

INTRODUCTION ABOUT 4G

4G stands for Forth Generation of Cellular Communications and is the next step in the evolution of mobile data. 4G provides high mobility with high speed data rates and also supports high capacity IP-based services and applications while it also maintains full backward compatibility.

It is also based on wireless communication that is IP based and is slated on Advanced MIMO technology. 4G technologies follow Multiple Input Multiple Output Technology that uses signal multiplexing between multiple transmitting antennas (space multiplex) and time or frequency.

Fourth generation (4G) technology will offer many advancements to the wireless market, including downlink data rates well over 100 megabits per second (Mbps), low latency, very efficient spectrum use and low-cost implementations.

4G enhancements promise to bring the wireless experience to an entirely new level with impressive user applications, such as sophisticated graphical user interfaces, high-end gaming, high-definition video and high-performance imaging.

4G VISIONS

The 4G systems are designed to provide a wide variety of new services, from high-quality voice to high definition video to high-data-rate wireless channels. The term 4G is used broadly to include several types of BWA communication systems, not only cellular systems. 4G is described as MAGIC — Mobile multimedia, anytime anywhere, Global mobility support, integrated wireless solution, and customized personal service.

The 4G systems will not only support the next generation mobile services,

but also will support the fixed wireless networks. The 4G systems are about seamlessly integrating terminals, networks, and applications to satisfy increasing user demands.

Accessing information anywhere, anytime, with a seamless connection to a wide range of information and services, and receiving a large volume of information, data, pictures, video, and so on, are the keys of the 4G infrastructure.

The future 4G systems will consist of a set of various networks using IP as a common protocol. 4G systems will have broader bandwidth, higher data rate, and smoother and quicker handoff and will focus on ensuring seamless service across a multiple of wireless systems and networks.

The key is to integrate the 4G capabilities with all the existing mobile technologies through the advanced techniques of digital communications and networking. Application adaptability and being highly dynamic are the main features of 4G services of interest to users. These features mean services can be delivered and be available to the personal preference of different users and support the users' traffic, air interfaces, radio environment, and quality of service. Connection with the network applications can be transferred into various forms and levels correctly and efficiently.

The following figure illustrates elements and techniques to support the adaptability of the 4G domain. The fourth generation will encompass all systems from various networks, public to private; operator-driven broadband networks to personal areas; and ad hoc networks. The 4G systems will interoperate with 2G and 3G systems, as well as with digital (broadband) broadcasting systems.

In addition, 4G systems will be fully IP-based wireless Internet. This all-encompassing integrated perspective shows the broad range of systems that the fourth generation intends to integrate, from satellite broadband to high altitude platform to cellular 3G and 3G systems to WLL (wireless local loop) and FWA (fixed wireless access) to WLAN (wireless local area network) and PAN (personal area network), all with IP as the integrating mechanism. With 4G, a range of new services and models will be available. These services and models need to be further examined for their interface with the design of 4G systems.

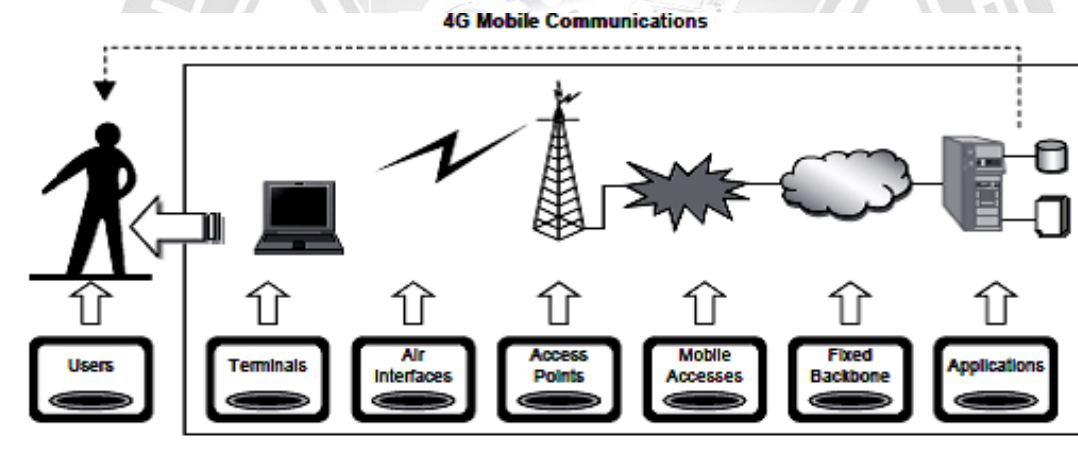


Fig.5.1: 4G Visions

[Source: Text book- Wireless Communications and networking , First Edition, Elsevier 2007 by Vijay Garg]

Table 5.1: Comparison of key parameters of 4G with 3G.

Details	3G including 2.5G (EDGE)	4G
Major requirement driving Architecture	Predominantly voice driven, data was always add on	Converge data and voice over IP
Network architecture	Wide area cell-based	Hybrid-integration of WLAN (WiFi, Bluetooth) and wireless wide-area networks
Speeds	384 kbps to 2 Mbps	20 to 100 Mbps in mobile mode
Frequency band	Dependent on country or continent (1.8 to 2.4 GHz)	Higher frequency bands(2 to 8 GHz)
Bandwidth	5 to 20 MHz	100 MHz or more
Switching design basis	Circuit and packet	All digital with packetized
Access technologies	WCDMA, CDMA2000	OFDM and multicarrier
Forward error correction	Convolutional codes rate 1/2, 1/3	Concatenated coding
Component design	Optimized antenna design, multiband adapters	Smart antenna, software defined multiband and wideband radios
Internet protocol(IP)	Number of air link protocol including IPv5.0	All IP (IPv6.0)
Mobile top speed	200 km/h	200 km/h

4G will need to be highly dynamic in terms of support for:

- ☐ The users' traffic
- ☐ Air interfaces and terminal types
- ☐ Radio environments
- ☐ Quality-of-service types
- ☐ Mobility patterns.

4G FEATURES

Some key features of 4G mobile networks are as follows.

- ☐ High usability: anytime, anywhere, and with any technology
- ☐ Support for multimedia services at low transmission cost
- ☐ Personalization
- ☐ Integrated services
- ☐ Support for interactive multimedia, voice, streaming video, Internet, and other broadband services
- ☐ IP based mobile system
- ☐ High speed, high capacity, and low cost per bit
- ☐ Global access, service portability, and scalable mobile services
- ☐ Seamless switching, and a variety of Quality of Service driven services
- ☐ Better scheduling and call admission control techniques
- ☐ Ad hoc and multi hop networks
- ☐ Better spectral efficiency

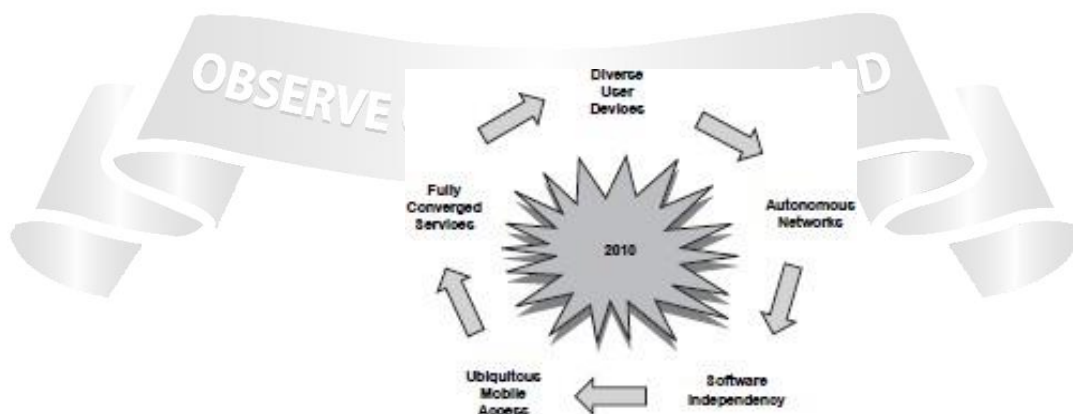


Fig5.2: 4G Features

[Source: Text book- Wireless Communications and networking , First Edition, Elsevier

2007 by Vijay Garg]

4G networks will be all-IP-based heterogeneous networks that will allow users to use any system at anytime and anywhere. Users carrying an integrated terminal can use a wide range of applications provided by multiple wireless networks. 4G systems will provide not only telecommunications services, but also data and multimedia services. To support multimedia services, high-data-rate services with system reliability will be provided. At the same time, a low per-bit transmission cost will be maintained by an improved spectral efficiency of the system.

Personalized service will be provided by 4G networks. It is expected that when 4G services are launched, users in widely different locations, occupations, and economic classes will use the services. In order to meet the demands of these diverse users, service providers will design personal and customized service for them. 4G systems will also provide facilities for integrated services. Users can use multiple services from any service provider at the same time.

4G technologies are significant because users joining the network add mobile routers to the network infrastructure. Because users carry much of the network with them, network capacity and coverage is dynamically shifted to accommodate changing user patterns. Users will automatically hop away from congested routes to less congested routes. This permits the network to dynamically and automatically self-balance capacity, and increase network utilization.

In a cellular infrastructure, user's network contribution is nil. They are just consumers competing for resources. But in wireless ad hoc peer-to-peer networks, users cooperate - rather than compete - for network resources.