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THE SERVICE ASPECTS OF THREE TDMA DIGITAL CELLULAR MOBILE SYSTEMS (GSM, IS-136 NA-TDMA AND PDC) - A COMPARATIVE STUDY

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ABSTRACT

The emerging trend of the mobile communication is to communicate with a person, at any time, at any place. This will be possible only when the service providers select the best out of the standard digital cellular mobile communication systems namely (i) GSM: The European TDMA Digital Cellular Standard, (ii) IS-136: The North American TDMA Digital Cellular Standard (D-AMPS) and (iii) PDC: The Japanese TDMA Digital Cellular Standard. With the rapidly increasing penetration of laptop computers which are primarily used by mobile users to access Internet services like e-mail and World Wide Web (WWW) access, support of Internet services in a mobile communication system is very important service aspect. To meet the demands, mobile computing will use standard networks. Thus, in this study the author is trying to highlight a comparative picture of the three standard digital cellular mobile communication systems based on service aspects.

KEYWORDS
GSM, IS-136 TDMA, PDC, Service Aspect

1. INTRODUCTION

In this present age, mobile communication takes a great role. In the early 1980s people were not much aware about mobile communication systems. But now a day we are handicapped if we don't have a mobile. Mobile communication is becoming a part and partial of our life. Again the underlying vision for the emerging mobile and personal communication service and the system is to enable communication with a person, at any time, at any place and in any form. Thus to be universalized, personal communication cover terminal mobility provided by wireless access, personal mobility based on personal number and service portability through use of intelligent network capabilities.

Terminal mobility systems are characterized by their ability to locate and identify a mobile terminal or it moves and to allow the mobile terminal to access telecommunication services from any location and even while it is in motion. In this mobility, the communication is always between the network and the terminal and it is still a static, so that call delivery and billing always based on terminal identity or mobile station number. In personal mobility, the relation between the terminal and the user is a dynamic so that the call delivery and billing can be based on a personal identity (personal no) assign to the user. It is characterized by this ability to identity end user as they moved and to allow end users to originate and receive calls and to access subscribed telecommunication services, in any location. It is applicable in both the wire line and the wireless network. In service portability, it refers to the capability of a network provided subscribed services at the terminal or location designated by the user. It is accomplished through the use of IN concept whereby the user service profile can be maintained in a suitable data based, while the user can access, interrogate and modify to manage and control subscribed services.

Due to the achievement and advancement of the ICT, mobile computing became a very important part in this present age. It can be defined as a computing environment over physical mobility. In this environment, a user can perform anywhere using a computing device in the public, corporate and personal information spaces. While on the move, the preferred device

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will be a mobile device, while back at home or in the office the device could be a desktop computer. But it should be through wired and wireless media. Be it for the mobile workforce, holidaymakers, enterprises or rural population, the access to information and virtual objects through mobile computing are absolutely necessary for optimal use of resource and increased productivity, and thus mobile computing is used in different contexts with different names e.g. virtual home environment, nomadic computing etc.

2. NEED OF THE STUDY

With the rapidly increasing penetration of laptop computers which are primarily used by mobile users to access Internet services like e-mail and World Wide Web (WWW) access, support of Internet services in a mobile communication system is very important service aspect. As the mobile and personal communication services and networks involve toward providing seamless global roaming and improve quality of service to its users the role of such network aspect as numbering and identity and quality of service will become increasingly important, well defined standards in these areas, as well as network performance for the present and future mobile and personal communication network, and to provide national management function in mobile communication network and to provide national and international roaming, well defined standardized subscriber and identifies are required. To meet these demands, mobile computing will use standard networks. Some of the standard digital cellular mobile communication systems are (i) GSM: The European TDMA Digital Cellular Standard, (ii) IS-136: The North American TDMA Digital Cellular Standard (D-AMPS) (iii) PDC: The Japanese TDMA Digital Cellular Standard and (iv) IS-95: The North American CDMA Digital Cellular Standard. The cellular industry continues to experience massive growth. While there remains a large subscriber base for analogue systems most of the recent growth has been on digital systems. So this paper is trying to give some knowledge of the networks by comparing the networks as mentioned above based on some preferred parameters like architecture, protocols, security, service, radio aspects etc.

3. OBJECTIVE OF THE STUDY

The main objective of this paper is to study the three TDMA based Cellular mobile system namely (i) (i) GSM: The European TDMA Digital Cellular Standard, (ii) IS-136: The North American TDMA Digital Cellular Standard (D-AMPS) (iii) PDC: The Japanese TDMA Digital Cellular Standard and to prepare a comparative analysis based on the service aspects.

4. TDMA BASED CELLULAR MOBILE SYSTEM

4.1 Global System for Mobile (GSM)

Development of GSM started in 1982 within CEPT for a future pan-European Cellular system. This was designed to replace the incompatible analog systems. The development was transferred to ETSI in 1989 and the phase 1 standards were frozen in 1990. The first commercial GSM service was launched in 1992 and the first DCS1800 launched in September 1993. GSM standardization continues with Phase 2 standards completed in 1995. The enhancement of GSM services from the original concept of a pan-European standard shows that GSM was an attractive option to operators around the world including USA, and has become the number one digital cellular standard.

4.2 North American TDMA

North American TDMA, often referred as TDMA, was developed in response to the need to increase cellular capacity. Unlike Europe and Japan where additional spectrum was made available for second generation digital systems US operators were constrained to re-use the same spectrum used for with AMPS. As a result the TDMA standard was developed to be compatible with the analogue AMPS system. Again the pressure on capacity forced the TIA to consider a rapid development of a digital

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standard. As a result two TDMA standards were developed. IS-54 often referred to as D-AMPS, was the first of these. It shares the same 21 analogue call set-up channels with AMPS so that the call processing is the same between the two systems and handsets can support dual AMPSD-AMPS. The second phase standard is IS-136 which implements digital call set-up channels to enable stand-alone TDMA handsets. IS-136 has effectively replaced IS-54.

4.3 PDC

A Third digital cellular system called PDC (Personal Digital Cellular) was developed in Japan and is in full commercial operation in that country. PDC is a second-generation technology used in digital cellular telephone communication in Japan. It uses a variation of TDMA (time division multiple access) which divides each cellular channel into individual time slots in order to increase the amount of data that can be carried. PDC is currently only used in Japan, with the first systems introduced by NTT DoCoMo in 1991 as a replacement for the earlier analog networks. It operates in the 800MHz and 1,500MHz bands, making very efficient use of the available bandwidth. With bandwidth demand so high in Japan, the system can operate in two modes: full rate and half rate. Half-rate channels have reduced speech quality and data transmission rates, but allow more channels to occupy the same bandwidth. Subscriber numbers are so high in Japan that, although PDC is only operational in this one country, it accounted for 12% of global digital subscriptions in December 1999.

Along with the other mobile communication standards, PDC can be developed along a gradual evolutionary path to the global IMT-2000 standard. Indeed, one of the IMT-2000 technologies, WCDMA (Wideband Code Division Multiple Access), is going through initial testing in Japan.

5. COMPARATIVE ANALYSIS

5.1 Service Aspects of GSM

GSM provides fully utilized 900 MHz frequency band with 200 KHz carrier spacing. The number of channels is 124. It supports 8 full-rate or 16 half-rate TDMA channels per carrier. GSM supports user/terminal authentication for fraud control. GSM facilitates the encryption of speech and data transmissions over the radio path. It has full international roaming facility. Its low speed data services are up to 9.6 kb/s. GSM is compatible with ISDN for supplementary services. It supports short message service (SMS). Besides these, GSM supports a range of basic and supplementary services which is analogous to those for ISDN. The most important service supported by GSM is telephony including emergency calling and voice messaging. There is a facility in GSM to save the power consumption by using discontinuous transmission techniques.

Other supplementary services provided by GSM are given below:

- Call offering services - Call forwarding
- Call restriction services - Call barring
- Call waiting service
- Calls hold service Multiparty service - teleconferencing
- Calling lines presenting restriction services
- Advice of change service
- Close user group service

5.2 Service Aspects of IS-136 NA-TDMA

The carrier spacing of IS-136 is 30 KHz. The channels per carrier of IS-136 are 3 full- rate and 6 half-rate. This standard supports short message services (SMS) and emergency (E.911) calling service. IS-136 lawfully authorized electronic surveillance (LAES) and also provides the facility on the air activation (OTA). It also supports sleep mode terminal operation and rolling mask message encryption.

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Other supplementary services provided by IS-136 NA-TDMA are given below:

- Call forwarding service (CF unconditional-CF-busy, CF-no answer-CF-default)
- Call termination services (Call delivery, call waiting, calling no, Identification presentation, Call no., Identification restriction, do not disturb flexible altering, message waiting notification, mobile access hunting)
- Call origination services (Preferred language, priority access and channel assignment (PACA), remote feature control, voice mail retrieval)
- Multiple party services, Call transfer, Conference calling, Three way calling
- Call restriction services, (password call acceptance, selective call acceptance, Subscriber PIN access, Subscriber PIN intercept)

5.3 Service Aspects of PDC

PDC offers interconnectivity with existing analog system and interconnectivity with ISDN and packet data network to integrate voice and non voice transmission services. The carrier spacing of PDC is 25 KHz with 3 full-rate and 6 half-rate channels/carrier. PDC supports 3 way party systems. This standard used User/Terminal authentication for fraud control and provides full International roaming capability.

Supplementary services supported by PDC are given below:

- Call waiting
- Voice mail
- Three party call
- Call forwarding

6. FINDING

From the comparative analysis of the three standards we can highlight the following findings:

i) GSM provides fully utilized 900 MHz frequency band with 200 KHz carrier spacing whereas carrier spacing of IS-136 and PDC are 30 KHz and 25 KHz. The channels per carrier of GSM is 8 full rate whereas for IS-136 and PDC is 3 full rate.

ii) All the three standard support short message services (SMS). These standards used User/Terminal authentication for fraud control and provides full International roaming capability.

iii) The most important service supported by GSM is telephony which will include emergency calling and voice messaging.

iv) PDC offers interconnectivity with existing analog system and interconnectivity with ISDN and packet data network to integrate voice and non voice transmission services.

v) IS-136 lawfully authorized electronic surveillance (LAES) and also provides the facility on the air activation (OTA).

vi) Out of these three systems GSM and IS-136 provides multi party service whereas PDC supports 3 way party systems.

vii) In GSM we find call hold service and Advice of charge service but it is not available in other two systems.

viii) Interestingly sleep mode service is not supported in GSM system but there is a facility in GSM to save the power consumption by using discontinuous transmission techniques. IS-136 supports sleep mode technology for longer battery life

ix) GSM and IS-136 supports an emergency service, where the nearest emergency service provider is notified by dialing three digits similar to 911.

x) It is also found that IS-136 has the ability to quickly roll out advanced services to meet future consumer's needs. It share the same 21 analogue call set up channels with AMPS so that the call processing is the same between the two systems and handsets can support dual AMPS/D-AMPS. The IS-136 system adds new power class of mobile phone to allow reduces the minimum cell site radius.

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xi) It is also found that a compact portable phone is one of the most special features of PDC. A key feature of PDC is mobile assisted hand off which facilitates the use of small cells for efficient frequency usage. It is gaining popularity due to high quality, high security, and a longer handset battery life. It has given the most spectrally of TDMA technology to the user. It also has prepaid calling, personal number, Universal access numbers, advanced charging scheme and wireless virtual private networks.

7. CONCLUSION

In this paper the researcher is trying to give an overview of mobile communication and the standards of digital cellular especially for GSM: The European TDMA digital cellular standard, IS-136: TDMA based digital cellular system in United States and PDC: The Japanese TDMA based digital cellular system based on service aspects. Nowadays industries are working on speeding up the development of mobile communication system where both voice and data services can be delivered regardless of location, network or terminal may be in the near future. This requires a mobile communication system which supports the requirements of the users. From the above discussion, it has been cleared that the three digital cellular systems have their own special features and form their achievement during short periods. It is also expected that the three standards will serve comfortably the demands of the customers.

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