# IMT-Advanced: The ITU standard for 4G Mobile Communication

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**Abstract**
The use of Information and Communication Technology (ICT) services, such as mobile phones and the Internet, continues to grow worldwide and Trends show explosive bandwidth growth of the Internet at large and for mobile broadband networks in particular. This is, consequently, driving the need for continued innovations in wireless data technologies to provide more capacity and higher quality of service. The International Telecommunications Union (ITU) has coined the term International Mobile Telecommunications-Advanced (IMT-Advanced) to identify mobile systems whose capabilities go beyond those of IMT-2000. Some of the key features of IMT-Advanced will be; Worldwide functionality & roaming, Compatibility of services, Interworking with other radio access systems and Enhanced peak data rates to support advanced services and applications (100 Mbit/s for high and 1 Gbit/s for low mobility). The IMT-Advanced systems will support low to high mobility applications and wide range of data rates, in accordance with service demands in multiuser environment. This paper provides a brief insight in to the IMT-Advanced standards and its key requirements which will be a pathway to next generation of wireless communication or 4G.

**Keywords**
ITU, IMT-Advanced, ICT, 4G

## I. Introduction

The use of Information and Communication Technology (ICT) services, such as mobile phones and the Internet, continues to grow worldwide, despite the recent economic downturn. By the end of 2009, there were an estimated 4.6 billion mobile cellular subscriptions, corresponding to 67 per 100 inhabitants globally (see Fig. 1). According to ITU, by the end of 2010, there will be an estimated 5.3 billion mobile cellular subscriptions worldwide, including 940 million subscriptions to 3G services [6,7]. Wireless data usage is increasing faster now than ever before (see Fig. 2). This is, consequently, driving the need for continued innovations in wireless data technologies to provide more capacity and higher quality of service [5].

Trends show explosive bandwidth growth of the Internet at large and for mobile broadband networks in particular. Cisco projects global IP traffic growing at a compound annual growth rate of 38% between 2009 and 2014, quadrupling traffic in that period. Mobile broadband traffic will grow at a CAGR of 108 percent in that same period. With declining voice revenue, but increasing data revenue, cellular operators face a tremendous opportunity in continuing to develop their mobile broadband businesses. Successful execution, however, means more than just providing high speed networks. It also means nurturing an application ecosystem, providing complementary services, and supplying attractive devices [3].

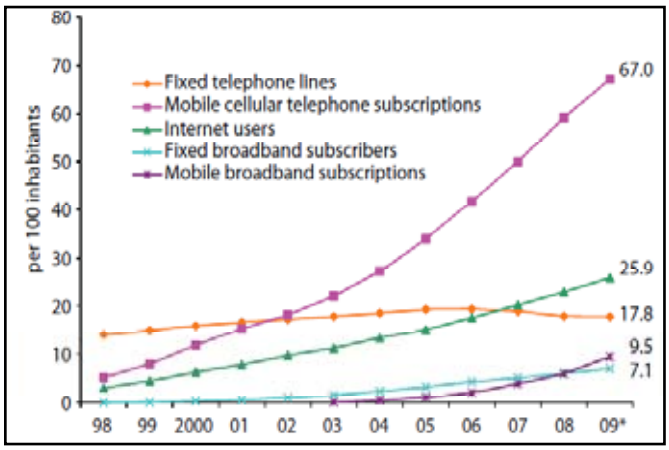


Fig. 1: Global ICT developments, 1998-2009 [6]
Source: ITU World Telecommunication/ICT Indicators database

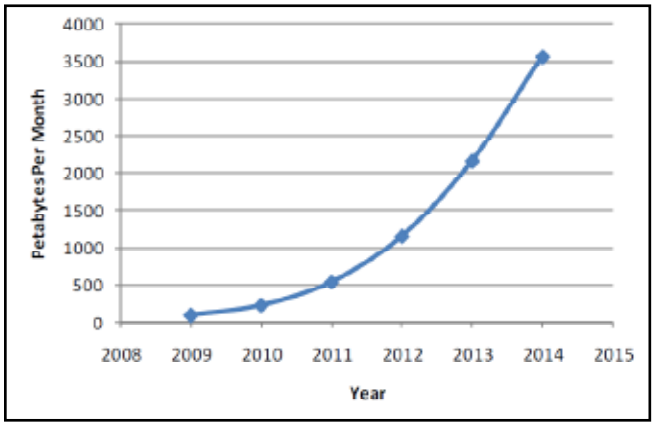


Fig. 2: Global Mobile Data Growth [3]

Broadband communication is becoming a foundational element of the entire economy, supporting entire industries, and is transforming the nature of human life itself. According to Morgan Stanley's recent report entitled "Internet Trends" (June 2010), in a survey among the hierarchy of human needs, voice and data connectedness now ranks third, behind food and shelter [3]. International Telecommunication Union (ITU) is the internationally recognized entity tasked with defining the next generation(s) of global wireless technologies through its work on IMT. The ability of technologies such as IMT to enable readily available and affordable communications supports ITU's effort to "connect the unconnected by 2015". In this paper we have discussed the IMT-Advanced specifications by ITU for the next generation (4G) wireless communication networks.

## II. IMT-Advanced

International Mobile Telecommunications-Advanced (IMT-Advanced) systems are mobile systems which include the new capabilities of IMT that go beyond those of IMT-

2000. Such systems will provide access to a wide range of telecommunication services (including advanced mobile services), supported by mobile and fixed networks that are increasingly packet-based. In other words, IMT-Advanced (or 4G) will see a progression beyond third-'generation (3G) technology [1]. The IMT-Advanced systems will support low to high mobility applications and wide range of data rates, in accordance with service demands in multiuser environment. 100 Mbps for high and 1 Gbps for low mobility conditions are establishes as the research objectives [2]. IMT-Advanced also has capabilities for high-quality multimedia applications within a wide range of services and platforms providing a significant improvement in performance and quality of service. This is depicted by what has been referred to as the "Van Diagram" (see Fig. 3) adapted from Recommendation by ITU's Radiocommunication Sector (ITU–R) [1].

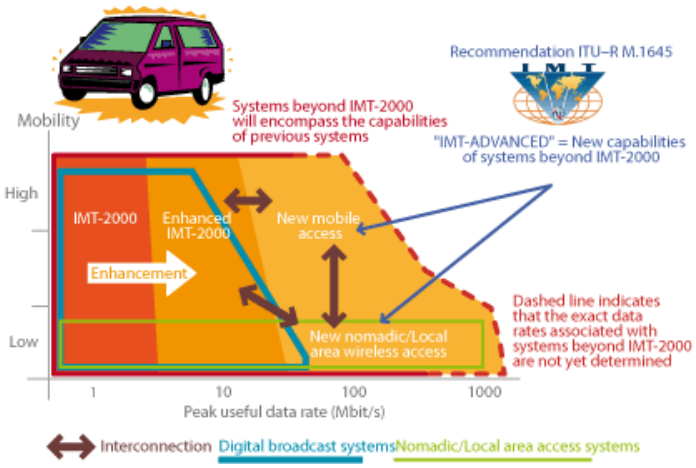


Fig. 3: The "VAN diagram" (Source: ITU)

ITU–R is tying all the SMaRT factors (Spectrum, Marketplace, Regulatory, Technology) together through the development of a comprehensive and interrelated set of Recommendations and Reports that are defining the next level of wireless communication capabilities for global deployment under the scope of an IMT-Advanced process and timelines. The requirements for IMT-Advanced are a significant milestone in capability when compared to those of IMT-2000. IMT-Advanced is a leap beyond. It offers new capabilities for the physical layer of the radio interface and brings into play a greater level of radio resource management and control, advanced capabilities for spectrum channel and bandwidth aggregation, and improved performance at all levels, including quality of service aspects. IMT-Advanced represents a wireless telecommunication platform that has the flexibility to accommodate services that are yet to be imagined. The release of IMT-Advanced Recommendations for detailed technical specifications is anticipated in early 2011, following the receipt of candidate technology submissions throughout 2009 and their evaluation during 2010. Thus, in 2011, IMT-Advanced will move from concept into reality. The subsequent deployment of IMT-Advanced systems will then establish yet another pinnacle in the advancement of ICT in all regions of the world [1].

The ITU has defined requirements that will officially define and certify technologies as IMT-Advanced or "4G," and technology submissions from standards organizations occurred in October 2009 timeframe pending evaluation and potential certification in the 2010 timeframe; the certified technology specifications are projected to be published by early 2011 [5]. Table 1 lists the IMT-Advanced requirements specified by ITU.

Table 1: IMT-Advanced Requirements [4]

| Item | IMT-Advanced |
|---|---|
| Peak Data Rate (DL) | 1 Gbps |
| Peak Data Rate (UL) | 500 Mbps |
| Spectrum Allocation | >40 MHz |
| Latency (User Plane) | 10 ms |
| Latency (Control Plane) | 100 ms |
| Peak Spectral Efficiency (DL) | 15 bps/Hz (4 X 4) |
| Peak Spectral Efficiency (UL) | 6.75 bps/Hz (2 X 4) |
| Average Spectral Efficiency (DL) | 2.2 bps/Hz (4 X 2) |
| Average Spectral Efficiency (UL) | 1.4 bps/Hz (2 X 4) |
| Cell-Edge Spectral Efficiency (DL) | 0.06 bps/Hz (4 X 2) |
| Cell-Edge Spectral Efficiency (UL) | 0.03 bps/Hz (2 X 4) |
| Mobility | Up to 350 km/h |

Preliminary research for IMT-Advanced is focused on technologies capable of delivering peak data speeds of 1 gigabit per second in "hotspot" locations and 100 Mbps in a mobile environment. Radio channels to support such networks are expected to be in excess of 20 MHz. Further ideas under consideration for IMT-Advanced includes, evolution of current OFDMA approaches, High-order MIMO (e.g., 4X4), wider radio channels (e.g., 50 to 100 MHz), optimization in narrower bands (e.g., less than 20 MHz) due to spectrum constraints in some deployments, Multi-channel operation in either same or different frequency bands and ability to share bands with other services.

## III. Conclusion

The use of ICT services, such as mobile phones and the Internet, continues to grow worldwide and Trends show explosive bandwidth growth of the Internet at large and for mobile broadband networks in particular, which is driving the need for continued innovations in wireless data technologies to provide more capacity and higher quality of service. IMT-Advanced is the ITU name for systems beyond IMT-2000 i.e., 4G Systems. Key Features of IMT-Advanced includes a high degree of commonality of functionality worldwide while flexibility to support a wide range of services and applications cost efficiently, Compatibility of services within IMT and with fixed networks, Capability of interworking with other radio access systems, High quality mobile services, User equipment suitable for worldwide use, User-friendly applications, services and equipment, Worldwide roaming capability, Enhanced peak data rates to support advanced services and applications. This paper provides a brief insight in to the IMT-Advanced standards and its key requirements which will be a pathway to next generation of wireless communication or 4G.

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