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A look on 3G mobile services

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ABSTRACT

The objective of this paper is to evaluate the underlying paradigms of third generation (3G) mobile services. Given the success of second generation (2G) mobile communications systems and services, the third generation mobile networks and applications are faced with a lot of expectations such as providing ubiquitous access to online services via mobile terminals. This comes with enhancements over previous wireless technologies, as high-speed transmission, advanced multimedia access and. 3G is mostly used with mobile phones and handsets as a means to connect the phone to the Internet or other IP networks in order to make voice and video calls, download and upload data and to surf the net. 3G is the successor of 2G and 1G standards. The 3G networks handle the majority of all data transfers for cellular service providers.

1. INTRODUCTION

3G wireless technology is the convergence of various 2G wireless telecommunications systems into a single global system which includes both terrestrial and satellite components. 3G wireless technology has ability to unify existing cellular standards with CDMA, GSM, and TDMA. 3G has the following enhancements over 2.5G and previous networks: Higher data speed, Video-conferencing support, Enhanced audio and video streaming, Web and WAP browsing at higher speeds, IPTV (TV through the Internet) support transfer rate for 3G networks is between 128 and 144 kbps for devices that are moving fast and 384 kbps for slow ones. For fixed wireless LANs, the speed goes beyond 2mbps. Figure 1 shows the various technologies related to 3G and their suitability for mobile users. Beyond 3G, it is predicted that mobile networks and the wireless communication landscape will be based on various technologies, offering seamless mobility with cellular networks. Fourth generation (4G) services will enable broadband wireless communication at home, at the office and on the move. In other words, new networks will make the services provided by the Web and the Internet as well as a variety of other services such as multimedia and entertainment available to mobile users.

3G technology is the result of research and development work carried out by the International Telecommunication Union (ITU) in the early 1980s. 3G specifications and standards were developed in fifteen years. The technical specifications were made available to the public under the name IMT-2000. The communication spectrum between 400 MHz to 3 GHz was allocated for 3G. Both the government and communication companies approved the 3G standard. The first pre-commercial 3G network was launched by NTT DoCoMo in Japan in 1998, branded as FOMA. It was first available in May 2001 as a pre-release (test) of W-CDMA technology. The first commercial launch of 3G was also by NTT DoCoMo in Japan on 1 October 2001, although it was initially somewhat limited in scope; broader availability of the system was delayed by apparent concerns over its reliability.

The first European pre-commercial network was an UMTS network on the Isle of Man by Manx Telecom, the operator then owned by British Telecom, and the first commercial network (also UMTS based W-CDMA) in Europe was opened for business by Telenor in December 2001 with no commercial handsets and thus no paying customers.

The first network to go commercially live was by SK Telecom in South Korea on the CDMA-based 1xEV-DO technology in January 2002. By May 2002 the second South Korean 3G network was by KT on EV-DO and thus the South Koreans were the first to see competition among 3G operators.

The first commercial United States 3G network was by Monet Mobile Networks, on CDMA2000 1x EV-DO technology, but this network provider later shut down operations. The second 3G network operator in the USA was Verizon Wireless in July 2002 also on CDMA2000 1x EV-DO. AT&T Mobility is also a true 3G UMTS network, having completed its upgrade of the 3G network to HSUPA.

The first pre-commercial demonstration network in the southern hemisphere was built in Adelaide, South Australia by m.Net Corporation in February 2002 using UMTS on 2,100 MHz. This was a demonstration network for the 2002 IT World Congress. The first commercial 3G network was launched by Hutchison Telecommunications branded as Three or "3" in June 2003.

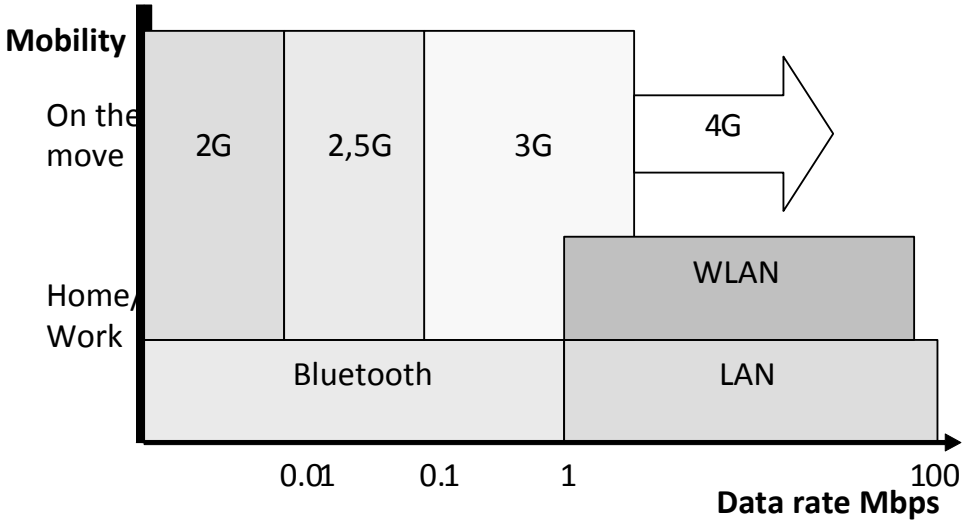
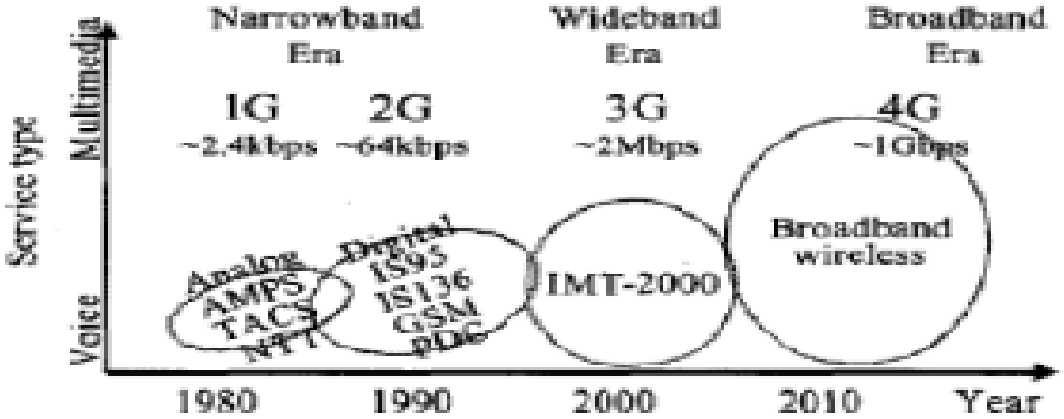


Figure 1 Classification of Mobile Networks and Mobility

2. EVOLUTION OF MOBILE CELLULAR NETWORKS

The first mobile telephone systems (car phone) were introduced in the late 1940s in the United States and in 1950s in Europe. Those early single cell systems were constrained by restricted mobility, limited service, low capacity, and poor speech quality. The equipment's were heavy, expensive, bulky and susceptible to interference. Because of these limitations, less than one million subscribers were registered worldwide by 1980s. The figure below describes the evolution of the cellular networks.



2.1 First Generation (1G):

1-G refers to the first generation of wireless telephone technology (mobile communications). These are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital communications. These are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital The main difference between the two mobile telephone systems (1G and 2G), is that the radio signals used by 1G networks are analog, while 2G networks are digital.

Although both systems use digital signaling to connect the radio towers (which listen to the handsets) to the rest of the telephone system, the voice itself during a call is encoded to digital signals in 2G whereas 1G is only modulated to higher frequency, typically 150 MHz and up. The inherent advantages of digital technology over that of analog meant that 2G networks eventually replaced them almost everywhere.

2.2 Second Generation (2G):

The second generation 2G systems fielded in the late 1980s and finished in the late 1990s was planned mainly for voice transmission with digital signal and the speeds up to 64kbps. 2G wireless cellular mobile service was a step ahead of 1G services by providing the facility of short message service (SMS) unlike 1G that had rime focus on verbal communication The Bandwidth of 2G is 30-200 KHz. During the second generation, the mobile telecommunications industry experienced exponential growth in terms of both subscribers and value-added services. An revolutionary technology GSM was introduced. GSM stands for Global System for Mobile communication or GSM use digital modulation to improve voice quality but he network offers limited data service. It used GPRS standard which delivered packet-switched data as packets.

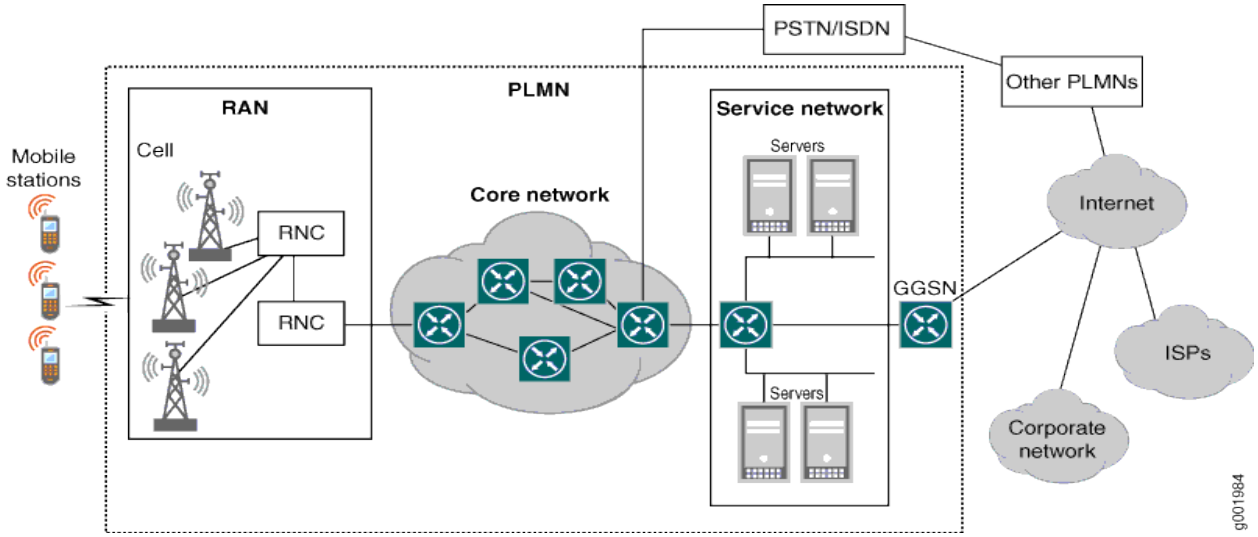
2.3 Second Generation (2G) + Wireless Networks:

The development of 2G cellular system was driven by the need to improve transmission quality, coverage and system capacity. Further advances in microwave devices and semiconductor technology brought digital transmission to mobile communications. Speech transmissions are still dominates the airways, but the demands for short message, fax, and data transmissions are growing rapidly. Supplementary services as encrypting of user data and fraud prevention have become standard features which are comparable to those in fixed networks. 2G cellular systems that includes GSM, D-AMPS, CDMA and PDC.

2.4 Third Generation (3G) Networks:

The third generation mobile technology based on wide band wireless network fulfilling the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. As per the IMT-

2000 standards, a system is required to provide peak data rates of at least 200 Kbit/s. 3G functions in the range of 2100 Hz and bandwidth 15-20 MHz The communication provides enhanced clarity and perfection like the real conversation. Recent 3G releases provide mobile broadband access of several M bit/s to smart phones and mobile modems in laptop computers. The first release of (Third Generation Partnership Project) 3GPP Long Term Evolution (LTE) standard completely fulfil the (International Telecommunications Union) ITU 4G requirements called the IMT-Advanced. 4G or 3.9G technology is the first release LTE. Its evolution LTE Advanced is a 4G technology. The three major components of the 3G networks are explained below.



- A Radio Access Network (RAN). This is a hierarchical arrangement of cell towers and base stations. The base stations are called as base transceiver station(BTS) or NobeBs in 3G. In some versions , there are also Radio Network Controllers(RNCs) that link to the BTSs to form a Radio Network Subsystem(RNS). A collection of RNSs using the wideband CDMA(WCDMA) air interface option form the UTMS Terrestrial Radio Access Network (UTRAN). All of these are referred as " network devices" in figure 1. The important point is that all handovers between cell towers are centrally controlled in the 3G network hierarchy.
- A core network (usually IP) typing the RAN to the 3G service Network. The network consist of all switches , routers and other network components required to transport mobile traffic.
- A service network reached through the core network. Some the services reached(the servers in the figure1) are specific to the service provider , such as accounting information(current balance) , short Message service(SMS), paging , voice mail. Other services are reached through the GGSN, such as internet , other internet service providers(ISPs), corporate network virtual private network (VPNs). The mobile next broadband gateway can be configured as GGS.

2.5 Fourth Generation (4G):

4^{TH} Generation is short for fourth generation cell phones or hand held devices. It is a wireless access technology. It will be a successor of 3G. Currently we are undergoing transition between 2G and 3G which is also known as 2.5G. 4G

mobile communications will have rates up to 20 Mbps higher than that of 3G. The Fourth Generation is available in many major metropolitan areas in the U.S., as companies continue to expand its service area. The 4G includes multiple technologies that are WiMAX and LTE. 4G LTE technology will have an average speed of download approximately 5 to 12 Mbps, according to Verizon Wireless. A download made using 4G WiMAX technology speed average will be between 3 and 6 Mbps. This is a significant upgrade over 3G networks; allow increased performance when multitasking, playing games or streaming video.

3. COMPARISON BETWEEN 1G, 2G, 3G AND 4G:

The Generation	Access Protocols	Key Features	Level of Evolution
1G	FDMA	Analog, primarily voice, less secure, support for low bit rate data	Access to and roaming across single type of analog wireless networks
2G and 2.5G	TDMA, CDMA	Digital, more secure, voice and data	Access to and roaming across single type of digital wireless networks and access to 1G
3G and 3.5G	CDMA2000, W-CDMA, HSDPA, TD-SCDMA	Digital, multimedia, global roaming across a single type of wireless network (for example, cellular), limited IP interoperability, 144Kbps to several Mbps	Access to and roaming across digital multimedia wireless networks and access to 2G and 1G
4G	TBD	Global roaming across multiple wireless networks, 10Mbps-100Mbps, IP interoperability for seamless mobile Internet	Access to and roaming across diverse and heterogeneous mobile and wireless broadband networks and access to 3G, 2G, and 1G

Comparison between 1G, 2G, 3G, 4G Technologies

4. FEATURES/SERVICES OF 3G

The ITU (International Telecommunication Union) has proposed 3G telecommunications standards to provide cost efficient high quality, wireless multimedia applications and enhanced wireless communications.

The features of 3g can be divided into two categories. One is data rates and the other is security.

- The main feature of 3G technology is that if it supports greater voice and data capacity and high transmission at low cost. 3G mobiles can operate on 2G and 3G technologies.
- The second main features is the security: 3G offers greater security features than 2G like Network Access Security, network domain Security, User Domain Security, Application Security.
- This technology provides localized services for accessing traffic and weather updates. Video calls and video conference is another major feature in 3G mobile.
- Data transfer rates are high and can support even live TV channels over phone. Online media is another exciting feature in 3G technology.

5. APPLICATIONS OF 3G

- The 3G mobiles can be used as a modem for a computer which can access internet and can download games and songs at high speeds.
- 3g provides high quality voice calls and video calls

- View live TV broadcasting in mobile. Get weather updates and new headlines in mobiles.
- 3G increases bit rate which helps the service providers to provide high speed internet facility and many applications to its customers.
- 3G devices can provide data transmission speed up to 2Mbits/s when used in stationary mode.
- Provides multimedia services such as sharing of digital photos and movies.
- This technology provides real time multiplayer gaming and location based services.
- 3G allows users to be online all the time.
- Teleconferencing at work is one of the best applications.

6. DRAWBACKS

- Upgrading the base station and cellular infrastructure to 3G incurs very high costs.
- Service providers has to pay high amount for 3G licensing and agreements.
- Problem with the availability of handsets in few regions and their costs.
- High power consumption.

7. CONCLUSIONS

Today, the majority of mobile services used via 3G networks are already available in current 2,5G networks (GPRS, EDGE) such as browsing the Web, sending and receiving multimedia messages (like pictures and video), and e-mailing. Therefore, 3G should not be viewed as a new technology surpassing the existing 2,5G networks, or a revolution in mobile communication. Instead, 3G should be considered to be evolution of existing mobile communications.

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