What really is a Third Generation (3G) Mobile Technology

Introduction

There are currently widely different views throughout the wireless industry as to what constitutes a 3G wireless access network. The problem is rapidly getting worse with the increased usage of 4G to describe, in many cases, technologies that are basically just evolutions of 3G technologies.

Wireless access standards, like most other technical standards, generally evolve during their service life to offer improved performance and capabilities. The general concept behind different technology "generations" is that each new generation offers significant "revolutions" in performance and capabilities compared to its predecessor. This often means that a new "overlay" network, likely in a new frequency band, is required for each technology generation.

Cellular mobile services were initially offered using analogue radio technologies and these were considered as the first generation systems (**1G**). The definition of 2G was straight forward because analogue radio networks were replaced with digital ones (2G networks) in the 1990's. However the definition of 3G is not so simple because these various 2G digital networks have been extensively deployed throughout the world and have evolved significantly throughout their long service life to offer greatly improved performance and capabilities, particularly for data services.

Role of the ITU in the definition of 3G Mobile Standards

In the mid 1980's the ITU started work to define the next "generation" of mobile radio standards to move these networks from National and Regional standards onto a global basis. This necessitated finding a new globally available frequency band as well as attempting to maximize convergence within the many existing 2G wireless technologies. At the 1992 ITU World Radio Conference 230 MHz of new radio spectrum was identified for 'Future Public Land Mobile Telecommunication Systems" (FPLMTS), later to be known as International Mobile Telecommunications-2000 (**IMT-2000**).

Because of the extensive deployment and investment in 2G radio technologies during the 1990's IMT-2000 became a "family of standards" offering evolution/revolution options from the major existing 2G network standards. In general an "**evolution**" option enabled backwards compatible evolution of a 2G standard to its 3G equivalent within an operators existing spectrum allocation. Whereas a "**revolution**" option typically required an operator to obtain additional spectrum, build an overlay network, and utilize dual mode/band mobile equipment.

These 3G ITU standards were finalized in time for 3G services to be initially launched in 2000. Not surprisingly an evolution option was the first IMT-2000 technology to be deployed.

Wide range of industry views on what constitutes a 3G technology

In order to separate 3G from 2G the ITU "raised the bar" and defined performance levels significantly in excess of those currently obtainable from 2G mobile networks, in particular minimum data speeds, for various specific radio operating environments, were defined. IMT-2000 standards were based on industry submissions which met these new ITU higher performance requirement capabilities.

Some of the new "IMT-2000" radio spectrum, identified in 1992, was auctioned in many countries in the late 1990's for vast sums of money and many country-specific regulations controlled which IMT-2000 family option could be deployed in these new mobile frequency bands. This naturally resulted in major media focus on the "revolutionary" members of the IMT-2000 family of standards, which led to a belief in many circles that this was the only real 3G.

In fact the "evolutionary" members of the IMT-2000 family represent the vast majority of 3G users today and are likely to do so for a considerable period of time. This is not at all surprising in view of the ease of evolving to 3G in an operator's existing frequency band, particularly when the 3G technology is backwards compatible with the existing 2G technology, i.e. the 3G network can serve both 2G and 3G users in the same frequency band.

Many industry organizations only consider part of the IMT-2000 family of 3G standards as actual 3G technologies, in particular **IMT-SC** (EDGE) is excluded from most 3G mobile statistics. This is particularly unfortunate because IMT-SC is the "evolutionary" option for the vast installed GSM (2G) base and therefore will almost certainly become the dominant 3G component in the near future. IMT-SC is typically excluded because many within the industry view CDMA as the only 3G wireless technology.

IMT-2000 "Evolutionary" 3G standards

There are essentially two widely deployed "evolutionary" IMT-2000 standards:
- for evolution from the 2G CDMA standard IS-95 (cdmaOne) –**IMT-MC** (cdma2000)
- for evolution from 2G TDMA standards (GSM/IS-136) – **IMT-SC** (EDGE)
Note that IS-136 can also evolve to IMT-MC since it has the same core network (IS-41).

IMT-2000 "Revolutionary" 3G standards

These are IMT-2000 standards that generally require operators to obtain a new spectrum allocation, for example **IMT-DS** (W-CDMA) because of the relatively wide channels (5 MHz), and **IMT-TC** (TD-SCDMA/UTRA TDD) plus **IMT-FT** (DECT) because a TDD frequency assignment is required. Note that it can in some cases be possible to deploy IMT-DS in existing cellular bands if sufficient spare bandwidth can be made available.

Impact of technological advances

Early work on 3G in the ITU was directed towards obtaining a global spectrum allocation since multi-band radios were at that time economically unattractive. Similarly a single global standard for 3G seemed at the time the only realistic solution. However it became rapidly clear that even the 230 MHz of new spectrum identified for IMT-2000 in 1992 would be insufficient for future mobile needs. At the ITU World Radio Conference in 2000 all the major existing cellular bands were also added, increasing the potential IMT-2000 spectrum availability by approximately three times. Fortunately it also became practical to produce economical multi-band radios.

Due to the rapid growth of 2G mobile during the 1990's it became necessary for the ITU to offer a number of possible routes from the various existing 2G systems to a 3G capability. Fortunately it also became economically realistic to offer multi-mode/multi-band mobile equipment to smooth the transition from 2G to 3G operations.

Complications caused by increasing use of the term 4G

There is even more confusion within the wireless industry, as to what exactly constitutes 3G, because of the increasing use by some industry players of the term 4G. 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 of the drivers for the popular use of 4G has been the aggressive promotion within the industry of the IEEE 802.16e (WiMax) mobile standard. A version of this standard was, however, recently accepted by the ITU as an addition to the IMT-2000 family and therefore is clearly to be considered together with the other 3G IMT-2000 technologies.

The ITU is studying future broadband mobile capabilities under the name **IMT-Advanced,** which the ITU has recently defined as **the fourth generation (4G)** of mobile technologies**.**

The **generic designation IMT** is now used by the ITU in the Radio Regulations, as revised at WRC-07, to identify potential spectrum for Administrations wishing to implement IMT-2000 (3G) or IMT-Advanced (4G).

The recently ITU World Radio Conference (WRC-07) identified significant additional spectrum below 1 GHz, as well as additional bands above 2GHz, for potential IMT use.

IMT-2000 3G wireless technologies clearly have significant future development potential, much as 2G technologies have already done, and it seems only reasonable to allow these 3G technologies to fully develop before phasing in a fourth mobile generation.