About mobile technology and IMT-2000

CONTENTS

Introduction - Evolution of the Mobile Market

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.

Third generation (3G) systems promise faster communications services, including voice, fax and Internet, anytime and anywhere with seamless global roaming. ITU's IMT-2000 global standard for 3G has opened the way to enabling innovative applications and services (e.g. multimedia entertainment, infotainment and location-based services, among others). The first 3G networks were deployed in Korea and Japan in 2000 and 2001. 2.5G networks, such as GPRS (Global Packet Radio Service) are already available in some parts of Europe.

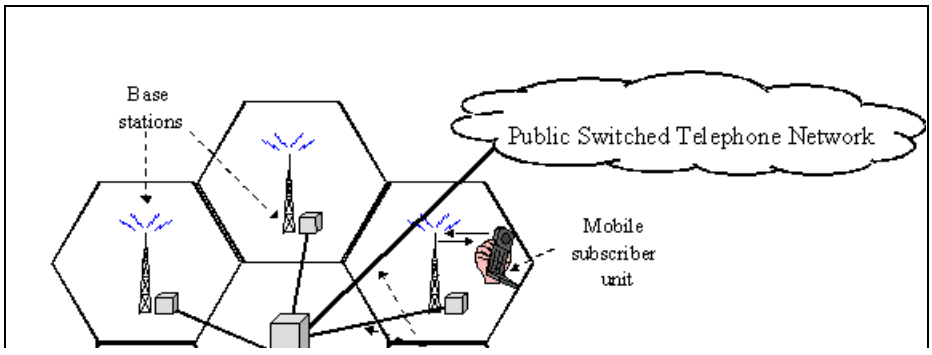
It is to be noted that analog and digital systems, 1G and 2G, still co-exist in many areas. Similarly, 2G and 3G systems will co-exist for some time.

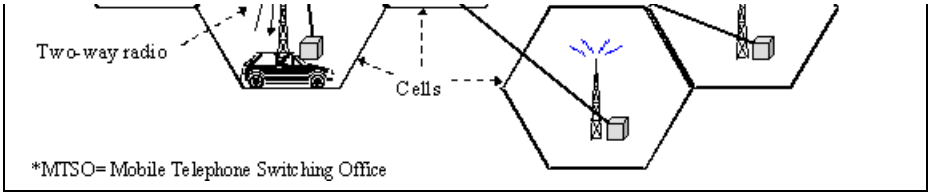
The Basics of Cellular Technology and the Use of the Radio Spectrum

Mobile operators use radio spectrum to provide their services. Spectrum is generally considered a scarce resource, and has been allocated as such. It has traditionally been shared by a number of industries, including broadcasting, mobile communications and the military. At the World Radio Conference (WRC) in 1993, spectrum allocations for 2G mobile were agreed based on expected demand growth at the time. At WRC 2000, the resolutions of the WRC expanded significantly the spectrum capacity to be used for 3G, by allowing the use of current 2G spectrum blocks for 3G technology and allocating 3G spectrum to an upper limit of 3GHz.

Before the advent of cellular technology, capacity was enhanced through a division of frequencies, and the resulting addition of available channels. However, this reduced the total bandwidth available to each user, affecting the quality of service. Cellular technology allowed for the division of geographical areas, rather than frequencies, leading to a more efficient use of the radio spectrum. This geographical re-use of radio channels is knows as "frequency reuse".

In a cellular network, cells are generally organized in groups of seven to form a cluster. There is a "cell site" or " base station" at the centre of each cell, which houses the transmitter/receiver antennae and switching equipment. The size of a cell depends on the density of subscribers in an area: for instance, in a densely populated area, the capacity of the network can be improved by reducing the size of a cell or by adding more overlapping cells. This increases the number of channels available without increasing the actual number of frequencies being used. All base stations of each cell are connected to a central point, called the Mobile Switching Office (MSO), either by fixed lines or microwave. The MSO is generally connected to the PSTN (Public Switched Telephone Network):





Cellular technology allows the " hand-off" of subscribers from one cell to another as they travel around. This is the key feature which allows the mobility of users. A computer constantly tracks mobile subscribers of units within a cell, and when a user reaches the border of a call, the computer automatically hands-off the call and the call is assigned a new channel in a different cell.

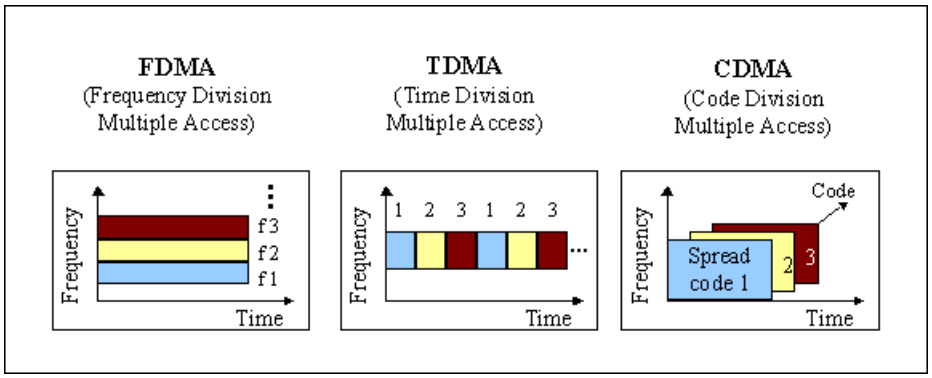
International roaming arrangements govern the subscriber's ability to make and receive calls the home network's coverage area.

Access Technologies (FDMA, TDMA, CDMA)

FDMA: Frequency Division Multiple Access (FDMA) is the most common analog system. It is a technique whereby spectrum is divided up into frequencies and then assigned to users. With FDMA, only one subscriber at any given time is assigned to a channel. The channel therefore is closed to other conversations until the initial call is finished, or until it is handed-off to a different channel. A "full-duplex" FDMA transmission requires two channels, one for transmitting and the other for receiving. FDMA has been used for first generation analog systems.

TDMA: Time Division Multiple Access (TDMA) improves spectrum capacity by splitting each frequency into time slots. TDMA allows each user to access the entire radio frequency channel for the short period of a call. Other users share this same frequency channel at different time slots. The base station continually switches from user to user on the channel. TDMA is the dominant technology for the second generation mobile cellular networks.

CDMA: Code Division Multiple Access is based on "spread" spectrum technology. Since it is suitable for encrypted transmissions, it has long been used for military purposes. CDMA increases spectrum capacity by allowing all users to occupy all channels at the same time. Transmissions are spread over the whole radio band, and each voice or data call are assigned a unique code to differentiate from the other calls carried over the same spectrum. CDMA allows for a " soft hand-off" , which means that terminals can communicate with several base stations at the same time. The dominant radio interface for third-generation mobile, or IMT-2000, will be a wideband version of CDMA with three modes (IMT-DS, IMT-MC and IMT-TC).



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Cellular Standards for 1G and 2G

Each generation of mobile communications has been based on a dominant technology, which has significantly improved spectrum capacity. Until the advent of IMT-2000, cellular networks had been developed under a number of proprietary, regional and national standards, creating a fragmented market.

First Generation:

1) Advanced Mobile Phone System (AMPS) was first launched in the US. It is an analog system based on FDMA (Frequency Division Multiple Access) technology. Today, it is the most used analog system and the second largest worldwide.

2) Nordic Mobile Telephone (NMT) was mainly developed in the Nordic countries. (4.5 million in 1998 in some 40 countries including Nordic countries, Asia, Russia, and other Eastern European Countries)

3) Total Access Communications System (TACS) was first used in the UK in 1985. It was based on the AMPS technology.

There were also a number of other proprietary systems, rarely sold outside the home country.

Second Generation:

1) *Global System for Mobile Communications* (GSM) was the first commercially operated digital cellular system. It was first developed in the 1980s through a pan-European initiative, involving the Eureopean Commission, telecommunications operators and equipment manufacturers. The European Telecommunications Standards Institute was responsible for GSM standardization. GSM uses TDMA (Time Division Multiple Access) technology. It is being used by all European countries, and has been adopeted in other continents. It is the dominant cellular standard today, with over (45%) of the world's subscribers at April 1999.

2) *TDMA IS-136* is the digital enhancement of the analog AMPS technology. It was called D-AMPS when it was fist introduced in late 1991 and its main objective was to protect the substantial investment that service providers had bmade in AMPS technology. Digital AMPS sevices have been launched in some 70 countries worldwide (by March 1999, there were almost 22 million TDMA handsets in circulation, the dominant markets being the Americas, and parts of Asia)

3) *CDMA IS-95* increases capacity by using the entire radio band with each using a unique code (CDMA or Code Division Multiple Access) . It is a family of digital communication techniques and South Korea is the largest single CDMA IS-95 market in the world.

4) *Personal Digital Cellular* (PDC) is the second largest digital mobile standard although it is exclusively used in Japan where it was introduced in 1994. Like GSM, it is based on the TDMA access technology. In November 2001, there were some 66.39 million PDC users in Japan.

5) *Personal Handyphone System (PHS)* is a digital system used in Japan, first launched in 1995 as a cheaper alternative to cellular systems. It is somewhere in between a cellular and a cordless technology. It has inferior coverage area and limited usage in moving vehicles. In November 2001, Japan had 5.68 million PHS subscribers.

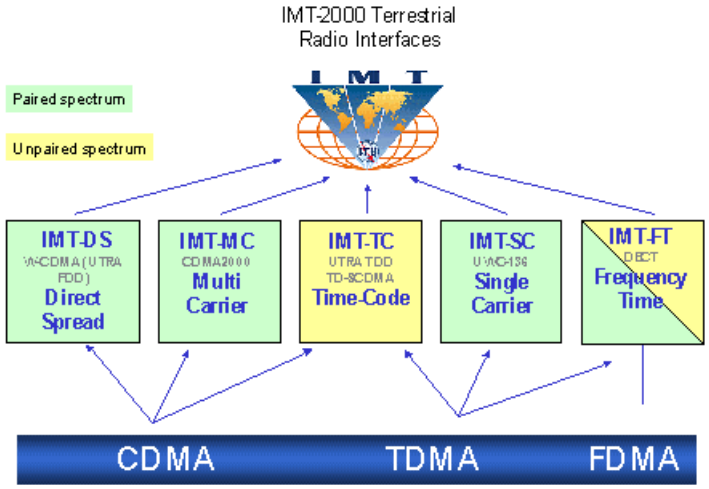
Cellular Standards for the Third Generation: The ITU's IMT-2000 family

It is in the mid-1980s that the concept for IMT-2000, "International Mobile Telecommunications", was born at the ITU as the third generation system for mobile communications. After over ten years of hard work under the leadership of the ITU, a historic decision was taken in the year 2000 : unanimous approval of the technical specifications for third generation systems under the brand IMT-2000. The spectrum between 400 MHz and 3 GHz is technically suitable for the third generation. The entire telecommunication industry, including both industry and national and regional standards-setting bodies gave a concerted effort to avoiding the fragmentation that had thus far characterized the mobile market. This approval meant that for the first time, full interoperability and interworking of mobile systems could be achieved. IMT-2000 is the result of collaboration of many entities, inside the ITU (ITU-R and ITU-T), and outside the ITU (3GPP, 3GPP2, UWCC and so on)

IMT-2000 offers the capability of providing value-added services and applications on the basis of a single standard. The system envisages a platform for distributing converged fixed, mobile, voice, data, Internet and multimedia services. One of its key visions is to provide seamless global roaming, enabling users to move across borders while using the same number and handset. IMT-2000 also aims to provide seamless delivery of services, over a number of media (satellite, fixed, etc...). It is expected that IMT-2000 will provide higher transmission rates: a minimum speed of 2Mbit/s for stationary or walking users, and 348 kbit/s in a moving vehicle. Second-generation systems only provide speeds ranging from 9.6 kbit/s to 28.8 kbit/s.

In addition, IMT-2000 has the following key characteristics:

1. *Flexibility*
With the large number of mergers and consolidations occurring in the mobile industry, and the move into foreign markets, operators wanted to avoid having to support a wide range of different interfaces and technologies. This would surely have hindered the growth of 3G worldwide. The IMT-2000 standard addresses this problem, by providing a highly flexible system, capable of supporting a wide range of services and applications. The IMT-2000 standard accommodates five possible radio interfaces based on three different access technologies (FDMA, TDMA and CDMA):



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Value-added services and worldwide applications development on the basis of one single standard accommodating five possible radio interfaces based on three technologies

2. *Affordability*
There was agreement among industry that 3G systems had to be affordable, in order to encourage their adoption by consumers and operators.

3. *Compatibility with existing systems*
IMT-2000 services have to be compatible with existing systems. 2G systems, such as the GSM standard (prevalent in Europe and parts of Asia and Africa) will continue to exist for some time and compatibility with these systems must be assured through effective and seamless migration paths.

4. *Modular Design*
The vision for IMT-2000 systems is that they must be easily expandable in order to allow for growth in users, coverage areas, and new services, with minimum initial investment.

Source: ITU

Industry Acronyms and Terms

ITU Glossary of Mobile Internet Terms

GSM Association's Glossary

UMTS Forum : Glossary of Terms

FCC's Glossary of Telecommunications Terms

Wireless Industry Terms from WirelessWeek

3G Technology Hot Links

- What is IMT-2000, International Telecommunication Union
- What is CDMA technology, CDMA Development Group
- Universal Mobile Telecommunications System (UMTS) Forum
- CDMA Development Group (CDG)
- GSM Association
- 3rd Generation Partnership Project (3GPP)
- 3rd Generation Partnership Project 2 (3GPP2)
- European Telecommunications Standards Institute (ETSI)
- Wireless World Research Forum (WWRF)
- China Wireless Telecommunication Standard Group (CWTS)
- Japan's Association of Radio Industries and Businesses (ARIB)