

An Appraisal of Mobile Technology

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Introduction

From ancient to modern times, mankind has been looking for means of long distance communications. For centuries, letter proved to be the most reliable means to transmit information. Fire, flags, horns etc. were used to transmit information faster. Technical improvement in 19th century simplified long distance communications with use of telegraphy and telephony. Both techniques were used for wired communication. In 1873, J.C. Maxwell laid the foundation of electromagnetic theory by summarizing empirical results in four equations, which are still valid today.[1] It however took several decades before Marconi made economic use of this theory by developing devices for wireless transmission of Morse signal took place. Voice was transmitted for the first time in 1906 and one of the first radio broadcast transmission was done in 1909 in New York.

Keywords: Mobile generations, 1G, 2G, 3G, Advantages, Limitations

History of Mobile Communication-

The history and status of mobile communications are shortly listed in the following, together with the respective evaluations on the chief contributions.

- 1) Traditionally, wireless systems were considered as an auxiliary approach that was used in regions where it was difficult to build a connection by wireline.
- 2) 1G was based on analog technique and deployed in the 1980s. It built the basic structure of mobile communications and solved many fundamental problems, e.g. cellular architecture adopting, multiplexing frequency band, roaming across domain, non-interrupted communication in mobile circumstances, etc. Speech chat was the only service of 1G.
- 3) 2G was based on digital signal processing techniques and regarded as a revolution from analog to digital technology, which has gained tremendous success during 1990s with GSM as the representative. The utilization of SIM (Subscriber Identity Module) cards and support capabilities for a large number of users were 2G's main contributions
- 4) 2.5G extended the 2G with data service and packet switching methods, and it was regarded as 3G services for 2G networks. Under the same networks with 2G, 2.5G brought the Internet into mobile personal communications.
- 5) 3G is deploying a new system with new services instead of only providing higher data rate and broader bandwidth. Based on intelligent DSP techniques, various multimedia data communications services are transmitted by convergent 3G networks.

Table 1 summarizes the entire development of mobile communications with the properties of each generation including starting time, driven technique, representative standard, radio frequency, bandwidth, multi-address technique, cellular coverage, core networks, and service type.

Property	1G	2G	2.5G	3G
Starting Time	1985	1992	1995	2002
Driven Technique	Analogue signal Processing	Digital signal Processing	Packet switching	Intelligent signal processing
Representative Standard	AMPS, TACS, NMT	GSM, TDMA	GPRS, I-Mode, HSCSD, EDGE	IMT-2000 (UMTS, WCDMA, CDMA2000)
Radio Frequency (HZ)	400M-800M	800M-900M	1800M-1900M	2G
Bandwidth (bps)	2.4K-30K	9.6K-14.4K	171K-384K	2M-5M
Multi-address Technique	FDMA		TDMA, CDMA	CDMA
Cellular Coverage	Large area		Medium area	Small area
Core Networks	Telecom networks	Telecom networks		Telecom networks, Some IP networks
Service Type	Voice Mono-service Person-to-person	Voice, SMS Mono-media Person-to-person	Data service	Voice, Data Some Multimedia Person-to-machine

Table1: Generation and development of mobile communication

Limitations of 3G

3G still leaves some unsolved problems that it does not concern or concerns only partly. The limitations and difficulties of 3G include:

- Difficulty in continuously increasing bandwidth and high data rate to meet multimedia services requirements, together with the coexistence of different services needing different QoS and bandwidth.
- Limitation of spectrum and its allocation.
- Difficult to roam across distinct service environment in different frequency bands.
- Lack of end-to-end seamless transport mechanism spanning a mobile sub-network and a fixed one.

The development trends of mobile communications can be summarized by the improvement of three aspects, including network area, e.g. data rate, bandwidth, and network capacity; mobility field, e.g. mobile spatial range, speed, coverage ability; and service property, e.g. services quantity, quality, cost, and category.

Limitation of 3G in India

- With WCDMA based 3G, as the data speed increases the coverage area of the cell become smaller and smaller. For data rates of 2 Mbps and above, a WCDMA cell can cover only an area of 10 meter radius i.e. about 300 sq. meters. Therefore, to provide 2Mbps data connectivity to an Airport terminal of say, 600-meter square (360,000 Sq.Mtr.), there should be 1200 W-CDMA cells.
- There has been some improvement with HSPDA, but still it is impossible to connect these by wireless links in cellular technology and therefore, will have to use Optical Fiber cable connectivity / PON up to the Cell terminal. In this situation the wireless portion of the network is only at the end link of 10 meter that can be better managed with alternate technology terminals and higher reach by WiMax / WiFi wireless system.
- As far as mobility is concerned; using W-CDMA cells, with increase in data rate the speed of movement of user terminal also become lesser and lesser. For 2Mbps, the speed of movement will be limited to 10 meters /second, i.e. A vehicle moving at 36 K.M per hour. Intricacy of 'hand over' at every 20 to 25 meters is also innumerable. Its products can generate. Volume can be built only when the product is available, accessible and affordable to community who are interested in such products.
- The success of any business comes from the volume its products can generate. Volume can be built only when the product is available, accessible and affordable to community who are interested in such products.

4G Review-

Different 4G feature frameworks have been defined from the standpoints of service subscriber, service provider, researcher and engineer. In the following we give some representatives of 4G perspectives.

1) It is easy to say, based on the developing trends of mobile communication, that 4G will have broader bandwidth, higher data rate, smoother and quicker handoff, wider mobile area, more various service, lower cost, etc. Obviously these ideas do not make too much sense as such.

2) Other than the words "more", "any" and/or "all" are preferred over expressions used by some others, e.g. anyone can communicate with anyone else, anywhere and anytime, or enjoy any service of any network operator, through any network of any network service provider. These sentences are truly attractive from a subscriber's viewpoint, and they sound quite like advertisements or word games.

3) DoCoMo introduced the concept of MAGIC for the vision of 4G [2]: Mobile multimedia; anytime, anywhere, anyone; Global mobility support; integrated wireless solution; and Customized personal service, which mostly focused on public systems and treat 4G as the extension of 3G cellular service.

4) European Commission (EC) presented a perspective focusing on ensuring seamless service provisioning across a multitude of wireless systems and networks, and providing for optimum delivery via the most efficient network available. Further discussion did continuous promotion around 4G concepts [3-5], e.g. private systems and ad-hoc networks, optimal resource utilization, multiple radio interfaces, WLAN use, standards for interoperability, etc.

5) A broader, all-encompassing perspective of 4G was proposed in [6], according to which 4G will encompass all systems from public to private, operator-driven to ad-hoc, broadband to personal area and ad hoc networks, 2G systems to 3G systems. It focused mainly on personalized services.

It is amusing to see that it is quite easy for anyone to give a prediction on some 4G characteristics, whereas it is more difficult to provide an exhaustive description and sufficient investigations, especially on the support of advanced techniques.

Features in 4G

1) User Diversity:

The external diversity of users, i.e. people in different situations, includes e.g. culture, educational background, economic capability, physical property, personal preference, etc. The internal diversity of users, i.e. people with different interfaces, include e.g. vision, hearing, speech, touch sense, hands and fingers, body, etc. Note that as for users, both their external and internal diversity are to be adapted by the other two targets: terminal and application. Moreover, for adapting the two kinds of user diversity, both the external and internal diversity of terminals and applications are the solution.

2) Terminal Diversity and Adaptability:

The terminals' external diversities are the differences of terminals in both static and mobile attributes. Static attributes include e.g. functionality, weight, size, battery life, human interface, antenna, processing capability, security, style, and cost. Mobile attributes include dynamic attributes of both temporal and spatial features. The former category contains e.g. moving speed and acceleration, along with stationary, pedestrian or vehicular qualities, while the latter is connected to spatial range, e.g. indoors, on-campus, in urban and rural environments, and also direction. The internal diversity of terminals means that one terminal may integrate multiple functions, modes, interfaces, flexibilities etc. There are three targets for terminal adaptability. For users, it includes the provision of different terminals to satisfy different users and an individual user's various requirements. As for applications, we hope that miscellaneous services can be delivered to one single terminal. When networks are concerned, a single terminal can reach a wide range of networks despite of location and mobile rate.

3) Network Diversity and Adaptability:

The external diversity of networks is obvious. Internet is assorted by nature, while wireless networks keep the same property. For instance air interfaces can integrate all kinds of standards and work on different frequencies. Moreover, multiple operators deploy networks with multiple standards and protocols. The internal diversity of networks means that one network can interconnect with other different networks and transfer various kinds of loads, e.g. cellular systems with coverage. Three targets are related to network adaptability. In reference to terminals, network adaptability aims to make multiform mobile devices with a wide range of moving speeds and mobile areas connectable to wireless networks. For applications, there is a requirement that any type and/or quality of service can be delivered through diverse fixed and mobile networks in the most suitable and efficient way. The target for networks themselves is to make it easy to build a new network or remove an old one, and to make interoperability with one's neighbors seamless despite its heterogeneous nature.

4) Application Diversity and Adaptability:

The external diversity of applications will be a reasonable property, and this need not mean that 4G services and applications must be multifarious, in all the aspects of quantity, quality, and type. With internal diversity we mean that one application can be tailored into e.g. multiple levels of quality, various styles, and different kinds of release shape, etc. Application adaptability is a main feature of 4G services. To users, this means that services can be delivered automatically according to personal preferences of different users. In view of terminals, we hope that various terminals are able to run one application with different formats, such as e-mail in text message, voice, image, or even video. In connection with networks, applications can be transformed into various forms and levels in order to be transmitted correctly and efficiently.

Advantages of 4G (Next Generation Mobile Technology)-

- 3G/4G visions take into account installed base and past investments.
- Strong position of telecommunications vendors expected in the marketplace.
- Faster data transmission and higher bit rate and bandwidth, allow more business applications and commercialization.
- Has advantage for personalized multimedia communication tools.

Conclusion

This paper presents 4G visions from a technical perspective. 4G is esteemed to possess benefits such as high usability providing accessibility anytime and anywhere through a range of technologies, increased data transfer speed, improved quality of service, and wide variety of interactive services. The success of Second-generation (2G) mobile systems in the previous decade prompted the development of third-generation (3G) mobile systems. While 2G systems such as GSM, IS-95, and cdmaOne were designed to carry speech and low-bit-rate data, 3G systems are designed to provide higher data-rate services. A range of wireless systems including GPRS, IMT-2000, Bluetooth, WLAN and HiperLAN have been developed with their own merits and demerits targeting different service types, data rates, and users. However, no single efficient system exists for integration of all these technologies. 4G system that integrates existing and newly developed wireless systems is in incipient stage and international standards do not exist.

Future wireless networks will need to support diverse IP multimedia applications to allow sharing of resources among multiple users. There must be a low complexity of implementation and an efficient means of negotiation between the end users and the

wireless infrastructure. The fourth generation promises to fulfill the goal of PCC (personal computing and communication)—a vision that affordably provides high data rates everywhere over a wireless network.

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