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Mobile Communication system survey: Past Present and Future

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Abstract— *The number of mobile and internet subscribers is growing rapidly on a global scale, and with this growth comes new and improved wireless services and increased quality of service (QoS) demands. This paper is mainly focused on reviewing the mobile technology from past to future.*
Keywords: *1G, 2G, 3G, GIMCV*

1. INTRODUCTION

There has been a paradigm shift in mobile communications systems each decade. The first generation (1G) systems within the 1980s were supported analog technologies, and therefore the second generation (2G) systems within the 1990s, such as global Systems for Mobile Telecommunications (GSM) [1], Personal Digital Cellular (PDC) [2], and Interim standard (IS)-95 [3], on digital technologies for voice-oriented traffic. The 3G systems are also supported digital technologies for mixed voice, data, and multimedia traffic and mixed-circuit and packet-switched network [4,5]. The first 3G system was introduced in October 2001 in Japan [6].

Cellular service suppliers are slowly setting out to deploy third-generation (3G) cellular services. As access technology will increase, voice, video, multimedia, and broadband data services have become integrated into the same network. The hope once envisioned for 3G as a true broadband service has all but dwindled away. it's apparent that 3G systems, whereas maintaining the attainable 2-Mbps data rate in the standard, will realistically achieve 384-kbps rates. To attain the goals of true broadband cellular service, the systems need to make the leap to a fourth-generation (4G) network. This is often not merely a numbers game. 4G is meant to produce high speed, high capability, low cost per bit, IP based mostly services. The goal is to possess data rates up to 20 Mbps, even once employed in such eventualities as a vehicle traveling 200 kilometers per hour.

2. NEURAL NETWORKS

A conclusion can be drawn from this: Even if at a certain point it may look “academic” to developed a system for a capacity much higher than what seems reasonable (in the sense that are no application requiring such high capacity), it is worthwhile to do it since almost certainty in the future (which may not be very far off) applications will comes out that need a capacity of even more 1Gbps. The story of fiber optics is elucidative on that. Rapid development will shrink the world into a Global Information Multimedia Communication Village (GIMCV). Figure 1 illustrates the basic concept of GIMCV, which consist of version components of different scales ranging from global to picocelluar in size.

3. LITERATURE REVIEW

I. THE EVOLUTION OF MOBILE CELLULAR TECHNOLOGIES

Primarily, voice traffic was seen as the major service priority offered via mobile communications. More recently subscribers have been benefiting from additional wireless services such as text services including short message service (SMS), imaging services including multimedia message service (MMS), and Internet based applications including fast file transfer, web browsing and remote email. Such additional services have appeared as a result of the surge in telecommunications demand and the successful evolution of mobile cellular technologies over the past decade. The evolution of mobile cellular technologies continues to accommodate the advances in the telecommunications industry offering "bigger and better" wireless services.

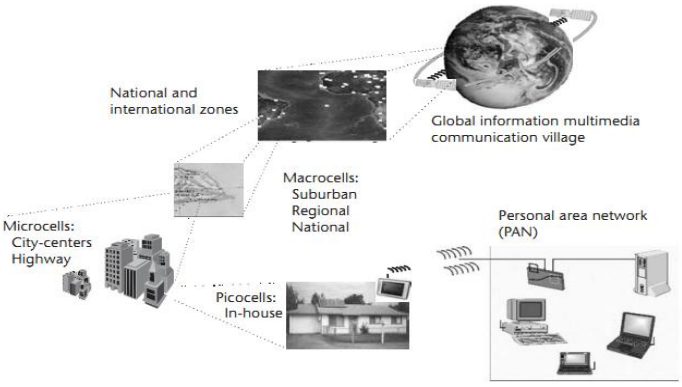

Fig 1: GIMCV

A. First Generation Cellular technologies

The first generation (1G) of mobile cellular systems simply refers to the superseded analog mobile technologies of the late 1970’s and early 1980’s such as the Nordic Mobile Telephone system (NMT), Advanced Mobile Phone System (AMPS) and Total Access Communications System (TACS) no longer beneficial in today’s communications boom; such cellular technologies have since been replaced through the roll-out of digital cellular systems. While 1G system supported primarily voice services, the digital technology of the next generation of cellular systems supports, in addition to voice traffic, paging, data and fax services.

B. Second Generation Cellular Technologies

In replacing the 1G cellular system in the early 1990’s, the second generation (2G) of mobile cellular systems introduced digital wireless technology to the world of mobile communications. 2G systems expanded on the capabilities of

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1G systems in terms of improved capacity, voice quality and coverage area. Emphasis was also placed on in-creasing the compatibility between mobile technologies worldwide. Regions around the world were divided with respect to spectrum allocations and multiple access techniques resulting in multiple 2G standards. The dominant 2G standard deployed in over 100 countries worldwide was the Global System for Mobile Communications (GSM). The GSM standard, initially introduced by the European Telecommunications Standards Institute (ETSI) [7] in the early 1990's uses a combination of time division multiple access (TDMA) and frequency division duplexing (FDD). Data is transmitted via slots created by subdividing both time and frequency; the available frequency is divided into sub bands of 200kHz and TDMA frames consist of eight timeslots each of 0.577ms [8]. In Europe the 1710-1785MHz and 1805-1880MHz frequency bands were allocated for GSM1800 while the GSM system utilized in Asia Pacific (including Australia), GSM900, operates on the 880−915MHz and 925−960MHz frequency bands. Other successfully deployed 2G standards include TDMA/136, IS-95-A (Interim Standard 1995 release) and Japan's PDC (Pacific Digital Communications). The IS-95-A standard is based on narrowband (as opposed to wideband to appear in the following generation of cellular systems) direct-sequence code division multiple access (DS-CDMA) and was successfully standardized and deployed as a 2G technology in the United States by the Telecommunications Industry Association (TIA).

The second phase of 2G systems, commonly referred to as 2.5G saw the inclusion of packet radio data and the further improvement of voice quality, data rates and coverage area. The 2.5G upgrade of GSM came in 1997 with the General Packet Radio System (GPRS) standard [9]. The packet-switched GPRS standard was developed to support internet applications (fast file transfer, web browsing and remote email) instead of using the circuit-switched GSM standard [10]. GPRS offered increased data rates of 22.8kbps compared to those of 14.4kbps of circuit-switched GSM [11]. Further enhancement of the GSM systems emanated from the release of Enhanced Data rates for GSM Evolutions (EDGE) in 1999 [8][11]. In 1998 IS-95-B was introduced, upgrading the existing IS-95-A standard to include higher rate packet data services. IS-95-B is backwards compatible with IS-95-A and both of these 2G standards are collectively known as cdmaONE [12]. As with the GSM based technologies, the IS-95-B enhancement brought higher data rates, increasing the 14.4kbps data rate of IS-95-A to 115.2kbps through packet data services [13][14].

C. Third Generation Cellular Technologies

The third generation (3G) mobile systems aim at evolving the 2G technologies to include IP based multimedia communication capabilities such as reliable internet access and high definition image and video services. The International Telecommunications Union (ITU) is the governing body of telecommunications worldwide and as such is responsible for the development of mobile telephony technologies and standardization [15]. In 1992, it was announced during the World Administrative Radio Conference (WARC) of the ITU that 3G systems were to be allocated the 1885 −2025MHz and 2110 −2200MHz bandwidths (2GHz frequency bands) [16].

The common objective of 3G systems was to create a seamless global coverage area enabling the connection of any two mobile terminals throughout the world. This was initially desired to be facilitated through the use of a sole air interface; however, such an ideal did not eventuate. Due to deferring desires in various regions, there exist subtle variations of the standardized 3G systems. UMTS (Universal Mobile Telecommunications System) [17][18] is the name given to 3G systems in Europe by the ETSI while IMT-2000 (International Mobile Telephony 2000) [13] formerly known as FPLMTS (Future Public Land Mobile Telecommunication Systems) [16] is the name given by the ITU, referring to the equivalent 3G systems in Japan and the United States. The ITU set data rate requirements for 3G UMTS/IMT-2000 technologies to facilitate the desired multimedia services; data rate requirements of 384kbps for pedestrian communications and 2Mbps for fixed terminal have been specified by the ITU. The most predominant multiple access scheme for the air interface of 3G technologies is W-CDMA(Wideband CDMA) [13][19][20]. Other air interfaces facilitating 3G services include EDGE [8] and cdma2000 [12]; the EDGE standard is the 3G upgrade of the 2G GSM/GPRS and TDMA/136 standards [11], while cdma2000 (comprising of cdma2000 1xEV-DO, cdma2000 1xEV-DV and cdma2000 3x) is an upgrade of the cdma ONE standard [14].

In the evolution of 2G technologies to include 3G technologies, the 3G systems are standardized in such a way to operate successfully over existing 2G core networks. This is to say 3G technologies are standardized to be backwards compatible with 2G technologies, allowing for example, EDGE systems to provide GSM services. The evolution from 2G to 3G systems and their corresponding air interface are displayed in Table I [18]. The dominance of W-CDMA in the air interface of 3G cellular systems is evident from Table I.

TABLE I. 2G TO 3G MOBILE SYSTEM EVOLUTION

Region	2G Technology	3G Air Interface Scheme
US	cdmaONE,GSM1900,TDMA	W-CDMA,EDGE,cdma2000
Europe	GSM1900/1800	W-CDMA,GSM,EDGE
Japan	PDC	W-CDMA

The enhancement and evolution of GSM systems was previously conducted through the ETSI. These enhancements included the GPRS and EDGE standards. More recently (since 2000), GSM based evolutions have been orchestrated by the 3rd Generation Partnership Project (3GPP) [21] in an effort to transform the GSM technologies towards the desired UMTS/IMT-2000. The systems currently under standardization by the 3GPP include GERAN (based on GSM/EDGE radio access technologies) and UTRAN (UMTS terrestrial radio access network). Due to the absence of a single 3G standard, a second partnership project, 3GPP2 [22], was also formed to work towards the standardization of cdma2000 technologies based on the evolution of cdmaONE.

D. Fourth Generation Cellular Technologies

The basis of 3G cellular systems has been based around DS-CDMA; this basis is evident from the global appearance of W-CDMA in 3G technologies. As the number of mobile subscribers continues to surge along with the evolution of wireless services, the next generation of mobile communications, the fourth generation (4G), will also need to

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evolve in order to support even higher data rates and network capacity. W-CDMA is seen as the dominant multiple access scheme for the air interface in 3G systems standardization and will remain a candidate for 4G standardization. Since the recent popularity of orthogonal frequency division multiplexing (OFDM) [23] and multicarrier modulation (MCM) techniques, multicarrier code division multiple access (MC-CDMA) [23][24][25][26] is emerging as a possible candidate for the air interface multiple access scheme of 4G technologies.

4. NEW PROPOSED SCHEME

LTE: THE FUTURE OF MOBILE TECHNOLOGY

Long Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX) the leading technologies for next-generation mobile broadband. The major benefit of LTE is greater security and privacy. It supports real time application due to low latency, create a platform upon which to build and deploy the products and services of today and those of tomorrow. It also reduces the cost per bit through improving spectral efficiency.

LTE is a global 4G standard, with researchers and development engineers throughout the world participating in the joint-LTE radio access standardization effort, involving more than 60 operators, vendors, and research institutes. This is the same standards body that researched and established the GSM, GPRS, W-CDMA, and HSPA wireless standards. The LTE standard is tightly integrated with GPRS/UMTS networks and represents an evolution of radio access technologies and networks for UMTS.

5. CONCLUSIONS AND FUTURE WORK

Over the next five years, mobile Internet services will move beyond a novelty, and become a core solution for consumers and businesses. Corporations will invest in technologies that allow their remote users and field offices to tap into the corporate databases and information sources, and to take part in daily operations from anywhere, any time. These efficiencies will allow companies to keep pace with the changing work force and a global economy. For consumers, the ability to communicate, get information and ultimately conduct transactions over cell phones and mobile devices will fuel a new industry of solutions targeted at the mobile user. In this paper we have deals with the mobile communication.

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