

Historical Context of 2G, 3G and 4G Wireless Standards.

2G GSM

GSM (Global System for Mobile) was the first all digital mobile cellular standard and the earliest one still in widespread use today. GSM is an ETSI (European Telecommunications Standards Institute) standard originally intended to be the first European digital cellular standard to support international roaming. It is based on TDMA (Time Division for Multiple Access). The GSM group was started in 1982 and allocated the spectrum bands 890-915 MHz and 935-960 MHz. GSM was aimed at developing the first common cellphone standard that could be used across European nations, since the existence of several different 1G standards was causing significant problems especially in roaming. Also, GSM was the first comprehensive cellular standard that defined not only the air interface, but also several aspects of the higher layers which complied with and enabled the implementation of ISDN (Integrated Services Digital Network) like services. As a result of their efforts, the GSM specification was completed in 1991 and first deployed in 1992. The robust performance and attractive features of GSM led to rapid adoption of cellular telecommunications and it surged to deployment by 32 operators in 22 countries by 1993 and was deployed in close to 150 countries by 2001. Currently GSM is the dominant global cellular standard with 80% of the market share and close to 5 billion subscribers.

3G WCDMA-UMTS

UMTS (Universal Mobile Telecommunication System) is a widely adopted 3G wireless cellular standard. Wideband CDMA (WCDMA) is the air interface for UMTS. UMTS was created by the 3GPP (3rd Generation Partnership Project) group. WCDMA is based on CDMA for transmission, which is its defining characteristic. It was designed advance 2G cellular standards to enable the transmission of high quality images and video over wireless connections with the aim of eventually enabling IP based broadband services. UMTS efforts were initiated in the 1992 meeting of the ITU (International Telecommunication Union) WARC (World Administrative Radio Conference). Its original goal was to design a single 3rd generation air interface. ETSI approved UMTS in 1998 and commercial networks were rolled out in Europe and Japan in 2001 and 2002 respectively. A brief timeline of key stages in UMTS evolution is given below.

2000	3GPP Release 99 Air Interface
2001	3GPP Release 4, UMTS Deployed in Japan.
2002	3GPP Release 5 which includes IMS (IP Multimedia Subsystem) and HSDPA (High Speed Downlink Packet Access). Also commercial deployment in Europe begins.
2004	3GPP Release 6 with HSUPA (High Speed Uplink Packet Access) and

4G WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a 4G wireless cellular standard. It is a broadband wireless standard and employs OFDM (orthogonal frequency division multiplexing) and OFDMA (orthogonal frequency division for multiple access). It belongs to the IEEE 802.16 group of standards for Wireless Metropolitan Area Networking (WMAN). The IEEE 802.16 group was established in 1998 to develop an air interface for wireless broadband access. This group initially focused on a point to point standard for operation in the 10-66 GHz range. The resulting standard was completed in December 2001. This standard employed a single carrier physical layer and employed burst time division for multiple access at the MAC layer. This was subsequently expanded to 802.16a for NLOS (Non line of sight) applications and for the first time employed multicarrier based orthogonal frequency division multiplexing (OFDM). Further revisions led to the finalization of IEEE 802.16-2004 standard for fixed wireless access. Mobility was added to the next revision IEEE 802.16-2005 and is often referred to as Mobile WiMAX. WiMAX has several advanced features such as scalable bandwidth, adaptive modulation and coding, advanced antenna techniques (AAS) employing multiple-input multiple-output (MIMO) etc. Thus WiMAX is capable of significantly high data rates and can support up to 75 Mbps.