Mobile technology essay

Business, Branding

Introduction.

In the 1940s mobile phone technology underwent several changes which provided improved services to the people and revolutionized communication due to the concept of mobility in communications, which has enabled the users to talk and listen even while traveling or on the move. At present more than 50% of the people are connected through cellular phones. In the year 1940 the radiotelephone service was launched in the US in order to connect the users in cars by connecting to a public fixed network. In the 1960s Bell Systems introduced the IMTS or Improved Mobile Telephone Service, which offered higher bandwidth and direct dialing this was the basis for the analog systems developed in 1970s. The coverage areas were split into smaller areas called ‘ cells’ empowered by a low power transreceiver. Then came the First Generation or 1G communication on analog system with the development of microprocessors and the control linkage was digitized between the transmitter and the mobile phone. The Second generation or 2G digitized cellular systems started in 1980. The digitization, which included the control link as well as the voice signal helped to provide better quality reception at lower costs.

In order to meet the need for voice, fax and the Internet on the cell phones with global roaming, the ITU’s IMT- 2000 global standard for 3G or Third generation technology was implemented, it includes multimedia entertainment, infotainment and location based services[1]. Implementing 3G technology poses many hurdles in terms of the services provided, the standard to be adopted in reaching 3G, the time factor and the cost effectiveness. An examination of the results of the 2G technology in general and that of the GSM technology in particular is imperative before implementing of the 3G technology. The success of GSM in the mobile field is attributable to the evolution of the 2G systems. The 3G system is developed from the outcomes of the 2G systems or because the operators deploying them must influence pre-established 2G infrastructure or customer bases. These two factors are interlinked so examining one implies looking at the successes or weaknesses of the other.

European telecom markets were controlled by national governments prior to the globalization of markets in the 1990s. Since then European telecommunications policy had been characterized by principles of market liberalization, harmonization of conditions of the regulatory framework and the promotion of the European telecommunication industry. The GSM was a product of this background. It is the leading 2G system having pan-European coverage and systems are also installed in Asia, Australia, North America and South America. The European national companies have standardized the system of GSM and the working process is a great success.

The companies then realized, first the advantages of the cross-boarder standard and second, the amount of money and energy that would be wasted in its absence when competing for mobile technology world domination[2]. The course of digital technology and its commercial applications influences the establishment of GSM. In other words, control over network evolution translates into control over the architecture of the digital marketplace[3]. The 1st GenerationIn 1970s, the Bell Laboratories of USA introduced the mobile radio system. This was commercialized only in the 1980s in Europe with analog cellular telephone systems, particularly in the UK and Scandinavia. However, the telecommunications companies provided limited local cellular solutions. The need for a technology that could enable flexible and reliable mobile communications was on the increase and in the early 1990s the companies had to respond to the market demand for better coverage.

The technology standard at that time was AMPS or Advanced Mobile Phone System based on analog transmission. These standards operated on bands of spectrum with a lower frequency and greater wavelength than subsequent standards, providing a significant signal range per cell along with a high propensity for interference[4]. The 2nd GenerationIn the 1980s deployments of 2nd generation wireless networks occurred in Europe. These networks were circuit-switched and digital. Cellular data based on circuit switch is still the most widely used mobile wireless data service. Digital technology is characterized by Spectral efficiency and better performance and permits features like speech security and data transfers.

It is compatible with Integrated Services Digital Network or ISDN technology, on which GSM proved to be successful. Further, the use of very large scale integrated silicon technology has made handsets cheaper. Second generation equipment has offered many advantages over analog systems. These are efficiency in using the radio magnetic spectrum, enhanced security, extended battery life and data transmission capabilities. The 2G system has four main standard networks: Time Division Multiple Access or TDMA, Global System for Mobile Communication or GSM, Code Division

Multiple Access or CDMA and Personal Digital Cellular or PDC. The PDC system is mainly used in Japan[5].

TDMA was given an add-on to create ' Digital AMPS' or D-AMPS which facilitated the ability of handsets to switch between analog and digital operation. TDMA is widely used in the western hemisphere and forms the basis for GSM and PDC systems. CDMA referred to as IS-95 is a system introduced in the 1990s by Qualcomm. CDMA uses digital encoding and spread-spectrum techniques to let multiple users share the same channel, it also increases system capacity by about ten to fifteen times in comparison to AMPS and by more than three times in comparison to TDMA. Hence companies use CDMA in GSM, which is popular due to its international roaming feature[6].

CDMA is largely used in Asia and handles voice efficiently but provides limited data and Internet support. The GSM standard dominated the European market in 1999 with 89% share[7]. GSM systems are operated at higher frequencies but are based on technologies similar to TDMA.

In Europe, Asia Pacific and North America GSM has become a dominant standard with a high degree of extra services and ensuing popularity. China with 35 million customers in 2000 is the largest GSM market. Market penetration has reached 70% in many developed GSM markets, with Finland and Italy expecting to be the first countries to reach 100%. In several Asia Pacific markets, the penetration of mobile wireless phones is overtaking that of fixed line phones[8]. The third generation mobile communications, as distinct from its predecessors, are likely to change many areas of social and economic activity, and to unleash a wave of investments in the creation of new data-intensive services. Many of these changes are likely to be revolutionary, in a way that will be difficult, expensive and destructive, fundamentally affecting existing trends in the development of current technologies and the companies that support them.

The 3rd GenerationIn the 3G technology the radio component of advanced technologies varies in terms of at least: The RF channel width, which can range from 200 kHz for GSM-GPRS to 5 MHz for UMTS. The RF spectrum allocation. This can vary from deployment on currently assigned spectrum at 800 and 1900 MHz for CDMA2000 1X to deployment on newly allocated spectrum at 1900 and 2100 MHz for UMTS. This latter spectrum is also suitable for CDMA2000 1X.

The data rate. Depending on technology, this may range from theoretical rates of 115 kbps to beyond 2 Mbps. Some advanced technologies are called 2.

5 G; others are called 3G. The International Telecommunication Union (ITU) serves as the arbiter of 3G standards. It does not define 3G in terms of channel width or spectrum allocation, but rather on the basis of data rates. By ITU definition, the 3G RF interface can deliver data rates of 144 kbps or greater. The ITU recognizes W-CDMA (UMTS) and CDMA2000 1X as meeting this criterion[9]. Higher data rates enable end-users to experience richer content than is now available and, in conjunction with packet architecture, to gain instant and low cost access to the Internet. Higher data rates, and

especially instant and low cost access to the Internet, will expand future network traffic. As network traffic expands, operator revenues will increase.

However, independent of the capability of technologies, operators must recognize the economic-commercial trade-off of network costs versus data rates. The higher the data rates, the greater the network costs. Eventually optimization has to be done of the data rate offered to end-users in terms of the cost to provide it versus the revenues it generates. At present TDMA/IS-136 operators AT&T and Rogers AT&T have chosen to adopt GSM, in order to progress to GSM-GPRS, then to deploy GSM-GPRS-EDGE and finally to adopt UMTS (also referred to as W-CDMA).

This last step assumes that spectrum for UMTS will be available. This migration path has evolved only recently and other TDMA operators are not yet decided as to which migration path to pursue. Previously, the assumed migration path for TDMA/IS-136 operators was to deploy TDMA-GPRS, then TDMA-GPRS-EDGE, and afterwards to adopt UMTS. 3G is also known as IMT-2000 or International Mobile Telecommunications 2000. CDMA systems are based on a different platform compared to TDMA systems.

Thus CDMA 2000 is similar to 3G and TDMA systems including GSM system shall adopt W-CDMA standards to attain the 3G standard. Further, CDMA carriers will have to change channel cards in the base stations and upgrade the software in the network which is cheaper when compared to GSM or TDMA carriers who will have to completely implement all the network overlays. These overlays are HSCSD or High Speed Circuit Switched Data, GPRS or General Pack Radio Service and EDGE or Enhanced Data Rate of

GSM evolution. These changes will allow higher data transmission rates for 2G GSM to upgrade to 3G GSM. A look at the Services and Applications The 2nd generation systems have offered telephone, email, sms, and digital text delivery to their customers. The 2. 5 G systems offered, mobile banking, voice mail, web, mobile audio player, digital news paper publishing, digital audio delivery, mobile radio, karaoke, push marketing, targeted programs, location based services and mobile coupons. The 3G systems would offer mobile video conferencing, video phone/mail, remote medical diagnosis and education, mobile TV/video player, advanced car navigation/city maps, digital catalog shopping, digital audio video delivery and collaborative B2B applications[10].

The major endeavor involves, not changing from GPRS to UMTS, but changing from GSM into GPRS. This is because of the complete changeover to be made in the business model which involves a change from time based to volume based charging. GSM based services rely on digital transmission between base stations and handsets with high speed connections to and from the centers equipped with circuit switches. The transmission at 9. 6 Kbit/s is slow and the architecture itself is incompatible for data traffic or streaming as it is circuit switched rather than packet switched. Thus GPRS seems to be an obvious migration step for GSM operators. HSCSD or High Speed Circuit Switched DataHSCSD is the enhancement of the circuit switched data capability of conventional 2G GSM networks.

It is possible to transmit narrow band data and digital fax over the TDMA air interface. The user establishes a connection for the whole duration of that session. To set up the circuit, a call set-up process is involved when dialing the called party; network resources are allocated along the path to the final destination. At present under the GSM encoding techniques the maximum circuit switched data or CSD speed is 9. 6 Kbit/s or with improved encoding 14. 4 Kbit/s. The GSM TDMA interfaces assign up to 8 time division slots per user frequency, which enables it to expand the existing CSD into HSCSD. For this up gradation, the operator needs only a software upgrade of the Base Station Systems and Network and Switching System.

In a multi timeslot environment Dynamic call transfer between different cells on a mobile network is complicated unless the same slots are available throughout the duration of the circuit switched data call[11]. GPRS or General Packet Radio ServiceGPRS is an overlay technology added on top of existing GSM systems. The GSM part handles voice and handsets are capable of supporting both voice and data functions.

GPRS essentially supplements present-day circuit-switched data and short message services (SMS), and serves as an enabler of mobile wireless data services and as an optimizer of the radio interface for bursty packet mode traffic. The upgrade to GPRS is easy and cost effective for operators, as only a few nodes need to be added. GPRS is packet-based and promises data rates from 56 up to 114 Kbit/s, as well as continuous connection to the Internet for mobile phone and computer users. More specifically, packet-switching means that GPRS radio resources are used only when users are actually sending or receiving data and available radio resources can be concurrently shared between several users. This efficient use of scarce radio resources means that large numbers of GPRS users can potentially share the same bandwidth and be served from a single cell. The actual number of users supported depends on the application being used and how much data is being transferred. Due to the spectrum efficiency of GPRS, need to build in idle capacity used only in peak hours is reduced. Thus GPRS lets network operators maximize the use of their network resources in a dynamic and flexible way, along with user access to resources and revenues.

GPRS packet-based service costs less than circuit-switched services as communication channels are used on a shared-use, as-packets-are-needed basis rather than being dedicated to one user at a time. Availability of applications to mobile users and WAP or i-mode is far more attractive for the user, due to being easier to provide. In addition to the Internet Protocol, GPRS supports X. 25, a packet-based protocol that is used mainly in Europe. GPRS at present has fallen short of the theoretical 171. 2 Kbit/s maximum speed due to the technical limitations of currently available handsets. GPRS has the potential to ‘ help WAP get back on its feet again’, according to John Hoffman of the GSM Association[12].

EDGE, Enhanced Data GSM Environment Enhanced Data rates for Global Evolution (EDGE) is a radio based high-speed mobile data standard that allows data transmission speeds of 384 Kbit/s to be achieved when all eight timeslots are used. EDGE was formerly called GSM384, and is also recognized as ‘ UWC-136’ under the ITU’s specifications for IMT- 2000. It was initially developed for mobile network operators who failed to win spectrum for third generation networks.

It is a cost-efficient way of migrating to full 3G services. It gives the existing GSM operators the opportunity to offer data services at speeds that are near to those available on UMTS networks. EDGE does not change much of the core network, which still uses GPRS/GSM.

Rather, it concentrates on improving the capacity and efficiency over the air interface by introducing a more advanced coding scheme where every time slot can transport more data. In addition, it adapts this coding to the current conditions, which means that the speed will be higher when the radio reception is good. Implementation of EDGE by network operators has been designed to be simple, with only the addition of one extra EDGE transceiver unit to each cell. With most vendors, it is expected that software upgrades to the BSCs and Base Stations can be carried out remotely. The new EDGE capable transceiver can also handle standard GSM traffic and automatically switches to EDGE mode when needed.

‘ EDGE-capable’ terminals are needed, since existing GSM terminals do not support new modulation techniques and need to be upgraded to use EDGE network functionality. EDGE provides an evolutionary migration path from GPRS to UMTS by expeditiously implementing the changes in modulation that are necessary for implementing UMTS later. The main idea behind EDGE is to squeeze out even higher data rates on the current 200 kHz GSM radio carrier, by changing the type of modulation used, whilst still working with current circuit and packet switches.

In addition, the TDMA industry association, the “ Universal Wireless Communications Corporation”, has introduced what it calls EDGE Compact.

This is an even more spectrum-efficient version of EDGE that will support the 384 Kbit/s mandated packet data rates, whilst requiring only minimum spectral clearing, because of this EDGE has been renamed Enhanced Data Rates for GSM and TDMA Evolution[13]. Operators running GSM 1800 networks will have an advantage over those running GSM 900 networks because the higher frequency and lower power are closer to providing good coverage at UMTS frequencies. Many GSM 1800 cell sites will be re-usable. From GSM, at 9. 6 Kbit/s, to EDGE and UMTS, at 384 Kbit/s, the percentage increase in data throughput is less than the figures suggest.

Nevertheless, the faster speeds are sufficient for applications such as e-mail, Short Message Service (SMS) and access to the Internet and corporate intranets. Network operators will not able to guarantee customers maximum data throughput at any instant during a call session. IMT-2000 Technology The vision of IMT-2000 (3G) networks is defined by a single standard comprised of a family of technologies intended to provide users with the ability to communicate anywhere, at any time, with anyone. 3G network architecture is based on two main principles: one is that mobile cellular networks should be structured to maximize network capacity, and the other is to offer multimedia services independently of the place of the end users. It encompasses a range of competing mobile wireless technologies, namely CDMA-2000 and WCDMA. European UMTS (which stands for Universal Mobile Telecommunications System), includes WCDMA radio access technologies, together with a core network specification based on the GSM/MAP (Mobile Application Part) standard. As reflective of 3G in Europe, UMTS is actually intended to provide the kinds of data speeds and protocols to allow people with appropriate handsets to access the Internet, watch movies, exchange large data files and have video conference calls to and from locations of temporary choice and convenience. The new network, improving upon previously described shortcomings, has to allow for data traffic, which comes in unpredictable bursts, voice conversations, which should not be interrupted, and the streaming of large contents like movies.

The goal for 3G is to provide standard facilities good enough for mobile devices to handle color video. 3G communications are based on standards that are intended to ensure global interoperability and standardized usage of spectrum frequency. IMT-2000 itself offers the capability of providing value-added services and applications on the basis of a single standard. The system envisages a platform for distributing converged fixed, mobile, voice, data, Internet and multimedia services.

One of the key aspects of its vision is the provision of seamless global roaming, enabling users to move across borders while using the same number and handset. It also aims to provide seamless delivery of services, over a number of media (including satellite, fixed, etc.). It is expected that IMT-2000 will provide higher transmission rates than currently possible, i. e.

, a minimum speed of 2Mbit/s for stationary or walking users, and 348 Kbit/s in a moving vehicle. The ITU has clearly indicated that at the heart of the IMT-2000 project is the objective to raise awareness of the importance and reach of IMT-2000 as a global, harmonized mobile personal communication system and access platform, with emphasis on its role in the deployment of the global wireless information society. The ITU is committed to its role as the most suitable and best-positioned organization to act as facilitator and coordinator of global standards development, global frequency spectrum harmonization, and global circulation of IMT-2000 terminals. One of the goals of IMT-2000 is to provide an evolutionary path from 2G systems to 3G systems and to protect existing investments in legacy 2G systems. Proponents of the different approaches to 3G technologies – CDMA2000 (US, Korea), and W-CDMA (Europe, Japan) were not able to agree on a single standard – hence the variety of ‘ flavours’ of wideband CDMA that comprises achievement of “ 3rd generation” status. IMT-2000 therefore, as mentioned earlier, consists of a ‘ single standard of a family of technologies’, which implies the need for multiple mode and multiple band handsets capable of handling various optional mode and frequency bands.

The system as a whole is highly flexible, capable of supporting a wide range of services and applications. The IMT-2000 standard accommodates five possible radio interfaces or flavours based on three access technologies namely FDMA, TDMA, and CDMA. The two main interfaces fall under the ‘ Wideband–CDMA’, and the US-supported ‘ cdma2000’ categories.

The W-CDMA standard includes the European usage of W-CDMA, and the Japanese standard used by NTT DoCoMo. Cdma-2000 is a Telecommunications Industry Association or TIA standard for third generation technology that is an evolutionary outgrowth of cdmaOne from the United States. Both WCDMA and cdma2000 are mainly based on Frequency-Division-Duplex or FDD frameworks. A third interface falls under the TD-

SCDMA category, the radio interface proposed by China and approved by the ITU, which is based on Time-Division-Duplex or TDD.

The fourth interface falls under the TDMA category UWC-136 or ‘ Universal Wireless Communications’-136, which is known as EDGE; this was developed by CDMA AMPS operators, many of which have since developed different migration strategies. Finally, the last interface falls under the FD-TDMA category, which performs like IMT-2000, but is in fact used mainly for indoor environments. In order for IMT-2000 to be possible, it has been necessary over the past few years to create the momentum for its realization; part of this, of course, being driven by the simple fact that existing 2G circuit-switched systems will be inadequate for forthcoming data transmissions. “… Existing systems like GSM are running out of capacity… and the mobile phone market is growing at an annual rate of about 55% … it has been estimated that 80% of the population in the European Union will have some form of mobile communicator by the year 2020…”[14].

Resolution 223 adopted at WRC-2000 found that ITU studies demonstrated the need for approximately 160 MHz of spectrum in addition to that identified at WRC- 92, and in addition to the spectrum already being used for first and second generation wireless services[15]. Spectrum – A Major Factor. The WRC 2000, the international forum which serves to provide the technical, operational and regulatory conditions for the use of radio frequency spectrum and satellite orbits, was critically important in its management of radio frequency spectrum for 3rd Generation technologies[16]. The need for added spectrum stemmed from three main considerations: the first being that the number of users is expected to reach an estimated 2 billion worldwide by 2010[17], the second being the rapid growth of mobile data services, mobile e-commerce, wireless internet access and mobile video-based services, and the third being the need to secure common spectrum worldwide for global roaming and cheaper handsets. The entire spectrum between 400 MHz and 3 GHz is technically suitable for third generation mobile.

The entire telecommunication industry, including both private sector and national and regional standards-setting bodies gave a concerted effort to avoid the fragmentation that had thus far characterized the mobile market. WRC approval meant that for the first time, full interoperability and inter-working of mobile systems could be achieved. Three common bands are available on a global basis for countries wishing to implement the terrestrial component of IMT-2000. The three bands identified for use by IMT-2000 include one below 1 GHz, another at 1. 7 GHz (where most of the second-generation systems currently operate to facilitate the evolution, over time, of these systems to third generation), and a third band in the 2.

5 GHz range. These complement the band in the 2 GHz range already identified for IMT-2000. The Conference also identified the use of additional frequency bands for the satellite component of IMT-2000. For the European UMTS (3G) network specifically, bands are available in a 155 MHz wide spectrum in the 1.

9 and 2. 1 GHz band. One way of gauging the likelihood of 3G's success is to look at one of its closest forerunners: SMS via GSM.

Some consider it to be the best indicator of the money-generating potential of the mobile internet, assuming that SMS usage can be easily translated to demand for data on mobile devices. The widespread success of SMS in Western Europe contributed significantly to mobile data revenue in 1999 and showed that consumers will use mobile phones for more than just voice. Most importantly – in terms of its potential implications for IMT-2000 – it must be recalled that SMS was a value-added service innovation which could not have been predicted when the service was first launched in the 1990's. The GSM Association estimated that GSM networks transported one billion messages worldwide in October 1999, and SMS revenue apparently comprised a significant portion of overall service revenue figures in more mature markets such as Finland and Norway. By December, volume was up to two billion, and by March 2000 it was over three billion. Some 50 billion text messages were sent worldwide in the first three months of 2001 alone; " some 25. 3 billion SMS text messages were sent in the first twenty-seven days of June 2001"[18]. The importance of the role of handsets in the deployment of GSM, both in terms of functionality and cost, is compounded now in the 3G scenario.

While handsets for GSM are at this point highly regulated and, serious concerns for 3G handsets proliferate. According to a survey of operators by ARC Group, almost 90% ranked non-availability of 3G handsets as the primary barrier to the successful introduction of next generation services. Many companies are still smarting from problems with the supply of WAP and GPRS handsets and fear that similar problems will affect 3G services with potentially disastrous consequences[19]. 3G base-stations and telephone handsets have had to be created from scratch because of Europe’s insistence on following its own version of the CDMA technology. Third generation handsets will need to roam between 2G, 3G, GPRS and GSM networks in Europe, between PDC and wideband CDMA (W-CDMA) in Japan and between time division multiple access (TDMA)/code division multiple access (CDMA) in the Americas. There may also be a need for roaming between different implementations of the 3G standard, such as Wideband CDMA (W-CDMA) and CDMA-2000.

A good example of the echoing importance of handsets appeared in July 2001. Japan’s NTT DoCoMo issued “ an advisory” to owners of 100, 000 Web-enabled P503i i-mode phones after finding they were unable to receive voice calls and email at certain geographical locations. DoCoMo also temporarily halted sales of Panasonic phones made by Matsushita, while it identified which handsets were subject to the glitch by checking serial numbers[20].

A hold-up of this nature of GPRS handsets, affects replacement cycles as mobile users hold out for the new technology before replacing their handsets. GSM success is best observed in the context of escalating penetration rates and high subscriber growth. High subscriber levels for GSM, however, did not necessarily equate to high profit margins: operators have to face the issue of higher subscriber acquisition costs (SACs) when attempting to attract the less profitable customers of the mass market. In the context of examining the potential cost burdens carried by users of 3G mobile technologies, it is crucial to briefly consider the subscriber acquisition costs (SACs) associated with these consumers. As services become increasingly broad-ranging both in terms of breadth and geographical reach, it becomes apparent that not all consumers are created equal; in other words, different users become valued differently as a result of increasing acquisition costs. This is inevitable, since as markets get more competitive, a general struggle around price offerings becomes discernible; discriminating, price-conscious consumers in a fickle market constantly impose pressure for better value for their money. Therefore, new users are attracted to cellular at the expense of growing acquisition costs while yielding lower than average revenues in all but the longest of terms[21]. When GSM was being developed, national governments were free to choose to whom a license would be issued – and with the exception of the UK – issued the first of their GSM licenses to their national PTT’s.

One could argue in this case that the success of GSM – particularly in its harmonized approach to license allocation – has not been replicable (or even applicable) to the global 3G case. In Europe, in preparation for IMT-2000, each country regulator was given the responsibility of setting its own licensing conditions and procedures – and this has led to wide cost variations in the price of 3G licenses across Europe. The Council of Ministers and the European Parliament of the EU adopted a ‘ UMTS Decision’ in 1998, aimed to ensure the availability of at least one inter-operable service in the EU, while leaving the characteristics of that service to concerned operators and suppliers. The corresponding 3G licensing conditions set by most country regulators ruled that all license winners should build their own networks, and specified a date by which network rollout must be complete and services launched.

This led, as we have seen, to massive volatility in the valuation of spectrum, as well as considerable doubt as to the financial viability of countless European operators. It is interesting to see that the US is only doing things slightly differently for 3G than they did during the development of GSM. There are differing perspectives on the American treatment of questions around 3G spectrum.“ The lesson from GSM [the predominant technology for mobiles in Europe and much of Asia] is that we did it our way and we got left out of global roaming,” said Leslie Taylor, president of a wireless consultancy in Washington, D. C.[22] The U. S.

, from the start, has been opposed to any measures that restrict competition or limit the flexibility of service providers to meet market needs, particularly in order to protect consumers from increased costs. The U. S. government has maintained thus far a rather cautious approach to 3G services in general, which opts for leaving the major details of wireless spectrum usage ‘ to the industry’. Copy Rights, Patents and Controls on Manufacturers.

The Intellectual property rights play a crucial rule in the development of the IMT-2000 or the 3G based handsets by manufacturers. In the case of the GSM, the intellectual properties rights put severe limitations on the number of companies that were accredited with the right to manufacture GSM equipment. There were nearly 20 companies that owned the essential technology necessary to realize GSM system[23].

Operators in countries who had all the makings for cost-effective successful deployments, including the skills and manufacturing base to produce their own equipment, were forced to buy from the privileged few European manufacturers, and thereby impose their incurred cost burdens ultimately on their own customers. Certainly, this put a strain on the attainment of market efficiency for operators in non-accredited countries. It is believed that over a 100 companies/organisations will now own the technology such as patents necessary to realize a 3G system, reflecting a vast improvement over the past[24]. To illustrate this point, Motorola represents a good example in the GSM context because of its competing handsets with Nokia.

Indeed, the monopoly of manufacturers of GSM equipment was extremely difficult to penetrate by companies like Motorola. Although standardization issues in the 3G context are more global, and despite the fact that many numbers of corporations are now involved, two competing specifications groups still remain, and both are moving in their own respective directions although ‘ bridges’ have been built between the two projects. One is the European-backed 3GPP[25], and the other is the US-based Qualcomm-backed 3GPP2[26]. Thus, despite the existence of hundreds of manufacturers, there is unlikely to be a solution to the broader Intellectual Property Rights dilemmas until the efforts of 3GPP and 3GPP2 are effectively merged to make real collaboration possible.

Operational Difficulties and Problems Involved. The various factors of IMT-2000 or UMTS such as deployment and license allocation make the 3 G development unique. Governments have to consider the real possibility of paying for spectrum and this will result in the commercial rivalry among the operators and have to encourage a healthy mobile communications sector. The huge cost of 3G has led the majority of operators to begin discussions with their domestic competitors to share networks in order to reduce build-out expenses.

In most countries like Sweden, Italy, Spain and the UK, regulators are open to this proposition. 3G operators will have to pay huge spectrum licenses and must invest in building or expanding their physical infrastructures. Infrastructure is and continues to be a primary concern in the area of estimated operator costs, and one common assumption is that these costs will come close to the amounts that operators paid for their spectrum licenses. The Yankee Group estimates average roll-out including license, network infrastructure, application and content development costs at $2. 5 billion[27]. Building out infrastructure for 3G services is estimated in the ballpark of around $5 billion per operator per country[28].

Investments in the respective IMT-2000 standards are extremely high, and that those sustaining these commitments consist of a number of highly leveraged stakeholders like manufacturers, distributors, and standards consortia – all keen to justify their own paths toward IMT-2000. The growth of consolidation and collaboration between operators has made up the 3G is unique in nature. In the broadest scope, the transition from 2G to 3G would have been inconceivable had it not been for the justifications of significant forecasted increases in mobile penetration numbers for the coming years. Despite huge costs, anticipated delays, and unfavorable market conditions, the transition is well under way, and IMT-2000 is the only way forward for European, and other mobile operators[29]. Though the transmission to 2. 5G in the U.

S. seems to be going pretty smoothly, experts believe changing the system to 3G will prove much more difficult. 3G requires a much wider radio spectrum than existing wireless services, and this can create many problems.

Countries are currently auctioning off their spectrum to phone companies for huge sums of money. The phone companies may find themselves without enough money left over to build the new networks. More than $100 billion was spent in Europe just for the rights to the airwaves necessary to implement 3G service. Analysts say it will cost another $80 billion to upgrade their existing network[30].

The U. S. has an additional problem – all of potential 3G airwaves are currently in use, some by the U. S.

Defense Department and some by universities. If 3G is going to move in, those other services have to move out. Despite the problems and the difficulty in implementing 3G, many companies are already hard at work. NTT DoCoMo Inc. has already been making investments all over the globe, including purchasing 16% of AT&T Wireless[31]. Migration PathsGSM operators, or more precisely those assigned 900 and/or 1800 MHz spectrum, will evolve first to GSM-GPRS and eventually to UMTS. They may or may not deploy GSM-GPRS-EDGE as an intermediary step.

Deploying UMTS will require these operators to use newly allocated and assigned 3G (UMTS) spectrum at 1900 (uplink) and 2100 MHz (downlink) in conjunction with their currently assigned GSM spectrum at 900 and/or 1800

MHz. It will require multi-mode/multi-band GSM-GPRS-UMTS (or GSM-GPRS-EDGE-UMTS) handsets and multi-mode handsets will enable handoff from network to network. This will enable seamless provision of basic GSM services like voice and messaging throughout the network and provision of UMTS in the heaviest traffic parts. This also enables operators to deploy 3G infrastructure only as demand requires, thus minimizing their investment burdens. The migration path for GSM operators assigned 1900 MHz spectrum is less clear. Separate 3G spectrum, suitable for UMTS, has yet to be allocated.

Until such spectrum is allocated and cleared, this precludes GSM operators at assigned 1900 MHz spectrum from advancing beyond GPRS and EDGE, if the latter becomes commercially available. CDMA One operators, whether assigned frequencies at 800 MHz, 1900 MHz, or both, can evolve to CDMA2000 1X, using their current spectrum obviating the challenge of finding new spectrum. The evolution to CDMA2000 1X requires channel cards and software upgrades to cdmaOne base stations and introduction of CDMA2000 1X handsets.

All CDMA2000 1X handsets are backward compatible with legacy cdmaOne infrastructure. This obviates the need for multi-mode handsets. In Japan, PDC operators will construct entirely separate UMTS networks on newly assigned 1900 and 2100 MHz spectrum. Subscribers will access those networks with single-mode/single-band UMTS handsets. Regardless of whether TDMA/IS-136 operators choose GSM or CDMA One as their migration path, they will have to overcome challenges never before faced. Because of this, both paths will prove more complex, expensive, difficult, and time consuming than many initially imagined[32]. AT&T's approach is premised on AT&T's taking advantage of the massive R&D efforts that are being devoted to the GSM transition path i. e.

, GSM-GPRS and GSM-GPRS- EDGE, and the expected economies of manufacturing scale of GSM, and eventually of UMTS, over time. Indeed, this premise of long-term economies of R&D and manufacturing scale is the fundamental rationale underlying the choice of GSM as a 3G-transition path. In adopting GSM, AT&T ended any hope for further development of TDMA/IS-136 and a migration to 3G based on it. This means that all TDMA operators must now choose a new migration alternative. While most industry observers have assumed that this would be GSM, it could be cdmaOne as well.

Using GSM as a means of reaching 3G is appealing. However, it requires that TDMA/IS-136 operators deploy what, in effect, will be a completely separate 3G network. This will prove a challenging and expensive proposition especially to TDMA operators assigned to the 800 MHz rather than the 1900 MHz frequencies. For the 800 MHz operators, the availability of GSM infrastructure is still a promise, although Nokia, Ericsson, Motorola, and Nortel, who have made such promises, are credible vendors. Far more important is the timely delivery of 800 MHz GSM handsets at a reasonable cost[33]. The main difference between 2G and 3G is data. 2G services were developed with mostly voice services in mind but are capable of providing relatively slow i.

e. 14. 4 kbps speed data services. Most of US carriers offer some data services including limited wireless Internet access. For 3G, the data speeds are expected to be much higher up to 2Mbps for fixed applications and 384 Kbps for mobile applications.

This will allow new services to be provided including audio and video streaming, remote access to company databases, and a wider variety of entertainment and information services. 3G will also support a range of devices, including phones, personal digital assistants, and laptop computers. Initially, 3G devices are expected to be more expensive than existing devices. However, since the 3G spectrum is expected to be more harmonized than 2G services, the greater economies of scale should allow low cost phones and other devices to be produced that can be affordable by more people around the world. However, some US operators like Verizon Wireless are planning to deploy 3G technologies this year based on cdma2000 technology – one of the technology standards approved by the ITU for 3G.

Using cdma2000 1xRTT technology, this initial phase of 3G deployment will support higher data speeds than current 2G technology, but not all of the services, such as multimedia, that are envisioned for 3G. Other operators are planning to deploy GPRS and other 2. 5G technology that will support comparable services. Existing CDMA operators like Verizon Wireless have chosen to deploy cdma2000 technology because the technology is backward-compatible with their existing CDMA technology. Ultimately, new spectrum will be required to satisfy the long term demands for 3G services, and the importance of 3G technology being backward-compatible with technology in existing bands will diminish. Technology and Market Potentiality. The technology for implementation is essentially important and available to the operators and finally it should work as per the stipulations. But the present availability is scarce and it is still immature.

Particularly the network equipments are to be manufactured for availability to the operators. The handsets made at present are suitable for both GSM and 3G and shown malfunction and poor in design. Hence much more research is to be done in this area for free of the malfunctions etc. The governments have also to introduce new Telecom package to enable the success of 3G service markets. This is important to both industry producing equipment and content and consumers because open and interoperable standards in this field make it easier to create new and viable applications and services and ultimately give consumers more choice. This requires dedicated efforts on standardization and efforts on providing open and inter-operable interfaces. Operators are facing some difficulties when deploying their physical 3G networks due to slow and fragmented local planning in connection with the acquisition of base stations; different regulations on emission levels; and sensitive public opinion regarding health impact of base stations and hand-sets. 3G-cellular systems have to be high-speed and more importantly, high-capacity networks, with low bit cost and the ability to support the services that the market will demand.

Difficulties in interoperability between handsets, operator networks and software platforms now represent the biggest obstacle to the development of 3G mobile data services. Vendors such as Nokia and Ericsson are implementing complex testing procedures alongside mobile operators and software developers to ensure their phones, networks and applications can communicate, but the process is likely to take a long time. High costs.

Various governments in North America, Europe, and parts of Asia have auctioned off licenses to companies that want to use part of the limited 3G spectrum to provide wireless services. In most cases, companies paid huge sums of money for the licenses. A key threat to 3G's success is the possibility that users will decide to get wireless services from other types of technology. T – Mobile's Experience in the field of 3G Technology. Office of Communication or Ofcom, UK had imposed fundamental changes to spectrum policy which will seriously impact T-Mobile's business plan and investment program while providing a windfall to other operators through the early removal of conditions on spectrum they acquired cheaply. These proposals alter the market model and the sheer extent of the changes creates substantial uncertainty that will deter future investment. Reflecting on these considerations, T-Mobile proposed that the trading of mobile spectrum be allowed from 2007 and that liberalization of spectrum for mobile use be allowed from the end of 2012, allowing a reasonable transition period before new entry is permitted without any such rollout obligations and probably with much lower spectrum prices given the flood of new spectrum entering the market. 2012 should also be the year in which the liberalization of non-mobile spectrum for use for 3G services is aligned with the liberalization of ' 2G' spectrum for use for 3G services.

Delaying liberalization until the end of 2012 would also alleviate concerns that other potential bidders for 3. 4 GHz spectrum are being disadvantaged through the proposed removal of conditions on those licenses. In relation to Ofcom's proposed auction Programme, T-Mobile was concerned that key uncertainties be resolved before the auctions commenced. Operators cannot be expected to decide whether to pay large amounts to acquire new spectrum while major uncertainties exist in relation to the date on which 2G spectrum will be able to be reformed for 3G services, the availability of additional valuable spectrum e. g. the broadcast dividend, potential changes to international harmonisation measures. The 3. 4GHz licenses were auctioned on the explicit basis that the use of the spectrum for mobile services was not permitted.

Ofcom is now proposing to permit the use of the spectrum for mobile services in 2007 which would deliver a substantial windfall to the 3. 4 GHz spectrum holder (who acquired the spectrum at much lower prices than the prices for 3G spectrum) while harming the interests of other parties who would have also participated in the bid if they had known that such a major change to the license conditions was to take place within a mere 4 years of the issue of the licenses. The discriminatory nature of this proposal is made all the more clear when compared with the proposals to retain license conditions relating to coverage on 3G operators even 7 years after the issue of those licenses and restrictions on the use of 2G spectrum well over a decade after the issue of those licenses. Reflecting on these considerations, T-Mobile believes that the liberalization of 3. 4GHz spectrum for use for mobile services should not occur before 2012. This time period would reduce the harm to other potential bidders in terms of the removal of license conditions and permit the liberalization of 3. 4 GHz spectrum to be aligned with the liberalization of 2G and 3G spectrum at a time that would better enable the mobile operators to recover the cost of their roll-out obligations.

At the time of the 3G auction in 2000, the release of new mobile spectrum was very scarce due to the prevailing spectrum policy of “ command & control”. This environment forced up the price of 3G licenses to unprecedented levels for spectrum fees. If some of the idle spectrum that Ofcom now proposes to make available was licensed then, the 3G license prices would have been considerably lower.

Ofcom is now proposing to auction a flood of new spectrum over a short period, and to make the spectrum available on a technologically and service neutral basis. While T-Mobile understands that this shift from spectrum famine to feast represents a genuine change in the regulator’s philosophy, the result is that the 3G operators have incurred expenditure to the tune of billions of pounds in acquiring their licenses while new entrants are likely to acquire spectrum at a small fraction of these costs. This change risks an unlawful interference in the 3G operators’ property rights and legitimate expectations. This is a direct consequence of the regulator’s action and, as such, the regulator should take steps to moderate the impact of the change. In particular, Ofcom needs to provide the operators with a reasonable opportunity to recoup the cost of their licences before new licences are able to be used for the supply of 3G services. After its successful bid in the auction in 2000, a number of factors have acted to delay the launch of 3G services by T-Mobile. These factors, which have affected other operators, also, are significant delays in the development and availability of compatible handsets in sufficient volume for commercial launch; key network equipment such as base stations and core switching not becoming available for deployment in the field until 2002 because the 3G standard did not " stabilize" until the end of 2002 and new sets of new 3G technical specifications have been introduced since; development of core network functionality, in particular in-call handover between 2G and 3G networks, was delayed ; and continued delays resulting from the UK planning regime, in particular following the Stewart Report[34] and other issues related to the health aspects of mobile networks. Only when technology issues were resolved, could T-Mobile start with testing and development of the 3G network design.

Most UK operators launched their initial 3G data services in 2004, aimed at business customers, with wider take-up expected in 2005. Roll-out of 3G services has thus been delayed by at least 4 years compared to expectations at the time of the 3G auction. The position of T-Mobile is far more problematic.

It is now a pigmy trailing behind three giants and has the least clear growth path of any of the players. Although it has been innovative in building a national Wi-Fi hotspot network that has improved its customer acquisition and loyalty overall, it does not expect to be able to launch 3G for two more years. While its parent company is highly committed to a creative multi-network strategy encompassing cellular, Wi-Fi, WiMAX and Flarion, the US arm, for all its successes in building subscriber base and ARPU, lacks the spectrum to move ahead confidently.

Further, its foreign ownership by Deutsche Telekom ties its hands in terms of possible merger opportunities of its own – the German giant, once apparently inclined to sell off its US subsidiary, has recently decided to abandon any such plans of sale. T-Mobile's continuing ability to compete in a 3G world pivots on spectrum. More of that will be becoming available, notably with the planned FCC auction of 1. 9GHz bands currently occupied by the government. However, this might not be usable for another 18 months, and there will be fierce competition for these precious assets.

T-Mobile declares that it has set aside $2. 64bn for the express purpose of acquiring spectrum; nevertheless this amount is unlikely to be enough to build a national network, even with network sharing deals. Verizon already set a marker price of twice that, when it argued – in fighting off Nextel's spectrum swap deal with the FCC – that it would pay more than $5bn for national PCS licenses. Significantly, T-Mobile lacks the type of management team and lobbying power that enables Verizon and others to get their own way so often with the FCC. Also, T-Mobile's revenues from current networks are not on a scale to support a massive network upgrade, particularly if its parent is unwilling to take on significant new debt for this move – which would be very unpopular with shareholders. T-Mobile has been a great success and a huge prop to its parent during the Telco slump, with earnings increasing fivefold in the past two years. All the same, the new scale of competition and its inability to roll out networks at the speed of its rivals are a real threat to its margins, and that will have a knock-on effect on confidence in Deutsche Telekom stock overall, which remains over dependent on the buzz factor of the US cellco which has risen in value by 13 per cent this year, primarily due to the support of T-Mobile USA’s strength. T-Mobile argues cogently that its membership of an international group implies that it gets better equipment pricing deals than its rivals and that the delay in rolling out 3G could prove to be an advantage, because it will be able to launch services into a market that is ready for them, rather than seeking to create one – an argument it is also using to slow down its 3G pace in Europe.

It has grown its subscriber base more rapidly this year than any other cellco apart from Verizon and is highly creative on branding. In addition, it could use its hotspot network to deliver some data services and VoIP. Yet it has no obvious deal partner of its own, even if its parent were willing.

If confidence in the US arm wanes and if that starts to affect Deutsche Telekom’s value, the German telco might again consider its option of selling off the unit. However, its likely partners would lie in the second tier. Vodafone could revisit its option of breaking with the Verizon Wireless joint venture and acquiring T-Mobile to go it alone in the US, but Deutsche Telekom would be hostile to helping one of its biggest challengers in Europe. ConclusionAfter a review of the recent activities regarding 3G technology, it is obvious that widespread 3G activities are happening around the globe. However, clouds loom on the horizon.

Factors such as slow growth, delayed deployment and technical and financial hurdles cast shadows on deployment times and pervasiveness. Furthermore, the emergence of new wireless data services may pose a great threat to the nascent 3G technology by being strong contenders for high-data-rate services. Another prevalent view among the wireless community is the lack of “ killer applications” to corroborate the need for migration to a new system. There is a need to see how people respond to current changes and whether they are ready to pay more for enhanced services. However, even with all these thorny issues, 3G is making a slow but steady progress toward positioning itself as the global voice and high-data-rate service of the future. The reason for delay so far has been the sheer technical complexity of 3G technology and the difficulties that were encountered in making it work – difficulties that were considerably greater than originally anticipated.

But those problems have been largely solved. The chief reason there will be further delays going forward is in large part the failure by your and my phone company to pay proper attention to the most important element of 3G – that is, the handset. In the world of 2G, the handset is essentially a carrier of voice data and therefore required less sophistication in terms of features and usability – it is an exaggeration, but not an egregious one, to say that a 2G phone is a box that you speak into. But with 3G technology a paradigm shift occurs from voice to content. As operators move toward content provision and content gateways, rather than just conduits for calls, the matter of how the user interacts with his phone becomes much more important than it had been in the 2G world. The operators have misjudged this paradigm shift and underinvested in the handset; as a result, the 3G handsets that did arrive did not meet consumer needs, depressing take-up of 3G services.

Telephone companies have spent an absolute fortune getting ready to deliver 3G. First, they spent an astounding 100 billion euros across Europe to buy licenses to provide this technology. This spending must have brought a rare if temporary smile to the faces of finance ministers across Europe, and a reinforcement of their suspicion that business is always good for a little extra money when push comes to shove. But the acquiring of these licenses didn’t actually bring the technology to the customer. Now, they’re spending between 25 euros and 50 billion euros across Europe on the 3G equipment that will receive and broadcast your 3G telephone calls and mine – mostly unnoticed, 3G masts (so-called base stations) and other infrastructure have been sprouting across Europe over the past couple of years. This additional spending brought something of a smile to the faces of the finance directors of Motorola, Nokia and Ericsson (even though the margins on these base stations were thin-to-negative), and perhaps helped prevent the telecom crash from becoming a near-permanent rout. But again, the building of these networks did not actually put 3G into the hands of us, the customers.

At the same time that the telephone network companies have been spending these gigantic sums, from what we can see they have spent almost nothing – sometimes less than 10 million euros from an individual company – in supporting the development of 3G handsets. This task they have left to the handset manufacturers, the most advanced of which (such as NEC) are in the Far East (although followed closely by Nokia, Ericsson and others in Europe). The agreement that network providers made with the handset manufacturers seems to have been “ we will build the networks – you will build the handsets – we will then move forward together successfully.”

Reflecting this split of responsibilities, the liaison teams that the telcos have set up to work with the handset manufacturers have been small, under-resourced, and under influential. On the other side of this deal, the 3G handset manufacturers have been too preoccupied with the very real technical issues of getting the handsets to work to pay sufficient attention to features, usability, and other such consumer-oriented issues. And the handset manufacturers are in any event at one step removed from us, the handset customer – and so are less likely to understand fully what it is that we need or want. Somewhat predictably, therefore, the telcos' hands-off (forgive me) approach has resulted in 3G handsets that, when they finally arrived, were big and clunky. Handsets are the most difficult part of the equation to get right.

In a handset, unlike with network infrastructure, a giant amount of technology has to be crammed into an extremely small physical space, using just one or two not-very-powerful chips as the basic engine of the phone. Add to this the fact that an enormous amount of testing has to be done with all these mobile phones, to ensure that they work with any UMTS network, anywhere in the world, interacting with infrastructure equipment from any one of half a dozen or more providers, and you face the inevitable consequence that handsets were bound to arrive late and would be inadequate when they did arrive. Hutchison's " 3" has learned this to its cost: the NEC handsets that it has been offering for the past six months have been insufficient to entice many potential customers into signing up. And yet we know that if you can come up with a great handset, customers will rush to buy. In Japan, DoCoMo has so far signed up over three million customers onto its 3G service – over one million in the past month alone, as new and exciting handsets became available.

DoCoMo has a history of working very closely with handset manufacturers, to create handsets that customers will want, and will run out to buy. In Europe, the network providers have been less committed to allocating significant resources in that direction. As we contemplate the gigantic sums that network operators have sunk into 3G, we have to wonder which among them will be the winners. It is becoming increasingly clear that the way to a winning position is to focus on the handset. Traditional mobile phones are under challenge as never before by mould-breaking concepts such as the Blackberry and the Treo. The new Nokia 6000 and the Sony Ericsson 800, both large sellers, are doing better, but do not significantly satisfy customer needs. For consumers, as the experience in Japan shows, video capabilities will prove irresistible. This new competitive field will be won by the network providers with the best phones.

They in turn will be the firms that start thinking and changing their strategic approach to the business, now. These companies will allocate more resources to the handset side: currently the majority of network providers are in detached mode, leaving it to the handset manufacturers to define the features, and accepting more or less whatever they are offered. Forward-looking network providers should be looking to speed up the pace of progress and improve their process of interaction with the handset manufacturers so that the handsets come quicker and work more effectively with that provider’s particular network. And finally, the winners among the network companies will be those who achieve the differentiation — in both hardware and software – that is then obtainable only by those users who sign up to that particular network. Getting deeper into the handset space will require a change of mindset, and a different way of organization, for the major network providers. The current allocation of resources – billions for licenses and infrastructure, yet hardly tens of millions for handsets – is lop sided and if 3G is to flourish, the network providers have to focus on the handset, that one part of the whole value chain that customers actually see, touch, and therefore base up to 90% of their buying decision on.

If the network providers can make this change of mindset, the explosion of usage in the 3G space will be all that has been predicted, and more – and sooner[35]. If implementation is delayed as hoped for by T – Mobile, then it might emerge as a very powerful entity in this highly competitive market. Bibliography1.

Andersson, Christoffer, " GPRS and 3G Wireless Applications". Wiley Computer Publishing, New York, 2001 AT&T to Ditch TDMA for GSM-Based Data Migration, 3G Mobile, November 29, 2000 Cukier, Kenneth and Hibbard, Justin. " Spectrum Shortage". Red Herring Magazine, September 1, 2000. Francois Bar ," The Digital Economy in Comparative Perspective", May 27, 1999 in the 12th International Conference of Europeanists, Chicago, IllinoisGuyton, James. " Wireless Networks in Europe: A Three-Step Evolution". The Fletcher School of Law & Diplomacy, April 20006. Generation Wireless, Network Computing, Volume 12, Issue 2, June 11, 2001.

Jon Moynihan, Waiting for 3G: It’s the handset, stupid , The Wall Street Journal Europe, 24 May 2004Provisional Final Acts of the World Radiocommunication Conference (Istanbul, WRC-2000), Resolution 223, § h. Roberts, Simone. “ 3G in Europe: Expensive but Essential”; Wireless/Mobile Europe, TheYankee Group. Report Vol. 5, No. 8 June 2001 10.

The Shosteck Group, Third Generation Wireless (3G): The Continuing Saga, Wheaton, Maryland, February 2001, Van Grinsven, Lucas. “ Mobile & Satellite: Nokia 3G guru cites SMS as key to wireless web success”. Reuters, June 28, 2001.

[1] Introduction – Evolution of the Mobile Market, retrieved from http://www. itu. int/osg/spu/ni/3G/technology/index. html[2] Andersson, Christoffer, “ GPRS and 3G Wireless Applications”. Wiley Computer Publishing, New York, 2001, pp.

14 – 15.[3] Francois Bar ,” The Digital Economy in Comparative Perspective”, May 27, 1999 in the 12th International Conference of Europeanists, Chicago, Illinois, p. 1.[4] Guyton, James. “ Wireless Networks in Europe: A Three-Step Evolution”. The Fletcher School of Law & Diplomacy, April 2000, p. 8.

[5] Andersson, Christoffer. “ GPRS and 3G Wireless Applications”. Wiley Computer Publishing, New York. 2001, 15.

[6] “ Generation Wireless”, Network Computing, Volume 12, Issue 2, June 11, 2001. p. 118.[7] Guyton, James.

“ Wireless Networks in Europe: A Three-Step Evolution”, The Fletcher School of Law & Diplomacy, April 2000, p. 9.[8] GSM Approaches half a billion customers, GSM World Press Release, April 2000, P. 1. available at http://www. gsmworld.

com/news/press_releases_54. html[9] “ The Road to IMT-2000,” retrieved from http://www/itu. int/imt/what_is/roadto/index. html. More precisely, the 3G standard specifies 144 kbps in a mobile environment, 384 kbps in a pedestrian environment, and 2 Mbps in a fixed environment.[10] International Telecommunications Union[11] “ Wireless Overview For Non Wireless Professionals”.

White paper by Nortel Networks. N. d[12] “ Bridge Over Troubled Water”, Mobile Matters, May 2001.

p. 56.[13] “ Comprehensive information about GPRS and Edge”, retrieved from http://www.

3g-generation. com/gprs_and_edge. htm.[14] Berg, Andreas, “ UMTS – Universal Mobile Telecommunications System”. Retrieved from http://www.

tml. hut. fi/Opinnot/Tik-111. 350/1998/esitykset/Umts/UMTS. html.[15] Provisional Final Acts of the World Radiocommunication Conference (Istanbul, WRC-2000), Resolution 223, § h.[16] ITU Press Release on WRC 2000 decisions: “ Thumbs up for IMT-2000”, May 30, 2000. available at: http://www. itu. int/newsarchive/press/releases/2000/12. html.[17] “ The UMTS Forum – Shaping the Mobile Future” October 2000. p. 3. retrieved from: http://www. umts-forum. org/brochures/UMTS. pdf.[18] Van Grinsven, Lucas. “ Mobile & Satellite: Nokia 3G guru cites SMS as key to wireless web success”. Reuters, June 28, 2001.[19] “ Operators Express Concern Over Handsets” Arc Group, January 16, 2001. Retrieved from: http://www. arcgroup. com/press2/cut_concernhandsets. htm[20] “ DoCoMo takes 2 million minutes to fix flawed i-mode phones”. Mobile Media Japan, July 11, 2001. retrieved from: http://www. mobilemediajapan. com/2001/07/11. html.[21] “ Wireless: riding its luck into 3G”. Mobile Matters, February 2001, p. 48.[22] “ 3G Spectrum Allocation: The U. S. Leaves the Industry to Divide.” Retrieved from http://www. pervasiveweekly. com/issues/pvw06082000. html.[23] “ Modern Technology Transfer Approach”. The 3G Patent Platform, retrieved from: http://www. 3gpatents. com/.[24] “ Modern Technology Transfer Approach”. The 3G Patent Platform, retrieved from: http://www. 3gpatents. com/.[25] Ibid[26] “ 3rd Generation Partnership Project 2”, retrieved from http://www. 3gpp2. org/.[27] “ Wireless: riding its luck into 3G”. Mobile Matters, February 2001, p. 52.[28] Cukier, Kenneth and Hibbard, Justin. “ Spectrum Shortage”. Red Herring Magazine, September 1, 2000.[29] Roberts, Simone. “ 3G in Europe: Expensive but Essential”; Wireless/Mobile Europe, The Yankee Group. Report Vol. 5, No. 8 June 2001, p. 1.[30] Ibid.[31] Retrieved from http://www. IDG. net[32] The Shosteck Group, Third Generation Wireless (3G): The Continuing Saga, Wheaton, Maryland, February 2001, pp. 263-264.[33] “ AT&T to Ditch TDMA for GSM-Based Data Migration,” 3G Mobile, November 29, 2000, pp. 1-2.[34] Report of the Independent Expert Group on Mobile Phones chaired by Sir William Stewart, Mobile Phones and Health, 28th April 2000.[35] Jon Moynihan, Waiting for 3G: It’s the handset, stupid , The Wall Street Journal Europe, 24 May 2004.