3

2G COMMUNICATION TECHNOLOGY IN MALAYSIA

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3.1 INTRODUCTION

The first radiotelephone service was introduced in the US at the end of the 1940s, and was meant to connect mobile users in cars to the public fixed network. In the 1960s, a new system launched by Bell Systems, called Improved Mobile Telephone Service" (IMTS), brought many improvements like direct dialing and higher bandwidth. The first analog cellular systems were based on IMTS and developed in the late 1960s and early 1970s.

The systems were "cellular" because coverage areas were split into smaller areas or "cells", each of which is served by a low power transmitter and receiver.

This first generation (1G) analog system for mobile communications saw two key improvements during the 1970s: the invention of the microprocessor and the digitization of the control link between the mobilephone and the cell site.

Second generation (2G) digital cellular systems were first developed at the end of the 1980s. These systems digitized not only the control link but also the voice signal. The new system provided better quality and higher capacity at lower cost to consumers.Before we go through second generation communication (2G) we have been using first generation communication (1G). First generation (1G) analog system for mobile communications saw two key improvements during the 1970s which the invention of the microprocessor and the

digitization of the control link between the mobile phone and the cell site [1]. Frequency Division Multiple Access (FDMA) is the most common analog system [1]. It is a technique whereby spectrum is divided up into frequencies and then assigned to users [1]. With FDMA, only one subscriber at any given time is assigned to a channel [1]. The channel therefore is closed to other conversations until the initial call is finished, or until it is handed-off to a different channel [1]. A "full-duplex" FDMA transmission requires two channels, one for transmitting and the other for receiving [1]. FDMA has been used for 1G analog system [1]. Second generation (2G) digital cellular systems were first developed at the end of the 1980s [1]. These systems digitized not only the control link but also the voice signal [1].

The new system provided better quality and higher capacity at lower cost to consumers [1]. The main differentiator to previous mobile telephone systems, retrospectively dubbed 1G, is that the radio signals. The radio signal that 1G networks use are analog, while 2G networks are digital. Both systems use digital signaling to connect the radio towers (which listen to the handsets) to the rest of the telephone system [2]. There been a few problems in 1G communication such as the security of the system was very low. Other can interrupt the communication easily and people cannot have their own privacy [2]. These are
why we have until 2G communication system and even more in 3G communication system now.

2G is short for second-generation wireless telephone technology. It is base on digital radio signaling in its wireless connection. 2G technologies can be divided into TDMA-based and CDMA-based standards depending on the type of multiplexing used [2]. The main 2G standards are:

- Global System for Mobile communications (GSM: originally from Groupe Special Mobile) used TDMAbased, originally from Europe but used worldwide [2].

- Integrated Digital Enhanced Network (iDEN) a TDMAbased, proprietary network used by Nextel in the United States and Telus Mobility in Canada [2].
- IS-136 aka Digital AMPS (D-AMPS), a TDMA-based, commonly referred as simply TDMA in the US, were used in the Americas [2].
- Interim Standard 95 (IS-95) aka cdmaOne, a CDMAbased and commonly referred as simply CDMA in the US, were used in the Americas and parts of Asia [2].
- Personal Digital Cellular (PDC) a TDMA-based, were used exclusively in Japan only [2]. This 2G generation use a digital technology. The advantage of the digital over analog transmission;
- It economizes on bandwidth [3].
- It allows easy integration with personal communication system (PCS) devices [3].
- It maintains superior quality of voice transmission over long distances [3].
- It is difficult to decode [3].
- It can use lower average transmitter power [3].

3.2 CONTENTS

3.2.1 The Two Type of Base In 2G

In the 2G communication system, it have two bases which is Time Division Multiple Access (TDMA) and Next Code Division Multiple Access (CDMA). We will go through TDMA based first and then followed by CDMA-based.

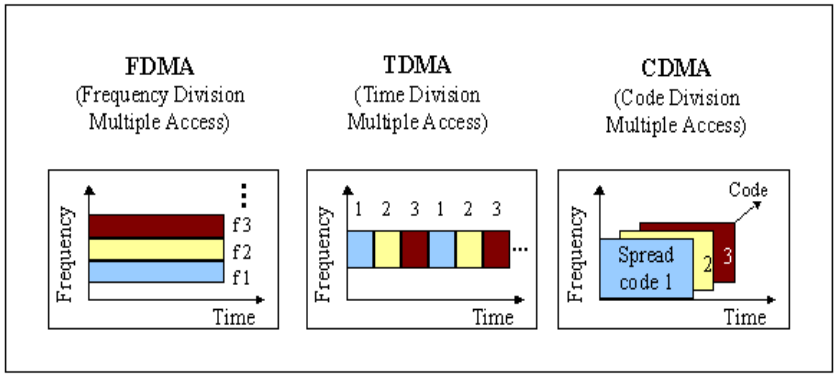

Figure 3.1 A graphical difference between FDMA, TDMA and CDMA [4]

Time Division Multiple Access (TDMA) is a channel access method for shared medium (usually radio) networks [4]. It allows several users to share the same frequency channel by dividing the signal into different timeslots. The users transmit in rapid succession, one after the other, each using its own timeslot [4]. This allows multiple stations to share the same transmission medium (e.g. radio frequency channel) while using only the part of its bandwidth they require [4]. TDMA is used in the digital 2G cellular systems such as Global System for Mobile Communications (GSM), IS-136, Personal Digital Cellular (PDC) and iDEN, and in the Digital Enhanced Cordless Telecommunications (DECT) standard for portable phones. It is also used extensively in satellite systems, and combat-net radio systems [4].

TDMA is a type of Time-division multiplexing, with the special point that instead of having one transmitter connected to one receiver, there are multiple transmitters [4]. In the case of the uplink from a mobile phone to a base station this becomes particularly difficult because the mobile phone can move around and vary the timing advance required to make its transmission match the gap in transmission from its peers [4]. TDMA features:

- Shares single carrier frequency with multiple users [4].
- Non-continuous transmission makes handoff simpler [4].
- Slots can be assigned on demand in dynamic TDMA [4].
- Less stringent power control than CDMA due to reduced intra cell interference [4].
- Higher synchronization overhead than CDMA [4].
- Advanced equalization is necessary for high data rates [4].
- Cell breathing (borrowing resources from adjacent cells) is more complicated than in CDMA [4].
- Frequency/slot allocation complexity [4].
- Pulsating power envelop: Interference with other devices [4].

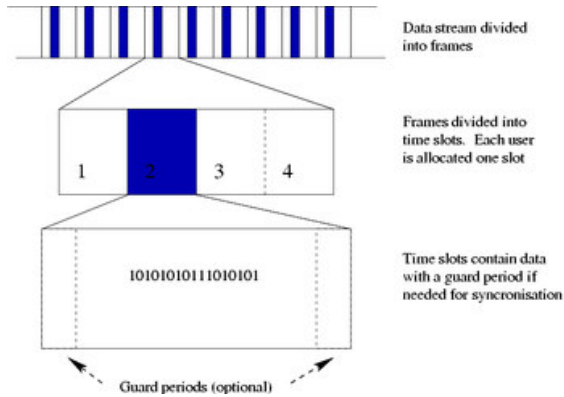

Figure 3.2 TDMA frame structure showing a data stream divided into frames and those frames divided into timeslots [4].

Most 2G cellular systems, with the notable exception of IS-95, are based around TDMA. GSM, D-AMPS, PDC, and PHS are examples of TDMA cellular systems. GSM combines TDMA with Frequency Hopping and wideband transmission to reduce interferences, this minimizes common types of interference [4].

In the GSM system, the synchronization of the mobile phones is achieved by sending timing advance commands from the base station which instructs the mobile phone to transmit earlier and by how much [4]. This compensates for propagation delay as the speed of radio waves is the same as light (finite). The mobile phone is not allowed to transmit for its entire timeslot, but there is a guard interval at the end of each timeslot. As the transmission moves into the guard period, the mobile network adjusts the timing advance to synchronize the transmission [4].

Initial synchronization of a phone requires even more care [4]. Before a mobile transmits there is no way to actually know the offset required [4]. For this reason, an entire timeslot has to be dedicated to mobiles attempting to contact the network (known as the RACH in GSM). The mobile attempts to broadcast at the beginning of the timeslot, as received from the network [4]. If the mobile is located next to the base station, there will be no time delay and this will succeed [4]. If, however, the mobile phone is at just less than 35km from the base station, the time delay will mean the mobile's broadcast arrives at the very end of the timeslot. In that case, the mobile will be instructed to broadcast its messages starting nearly a whole timeslot earlier than would be expected otherwise [4]. Finally, if the mobile is beyond the 35 km cell range in GSM, then the RACH will arrive in a neighboring timeslot and be ignored. It is this feature, rather than limitations of power, that limits the range of a GSM cell to 35 kilometers when no special extension techniques are used [4]. By changing the synchronization between the uplink and downlink at the base station, however, this limitation can be overcome [4].

Next is Code Division Multiple Access (CDMA). CDMA is a channel access method utilized by various radio communication technologies. It should not be confused with cdmaOne (often referred to as simply "CDMA"), which is a mobile phone standard that uses CDMA as its underlying channel access method [5].

CDMA employs spread-spectrum technology and a special coding scheme (where each transmitter is assigned a code) to allow

multiple users to be multiplexed over the same physical channel [5]. By contrast, time division multiple access (TDMA) divides access by time, while frequency-division multiple access (FDMA) divides it by frequency. CDMA is a form of "spreadspectrum" signaling, since the modulated coded signal has a much higher bandwidth than the data being communicated [5].

An analogy to the problem of multiple access is a room (channel) in which people wish to communicate with each other. To avoid confusion, people could take turns speaking (time division), speak at different pitches (frequency division), or speak in different directions (spatial division) [5]. In CDMA, they would speak different languages [5]. People speaking the same language can understand each other, but not other people. Similarly, in radio CDMA, each group of users is given a shared code [5]. Many codes occupy the same channel, but only users associated with a particular code can understand each other [5].

CDMA has been used in many communications and navigation systems, including the Global Positioning System and the OmniTRACS satellite system for transportation logistics [5].

3.2.2 G Type in Malaysia.

In Malaysia, we used what we call Interim Standard 95 (IS-95) aka cdmaOne like in Americas. IS-95 and its use of CDMA techniques, like any other communications system, have their throughput limited according to Shannon's theorem. Accordingly, capacity improves with SNR and bandwidth. IS-95 has a fixed bandwidth, but fares well in the digital world because it takes active steps to improve SNR [6].

With CDMA, signals that are not correlated with the channel of interest (such as other PN offsets from adjacent cellular base stations) appear as noise, and signals carried on other Walsh codes (that are properly time aligned) are essentially removed in the de-spreading process [6]. The variable-rate nature of traffic channels provide lower-rate frames to be transmitted at lower power causing less noise for other signals still to be correctly

received [6]. These factors provide an inherent lower noise level than other cellular technologies allowing the IS-95 network to squeeze more users into the same radio spectrum [6].

Active (slow) power control is also used on the forward traffic channels, where during a call, the mobile sends signaling messages to the network indicating the quality of the signal [6]. The network will control the transmitted power of the traffic channel to keep the signal quality just good enough, thereby keeping the noise level seen by all other users to a minimum [6]. The receiver also uses the techniques of the rake receiver to improve SNR as well as perform soft handoff [6].

3.2.3 2G Mobile Protocols

2G protocols generally rely on shared long-term keys between mobile devices and home network servers in order to allow the generation of session keys [7]. This means that once a shared session key is established between two mobiles across a network, symmetric encryption algorithms can protect digitally encoded speech and control information. Symmetric key algorithms are generally used due to the computational limitations of 2G mobile devices [7].

In 2G systems the mobile's home domain server needs to be on-line at the time of the call setup in order to help establish a session key between mobiles [7]. This means that the home server needs to be ultra reliable. A solution to this problem is to use public key algorithms between mobiles [7]. However, this solution was not feasible in 2G systems due to the computational limitations of mobile devices. Public key protocols can be more readily used in 3G systems due to their improved computational abilities [7].

3.2.4 Advantages

The 2G communication is a digital system that has been embraced by consumers for several reasons. Those reasons are:

- The lower powered radio signals require less battery power, so phones last much longer between charges, and batteries can be smaller [1].
- The digital voice encoding allowed digital error checking which could increase sound quality by reducing dynamic and lowering the noise floor [1].
- The lower power emissions helped address health concerns [1].
- Going all-digital allowed for the introduction of digital data services, such as SMS and email [1].

3.2.5 Disadvantages

The downsides of 2G systems, not often well publicized, are:

- n less populous areas, the weaker digital signal will not be sufficient to reach a cell tower [1].
- nalog has a smooth decay curve, digital a jagged steppy one. This can be both an advantage and a disadvantage. Under good conditions, digital will sound better. Under slightly worse conditions, analog will experience static, while digital has occasional dropouts. As conditions worsen, though, digital will start to completely fail, by dropping calls or being unintelligible, while analog slowly gets worse, generally holding a call longer and allowing at least a few words to get through [1].
- ith analog systems it was possible to have two or more "cloned" handsets that had the same phone number. This was widely abused for fraudulent purposes. It was, however, of great advantage in many legitimate situations.

One could have a backup handset in case of damage or loss, a permanently installed handset in a car or remote workshop, and so on. With digital systems, this is no longer possible [1].

- hile digital calls tend to be free of static and background noise, the losses compression used by the CODECs takes a toll; the range of sound that they convey is reduced. You'll hear less of the tonality of someone's voice talking on a digital cell phone, but you will hear it more clearly [1].

3.3 CONCLUSION

In Malaysia, we have use the 2G system for quite a time now. It's has been establish now and we also have grown up the communication system in Malaysia up until more than 3G communication. The upgrade of this communication system has improved many things such as give us privacy in wireless communication not like in the past. In 2G communication, we manage to have a simple and more efficient way of communication. The battery of the mobile can last much longer than using the previous communication system. It helps us to have an endless communication with others.

In this 21 century, we need a faster and bigger transfer rates. It will help us to have an instant update in information. In this 2G system, the transfer rates of the data were increase from the 1G system. The system also has a more efficient data transfer. The SNR of the system have been increase just like in the IS-95, the SNR has been increase in the way of the reducing of the noise of the system. Once the noise has been reduce, the communication can be clearer because of less interruption from other source. In year to come, the better way of communication system in Malaysia can be manage and people of Malaysia will not be left behind in term of world information. We can be a developed country and can stand up as the world class country.

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