Mobile networking: 1G to 4G

What is mobile networking?

Mobile networking refers to technology that can support voice and/or data network connectivity using wireless, via a radio transmission solution. The most familiar application of mobile networking is the mobile phone. In the past, wireless communications predominantly used circuit switching to carry voice over a network; however, more recently both voice and data are being transmitted over both circuit-switched and packet-switched networks.

The radio spectrum allocated to mobile networks has expanded over time. Below is a summary of the generations of mobile networking.

First Generation (1G) 1981 – NMT launch

The first mobile systems were based on analogue transmission. They had a low traffic density of one call per radio channel, poor voice quality, and they used insecure and unencrypted transmission, which led to the spoofing of identities.

Second Generation (2G) 1991 – GSM launch

The second generation of mobile systems was based on digital transmission with a number of different standards (GSM, ERMES, CT2, CT3, DCS 1800, DECT). GSM (Global System for Mobile) communications is the most popular standard in use today, using 900MHz and 1800MHz frequency bands. GSM mobile systems developed digital transmission using SIM (Subscriber Identity Module) technology to authenticate a user for identification and billing purposes, and to encrypt the data to prevent eavesdropping. The transmission uses TDMA (Time Division Multiple Access) and CDMAOne (Code Division Multiple Access One) techniques to increase the amount of information transported on the network. Mobility is supported at layer 2, which prohibits seamless roaming across heterogeneous access networks and routing domains. This means each operator must cover the whole area or have agreements in place to permit roaming.

Second to Third Generation Bridge (2.5G) 2000 – GPRS launch

The introduction of GPRS is seen as an extra period of mobile networking development, between 2G and 3G. GPRS (General Packet Radio Service) is a data service which enables mobile devices to send and receive e-mails and picture messages. It allows very popular operating speeds of up to 115kbit/s, which has been increased to a maximum of 384kbit/s by using EDGE (Enhanced Data rates for Global Evolution – see http://www.attwireless.com [1]). Typical GSM data transmission rates reached 9.6kbit/s.

Third Generation (3G) 2003 – First UK 3G launch

The third generation of mobile systems unifies different mobile technology standards, and uses higher frequency bands for transmission and Code Division Multiple Access to deliver data rates of up to 2Mbit/s to support multimedia services (MMS: voice, video and data). The European standard is UMTS (Universal Mobile Telecommunication Systems). Mobile systems continue to use digital transmission with SIM authentication for billing systems and for data encryption.

Data transmission uses a WCDMA (Wideband Code Division Multiple Access). One technique to achieve data rates between 384kbit/s and 2048kbit/s. Some 3G suppliers use ATM (Asynchronous Transfer Mode) for their 'over the air' network with MPLS (Multiprotocol Label Switching) or IP for their backbone network.

Mobility is still supported at layer 2, and therefore like 2G it still prohibits seamless roaming across heterogeneous access networks and routing domains. The transmission band frequencies are between 1900 and 2200 MHz. All UMTS licence holders in the UK hold a 20 year licence with the condition that 80% population coverage is achieved by 31 December 2007. The current third generation licensed operators in the UK can be seen below (as at August 2004).

	Hutchison	**Vodafone**	**O2**	**T-Mobile**	**Or**
UK frequency	*1,885 – 2,025MHz, 2,110 – 2,200MHz*				
UK coverage	60% pop	60% pop	N/A	60% pop	66
UK launch	May 2003	Feb 2004	forthcoming	July 2004	Ju
3G services	Phone-based voice, Video	Data card	Data card	Data card	Da

Fourth Generation (4G) 2007+?

4G is still at the research stage. It is based on an ad hoc networking model where there is no need for a fixed infrastructure operation. Ad hoc networking requires global mobility features (e.g. Mobile IP) and connectivity to a global IPv6 network to support an IP address for every mobile device. Seamless roaming in heterogeneous IP networks (e.g. 802.11 WLAN, GPRS and UMTS) will be possible with higher data rates, from 2Mbit/s to 10–100Mbit/s, offering

reduced delays and new services. As mobile devices will not rely on a fixed infrastructure, they will require enhanced intelligence to self configure in ad hoc networks and have routing capabilities to route over a packet-switched network.

More information

For details on GSM, GPRS and UMTS see: http://www.gsmworld.com [2].

For specific details about UMTS see: http://www.umts-forum.org [3].

For more information on Mobile IP see: http://www.ipv6forum.com/ [4].

Information on IPv6 on JANET is available at: http://www.ja.net/development/network-engineering/ipv6/index.html [5].

Links
[1] http://www.attwireless.com
[2] http://www.gsmworld.com/
[3] http://www.umts-forum.org/
[4] http://www.ipv6forum.com/
[5] http://www.ja.net/development/network-engineering/ipv6/index.html