

Beyond 3G Communication: Defining a new border and standard

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Abstract – Mobile communication area has proven that this industry has changed in a relatively short time. Many new inventions and improvements have been made by the organization due to market demand. ITU-T as a worldwide organization has an important role to setup standards for interoperability. IMT-2000 as a group of standards for third generation (3G) technology has experienced evolution and revolution of its specification. However, the proper understanding about IMT-2000 is needed to avoid confusion with the term “4G” that is currently used by many organizations. In addition, ITU-T needs to define a new standard for the next generation technology, IMT-advanced.

Index Terms – 3G, evolution and revolution, ITU-T standard, WiMax, LTE, 4G confusion, IMT-2000, IMT-advanced.

ERA BEFORE 3G

The first generation of mobile communication was started in 1970, while its first commercial implementation was done 10 years later in about 1980s. The key characteristics of technology in this generation are: analog signal, FDMA (Frequency Division Multiple Access), and the service provided were only voice. Some 1G's standards were: NMT, AMPS, TACS [1]. The standards were developed especially for certain country only; therefore, it had lack of interoperability.

In the beginning of 1990s, the second generation mobile communication had been implemented. This system brought new improvements to its users and gained a huge success. Several key features of the second generation were: the use of digital signal, have

a worldwide standard, and its capability to use data communication over circuit switch at low speed. With the use of digital signal, then it is possible to compress/decompress the data as well as encrypt/decrypt it. Global standard was one of reason why this 2G had worldwide users. Some standards in 2G were GSM, iDEN, DAMPS, PHS. [1]

EVOLUTION AND REVOLUTION OF THE STANDARDS

Mobile Communication standards, as well as it happens in other standards, had a dynamic in order to improve the quality. The main idea of labeling “generations” against the standards or technology is if the technology offers a significant feature that is not available in the previous version. This term is also know as what it called “revolution”, which is often requires a lot of effort and new resources (eg. Equipment and Frequency). Conversely, if the new standard offers improvement without any vital change, and compatible with previous technologies, then it is called evolution. [2]

IMT-2000 AND 3G

ITU-T, as a world organization which one of its main tasks is defining standard of telecommunication, had prepared a standard for generation after 2G. The standard name is International Mobile Telecommunication 2000 (IMT-2000) and it was signed in the year 2000. Due to several technology implementations on 2G network, ITU-T needs to accommodate these standards so that they can go through evolution or revolution to IMT-2000. Therefore, IMT-2000 is formed as a group of standards instead of a single specification. Several

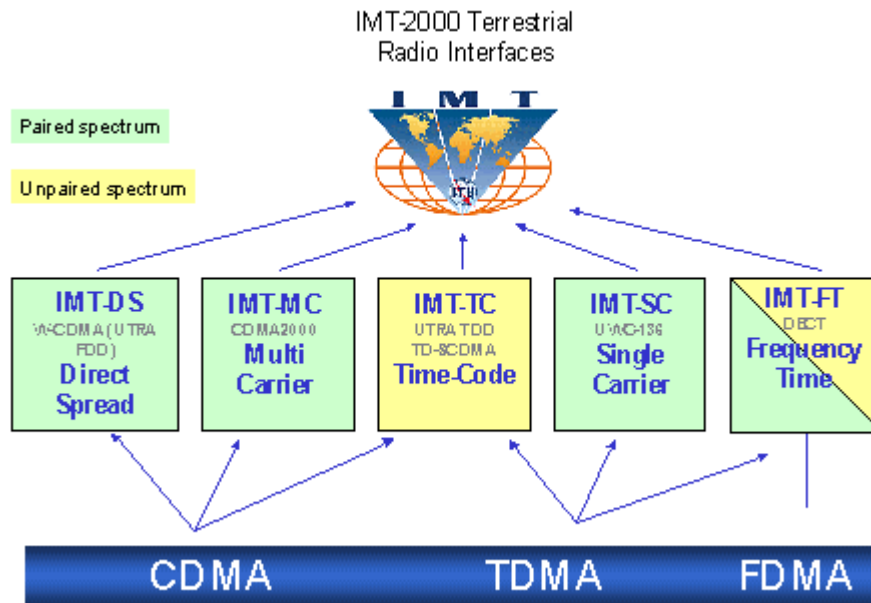


Fig.1 IMT-2000 standards
 (http://www.itu.int/osg/spu/ni/images/cdmatdma.gif)

standards in IMT-2000 are: IMT-FT (Frequency Time), IMT-SC (Single Carrier), IMT-TC (Time Code), IMT-MC (Multi-Carrier), and IMT-DS (Direct Spread).

Key characteristics of IMT-2000 are [3]:

1. Flexibility. IMT-2000 will accommodate a range of standards that can be classified as third generation system. See the picture above.
2. Affordability. This means IMT-2000 standard is affordable to be adopted by user or operator.
3. Compatibility with existing system. In other word, IMT-2000 needs to provide backward compatibility with current technology.
4. Modular Design. This means IMT-2000 can be implemented gradually, depending on market condition.

The unique features of IMT-2000 from 2G are:

1. Provides packet switching technology through additional node called GPRS Support Node (GSN).
2. Higher data speed
3. Ability to provide new services such as MMS and WAP.

However, many organizations did not consider some of IMT-2000 parts as third generation technologies. Some standards such as GPRS, EDGE (IMT-SC), and CDMA2000 (IMT-SC) which are evolutionary and provide a basic foundation for 3G, are classified as 2.5G technology. Most operators put more attention on revolutionary components, such as IMT-DS (W-

CDMA), and IMT-TC (TD-SCDMA/UTRA) because it requires new investment to buy a new spectrum license, and not compatible with previous technology [2]. However, the handset manufacturers answer this challenge by producing dual capability 2G/3G mobile station. Thus, it provides smooth migration from 2G to 3G.

CONFUSION ABOUT THE TERM “4G”

The use of term “4G” by some organizations create confusion in mobile communication world, because the technology that is mentioned as 4G does not have a revolutionary characteristic. ITU-T mentioned this in the article [2]:

“A number of the so called 4G technologies are in fact actually evolutions of 3G technologies, e.g. Long Term Evolution (LTE) from 3GPP and Ultra Mobile Broadband (UMB) from 3GPP2. It will clearly also be difficult to define the dividing line between 3G and 4G. ”

One popular technology that is so called 4G is WiMax (IEEE 802.16e). However, ITU-T received this technology and put it on IMT-2000 family standard. As a result, WiMax now is clearly defined as 3G technology together with existing standards [4].

DEFINING A STANDARD BEYOND 3G (IMT-ADVANCED)

With the growing mobile communication market as well as the increasing demand of applications that need more bandwidth, ITU-T is doing research for the next generation revolution standard beyond 3G. The new standard will be called IMT-advanced and the status is on progress now. The ITU-R committee is still studying about several key aspects of IMT-advanced such as frequency spectrum, coding, and minimum data rate. At this moment, ITU-R has been setting up a recommendation ITU-R M.1645 which describes customers' demand, framework, and future development of IMT-2000.

IMT-ADVANCED PERSPECTIVE

ITU-R in ITU-R M.1645 recommendation has made a diagram about transition from IMT-2000 to IMT-advanced.

defined currently. The level of mobility is described as: low mobility include pedestrians speed and high mobility covers high speed vehicle (train or car) [5].

4G features

Although 4G standard is not yet finalized by ITU-T, several key features of 4G technology are [1]:

1. High performance. 4G will provide more bandwidth to the users, which means it is increasing the download speed.
2. High interoperability. With the use of united 4G standard, it is possible to deploy system that can interact seamlessly.
3. Scalable. With the use of Internet Protocol (IP) as network layer in 4G it will provide better

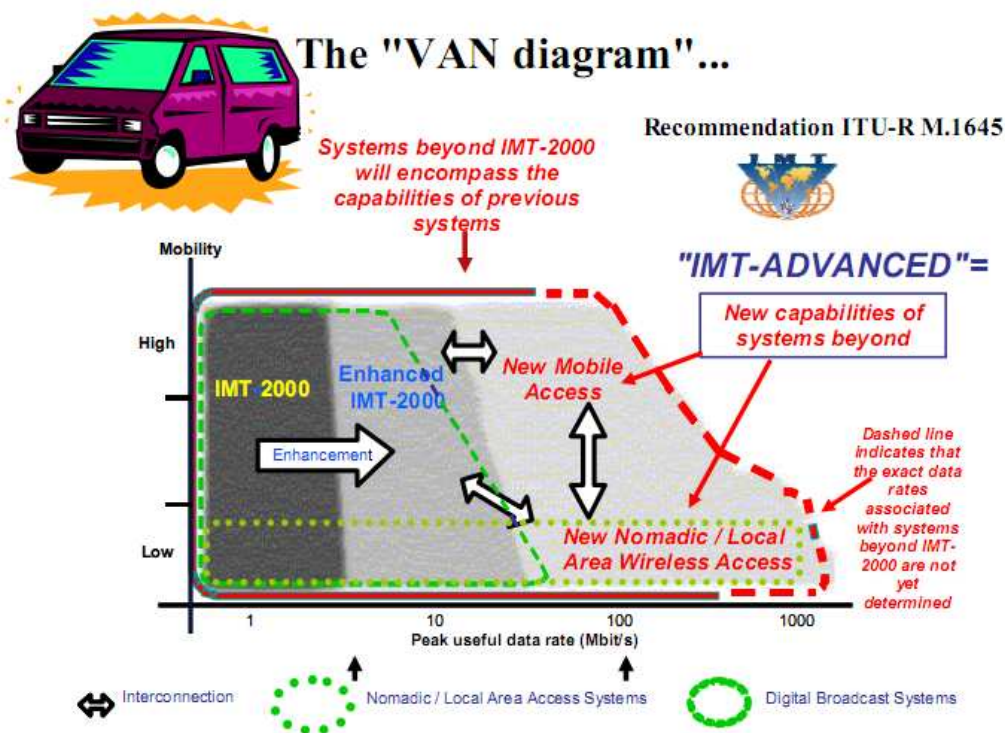


Fig.2 IMT-advanced “VAN diagram”

(<http://www.4gamerics.org/images/VAN%20Diagram%20WEbsize.jpg>)

scalability.

In the figure above, dark grey means current IMT-2000 system (3G), medium gray indicates improvement of IMT-2000 system, and light grey indicates new system beyond 3G which is not yet

CONCLUSION

This paper writes an overview of IMT-2000, the history, the confusion, and some ideas about technology beyond 3G. The right perception about IMT-2000 is crucial in order to understand what 3G really is. Even though IMT-advanced is not finished yet, one important thing is to define some revolutionary aspect that is unique from 3G.

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