INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

4G WIRELESS SYSTEMS

MR. PRAVIN WARARKAR, MR. ANKIT DIXIT, MRS. CHHAYADEVI BHAMARE, MS. PRATIKSHA MESHRAM

Electronics & Telecommunication Engineering (Assistant Professor), SVKM's Narsee Monjee Institute of Management Studies, (Deemed-to-be-University), Mukesh Patel School of Technology, Management & Engineering, Shirpur, India.

Accepted Date: 15/03/2016; Published Date: 01/05/2016

Abstract- Fourth generation wireless system is a packet switched wireless system with wide area coverage and high throughput. It is designed to be cost effective and to provide high spectral efficiency .The 4G wireless uses Orthogonal Frequency Division Multiplexing (OFDM), Ultra-Wide Radio Band (UWB), and Millimeter wireless. Data rate of 20mbps is employed. Mobile speed will be up to 200km/hr .The high performance is achieved by the use of long term channel prediction, in both time and frequency, scheduling among users and smart antennas combined with adaptive modulation and power control. Frequency band is 2 -8 GHz. it gives the ability for world-wide roaming to access cell anywhere. Wireless mobile communications systems are uniquely identified by "generation designations. Introduced in the early 1980s, first generation (1G) systems were marked by analog frequency modulation and used primarily for voice communications. Second generation (2G) wireless communications systems, which made their appearance in the late 1980s, were also used mainly for voice transmission and reception The wireless system in widespread use today goes by the name of 2.5G-an "in between " service that serves as a stepping stone to 3G. Whereby 2G communications is generally associated with Global System for Mobile (GSM) service, 2.5G is usually identified as being "fueled" by General Packet Radio Services (GPRS) along with GSM. In 3G systems, making their appearance in late 2002 and in 2003, are designed for voice and paging services, as well as interactive media use such as teleconferencing, Internet access, and other services. The problem with 3G wireless systems is bandwidth-these systems provide only WAN coverage ranging from 144 kbps (for vehicle mobility applications) to 2 Mbps (for indoor static applications). Segue to 4G, the "next dimension" of wireless communication.

Keywords: 4G, Wireless System.

Corresponding Author: MR. PRAVIN WARARKAR

Access Online On:

www.ijpret.com

How to Cite This Article:

Pravin Wararkar, IJPRET, 2016; Volume 4 (9): 739-746

PAPER-QR CODE

INTRODUCTION

4G (also known as **Beyond 3G**), an abbreviation for **Fourth-Generation**, 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, dat a and streamed multimedia can be given to users on an "Anytime, Anywhere" basis, and at higher data rates than previous generations. As the second generation was a total replacement of the first generation networks and handsets; and the third generation was a total replacement of second generation networks and handsets; so too the fourth generation cannot be an incremental evolution of current 3G technologies, but rather the total replacement of the current 3G networks and handsets. The international telecommunications regulatory and standardization bodies are working for commercial deployment of 4G networks roughly in the 2012 -2015 time scale. At that point it is predicted that even with current evolutions of third generation 3G networks, these will tend to be congested.There is no formal definition for what 4G is; however, there are certain objectives that are projected for 4G. These objectives include: that 4G will be a fully IP-based integrated system.4G will be capable of providing between 100 Mbit/s and 1 Gbit/s speeds both indoors and outdoors, with premium quality and high security. Many companies have taken self –serving definitions and distortions about 4G to suggest they have 4G already in existence today, such as several early trials and launches of WiMAX, which is part of the formal ITU standard for 3G.Other companies have made prototype systems calling those 4G. While it is possible that some currently demonstrated technologies may become part of 4G, until the 4G standard or standards have been defined, it is impossible for any company currently to provide with any certaint wireless solutions that could be called 4G cellular networks that would conform to the eventual international standards for 4G. These confusing statements around "existing" 4G have served to confuse investors and analysts about the wireless industry

II Objectives and Principal Technologies

2.1 Objectives 4G is being developed to accommodate the quality of service (QoS) and rate requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal service like voice and data, and other streaming services for "anytime - anywhere". The 4G working group has defined the following as objectives of the 4G wireless communication standard:

- A spectrally efficient system (in bits/s/Hz and bits/s/Hz/site),
- High network capacity: more simultaneous users per cell,

- 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 across heterogeneous networks,
- Seamless connectivity and global roaming across multiple networks,
- High quality of service for next generation multimedia support (real time audio, high
- speed data, HDTV video content, mobile TV, etc)
- Interoperability with existing wireless standards , and
- An all IP, packet switched network.

In summary, the 4G system should dynamically share and utilize network resources to meet the minimal requirements of all the 4G enabled users.

2.2 Principal Technologies

 Baseband techniques

- OFDM: To exploit the frequency selective channel property
- MIMO: To attain ultra high spectral efficiency
- Turbo principle: To minimize the required SNR at the reception side
    - Adaptive radio interface
    - Modulation, spatial processing including multi -antenna and multi-user MIMO
    - Relaying, including fixed relay networks (FRNs), and the cooperative relaying concept ,known as multi-mode protocol
    - It introduces a single new ubiquitous radio access system concept, which will be flexible to a variety of beyond-3G wireless systems.

3 Features of 4G Wireless System

The following are some possible features of the 4G systems :

- Support interactive multimedia, voice, video, wireless internet and other broadband services.
- High speed, high capacity and low cost per bit.
- Global mobility, service portability, scalable mobile networks.
- Seamless switching, variety of services based on Quality of Service (QoS) requirements
- Better scheduling and call admission control techniques.
- Ad hoc networks and multi -hop networks.

3G Vs 4G

The following table shows comparisons between some key parameters of 3G Vs possible 4G systems.

3G 4G

	4G	5G
Frequency Band	1.8 - 2.5 GHz	2 - 8 GHz
Bandwidth	5-20 MHz	5-20 MHz
Data rate	Up to 2Mbps (384 kbps WAN)	Up to 20 Mbps or more
Access	Wideband CDMA	Multi-carrier - CDMA or OFDM(TDMA)
FEC	Turbo-codes	Concatenated codes
Switching	Circuit/Packet	Packet
Mobile top speeds	200 kmph	200 kmph

4. Physical and MAC Layer specifications

One promising underlying technology to accomplish the divisiveness is multi -carrier modulation, a derivative of frequency division multiplexing. MCM was earlier used in D SL modems and digital audio-video broadcasts. It is a baseband process that uses parallel equal bandwidth channels to transmit information. Normally implemented with Fast Fourier transform (FFT) techniques, MCM's advantages include better performance in the inter symbol interference (ISI) environment, and avoidance of single frequency interferers.

However, MCM increases the peak - to-average ratio (PAVR) of the signal, and to overcome ISI a cyclic extension or guard band must be added to the data. Two different types of MCM are likely candidates for 4G as listed in the above table. These are the multi -carrier CDMA and orthogonal FDM using TDMA.

Similar to single carrier CDMA systems, the users are multiplexed with orthogonal codes to distinguish users in MC-CDMA. However, in MC-CDMA, each user can be allocated several codes, where the data is spread in time or frequency. Either way, multiple users access the system simultaneously. In OFDM with TDMA, the users are allocated time intervals to transmit and receive data. Differences between OFDM with TDMA and MC -CDMA can also be seen in the types of modulation used in each subcarrier. Typically, MC -CDMA uses quadrature phase-shift keying (QPSK), while OFDM with TDMA could use more high -level modulations (HLM), such as, multilevel quadrature amplitude modulation (M-QAM) (where M = 4 to 256). How-ever, to optimize overall system performance, adaptive modulation can be used; where the level of QAM for all subcarriers is chosen based on measured parameters.

Channel Access

The allocation of the spreading codes or the time slots can be done in such a way that the throughput is maximized. For example, all the resources can be allocated to a user whose channel is very clean and users who have very noisy channels can be alloc ated little amount of bandwidth till their channel becomes better. However, the allocation should maintain certain amount of fairness while distributing the resources.

Error control coding

In 4G systems rate-adaptive coding schemes can be used which can make use of the channel information from the measured parameters or feedback from the Mobile

Terminal (MT). A Hybrid ARQ scheme can be used to minimize the overhead in case of retransmission. Space time codes, multiple antennas systems like the smart antenn as can be used to further improve the data rates.

5. Higher Layer Issues in 4G

4G is going to be a packet-based network. Since it would carry voice as well as internet traffic it should be able to provide different level of QoS. Other network level issues include Mobility Management, Congestion control, and QoS Guarantees:

5.1 Mobility Management

Mobility Management includes location registration, paging and handover. The MT should be able to access the services at any place possible. The global roaming can be achieved by with the help of multi-hop networks that can include the WLANs or the satellite coverage in remote areas.

A seamless service (Ex: soft handover of the MT from one network to another or from one kind of service to other) is also important. The hand-over techniques should be designed so that they make efficient use of the network (routing) and make sure that hand offs are not done too often .New techniques in location management might be implemented. Each MT need not do location registration every time. They can instead do concatenated location registration, which reports to the network that the are concatenated to a common object. Ex - MTs in a train need to re-register only when they get off the train and till the network knows that the y are in the train.

5.2 Congestion Control

Congestion control will be another critical issue in the high performance 4G networks. Two basic approaches can be taken towards the congestion control: 1. avoidance or prevention of the congestion and 2. detection and recovery after congestion. The avoidance scheme will require the network to suitably implement the admission control (measurement based or pre –computed model) and scheduling techniques. The detection and recovery would require flow control and feedback traffic management. A conservative approach might be proposed for the 4G systems because of the wide variety of QoS requirements.

5.3 Quality of Service (QoS)

4G systems are expected to provide real -time and internet-like services. The real-time services can be classified into two kinds:

- ✓ Guaranteed: pre-computed delay bound is required for the service. Ex voice
- ✓ 2 : Better-than-best effort :

Predictive: Service needs upper bound on end -to-end delay.

Controlled delay: service might allow dynamically variable delay.

Controlled load: Service needs resources (bandwidth and packet processing). Guaranteed and Controlled Load services are proposed to appear in 4G.

6. Some New Challenges in 4G

1. Multi-access interface, timing and recovery.

2. Higher frequency reuse leads to smaller cells that may cause intra -cell interference or higher noise figures due to reduced power levels.

3. The Digital to analog conversions at high data rates, multiuser detection and estimation (at base stations), smart antennas and complex error control techniques as well dynamic routing will need sophisticated signal processing.

4. Issues in the interface with the ad hoc networks should be sorted out. 4G systems are expected to interact with other networks like the Bluetooth, hyper lan, IEEE802.11b, etc.

5. Voice over multi-hop networks is likely to be an interesting problem because of the strict delay requirements of voice.

6. Security will be an important issue.

7. A new IP protocol might be needed because of the variable QoS services and the network should do "better than best " effort.

8. Networking protocols that adapt dynamically to the changing channel conditions.

9. Seamless roaming and seamless transfer of services.

7. Conclusions

1. 4G is still in formative stages.

2. The work on 4G systems has begun in the industry as well the academia. Ex: - Wireless World Research Forum (WWRF) has Ericcson, Alcatel, Nokia and Siemens AG. The Nat ional Science Foundation (NSF) has announced a program in 1999 that calls for proposals that would look at issues involved in 4G systems. In the USA, Motorola, Lucent, AT&T, Nortel and other major companies are also working on 4G systems.

3. Multimedia traffic will be dominant in the future. It is estimated that voice would contribute to only 20-30 % of total traffic in the future.

4. A modified IP will be the universal network layer protocol in the future.

5. Diverse array of applications like virtual n avigation, tele-medicine, etc.

6. The entire network would be digital and packet switched.

8. References

1. Bill Krenik “4G Wireless Technology:When will it happen? What does it offer?” IEEE Asian SolidState Circuits Conference November 3-5, 2008.
2. Ahmet AKAN, C¸ agatay EDEMEN “Path to 4G Wireless Networks” 2010 IEEE 21st International Symposium on Personal.
3. Augustine C. Odinma, Lawrence I. Oborkhale and Muhammadou M.O. Kah, “The Trends in Broadband Wireless Networks Technologies “, The Pacific Journal of Science and Technology, Volume 8. Number 1. May 2007.
4. Odinma, A.C. 2006. “Next Generation Networks: Whence, Where and Thence”. Pacific Journal of Science and Technology. 7(1):10-16.
5. Leo yi, Kai Miao, Adrian Liu “A Comparative Study of WiMAX and LTE as the Next Generation Mobile Enterprise Network” Feb. 13~16, 2011 ICACT 2011.