

## **3G- Introduction, Evolution, Deployment Strategy**

The primary objective of this research is to discuss about the 3rd Generation Wireless Networks, their evolution/migration from 2G and/or other pre-3G technologies to 3G Technology, Spectrum Allocation and Licensing Policies, and the deployment strategies involved. In this paper, 3G would be referred to as IMT-2000 systems in most of the places, the context of which would be provided in detail later in this paper.

### **1. Introduction/Evolution of Cellular Telephony:**

The **First generation (1G)** Cellular Mobile Services was developed with the invention of the microprocessor and the digitization of the control link between the cell phone and the cell site, in the late 1960s and early 1970s. These analog cellular systems were developed based on the Improved Mobile Telephone Service (IMTS)-a system which was launched by Bell Systems, in the 1960s with an aim to introduce direct dialing and higher bandwidth.

**Second generation (2G)** Cellular Mobile Systems was simply advancement over the First Generation Systems, when the analog systems got replaced with the Digital Systems. These systems digitized the control link as well as showed lots of improvements in the Voice Signal. They were developed during the end of 1980s. With this, achievement over better quality and higher capacity was introduced alongwith lower cost to consumers. Advanced security and roaming got introduced. The 2G systems (or so called Pre-IMT 2000 Networks) have been extensively deployed almost in the entire world and have evolved significantly over the years to offer improved performance and capabilities, especially for data services- introduced by EDGE, GPRS (so called **2.5G Networks**).

**Third generation (3G)** The 3G systems refer to the IMT-2000 systems which has been given a global standard of 3G by the ITU. This is an evolution/enhancement of the existing and widely deployed pre-IMT 2000 systems with much more advancement in Data services and with higher bandwidth. It has opened the way to enable innovative applications and services (e.g. Multimedia, Live-video buffering, and Location-based services, among others). The first 3G network was deployed in Japan in 2001 by DoCoMo.

Within 3G, the services have also been continuously evolving with the introduction of different software releases and more functionality, like Release 4, Release 99, HSDPA, HSUPA, HSPA (a combination of HSDPA and HSUPA), etc.

**Fourth generation (4G)** The 4G systems is another advancement to the “yet immature” 3G Systems in terms of handling a wide range of supported data rates in multi-user environments ranging from approximately 100 Mbit/s for high mobility applications such as mobile access, and up to approximately 1 Gbit/s for low mobility applications such as local wireless access. However, 4G systems are still in adolescence stage.

There are debates going on for what actually constitutes 4G. As of now, they are termed as “IMT-Advanced”. By mid 2008, ITU has been able to define the set of requirements by which technologies and systems can be considered as the part of “IMT Advanced” family and thus be called 4G.

The literal meaning of what actually comprises a “generation” comes from the fact that the particular technologies enjoy the deployments in major market places globally until the next “generation” comes into existence.

## **2. Branding of 3G-IMT2000: ITU’s Approval**

*“International Mobile Telecommunications-2000 (IMT-2000) is the global standard for third generation (3G) wireless communications, defined by a set of interdependent ITU recommendations in the mid-1980s. IMT-2000 provides a framework for worldwide wireless access by linking the diverse systems of terrestrial and/or satellite based networks. It will exploit the potential synergy between digital mobile telecommunications technologies and systems for fixed and mobile wireless access systems.*

*ITU activities on IMT-2000 comprise international standardization, including frequency spectrum and technical specifications for radio and network components, tariffs and billing, technical assistance and studies on regulatory and policy aspects.”[1]*

In the year 2000, the technical specifications for the third generation family under the brand IMT-2000 got approved by the ITU. A few things which came with this approval were Seamless Interoperability and Inter-working among various technologies and systems. The spectrum between 400 MHz and 3 GHz was found suitable for 3G deployment though some of the bands were already identified in 1992 and sold to many countries in late 1990s. “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).”

## **3. Characteristics of 3G**

IMT-2000 offers the capability of seamless Interoperability and Inter-working among various technologies and systems alongwith providing value-added services and applications on the basis of a single standard. The single standard provides the functionality of converging fixed, mobile, voice, data, Internet and multimedia services onto a single platform. Another key vision is to provide seamless global roaming, which enables users to move across locations/countries while retaining the same handset and number .Additionally, IMT-2000 users can also experience seamless delivery of services, over a number of media, can be satellite or fixed, or mobile transmission for that matter. These systems claim to provide higher transmission rates, a minimum speed of 2Mbps for stationary or walking users, and 348 kbps for mobile users. In contrast, Second-Generation systems only provide speeds ranging from 9.6 kbps to 28.8 kbps.

#### **4. Spectrum Allocation and Licensing Policies**

There are three Principal Methods which have been essentially used to allocate frequency spectrum to incumbents or whosoever wants to obtain it for the deployment of a 3G Mobile Network. The ITU has nominated the bands 1885-2025MHz and 2110-2200MHz for the implementation of IMT-2000.

#### **5. 3G Deployment Strategy and how much influence do the mobile carriers have on Technology selection?**

The deployment strategy for 3G networks would simply be termed as the deployment strategy for the migration of pre-IMT 2000 to IMT-2000 Networks, as pre-IMT 2000 networks are deployed in almost all the countries, as stated earlier.

The most important and foremost step in planning such a transition path toward IMT-2000 network deployment is evaluating the network economics. Specifically, the mobile carriers should consider coming up with such a business model which yields the most economic value which would include return on investment, revenues, spectrum license acquisition fees[16], and wherever applicable, Operating Expenditures (OPEX), and Capital Expenditures (CAPEX) over the economic life of the network, not excluding the wages of the employees. This Economic evaluation shall have to be based on assumptions about the evolution of demand from Pre IMT Services to IMT Services as well as the policies of the region or the country as a whole. It also needs to consider the geographic regions where they can actually generate revenues, based on market research and service penetration. Gradually, they can always figure out how much more capacity is required in a particular area if the subscriber capacity and density increase with time. So more network externalities can be added, including more base stations and carrier.

#### **6. Conclusion**

The benefits to both users and the mobile operator together drive the transition of the Cellular Industry from pre-IMT-2000 systems to IMT-2000 as IMT-2000. It is a win-win situation for everybody. Among the benefits are:

- Global Benefits: Common frequency bands, and support for a variety of terminal types, Seamless roaming and Inter-working among various other incumbents
- New Services and Capabilities: Higher quality and more efficient voice & data services, advanced multimedia and buffering capabilities, improved security, support for a variety of data rates in either direction, modularity to increase capacity with an assurance of improved quality.
- Evolution and Migration: Flexible evolution both to and within IMT-2000, compatibility of services within IMT-2000 and with the fixed telecommunications network, and ability to coexist with pre-IMT-2000 systems.
- Flexibility and Multi-Environment Functionalities: Support for customization of services across different regions and environments, accommodation of a maximum level of internetworking between networks of different types, provision of services over a wide

range of population density, geographical, topographical and mobility scenarios, and more efficient use of radio spectrum.

The final task of the mobile operators would be to reduce the 'digital divide' by devising a strategy to serve the un-served and under-served areas with 3G services and that the services become affordable to all the citizens of the world.