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4G – The Future

Saiesh N. Prabhu Verlekar
Assistant Professor,
Department of Information Technology, SRIEIT
Goa University, Goa, India

Abstract— Mobile communication had a great impact on how people interact and communicate with each other allowing people to telecommunicate as well as carrying out plenty of other activities. Mobile standards have been evolving rapidly with the aim of providing user with more services and convenience.The First generation wireless mobile communication systems were introduced in early eighties and second generations systems in the late 1980s were intended primarily for transmission of voice. The third generation wireless systems which are available in the world markets offer considerably higher data rates, and allow significant improvements over the 2G systems. The 3G Wireless systems were proposed to provide voice and paging services to provide interactive multimedia including teleconferencing and internet access and variety of other services. However, these systems offer wide area network (WAN) coverage of 384 kbps peak rate and limited coverage for 2 Mbps. Hence providing broadband services would be one of the major goals of the 4G Wireless systems.This paper provides the features, benefits and new challenges of 4G.

Keywords—1G, 2G, 3G, 4G, GSM, GPRS, Mobile Communications

I. INTRODUCTION

4G Wireless Systems or 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 20 mbps is employed. Mobile speed will be up to 200 km/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 worldwide 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).The 4G wireless uses Orthogonal Frequency Division Multiplexing (OFDM), Ultra Wide Radio Band (UWB), and Millimeter wireless and smart antenna. Data rate of 20 mbps is employed. Mobile speed will be up to 200 km/hr. Frequency band is 2.8 GHz. it gives the ability for worldwide roaming to access cell anywhere.

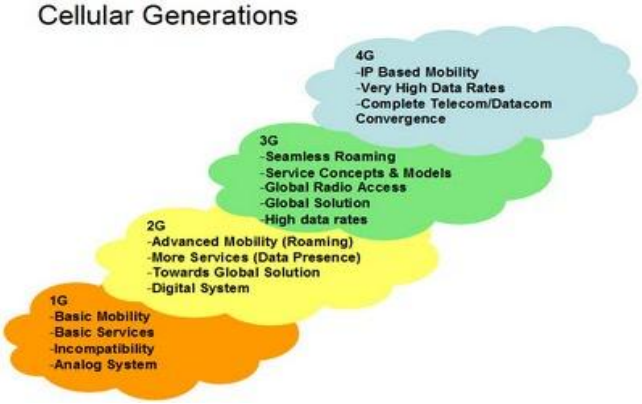

Fig. 1 Generations of Cellular Systems

II. 4G WIRELESS SYSTEMS

2.1 Features of 4G

1. Support interactive multimedia, voice, video, wireless internet and other broadband services.
2. High speed, high capacity and low cost per bit.
3. Global mobility, service portability, scalable mobile networks.
4. Seamless switching, variety of services based on quality of Service (QoS) requirements.
5. Better scheduling and call admission control techniques.
6. Ad hoc networks and multi hop networks.
7. Low Cost.
8. Interoperability and easy roaming.
9. Better spectral efficiency.

2.2 Benefits of 4G

4G have a greater focus on data allowing faster and more reliable mobile connectivity. The 4G standard also offer the opportunity for telecom companies to enter into the markets which will broaden the services they can provide to users. There is also the benefit for content providers as technology firms, as we move into a connected data telecommunication environment, technology firms are required to manufacture and provide us with the devices that will give us the possibility to connect to these networks and can fully utilise the features and capabilities that the new standard provides. 4G gives the opportunity to consumers to have richer communication and content experience.

2.3 3G versus 4G

	3G	**4G**
Frequency Band	1.8 - 2.5 GHz	2 - 8 GHz
Bandwidth	5-20 MHz	100 MHz or more
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	All digital with packetized voice
Mobile top speeds	200 kmph	200 kmph
Upload Rate	5 Mbps	500 Mbps
Download Rate	100Mbps	1 Gbps
Cost	Costly	Less Costly than 3G
Network Architecture	Wide area cell based	Hybrid

2.4 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:

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 they 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 they are in the train.

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.
2. Detection and recovery after congestion.

The avoidance scheme will require the network to suitably implement the admission control 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.

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:

1. Guaranteed: pre-computed delay bound is required for the service. Example: voice
2. Better than the best: Controlled load service needs resources (bandwidth and packet processing).Guaranteed and controlled load services are proposed to appear in 4G.

III. 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, 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.

IV. FUTURE OF 4G

In most networks data traffic already exceeds that of voice traffic and so operators are pressured to upgrade their infrastructure in order to meet those demands.4G will be capable of bringing super-fast internet to mobile devices and lead to growth in applications like IP telephony, IP multimedia, gaming services, mobile TV in High definition as well as video conferencing, this will lead to new market trends and new telecommunication business and so many see it as being the next step in the evolution of mobile technology.4G will have a focus on interactive-applications, with abundant bandwidth for video services, interactive gaming etc.

V. CONCLUSION

Telecommunications standards have been evolving throughout the years. In the early days of mobile telecommunication, voice the sole service available to user, but as it evolved, new services have emerged. This new services allowed users not only to make calls but to exchange SMS, transmit data, use of multimedia service such as video call, MMS etc. 4G eliminated completely the circuit switched side of the network as it is a full IP-based network; this was influenced by the growing trend of data consumption, as data services took more of the network traffic. It also brought about increased data processing speeds and limitless possibilities and services for user, businesses and service providers.

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