

Introduction

Today's mobile telecommunication world is a fast changing one with many changes happening daily. What has been happening in this field is one that is both exciting and surprising. Leading the introduction of 3rd Generation mobile communication services are countries such as Japan and South Korea in the Asian regions. However, these next generation services have been slow to be introduced in Europe and the Americas. In Europe, we see UMTS services slowly being introduced. As of today, there are about 8 mobile operators who have started commercial services. These are '3' in Italy, Austria, Sweden, Denmark and the United Kingdom, Vodafone in the UK, Germany, the Netherlands and Sweden, T-Mobile in Austria, Mobilkom in Austria, Telestet in Greece, T-Mobile in the UK, Austria and Germany, Telefonica in Spain. In Eastern Europe, Mobitel in Slovenia also has commercial services running since December 2003. ¹

Background

The success of GSM in the 1990s prompted many to assume that 3rd Generation services would be received with the same interest and enthusiasm. Since the time when mobile communications was digitized and GSM was introduced, the number of GSM users has increased manifold and today, the number of GSM users in the world is more than 1 billion². The advent of GSM was due to the lack of capacity offered by previous analogue systems and also to provide a ubiquitous, global system that would enable seamless roaming throughout the world. This vision is what drove this 2nd Generation system to be what it is today, having been adopted by more than 170 countries worldwide.

There are several reasons as to why GSM became as popular as it is today. These will be mentioned briefly in the following paragraphs.

Technically, the evolution from GSM to UMTS is a natural one^{3 4}, with the underlying network still being the one used for GSM. The difference is mainly in the air interface. While GSM used Time Division Multiple Access (TDMA) as its access scheme, UMTS makes use of wideband Code Division Multiple Access (WCDMA), which will enable more users to make use of the limited capacity available in the network. It is the natural progressive step for GSM operators to take. However, the road to UMTS or 3G in general has not been a smooth one for many operators. Some of the advantages and disadvantages of UMTS will be explored in the following sections.

¹ [http://www.umts-forum.org/servlet/dycon/ztumts/umts/Live/en/umts/Resources_Deployment_index-cited on 300304](http://www.umts-forum.org/servlet/dycon/ztumts/umts/Live/en/umts/Resources_Deployment_index-cited%20on%20300304)

² <http://www.gsmworld.com/index.shtml>

³ UMTS Forum White Paper No. 1, August 2002, Evolution to 3G/UMTS Services

⁴ UMTS Forum White Paper, August 2003, Mobile Evolution Shaping the Future

As penetration of the Internet becomes more profound in the world, there has been a requirement by first and foremost, business users to have internet connectivity for business purposes on the move. The concept of being able to access the Internet and other services as and when they are needed, even when users are not by a stationary computer has prompted the move to 3G. The industry has had to come up with new technologies to enable mobile internet technology to happen and this has led to the materialization of 3rd Generation services. As mentioned in the introduction, services for commercial use are already available but most network operators are either still holding trials or have held back the roll out of 3G services till a later date.

Technical aspects of 3G

The technical advantages of 3G are far more than that of 2G and its enhancements such as GPRS and EDGE. GSM was originally deployed as a circuit switched network for voice services. However, when it was deduced that data services will bring in more revenue, it led to operators upgrading their circuit switched networks with a packet switched data network on top of it. Although 3G was already conceived, the enhanced GSM network would provide data and voice services in the meantime. Circuit switched networks have always been used for voice services in organizations and the most obvious advantage is that of higher access speeds. When networks introduce UMTS, users will be able to experience a maximum speed of 2Mbps indoors and 384Kbps outdoors. Although these numbers are only theoretical maximums achievable, practically, the average should be around 300Kbps, and this would allow users to experience multimedia type services.

The big advantage of 3G is that it introduces entirely packet based networks. As compared to early GSM which was a circuit switched based network. Enhancement to GSM had introduced packet switching with GPRS and EDGE. However, with a fully IP based network such as UMTS, a lot more advantages are possible.

Quality of service, which was not fully addressed by GSM and its enhancements, is another advantage of UMTS. With UMTS, quality of service measures has been incorporated in to the technology to make sure that spectrum allocation is optimized. This means that for a particular type of data service, e.g. multimedia video streaming, the appropriate amount of bandwidth will be allocated by the network for that particular service to ensure that the user experience is maximized.

Because of the employment of WCDMA and direct sequence spread spectrum techniques, spectral efficiency is also increased for UMTS, as compared to GSM. Because of the nature of WCDMA, the spectrum available is translated into high data rates and this is ideal for high bandwidth data requirements.⁵ EDGE or EGPRS (Enhanced General Packet Radio System) is an upgrade from GSM and is, too, able to deliver data rates sufficient for most data services and this has been the chosen technology for operators who did not obtain licences for 3G operations and also to fill up coverage gaps when UMTS is being deployed. Because the underlying architectures of GSM (including

⁵ http://www.3gamericas.org/PDFs/data_capabilities_whitepaper_span.pdf

EDGE) and UMTS are based on GSM architecture, interconnectivity between the networks is possible.

The security aspects of UMTS are also an improvement over that of GSM, although what security functions found in UMTS are generally improved versions of GSM security functions. In GSM, security for users was found in the SIM and the radio interface was encrypted. In UMTS, encryption in the air interface is now broadened to include the base stations and radio network controller connections as well. Other security features have also been included in the base stations and in data authentication.⁶ Therefore, in terms of security, UMTS does show an improvement over GSM. However, like every other system, it is not a fully secure one and is vulnerable to misuse and abuse.

UMTS handsets are not introduced as quickly as many operators would like it to be. In the market, Nokia has introduced more EDGE handsets as compared to UMTS handsets and this has been a problem for most operators. With the limited number of mobile handsets, users are not likely to want to switch their GSM handsets for UMTS handsets which are bigger or bulkier and with less battery life than their GSM handsets. This means that operators will have a harder time selling 3G services to users. New, better handsets are constantly being developed and released to the market so this may not be a problem in the near future.

In terms of speed, there is competition coming from the other group of 3G standards, CDMA2000 1XEV-DO. Recently, it was publicized that with the new CDMA 2000 1XEV-DO Revision A, peak data rates of 3.1Mbps uplink and 1.8Mbps downlink are possible and this is optimized for rich multimedia services. These speeds are the highest possible in commercial networks at present.⁷ What this means for UMTS operators is that other operators, who have not adopted either WCDMA or CDMA2000, may decide, upon the advances that are being made in CDMA2000 to go with this technology rather than with WCDMA. And this will lead to fewer products for WCDMA from industry players and hence the development of WCDMA will be hindered. This is what makes it important that development work for WCDMA continues and that constant upgrading of the technology takes place. The competition between WCDMA and CDMA2000 1XEV-DO can be said to have originated from competition between the manufacturers in the US and in Europe. Patents for CDMA technology lies with Qualcomm Technologies in the US. In Europe, there was a move by companies, such as Eriksson, to have their own standard and not be subjected to the influence of their Qualcomm.

Business aspects of 3G

As briefly mentioned earlier, a lot of mobile operators have had to pay large sums of money for 3rd Generation operating licences. In Europe, some of the highest amounts paid came from German and British Mobile operators. In Germany, the cost per licence was approximately US\$ 7.6 billion and in the UK, it ranged from US\$ 6.3 to US\$ 9.4

⁶ <http://www.umtsworld.com.technology/security.htm>

⁷ <http://www.3g.co.uk/PR/April2004/6931.htm>

billion.⁸ This has led to many operators having less resource for putting in place of 3G infrastructure and has caused delays in the commercial launch of the services. While some operators had to pay billions for the licences, there were others, such as Finland and Sweden that were awarded licences for much smaller sums of money, through beauty contests. The disadvantage that these operators had was that rollout had to happen at a much faster rate as compared to operators who paid high sums of money. Therefore, we can see the high costs of licences as a major disadvantage to operators in terms of revenue lost and cost but also an advantage in terms of deployment time line.

There are operators who did not obtain licences to operate a 3rd Generation network, either due to not having been selected or having decided not to bid for the licences. A good alternative technology to UMTS is that of EDGE, which allows users to have reasonable quality of multimedia services over the GSM network. To deploy EDGE, what are required are upgrades to the radio access portion of the existing GSM/GPRS network. In contrast to the amount of work needed to deploy a UMTS network, what is needed for deploying EDGE is much simpler. Cost wise, it is also a lot less expensive to upgrade the existing GSM network than it is to introduce a whole new radio access network for UMTS. Some operators find it more favourable to offer EDGE services to their users and wait until 4G is introduced and deployed in the future. Advantages of doing this include savings on billions of dollars on licences and even more on UMTS infrastructural costs.

The advantage of 3G to mobile operators is of course the new revenue generation that would stem from services offered to users. With data services becoming more important day by day and mobility becoming an essential part of life, it is most likely that these new mobile data and internet services will draw many users. The reason why many operators were willing to pay such large sums of money for 3G licences speaks for itself. They predict that revenue that will be obtained from 3G services and applications will sometime down the road, make their investments worthwhile and reap profits for them. But on the other hand, there is a lot of speculation as to what services and applications will be the one that is the key revenue generator. A lot of development work has been done in the areas of gaming, monetary applications and others. These areas are perceived by many to be key revenue generating services for 3G. If 3G really becomes as popular and successful as predicted, then mobile operators will definitely gain much needed revenue to replace what was lost in licence and infrastructural costs.

Data services are used very differently with that of traditional voice services. This means that new forms of charging formulas will have to be introduced. When choosing their upgrade path to 3G, eg, with GPRS and/or EDGE, operators are at the same time, gaining experience in data services and how to charge their users. While voice calls are charged by the minute or on a bulk time basis, data calls will be charged by the amount of transmitted and received data. This means that a combination of accounting for both voice and data have to be introduced and implemented into the network. The disadvantage of this is that operators will have to set up new accounting and billing software applications in their network to keep track of user's data traffic usage as well as

⁸ <http://www.cellular-news.com/3G/>

voice traffic and to charge the users accordingly. Training of staff and maintenance of software are added costs, though not significant, when comparing to other costs. One other thing is that it is difficult for operators to gauge how much users are willing to pay for the different types of services. It is not in their best interest to charge high prices for popular services as this will render them unpopular to users.

As in the technical portion of this section, it is also important that 3G operators take into account potential threats coming from other types of wireless technology which may or may not pose as competition to 3G services. The example of WLAN is a good one and nowadays, one can see mobile units being equipped with WLAN hardware in order that these two market segments are covered. WLAN is one technology that complements UMTS by providing large bandwidth, wireless (but not necessarily mobile) internet access to users. If operators of UMTS networks are able to combine the two technologies and offer this as one package, they are likely to reap even more revenue.

Mobile operators are beginning to see that in order to usher in a new generation of mobile internet telephony, existing business models and strategies will have to change. Because new entrants by different players such as service providers and application developers and many other market players, it will require that all the parties work closely to provide useful services to users. It will not be possible for mobile operators to work alone to provide quality services to their users. The advantage of this is that many other people will be involved in this dynamic industry and will contribute in some way to the value chain of providing high quality 3G services and applications to users. The disadvantage, to mobile operators is that they will have to share their revenue pie with more players, and this will lessen their net revenue.

Social aspects of 3G

For users of mobile telephony, it is not so important to them what sort of technology makes communication possible. It is the type of service and the quality of the service that they obtain that is of more importance to them. What users want are services that make things more convenient and accessible. GSM is predominantly a voice service technology and this was the most important service to offer at the time when GSM was introduced because mobile telephones should offer just that: Telephone services but with mobility. However, it has since evolved to encompass some data services such as SMS and some internet access capability. Further enhancements allowed even faster access to the Internet and to other services. With 3G and UMTS, even more services can be introduced to the public.

However, there have been some predictions that the most popular service or the so called 'killer application' will still be voice service. As the traditional service of a mobile telephone, it will be difficult to surpass its usage by the masses. Voice will continue to be the dominant factor. However, charges for this service may be adjusted to make sure that users will also utilize the new data services. It remains to be seen the level of penetration that the different data services can have in the next few years. It is not easy to predict how users will take to the different services. It is expected that some will be failures

while others will be successful. The amount of time used in voice calls, however, is not likely to be reduced significantly. There are just some things that are done better with a voice call. Although volume is not likely to lessen, revenue from voice calls may be reduced, due to falling prices of per minute calls and other subsidies.

Although UMTS allows for data speeds of up to 2Mbps in an indoor environment, this is much less when compared to the data speeds achievable with other wireless technology such as the 802.11⁹ standards. 802.11b, which is the most popular standard nowadays, gives users up to 11Mbps data rates using the 2.4GHz band, while the newer 802.11a standard will give up to 54Mbps data rates, making use of the 5GHz frequency band.¹⁰ What this means for the user equipped with a mobile unit operable with both UMTS and WLAN is that if he wishes to download a big file or image, he will probably not do this with UMTS, if a WLAN network is available just 50 metres away. Only when WLAN is not available in the vicinity, will users make use of UMTS for large file downloads. If the choice is there for the user to choose between UMTS and WLAN, it is most likely that the user will go for the WLAN access rather than UMTS. Of course WLAN hotspots are not available everywhere, though there are some cities such as Paris¹¹, which have or are planning to have city wide WLAN services. Compared with WLAN, UMTS is still not able to compete in terms of data rates. However, if combined and marketed together with WLAN, UMTS can achieve success and it does have the advantage of being a mobile technology, used anywhere, and at anytime.

When GSM was introduced, it was the first time that mobile telephony was made available to the masses, not just businessmen and other high earners. With GSM, it was affordable for almost everyone to own a mobile phone and to have a minimum subscription with the mobile operator. From the earlier analogue system, GSM solved many problems, one of which was capacity. As the number of users exploded, there was the need to consider upgrade possibilities for GSM. Hence, UMTS was introduced. But there is a difference now, when we look at GSM and UMTS introduction. Because voice services were already available and effective with GSM, having a new platform for only this service is not a cost effective solution. However, because of the popularity of the internet, being able to access services via the mobile phone on top of voice services is one that seen to be profit making. Some operators, having used GPRS and EDGE as a testing ground for data services have found that users, mostly people in the younger age groups are very keen to try out new types of technology and services. GPRS users have increased since it was introduced and many more are making use of this everyday. Therefore it is very important how the new 3rd Generation services are marketed to users. With GSM, it was most common for operators to work with two sets of marketing groups, namely the business users and the consumers. With UMTS, it will be different and one probable marketing strategy is to define age groups or different interest groups and providing different services to them. It is difficult to predict users' preferences and how

⁹ WLAN Systems and Wireless IP for Next Generation Communications, Chapter 2, Neeli Prasad, Anand Prasad, editors, Artech House Publishers 2001

¹⁰ Mobile Communications, Chapter 7, Jochen Schiller, Addison Wesley 2003

¹¹ <http://www.iht.com/articles/95233.html>

the masses will take to UMTS. Users will expect something more from 3G and their demand for such services will depend on what is supplied and how it is supplied to them.

A lot of people look to the success of 3G services in Japan and in South Korea. But to expect that the success there can be replicated in Europe may not be very realistic. There are fundamental cultural differences that differ in the two regions of the world. Also, the Japanese operators have had very different mindsets when working with industry partners. Pulling resources from many different partners, they have managed to introduce services that are of high quality and which are what their users want. As opposed to the case of WAP in Europe which can be considered a failure, when the marketing hype far exceeded what the technology could actually deliver. Having raised users' expectation for the service, mobile operators was unable to bring about a reliable and cheap service for them. This made users' perception of mobile data services somewhat low and now, 3G will have to correct this. If 3G, especially UMTS, is able to deliver the services at a quality that is up to expectation of users, it will be likely that as with GSM, that this technology will also be taken up by the masses.

In Japan, there are some services such as multimedia rich content services such as movie on demand and also location based services that have gained much success and this is partly due to marketing and partly due to certain environmental and lifestyle factors. For many Japanese, commuting is an integral part of life and many spend as much as 3 hours each day commuting between their homes and work. It is more often than not, that on these commuter trains, that people are facing their mobile phone, either watching the news, reading the news or watching a movie. In Europe, it is highly unlikely that daily commutes will take more than an hour. Hence services such as movie on the go may not be as successful in this region of the world. Location based services have also been adopted readily by the Japanese. In some parts of the cities and towns, the roads are often small with high densities of roads. Also, road signs are not a common thing. To find services or restaurants, Japanese mobile users make use of location based services to help locate the service that they want. If we compare this scenario to Europe, street signs are usually better and densities of roads are not as great as in Japan, such location based advertisement and services may not be as successful here. One main characteristic of location based services is that of privacy. Because location based services usually requires personal information of users to be given to the network such as personal preferences, this has led to some debate over how much information should be given to the network and how personal should the service be to users. The way privacy is viewed in Japan and Europe differ somewhat. Privacy issues are not as strict in Japan as they are in Europe and hence the success of location based services may also differ in both parts of the world.

Discussion/Conclusion

As discussed in the previous few sections, there are several facets of 3G that have been explored, namely, the technology, business and social aspects. These aspects of 3G services give us an overall general picture of whether 3G really is a necessary step after all. Technically speaking, 3G is an advancement over present GSM services, able to offer

much in terms of quality multimedia services. However, for the time being, EDGE is also able to provide such services, though at a lower capacity and lower quality. Operators will have to consider whether GSM with GPRS or EDGE is able to satisfy their market for the time being. With this consideration, they will have to take into account the business perspective of 3G. High licence costs and new infrastructure will Operators of course will have to weigh the differences between potential revenue from new services and initial costs of licences and actual deployment. Also, potential revenue is at risk to emerging or existing technologies such as WLAN. Social behavior will also play a part in whether 3G will become a success in Europe or not. The 'right' type of services and applications will have to be introduced. What has been successful somewhere else may not work in the European market. Operators and its partners will have to ensure customer requirements are taken into account when designing these services.

The three different aspects of technology, business and social all play a part in determining whether 3G will be successful. The interplay between these three is close. One may have the best and latest technology, but coupled with lousy marketing and business strategy, not taking into account social behavior of users, will result in a total failure of the product. Success will come to something that is needed by the users, cheap and easy to use and market properly. And it would help if technology is able to give a high quality of service.

To see if 3G really is a necessary or unnecessary step would depend on factors weighed out by operators and their investors. If 3G is going to be chosen and if it is going to be successful would depend to some extent to the different aspects that have been mentioned here.