective since 2011.Key concepts for 5G systems have also been framed. It is expected to be launched by2020.

With the IMT-Advanced (IMT-A) standards ratified by the International Telecommunications Union in November 2010 and IMT-A, i.e. the fourth generation (4G), wireless communication systems being deployed in the world, the fifth generation (5G) mobile and wireless communication technologies are emerging into research fields. Based on the Internet Protocol architecture of 4G communication systems, unprecedented numbers of smart and heterogeneous wireless devices will be accessing future 5G mobile and wireless communication systems with a continuing growth of Internet traffic. Therefore, compared with 4G communication systems, significantly higher wireless transmission rates are expected in 5G communication systems, such as 10 Gbps peak data rates with 8~10 bps/Hz/cell. Moreover, energy efficiency concepts will be fully integrated into future wireless communication systems to protect the environment.

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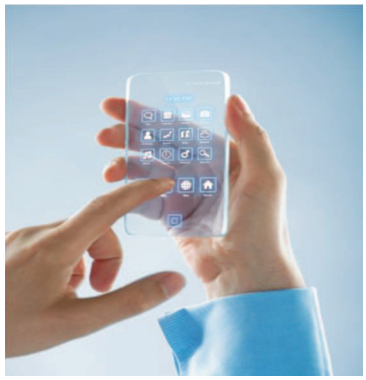
Key Concepts of 5G Systems:

- One unified global standard
- Peak download /upload speeds at a rate of at least 10Gbps
- Real wireless world with no more limitations with access and zone issues
- Internet Protocol Version (IPv6) where a visiting care of mobile IP address is assigned according to location and connected network.
- Multiple concurrent data transfer path
- Cognitive Radio Telephony----- Also known as Smart-Radio allowing different radio technologies to share spectrum efficiently by adaptively finding unused spectrum and adopting the transmission scheme to the requirements of the technologies currently sharing the spectrum.
- To provide High Altitude Stratospheric Platform Station (HASP System)
- To make use of Beam Division Multiple Access (BDMA) and group co-operative relay technique.
- To ensure user could be simultaneously connected to several technologies and seamlessly move between them.



Based on the above observations, some sources suggest that a new generation of 5G standards may be introduced approximately in the early 2020s. However, still no international 5G development projects have officially been launched, and there is still a large extent of debate on what 5G is exactly about. If 5G appears, and reflects these prognoses, the major difference from a user point of view between 4G and 5G techniques must be something else than increased peak bit rate; for example higher number of simultaneously connected devices, higher system spectral efficiency (data volume per area unit), lower battery consumption, lower outage probability (better coverage), high bit rates in larger portions of the coverage area, lower latencies, higher number of

supported devices, lower infrastructure deployment costs, higher versatility and scalability or higher reliability of communications.

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