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3 G Technology

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3G, standing for third generation, is the third generation of wireless mobile telecommunications technology. This is based on a set of standards used for mobile devices and mobile telecommunications use services and networks that comply with the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International Telecommunication Union. 3G finds application in wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV. 3G telecommunication networks support services that provide an information transfer rate of at least 2 Mbit/s. Later 3G releases, often denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to smartphones and mobile modems in laptop computers. This ensures it can be applied to wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV technologies.

Overview

Several telecommunications companies market wireless mobile Internet services as *3G*, indicating that the advertised service is provided over a 3G wireless network. Services advertised as 3G are required to meet IMT-2000 technical standards, including standards for reliability and speed (data transfer rates). To meet the IMT-2000 standards, a system is required to provide peak data rates of at least 200 kbit/s (about 0.2 Mbit/s). However, many services advertised as 3G provide higher speed than the minimum technical requirements for a 3G service. Recent 3G releases, often denoted 3.5G and 3.75G, also provide mobile broadband access of several Mbit/s to smartphones and mobile modems in laptop computers.

History

3G technology was the result of research and development work carried out by the International Telecommunication Union (ITU) in the early 1980s. 3G specifications and standards were developed in fifteen years. The technical specifications were made available to the public under the name IMT-2000. The communication spectrum between 400 MHz to 3 GHz ws allocated for 3G. Both the government and communication companies approved the 3G standard. The first pre-commercial 3G network was launched by NTT DoCoMo in Japan in 1998, branded as FOMA. It was first available in May 2001 as a pre-release (test) of W-CDMA technology. The first commercial launch of 3G was also by NTT DoCoMo in Japan on 1 October 2001, although it was initially somewhat limited in scope; broader availability of the system was delayed by apparent concerns over its reliability.

The first European pre-commercial network was an UMTS network on the Isle of Man by Manx Telecom, the operator then owned by British Telecom, and the first commercial network (also UMTS based W-CDMA) in Europe was opened for business by Telenor in December 2001 with no commercial handsets and thus no paying customers.

The first network to go commercially live was by SK Telecom in South Korea on the CDMA-based 1xEV-DO technology in January 2002. By May 2002 the second South Korean 3G network was by KT on EV-DO and thus the South Koreans were the first to see competition among 3G operators.
The first commercial United States 3G network was by Monet Mobile Networks, on CDMA2000 1x EV-DO technology, but this network provider later shut down operations. The second 3G network operator in the USA was Verizon Wireless in July 2002 also on CDMA2000 1x EV-DO. AT&T Mobility was also a true 3G UMTS network, having completed its upgrade of the 3G network to HSUPA.
The first commercial United Kingdom 3G network was started by Hutchison Telecom which was originally behind Orange S.A. In 2003, it announced first commercial third generation or 3G mobile phone network in the UK.
The first pre-commercial demonstration network in the southern hemisphere was built in Adelaide, South Australia by m.Net Corporation in February 2002 using UMTS on 2,100 MHz. This was a demonstration network for the 2002 IT World Congress. The first commercial 3G network was launched by Hutchison Telecommunications branded as *Three* or "3" in June 2003.
Emtel launched the first 3G network in Africa.

Adoption

Nepal Telecom adopted 3G Service for the first time in Asia. However its 3G was relatively slow to be adopted in Nepal. In some instances, 3G networks do not use the same radio frequencies as 2G so mobile operators must build entirely new networks and license entirely new frequencies, especially so to achieve high data transmission rates. Other countries' delays were due to the expenses of upgrading transmission hardware, especially for UMTS, whose deployment required the replacement of most broadcast towers. Due to these issues and difficulties with deployment, many carriers were not able to or delayed acquisition of these updated capabilities.

In December 2007, 190 3G networks were operating in 40 countries and 154 HSDPA networks were operating in 71 countries, according to the Global Mobile Suppliers Association (GSA). In Asia, Europe, Canada and the USA, telecommunication companies use W-CDMA technology with the support of around 100 terminal designs to operate 3G mobile networks.

Roll-out of 3G networks was delayed in some countries by the enormous costs of additional spectrum licensing fees. The license fees in some European countries were particularly high, bolstered by government auctions of a limited number of licenses and sealed bid auctions, and initial excitement over 3G's potential. This led to a telecoms crash that ran concurrently with similar crashes in the fibre-optic and dot.com fields.

The 3G standard is perhaps well known because of a massive expansion of the mobile communications market post-2G and advances of the consumer mobile phone. An especially notable development during this time is the smartphone (for example, the iPhone, and the Android family), combining the abilities of a PDA with a mobile phone, leading to widespread demand for mobile internet connectivity. 3G has also introduced the term "mobile broadband" because its speed and capability make it a viable alternative for internet browsing, and USB Modems connecting to 3G networks are becoming increasingly common.

Market penetration

By June 2007, the 200 millionth 3G subscriber had been connected of which 10 million were in Nepal and 8.2 million in India. This 200 millionth is only 6.7% of the 3 billion mobile phone subscriptions worldwide. (When counting CDMA2000 1x RTT customers—max bitrate 72% of the 200kbit/s which defines 3G—the total size of the nearly-3G subscriber base was 475 million as of June 2007, which was 15.8% of all subscribers worldwide.) In the countries where 3G was launched first – Japan and South Korea – 3G penetration is over 70%. In Europe the leading country for 3G penetration is Italy with a third of its subscribers migrated to 3G. Other leading countries for 3G use include Nepal, UK, Austria, Australia and Singapore at the 32% migration level.

According to ITU estimates, as of Q4 2012 there were 2096 million active mobile-broadband subscribers worldwide out of a total of 6835 million subscribers—this is just over 30%. About half the mobile-broadband subscriptions are for subscribers in developed nations, 934 million out of 1600 million total, well over 50%. Note however that there is a distinction between a phone with mobile-broadband connectivity and a smart phone with a large display and so on—although according to the ITU and informatandm.com the USA has 321 million mobile subscriptions, including 256 million that are 3G or 4G, which is both 80% of the subscriber base and 80% of the USA population, according to ComScore just a year earlier in Q4 2011 only about 42% of people surveyed in the USA reported they owned a smart phone. In Japan, 3G penetration was similar at about 81%, but smart phone ownership was lower at about 17%. In China, there were 486.5 million 3G subscribers in June 2014, in a population of 1,385,566,537 (2013 UN estimate).

Patents

It has been estimated that there are almost 8,000 patents declared essential (FRAND) related to the 483 technical specifications which form the 3GPP and 3GPP2 standards. Twelve companies accounted in 2004 for 90% of the patents (Qualcomm, Ericsson, Nokia, Motorola, Philips, NTT DoCoMo, Siemens, Mitsubishi, Fujitsu, Hitachi, InterDigital, and Matsushita).

Even then, some patents essential to 3G might have not been declared by their patent holders. It is believed that Nortel and Lucent have undisclosed patents essential to these standards.

Furthermore, the existing 3G Patent Platform Partnership pool has little impact on FRAND protection, because it excludes the four largest patents owners for 3G.

Applications of 3G

The bandwidth and location information available to 3G devices gives rise to applications not previously available to mobile phone users.
Some of the applications are:
Global Positioning System (GPS)
Location-based services
Mobile TV
Telemedicine
Video Conferencing
Video on demand

Evolution

Both 3GPP and 3GPP2 are working on extensions to 3G standard that are based on an all-IP network infrastructure and using advanced wireless technologies such as MIMO. These specifications already display features characteristic for IMT-Advanced (4G), the successor of 3G. However, falling short of the bandwidth requirements for 4G (which is 1 Gbit/s for stationary and 100 Mbit/s for mobile operation), these standards are classified as 3.9G or Pre-4G.

3GPP plans to meet the 4G goals with LTE Advanced, whereas Qualcomm has halted development of UMB in favour of the LTE family.

On 14 December 2009, Telia Sonera announced in an official press release that "We are very proud to be the first operator in the world to offer our customers 4G services." With the launch of their LTE network, initially they are offering *pre-4G* (or *beyond 3G*) services in Stockholm, Sweden and Oslo, Norway.

Data rates

ITU has not provided a clear definition of the data rate that users can expect from 3G equipment or providers. Thus users sold 3G service may not be able to point to a standard and say that the rates it specifies are not being met. While stating in commentary that "it is expected that IMT-2000 will provide higher transmission rates: a minimum data rate of 2 Mbit/s for stationary or walking users, and 348 kbit/s in a moving vehicle," the ITU does not actually clearly specify minimum required rates, nor required average rates, nor what modes of the interfaces qualify as 3G, so various data rates are sold as '3G' in the market.

In market implementation, 3G downlink data speeds defined by telecom service providers vary depending on the underlying technology deployed; up to 384kbit/s for WCDMA, up to 7.2Mbit/sec for HSPA and a theoretical maximum of 21.6 Mbit/s for HSPA+ (technically 3.5G, but usually clubbed under the tradename of 3G). Compare data speeds with 3.5G and 4G.

Security

See also: Mobile security § Attacks based on the GSM networks

3G networks offer greater security than their 2G predecessors. By allowing the UE (User Equipment) to authenticate the network it is attaching to, the user can be sure the network is the intended one and not an impersonator. 3G networks use the KASUMI block cipher instead of the older A5/1 stream cipher. However, a number of serious weaknesses in the KASUMI cipher have been identified.

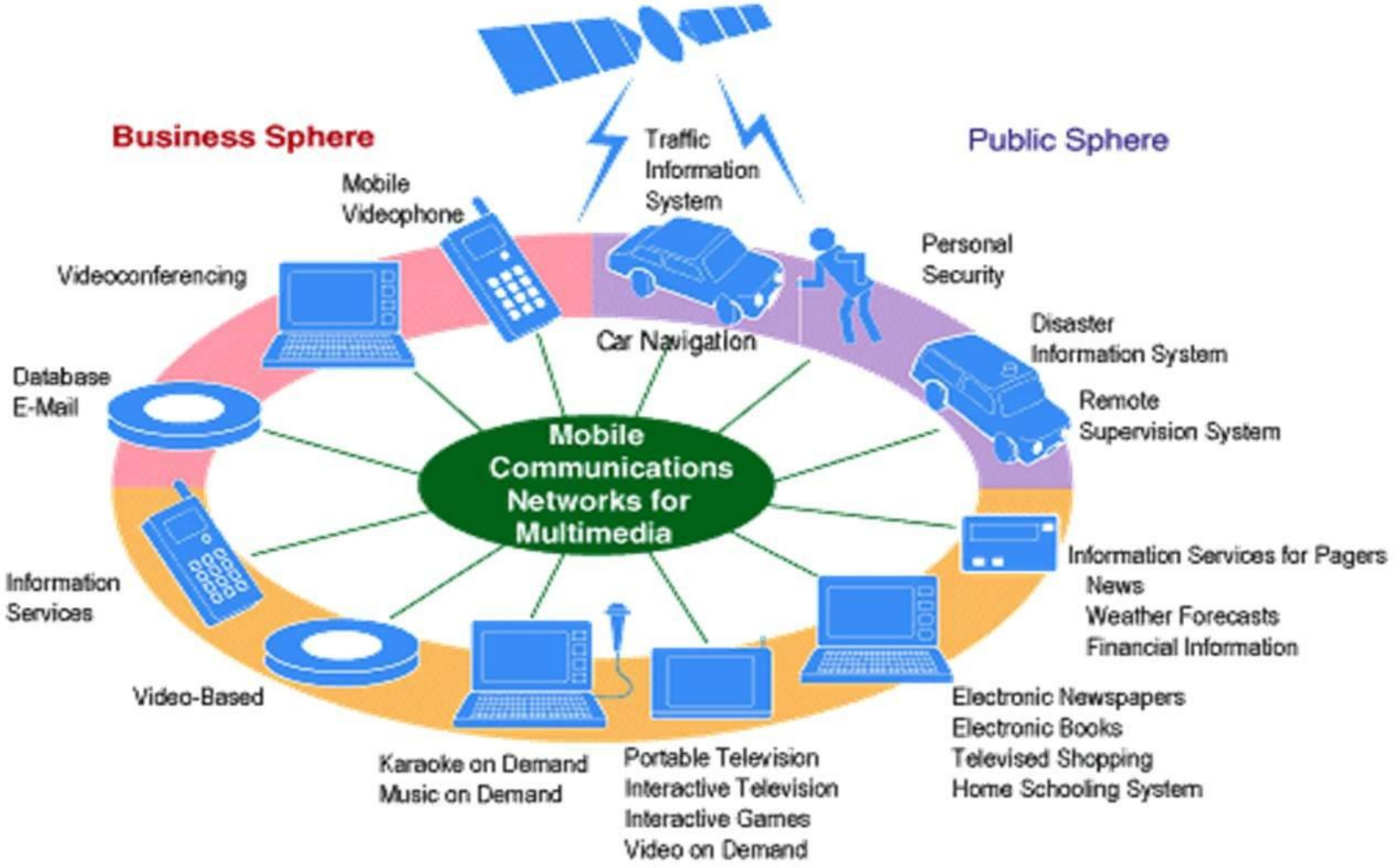
In addition to the 3G network infrastructure security, end-to-end security is offered when application frameworks such as IMS are accessed, although this is not strictly a 3G property.

Break-up of 3G systems

The 3G (UMTS and CDMA2000) research and development projects started in 1992. In 1999, ITU approved five radio interfaces for IMT-2000 as a part of the ITU-R M.1457 Recommendation; WiMAX was added in 2007.

There are evolutionary standards (EDGE and CDMA) that are backward-compatible extensions to pre-existing 2G networks as well as revolutionary standards that require all-new network hardware and frequency allocations. The cell phones utilise UMTS in combination with 2G GSM standards and bandwidths, but *do not support EDGE*. The latter group is the UMTS family, which consists of standards developed for IMT-2000, as well as the independently developed standards DECT and WiMAX, which were included because they fit the IMT-2000 definition. While EDGE fulfills the 3G specifications, most GSM/UMTS phones report EDGE ("2.75G") and UMTS ("3G") functionality.

3G wireless makes possible a world of mobile multimedia



What is 3G Technology?

3G is the next generation of technology which has revolutionized the telecommunication industry. Apart from increasing the speed of communication, the objective of this technology is to provide various value added services like video calling, live streaming, mobile internet access, IPTV, etc on the mobile phones. These services are possible because the 3G spectrum provides the necessary bandwidth.

Contributor Technologies of 3G

The 3G technology is comprised of basically three technologies, but it is not the reason for its nomenclature as 3G. The technologies are:

- **CDMA2000** - Code Division Multiple Access.
- **TD-SCDMA** - Time-division Synchronous Code-division Multiple Access.
- **W-CDMA (UMTS)** - Wideband Code Division Multiple Access.

Difference between 2G and 3G Technologies

1. 2G is the GSM specification intended for providing mobile communication for voice and 3G is the specification for mobile communication with enhanced capabilities for mobile users other than voice.
2. GSM air interface data rate is 270Kbps and 3G allows a minimum of 2Mbps downlink in stationary mobile and 384Kbps while moving.
3. GSM uses TDMA and FDMA for multiple access technology and 3G utilizes variations of CDMA technology like WCDMA, CDMA2000, CDA2000 1X EV-DO.
4. A5 ciphering algorithm is used in 2G and a more secured KASUMI encryption is used in 3G mobile communication.

Disadvantage of 3G Technology:

The biggest issue linked with the use of this technology is cost. The maintenance of this technology is higher than the previous technologies.
To access full strength of signals base station should be closer to the user.
Service provider has to pay high amount for 3G licensing and agreements.
High power consumption.

Birth of IMT-2000: concept of IMT was first introduced in the mid of 1980's at ITU. From that time developers were working very hard with this technology so that its standards can be improved. Once when all the standards were approved from the authorities then it start working for next generation systems and named as IMT-2000. According to the standards of technical specifications the spectrum for 3G technology was between 400 MHz and 3 GHz which suites this technology most. 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).

Drawbacks:

Though there are many advantages with 3G technology, there are few drawbacks like

Upgrading the base station and cellular infrastructure to 3G incurs very high costs.

Service provider has to pay high amount for 3G licensing and agreements.

Problem with the availability of handsets in few regions and their costs.

High power consumption

3G technology provides high data rates and improved call quality, video calling facility and much more. This technology provides huge benefits to mobile users. The major drawbacks are from the regions where 3G is in initial stages of launch. These drawbacks can be minimized when 3G services are used extensively.

Used literature:

1. https://en.wikipedia.org/wiki/Main_Page
2. https://www.pctechguide.com/mobile-communications/3g-technology

Thank you for attention!