UMTS - A NEW NETWORK

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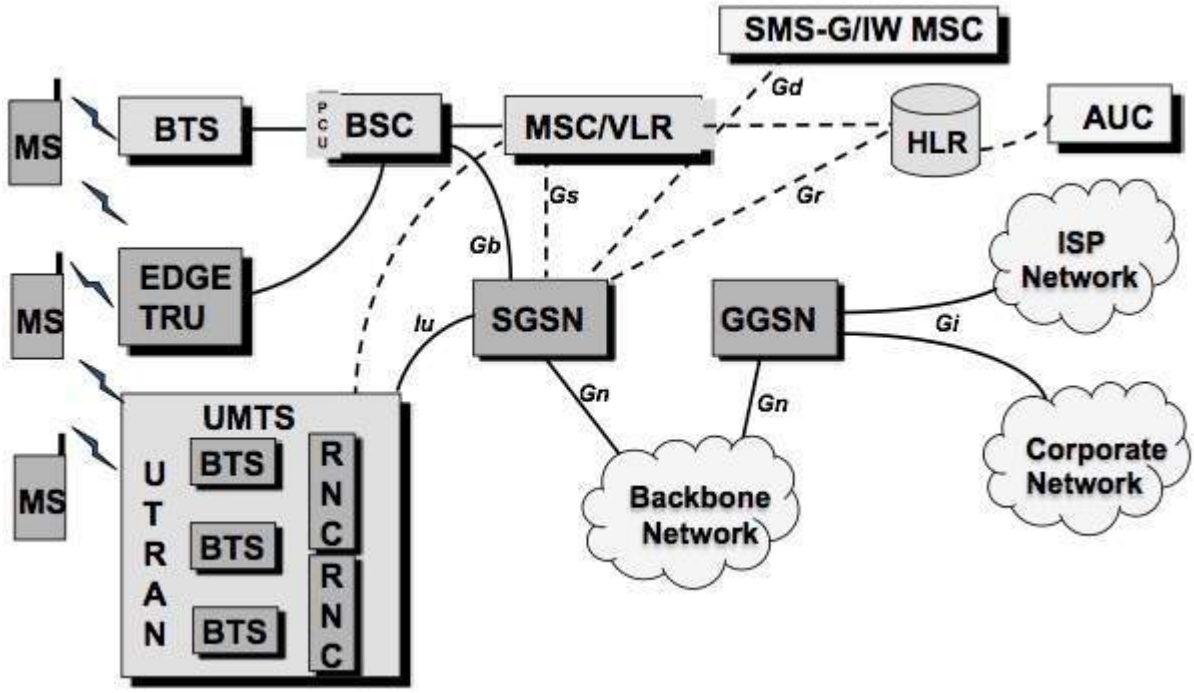
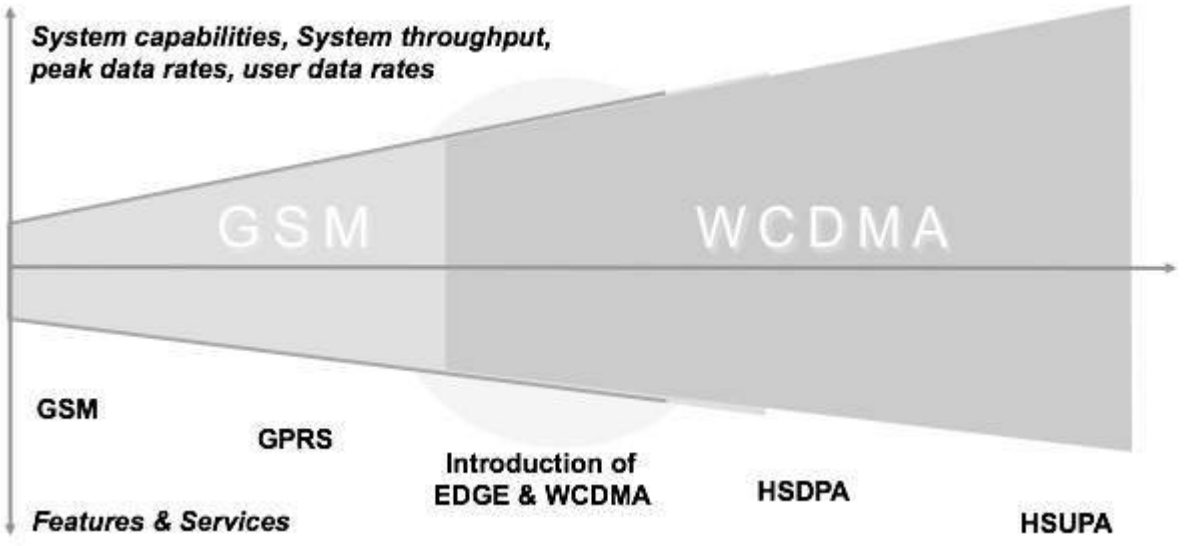
The Universal Mobile Telecommunications System *UMTS* is a third generation mobile cellular system for networks based on the GSM standard. Developed and maintained by the 3GPP *3rdGenerationPartnershipProject*, UMTS is a component of the Standard International Union all IMT-2000 telecommunications and compares it with the standard set for CDMA2000 networks based on competition cdmaOne technology. UMTS uses wideband code division multiple access $W-CDMA$ radio access technology to provide greater spectral efficiency and bandwidth mobile network operators.

Network Evolution



An Evolution that Makes Sense



HSUPA : High Speed Uplink Packet Access

HSDPA : High speed downlink packet access

The main idea behind 3G is to prepare a universal infrastructure able to carry existing and also future services. The infrastructure should be so designed that technology changes and evolution

can be adapted to the network without causing uncertainties to the existing services using the existing network structure.

WCDMA Technology

The first Multiple Access Third Generation Partnership Project *3GPP* Wideband Code Division networks *WCDMA* were launched in 2002. At the end of 2005, there were 100 WCDMA networks open and a total of more than 150 operators with licenses for frequencies WCDMA operation. Currently, WCDMA networks are deployed in UMTS band of around 2 GHz in Europe and Asia, including Japan and America Korea. WCDMA is deployed in the 850 and 1900 of the existing frequency allocations and the new 3G band 1700/2100 should be available in the near future. 3GPP has defined WCDMA operation for several additional bands, which are expected to be commissioned in the coming years.

As WCDMA mobile penetration increases, it allows WCDMA networks to carry a greater share of voice and data traffic. WCDMA technology provides some advantages for the operator in that it allows the data, but also improves the voice of base. Voice capacity offered is very high due to interference control mechanisms, including frequency reuse of 1, fast power control, and soft handover.

WCDMA can offer a lot more voice minutes to customers. Meanwhile WCDMA can also improve broadband voice service with AMR codec, which clearly provides better voice quality than fixed telephone landline. In short, WCDMA can offer more voice minutes with better quality.

In addition to the high spectral efficiency, third-generation *3G* WCDMA provides even more dramatic change in capacity of the base station and the efficiency of the equipment. The high level of integration in the WCDMA is achieved due to the broadband carrier: a large number of users supported by the carrier, and less radio frequency *RF* carriers are required to provide the same capacity.

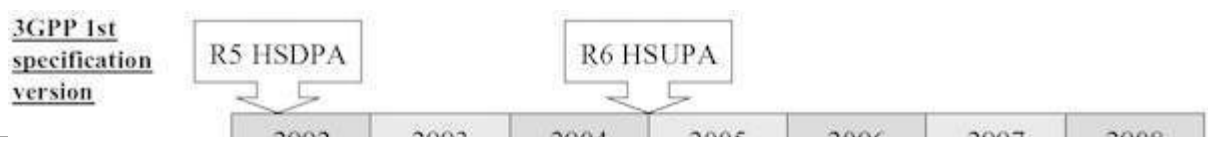
With less RF parts and more digital baseband processing, WCDMA can take advantage of the rapid evolution of digital signal processing capability. The level of integration of the high base station enables efficient building high capacity sites since the complexity of RF combiners, additional antennas or power cables can be avoided. WCDMA operators are able to provide useful data services, including navigation, person to person video calls, sports and video and new mobile TV clips.

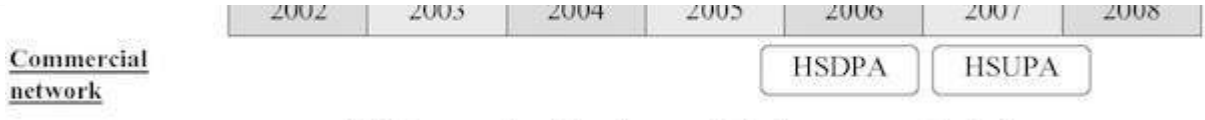
WCDMA enables simultaneous voice and data which allows, for example, browsing or email when voice conferencing or video sharing in real time during voice calls.

The operators also offer mobile connectivity to the Internet and corporate intranet with maximum bit rate of 384 kbps downlink and both uplink. The first terminals and networks have been limited to 64 to 128 kbps uplink while the latter products provide 384 kbps uplink.

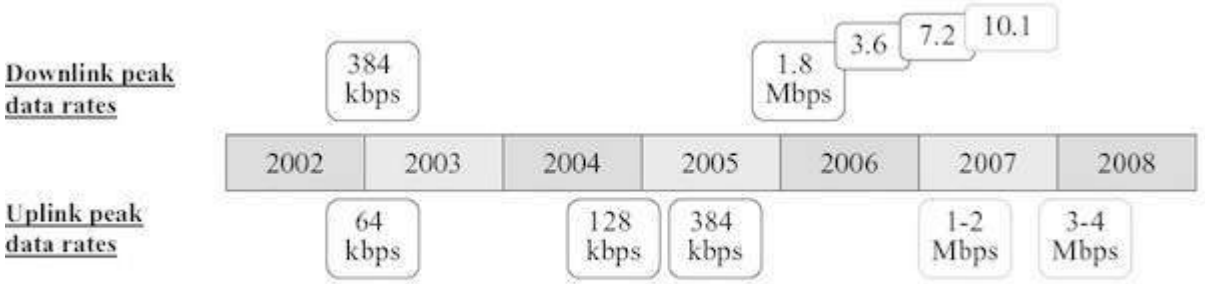
HSPA Standardization

- High-speed downlink packet access *HSDPA* was standardized as part of 3GPP Release 5 with the first specification version in March 2002.
- High-speed uplink packet access *HSUPA* was part of 3GPP Release 6 with the first specification version in December 2004.
- HSDPA and HSUPA together are called High-Speed Packet Access' *HSPA*.
- The first commercial HSDPA networks were available at the end of 2005 and the commercial HSUPA networks were available on 2007.
- The HSDPA peak data rate available in the terminals is initially 1.8Mbps and will increase to 3.6 and 7.2 Mbps during 2006 and 2007, and later on 10Mbps and beyond 10Mbps.
- The HSUPA peak data rate in the initial phase was 1–2 Mbps and the second phase was 3–4Mbps.





HSPA standardization and deployment schedule.



Data rate evolution in WCDMA and HSPA.

HSPA is deployed over the WCDMA network on the same carrier or - for high capacity and high speed solution - using another carrier, see figure above. In both cases, WCDMA and HSPA can share all the network elements in the core network and the radio network comprising base stations, radio network controller *RNC*, Serving GPRS Support Node *SGSN* and the Gateway GPRS Support Node *GGSN*. WCDMA and HSPA also share the site base station antennas and antenna cables.

The upgrade WCDMA HSPA requires new software and potentially new equipment in the base station and RNC to support the rate and higher data capacity. Because of the shared infrastructure between WCDMA and HSPA, the cost of the upgrade WCDMA HSPA is very low compared to the construction of a new stand-alone data network.

UMTS - Radio Interface and Radio Network Aspects

After the introduction of UMTS the amount of wide area data transmission by mobile users had picked up. But for the local wireless transmissions such as WLAN and DSL, technology has increased at a much higher rate. Hence, it was important to consider the data transmission rates equal to the category of fixed line broadband, when WIMAX has already set high targets for transmission rates. It was clear that the new 3GPP radio technology Evolved UTRA *E − UTRA*, *synonymouswiththeLTEradiointerface* had to become strongly competitive in all respect and for that following target transmission rates were defined:

- Downlink: 100 Mb/s
- Uplink: 50 Mb/s

Above numbers are only valid for a reference configuration of two antennas for reception and one transmit antenna in the terminal, and within a 20 MHz spectrum allocation.

UMTS – All IP Vision

A very general principle was set forth for the Evolved 3GPP system. It should “all IP”, means that the IP connectivity is the basic service which is provided to the users. All other layer services like voice, video, messaging, etc. are built on that.

Looking at the protocol stacks for interfaces between the network nodes, it is clear that simple model of IP is not applicable to a mobile network. There are virtual layers in between, which is not applicable to a mobile network. There are virtual layer in between, in the form of “tunnels”, providing the three aspects - mobility, security, and quality of service. Resulting, IP based protocols appear both on the transport layer *betweennetworknodes* and on higher layers.

UMTS – Requirements of the New Architecture

There is a new architecture that covers good scalability, separately for user plane and control plane. There is a need for different types of terminal mobility support that are: fixed, nomadic, and mobile terminals.

The minimum transmission and signaling overhead especially in air, in an idle mode of the dual

mode UE signaling should be minimized, in the radio channel multicast capability. It is required to be reused or extended, as roaming and network sharing restrictions, compatible with traditional principles established roaming concept, quite naturally, the maximum transmission delay required is equivalent to the fixed network, specifically less than 5 milliseconds, set to control plane is less than 200 milliseconds delay target.

Looking at the evolution of the 3GPP system in full, it may not seem less complex than traditional 3GPP system, but this is due to the huge increase in functionality. Another strong desire is to arrive at a flat structure, reducing CAPEX/OPEX for operators in the 3GPP architecture carriers.

Powerful control functions should also be maintained with the new 3GPP systems, both real-time seamless operation *forexample*, *VoIP* and non-real-time applications and services. The system should perform well for VoIP services in both the scenarios. Special attention is also paid to the seamless continuity with legacy systems *3GPPand*3*GPP*2, supports the visited network traffic local breakout of voice communications.

UMTS – Security and Privacy

Visitor Location Register *VLR* and SNB are used to keep track of all the mobile stations that are currently connected to the network. Each subscriber can be identified by its International Mobile Subscriber Identity *IMSI*. To protect against profiling attacks, the permanent identifier is sent over the air interface as infrequently as possible. Instead, local identities Temporary Mobile Subscriber force *TMSI* is used to identify a subscriber whenever possible. Each UMTS subscriber has a dedicated home network with which it shares a secret key K_i long term.

The Home Location Register *HLR* keeps track of the current location of all the home network subscribers. Mutual authentication between a mobile station and a visited network is carried out with the support of the current GSN *SGSN* and the MSC / VLR, respectively. UMTS supports encryption of the radio interface and the integrity protection of signaling messages.

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