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Research Article

REVIEW ON THE EVOLUTION OF MOBILE COMMUNICATIONS

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ABSTRACT

This article provides an outline of the mobile communications industry's evolution. Even though there are various systems that are not interoperable, 2G technologies have had a huge uptake. Although 3G will offer some convergence, it will fall short of the goal of creating a unified worldwide technology. IP is becoming more significant at the network level. WLAN is delivering a supplementary technology to cellular in hot spot environments.

Keywords: Radio Technologies, Mobile Network, Evolution, cellular

I. INTRODUCTION

In the beginning of 2002, the quantity of cellular clients will break the 1 billion imprint. This revolution in our life has been acknowledged through a consistent evolution of guidelines and items keeping an ideal degree of execution. This evolution began in the mid '90s with the substitution of the simple mobile network by the computerized one, and is proceeding with today with the organization of the third era (3G). From circuit-driven networks we currently enter the bundle world through middle overlay networks, continued in years to stop by all-IP networks. Worldwide System for Mobile Communications (GSM) presently represents around 66% of the world's complete market. This piece of the pie is probably going to increment as significant time-division numerous entrance (TDMA) entertainers have begun the transition to GSM. The purpose for the TDMA movement to GSM isn't just specialized yet in addition, and more significant, monetary on account of GSM's colossal economy of scale. Another innovative solidification is happen ring with 3G mobile technologies, where Universal Mobile Telecommunications System (UMTS) is the picked evolution for all GSM networks, just as for the Japanese Personal Digital Cellular (PDC) network. Thus UMTS is the 3G decision of around 85% of mobile administrators. Up to now, the development of mobile telephone clients has been simply determined by voice administrations. It is as of late that information has begun to contribute at an extensive level to the incomes of mobile administrators, coming to around 10% in the second quarter of 2001 for cutting edge administrators [1] like NTT DoCoMo (iMode) or Orange (Short Message Service, SMS). Voice portability is turning into an item for end clients, and the market is requesting new applications. Administrators right now face the test of playing out a social progress from a voice-just assistance offering toward offering new applications. This change is needed to keep their incomes developing. The goal of this article is to give an outline of the diverse radio technologies and their evolution, the evolution of the network design toward all-IP networks, and the interworking of various remote access technologies.

II. EVOLUTION OF THE CELLULAR TELEPHONE SYSTEM

A. First-Generation Mobile Systems:

During the mid '80s, simple cellular phone frameworks were sent. Around then each coun attempt fostered its own framework, restricting utilization inside public limits and keeping away from economies of scale. In many nations these frameworks were supplanted by 2G frameworks during the '90s.

B. Second-Generation Mobile Systems:

Currently, four 2G technology systems coexist: GSM, cdmaOne, TDMA, and PDC

GSM —To foster a container European computerized cellular framework, the GroupeSpécial Mobile (GSM) was shaped in 1982 by the Con férenceEuropéenne des Postes et des Télécommunications (CEPT). In 1989, GSM particulars were made by the European Telecommunications Standards Institute (ETSI) and as of late moved to the 3G Partnership Project (3GPP). GSM business administration began in July 1991, however handsets were truly accessible just over the span of 1992. By 1993, there were 36 GSM net works in 22 nations, including non-European nations like Australia and South Africa. In January 2002, there were in excess of 470 GSM administrators in 172 nations with 646 million clients.

GSM permits up to eight clients to share a solitary 200 kHz radio channel by apportioning a remarkable time allotment to every client. GSM is utilized in the 900 and 1800 MHz groups everywhere on the world with the exception of North America (1900 MHz band). Before long, new frequencies will be utilized in the 450 and 850 MHz groups.

Since its commencement, GSM has been offering SMS, a connectionless parcel administration restricted to messages containing under 160 characters. Information move are likewise made conceivable utilizing circuit-exchanged information (CSD), which offers through put up to 14.4 kb/s. These impediments prompted the normalization of the High Speed Circuit Switched Data (HSCSD) and General Packet Radio Service (GPRS).

HSCSD empowers higher rates (up to 57.6 kb/s), however like CSD is circuit-based. In this way, it is intrinsically wasteful for bursty traffic, continuously utilizing a few radio channels (up to four). The shortcomings of HSCSD imply that just around 30 administrators have presented it up until this point. Most administrators use GPRS all things considered.

GPRS, which keeps the GSM radio modulation, frequency bands, and frame structure, is designed around a number of guiding principles:

- Always on: Allows sending or receiving data at any time
- High bit rates: An actual bandwidth roughly equivalent to a wireline modem
- Improved usage of radio resources: Same radio channels shared between several users
- Separate allocation of uplink and downlink channels
- Simultaneous voice call and data transfer
- Billing based on volume

In September 2001 around 100 operators, including several American operators, deployed GPRS. Enhanced Data Rate for Global Evolution (EDGE) improves GPRS by presenting another radio balance conspire that significantly increases the band width offered by GPRS. The EDGE update will begin in 2002, for the most part in the United States during the principal stage.

The further evolution of the GSM standard is taken care of now by the GSM EDGE Radio Access Network (GERAN) gathering of 3GPP. This gathering covers specifically the association of GSM/EDGE to 3G center networks and backing of continuous administrations.

cdmaOne — Spread range innovation has been utilized in military applications for seemingly forever. During the '80s, the U.S. military declassified this innovation, and it was tried for cellular communication applications. The spread-range based code-division different access (CDMA) standard, was supported in July 1993 by the Telecommunications Industry Association (TIA). CDMA business networks opened in 1995, however by mid-1998 had drawn in just 9 million clients. Things have improved since that time, with today around 100 million clients, for the most part in the Americas (55 million) and Asia (40 million). CDMA is presently called cdmaOne to differentiate it from 3G CDMA frameworks. With CDMA, numerous clients (up to 64) share a similar 1.25 MHz channel. Appending a pseu doirregular code to every client permits decoders to isolate traffic at each end. All base stations send a similar pseudo-irregular code with a period balance; hence they should remain synchronized. CDMA is utilized in the 850 MHz and the 1900 MHz groups. Like GSM, IS-95A, the first version of CDMA, offers throughput limited to 14.4 kb/s. In June 1997 IS95B CDMA specifications were completed. By assigning up to seven supplementary codes in addition to the fundamental code, data rates up to 64 kb/s are possible. Some Asian operators have started to implement IS-95B CDMA offerings.

TDMA — With analog cellular systems, such as Advanced Mobile Phone Service (AMPS), a sin gle subscriber at a time is assigned to a 30 kHz channel. D-AMPS, the TDMA system designed to coexist with AMPS systems, divides this 30 kHz channel into three channels, allowing three users to share a single radio channel by allocating unique time slots to each user. Recent developments show that the TDMA community is moving toward GSM. AT&T Wire less was the first to announce its decision in November 2000. Since then, Cingular Wireless in the United States and other major Latin American TDMA operators have announced their preference for GSM.

These new GSM networks will integrate GPRS and EDGE. Deployment of UMTS will require additional spectrum and be limited to 3G operators gaining new frequencies.

PDC — PDC is the Japanese TDMA-based standard operating in the 800 and 1500 MHz bands. PDC hosts the most convincing example of mobile Internet, iMode. iMode has already con quered over 30 million subscribers (January 2002) thanks to a large service offering and an excellent business model (billing on volume, revenue sharing arrangement with content owners, etc.). The congestion of the PDC system urged NTT DoCoMo to replace it rapidly with a 3G system.

C. Third-Generation Mobile Systems:

The idea of 3G became evident with the need for more capacity, new frequencies, and higher bit rates. A unique truly international standard was targeted, but unfortunately not successfully. Two main proposed systems for 3G (Fig. 2) have been recognized by the International Telecommunication Union (ITU): UMTS is composed of two different but related modes: –CDMA-direct spread: Wideband CDMA, also called frequency division duplex (FDD) –CDMA-TDD (time-division duplex) cdma2000: CDMA multicarrier, which is the evolution of cdmaOne.

EDGE, despite being part of the approved 3G systems, should be considered a simple evolution of the GSM system described earlier.

UMTS — Technical specification work on FDD and TDD standardization is being done within the 3GPP. The edition of specifications is phased in different releases:

- 3GPP release 3 specifications, formerly called release '99, define FDD and TDD modes, and are based on asynchronous transfer mode (ATM) in the radio access network.
- Release 3 was actually issued in March 2000 and became stable in June 2001.
- 3GPP release 4 specifications define a new version of TDD and FDD mode improvements.
- Release 4 was frozen in March 2001. 3GPP release 5 specifications shall include IP based transport within the radio access network
- Release 5 is scheduled for March 2002

FDD mode is considered the main technology for UMTS. FDD mode is derived from CDMA and also uses pseudo-random codes. Separate 5 MHz carrier frequencies are used for the uplink and downlink, respectively, allowing an end user data rate up to 384 kb/s (2 Mb/s per carrier). Later on, high-speed downlink packet access (HSDPA) will allow downlink data rate transmission to increase. FDD allows the operation of asynchronous base stations. The TDD mode likely to be deployed is time division-synchronous code-division multiple access (TDSCDMA). TD-SCDMA operates on low-chip-rate carriers, with 1.6 MHz carrier spacing instead of 5 MHz for the other wideband standards. It allows end-user data rates up to 2 Mb/s in optimal conditions. NTT DoCoMo commercialized a 3G service, called FOMA, in October 2001. Elsewhere, the installation of the first UMTS system (FDD mode only) will start in 2002, and marketing of services during 2003.

Cdma2000 — Technical specification work for cdma2000 standardization is being done within 3GPP2 in the following steps:

- cdma2000 1x- An evolution of cdmaOne, supports packet data service up to 144 kb/s
- cdma2000 1xEV-DO introduces a new air interface and supports high-data-rate service on ownlink. It is also known as high rate packet data (HRPD). The specifications were completed in 2001. It requires a separate 1.25 MHz carrier for data only. 1xEV-DO provides up to 2.4 Mb/s on the downlink (from base station to terminal), but only 153 kb/s on the uplink. Simultaneous voice over 1x and data over 1xEV-DO is difficult due to separate carriers.
- cdma2000 1xEV-DV- introduce new radio techniques and an all-IP architecture for radio access and core network. The completion of specifications is expected in 2003. It promises data rates up to 3 Mb/s.

SK Telecom from Korea was the first operator to launch cdma2000 1x in October 2000. Since that time, only a few operators have announced cdma2000 1x service launches. Some operators recently announced setting up cdma2000 1xEV-DO trials.

III. EVOLUTION OF THE NETWORK ARCHITECTURE

A. The GSM/GPRS Network Architecture:

Current services (voice and circuit-switched data) are supported via the base station subsystem (BSS) and network subsystem (NSS). The BSS consists of the base transceiver station (BTS) that handles the radio physical layer and the base station controller (BSC) that deals with radio resource management and handover. The NSS for circuit-switched (CS) services consists of the mobile switching center (MSC), the visitor location register (VLR) integrated in the MSC, and the home location register (HLR). GPRS provides packet-switched services over the GSM radio. A new functional network entity, the packet control unit (PCU), is required in the BSS to manage packet segmentation, radio channel access, automatic retransmission, and power control.

B. UMTS Release 3 Network Architecture:

The UMTS release 3 network, consists of two independent subsystems connected over a standard interface:

- UMTS terrestrial radio access network (UTRAN): composed of node B and a radio network controller (RNC). Node B is functionally similar to the GSM BTS, and RNC is similar to the GSM BSC.
- UMTS core network: equivalent to the GSM/GPRS NSS. The UMTS core network reuses as far as possible the GSM/GPRS NSS:
- Packet switch (PS): an evolution of the GPRS SGSN/GGSN with a more optimized functional• split between the UTRAN and core network
- Circuit switch (CS): an evolution of the NSS with the transcoder function moved from the BSS• to the core network.

As described earlier, UMTS is based on a new radio technology having a big impact on the UTRAN. The UTRAN (Fig. 5) consists of several possibly interconnected radio network subsystems (RNSs). An RNS contains one RNC and at least one node B. The RNC is in charge of the overall control of logical resources provided by the node Bs. RNCs can be interconnected in the UTRAN (i.e., an RNC can use resources controlled by another RNC) via the Iur interface. Node B provides logical resources, corresponding to the resources of one or more cells, to the RNC. It is responsible for radio transmission and reception in the cells maintained by this node B. A node B controls several cells. At a later stage, an evolution of EDGE called GERAN will allow upgrading 2G infrastructure to offer UMTS capabilities such as real-time packet services. The UMTS functional split between BSS and core network will be applied to GERAN with the current assumption of a transcoder located in the core network

VI. CONCLUSION

The introduction of 2G mobile communications has resulted in a paradigm shift in people's lifestyles. In less than ten years since GSM's commercial launch, the adoption rate in Western Europe has surpassed 70%. The transformation is far from over, as mobile Internet and 3G services will be available in the coming years. New services have been or will be offered to subscribers as technology advances. With SMS and iMode, data services have exploded in recent years. GPRS packet data services are now available, with better data speeds and the ability to stay connected at all times. UMTS and its variants will enable faster data speeds and a more comfortable delivery of increasingly demanding services. The transition from 2G to 3G will result in more convergence by reducing the number of major 3G cellular technologies. Interworking with WLAN is planned in the short to medium term, as is the provision of multimedia (including real-time) services via the IMS system. Even Nevertheless, the evolution of mobile communications will continue because research on topics beyond 3G is happening within the research community (e.g., satellite component of UMTS, Mobile Broadband System at 60 GHz).

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