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WCDMA IN MALAYSIA

Alias Mohamad

Hamzah B. Mawari

14.1 INTRODUCTION

Wideband Code Division Multiple Access (WCDMA) A 3G high-speed digital data service provided by cellular carriers that use the time division multiplexing (TDMA) or GSM technology worldwide, including AT&T (formerly Cingular) and T-Mobile in the U.S. WCDMA works on WCDMA cell phones as well as laptops and portable devices with WCDMA modems [1]. Users have typically experienced downstream data rates up to 400 Kbps [1].

WCDMA has been used in the Japanese Freedom of Mobile Multimedia Access (FOMA) system and in the Universal Mobile Telecommunications System (UMTS); a third generation follow-on to the 2G GSM networks deployed worldwide [1]. Although TDMA and GSM carriers both use TDMA modulation, WCDMA stems from CDMA. Part of the 3GPP initiative, the International Telecommunication Union (ITU) refers to WCDMA as the Direct Sequence (DS) interface within the IMT-2000 global 3G standards [1].

More technically, W-CDMA is a wideband spread-spectrum mobile air interface that utilizes the direct sequence Code Division Multiple Access signaling method (or CDMA) to achieve higher speeds and support more users compared to the implementation of time division multiplexing (TDMA) used by 2G GSM networks [1].

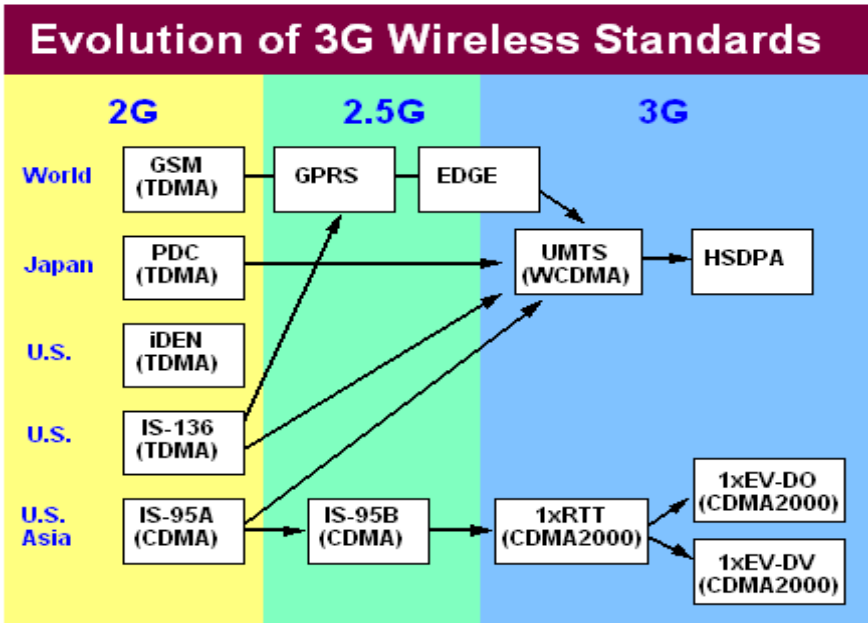


Figure 14.1: Evolution of 3G Wireless Standards [2].

14.2 TECHNICAL FEATURE

Radio channel for WCDMA are 5MHz wide and the chip rate for WCDMA is 3.84 Mcps [1]. It supports two basic modes of duplex, frequency division and time division. World current system use frequency division, these frequency divisions are divide in two frequencies, one frequency for uplink and another one for downlink [1]. For time division, FOMA uses sixteen slots per radio frame UMTS uses fifteen slots per radio frame. WCDMA also can be employs coherent detection on both the uplink and downlink based on the use of pilot symbols and channels. Another feature of WCDMA was, Supports inter-cell asynchronous operation, variable mission on a 10 ms frame basis, multicode transmission, adaptive power control based on SIR (Signal-to-Interference Ratio), multiuser detection and smart antennas can be

used to increase capacity and coverage, and multiple types of handoff (or handover) between different cells including soft handoff, softer handoff and hard handoff [1].

14.3 DEVELOPMENT

W-CDMA was developed by NTT DoCoMo (Do Communications Over the Mobile Network, NTT DoCoMo is a subsidiary of Japan's incumbent telephone operator NTT) as the air interface for their 3G network FOMA [1]. Later NTT DoCoMo submitted the specification to the International Telecommunication Union (ITU) as a candidate for the international 3G standard known as IMT-2000 [1]. The ITU eventually accepted W-CDMA as part of the IMT-2000 family of 3G standards, as an alternative to CDMA2000, EDGE, and the short range DECT system. Later, W-CDMA was selected as the air interface for UMTS, the 3G successor to GSM. Code Division Multiple Access communication networks have been developed by a number of companies over the years, but development of cell-phone networks based on CDMA (prior to W-CDMA) was dominated by Qualcomm, the first company to succeed in developing a practical and cost-effective CDMA implementation for consumer cell phones, its early IS-95 air interface standard [1]. IS-95 evolved into the current CDMA2000 (IS-856/IS-2000) standard [1].

In the late 1990s, NTT DoCoMo began work on a new wide-band CDMA air interface for their planned 3G network FOMA. FOMA's air interface, called W-CDMA, was selected as the air interface for UMTS, a newer WCDMA based system designed to be an easier upgrade for European GSM networks compared to FOMA. FOMA and UMTS use essentially the same air interface, but are different in other ways; thus, handsets are not 100% compatible between FOMA and UMTS, but roaming is supported. Qualcomm created an experimental wideband CDMA system called CDMA2000 3x which unified the W-CDMA (3GPP) and CDMA2000 (3GPP2) network technologies into a single design for a worldwide standard air interface [1]. Compatibility

with CDMA2000 would have beneficially enabled roaming on existing networks beyond Japan, since Qualcomm CDMA2000 networks are widely deployed, especially in the Americas, with coverage in 58 countries in 2006 [1]. However, divergent requirements resulted in the W-CDMA standard being retained and deployed. Despite incompatibilities with existing air-interface standards, the late introduction of this 3G system, and despite the high upgrade cost of deploying an all-new transmitter technology, W-CDMA has been adopted and deployed rapidly, especially in Japan, Europe and Asia, and is already deployed in over 55 countries as of 2006 [1].

14.3.1 Rationale for W-CDMA

W-CDMA transmits on a pair of 5 MHz-wide radio channels, while CDMA2000 transmits on one or several pairs of 1.25 MHz radio channels [1]. Though W-CDMA does use a direct sequence CDMA transmission technique like CDMA2000, W-CDMA is not simply a wideband version of CDMA2000. The W-CDMA system is a new design by NTT DoCoMo, and it differs in many aspects from CDMA2000. From an engineering point of view, WCDMA provides a different balance of costs vs. capacity vs. performance vs. density, and promises to achieve a benefit of reduced cost for video phone handsets [1]. WCDMA may also be better suited for deployment in the very dense cities of Europe and Asia. However, hurdles remain, and cross-licensing of patents between Qualcomm and W-CDMA vendors has not eliminated possible patent issues due to the features of W-CDMA which remain covered by Qualcomm patents. W-CDMA has been developed into a complete set of specifications, a detailed protocol that defines how a mobile phone communicates with the tower, how signals are modulated, how datagrams are structured, and system interfaces are specified allowing free competition on technology elements.

14.4 USER EQUIPMENT, UE

The UE for UMTS / WCDMA is equivalent to the mobile equipment used on GSM networks [3]. Essentially it is the handset, although having access to much higher speed data communications; it can be much more versatile, containing many more applications. It consists of a variety of different elements including RF circuitry, processing, antenna, battery, etc [3].

For UMTS / WCDMA mobiles, as for any system, the circuitry used within the UE can be broadly split into the RF and base-band processing areas. The RF areas handle all elements of the signal, both for the receiver and for the transmitter [3]. One of the major challenges for the RF power amplifier was to reduce the power consumption. The form of modulation used for W-CDMA requires the use of a linear amplifier [3]. These inherently take more current than non linear amplifiers which can be used for the form of modulation used on GSM [3]. Accordingly to maintain battery life, measures were introduced into many of the designs to ensure the optimum efficiency [3].

The base-band signal processing consists mainly of digital circuitry. This is considerably more complicated than that used in phones for previous generations. Again this has been optimized to reduce the current consumption as far as possible [3]. While current consumption has been minimized as far as possible within the circuitry of the phone, there has been an increase in current drain on the battery. With users expecting the same lifetime between charging batteries as experienced on the previous generation phones, this has necessitated the use of new and improved battery technology. Now Lithium Ion (Li-ion) batteries are used. These phones remain small and relatively light while still retaining or even improving the overall life between charges [3].

The UE also contains a SIM card, although in the case of UMTS it is termed a USIM (Universal Subscriber Identity Module). This is a more advanced version of the SIM card used in GSM and other systems, but embodies the same types of information. It contains the International Mobile Subscriber Identity number (IMSI) as well as the Mobile Station International

ISDN Number (MSISDN) [3]. Other information that the USIM holds includes the preferred language to enable the correct language information to be displayed, especially when roaming, and a list of preferred and prohibited Public Land Mobile Networks (PLMN) [3].

The USIM also contains a short message storage area that allows messages to stay with the user even when the phone is changed. Similarly "phone book" numbers and call information of the numbers of incoming and outgoing calls are stored [3].

14.5 RADIO NETWORK SUBSYSTEM

This is the section of the UMTS / WCDMA network that interfaces to both the UE and the core network. It contains what are roughly equivalent to the Base Transceiver Station (BTS) and the Base Station Controller (BSC). Under UMTS terminology, the radio transceiver is known as the Node B [3]. This communicates with the various UEs. It also communicates with the Radio Network Controller (RNC) [3]. This is undertaken over an interface known as the Iub [3]. The overall radio access network is known as the UMTS Radio Access Network (UTRAN). The RNC component of the Radio Access Network (RAN) connects to the core network [3].

14.6 CORE NETWORK

The core network used for UMTS is based upon the combination of the circuit switched elements used for GSM plus the packet switched elements that are used for GPRS and EDGE [3]. Thus for The Core the network is divided into circuit switched and packet switched domains. Some of the circuit switched elements are Mobile services Switching Centre (MSC), Visitor Location Register (VLR) and Gateway MSC [3]. Packet switched elements are Serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). Some network elements, like EIR, HLR,

and VLR are shared by both domains and operate in the same manner that they did with GSM [3].

The Asynchronous Transfer Mode (ATM) is specified for UMTS core transmission. The architecture of the Core Network may change when new services and features are introduced. Number Portability Database (NPDB) will be used to enable the subscriber to change network provider while keeping their old phone number [3]. Gateway Location Register (GLR) may be used to optimize the subscriber handling between network boundaries. MSC, VLR and SGSN can merge to become a UMTS MSC [3].

14.7 PACKET DATA

Packet data is an increasingly important element within mobile phone applications. WCDMA is able to carry data in this format in two ways. The first is for short data packets to be appended directly to a random access burst [4]. This method is called common channel packet transmission and it is used for short infrequent packets [4]. It is preferable to transmit short packets in this manner because the link maintenance needed for a dedicated channel would lead to an unacceptable overhead [4]. Additionally the delay in setting up a packet data channel and transferring the operational mode to this format is avoided.

Larger or more frequent packets have to be transmitted on a dedicated channel. A large single packet is transmitted using a single-packet scheme where the dedicated channel is released immediately after the packet has been transmitted. In a multipack scheme the dedicated channel is maintained by transmitting power control and synchronization information between subsequent packets [4].

14.8 SPEECH CODING

Speech coding in UMTS uses a variety of source rates. As a result, a variety of vocoders are employed including the GSM EFR vocoder. When a variety of rates are available, a system known as

Adaptive Multi-Rate (AMR) may be employed where rate is chosen according to the system capacity and requirements [4]. This scheme is the same as that used on GSM. The actual vocoder that is chosen is governed by the system.

The speech coding process can be combined with a voice activity detector [4]. This is particularly useful because during normal conversations there are long periods of inactivity. In the same way that discontinuous transmission is applied to GSM, the same is also true for UMTS [4]. It employs the same technique of inserting background noise when there is no speech as when the discontinuous transmission cuts out the transmission no background noise would otherwise be heard and this can be very disconcerting for the listener [4].

14.9 WCDMA HANDOVERS

- Avoidance of near far situation for circuit switched connections
 - For high mobility users shadow fading + (slow) hard handovers would create near far situations [5].
- Soft/Softer handovers will improve cell capacity (around 40-60 %) [5].
- Soft/Softer provides macro diversity gain: compared the hard handover larger cell range [5].
 - Gain against shadow fading (1 -3 dB) [5].
 - Gains against fast fading, typically 0.5 - 2 dB assumed [5].
- Soft/Softer essential interference mitigating tool.

14.10 DEPLOYMENT

The world's first commercial W-CDMA service, FOMA, was launched by NTT DoCoMo in Japan in 2001[4]. Elsewhere, W-CDMA deployments have been exclusively UMTS based. Malaysia now has moved forward and has employed the WCDMA

technology to Malaysia citizen. Research has been made by several companies such as Telekom Malaysia Berhad (TNB) [4].

14.10.1 3G Soft Launch in Malaysia

Huawei Technologies announced that the company, partnering with Telekom Malaysia, the pioneer 3G operator of Malaysia, has made a success in the soft launch of its pre-commercial WCDMA network in Malaysia. Malaysia government was one of the first in the region to issue 3G licenses [6]. Huawei-Telekom 3G pilot network covers the city center of Kuala Lumpur, including the renowned PETRONAS Twin Tower and KL Tower. The pilot project is intended for providing voice, video phone, plus a broad array of data services, such as Multimedia Message, KJAVA Download, Portal, WAP Browsing, Location Based Service, Personal Information Management, etc. at the speed up to 384 Kbps [6]. A variety of commercial 3G handsets can be supported in the network.

This soft launch is just the beginning of cooperation between Telekom Malaysia and Huawei. In the near future, Huawei will be working closely with Telekom Malaysia on the R&D, business plan, as well as the provisioning of attractive and lucrative 3G applications & services.

14.10.2 Ericsson to expand and upgrade MaxisWCDMA/HSPA network in Malaysia

Ericsson (NASDAQ:ERIC) has been selected by Malaysia's leading mobile operator, Maxis Communications Berhad (Maxis), to expand and upgrade its WCDMA/HSPA network enabling the operator to provide wireless residential broadband services to major cities and towns on mainland Malaysia [7].

Under the agreement, Ericsson will supply, integrate and deploy radio access network equipment and deliver radio optimization services. The contract includes Ericsson's latest HSPA software, enabling speeds of up to 14.4Mbps in the

downlink and up to 1.4Mbps in the uplink, allowing Maxis to enhance its broadband service quality and speed [7]. Implementation has commenced and is scheduled to be completed by the end of the year.

End users in areas that were previously without broadband access will be able to experience high-speed internet connections allowing seamless downloads of audio, video and large files.

Jon Eddy, Chief Operating Officer at Maxis, says: "We are aiming to expand our broadband footprint through this high-quality network while also supporting the government's national broadband plan. Maxis broadband is now widely available in Klang Valley, Penang and Johor Bahru. By extending our broadband services to more areas, we can address the shortage of residential broadband access while making broadband affordable and reliable. Ericsson is a strong partner in helping us to realize these ambitions, including our aim to become a major broadband player in the country [7]."

Krishna Kumar, President of Ericsson Malaysia, says: "Ericsson is proud to support Maxis and believes that the HSPA network providing wireless residential broadband will play a significant role in meeting broadband access needs in Malaysia. HSPA provides the fastest and most cost-effective solution for operators that want to offer broadband services and will deliver end users an enhanced experience with competitive pricing [7]."

Ericsson is shaping the future of Mobile and Broadband Internet communications through its continuous technology leadership. Providing innovative solutions in more than 140 countries, Ericsson is helping to create the most powerful communication companies in the world [7].

14.11 CONCLUSION

UMTS or as it is often termed, Wideband CDMA, WCDMA is being widely deployed. It offers many advantages over GSM, GPRS, and EDGE in terms of much higher data rates and greater flexibility. These basic technical abilities reflect as a much richer

number of applications and feature that the 3G phones can be used to perform. This not only gives the user a much more useful 'phone', but this also translates into higher revenues for the operator. Malaysia also has this WCDMA technology and have been using by Malaysia citizens now.

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