LICENSING OF THIRD GENERATION (3G) MOBILE:

BRIEFING PAPER[1]

[1] This paper was prepared by Dr Patrick Xavier of the School of Business, Swinburne University of Technology, Melbourne, Australia (pxavier@swin.edu.au) ahead of the ITU Workshop on licensing 3G Mobile, to be held on 19-21 September 2001 in Geneva. The author wishes to thank Lara Srivastava, Dr Tim Kelly and Audrey Selian of the ITU and John Bahtsevanoglou of the Australian Competition and Consumer Commission for significant contributions relating to the preparation of this paper. The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership.

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1 Introduction

1.1 Introduction

This document is designed to serve as a briefing paper for the ITU Workshop on: "Licensing of Third Generation (3G) Mobile", to be held on 19-21 September 2001, in Geneva[2]. It aims also to complement the country case studies on 3G licensing prepared for the Workshop, which cover China and Hong Kong SAR, Japan, Ghana, Sweden, Chile and Venezuela.

The objective of the paper is to raise awareness about important issues that need to be addressed to facilitate the successful development of 3G services, including:

- licensing issues;
- technological and other issues (such as global circulation of 3G terminals) relating to the seamless global roaming vision of 3G; and
- national as well as international policy and regulatory issues.

In keeping with its briefing paper function, the paper aims primarily to identify issues and policy considerations pertaining to these issues, without necessarily pointing to solutions. The paper does not purport to cover the full range of issues relating to the development of 3G services. Rather, its focus is on licensing, drawing out the lessons of experience with licensing thus far[3], in order to draw attention to the need for establishing a set of guidelines for 3G licensing. This is because licensing conditions have varied significantly across countries with different selection procedures used: auctions, comparative selection ('beauty contests') and, in some countries, a mixture of the two. The number of licences awarded has varied (commonly between three and six), while the price paid for the licences has also varied greatly. The spectrum assignment per operator is not harmonised, licences awarded are of varying duration and infrastructure and service rollout requirements and conditions have also differed considerably. Moreover, access conditions to 2G mobile networks, e.g., national roaming, is not treated the same way in various countries. If the 3G vision of seamless international roaming is to materialise, international co-operation and policy harmonisation will be required[4].

The development of 3G service is perceived to have important economic and social impacts, with the development of large new markets expected. [5] But while 3G is an important issue for developed countries, the stakes are perhaps even higher for developing countries. Successful development of 3G service can help developing countries to close technology gaps with developed countries. But failure to do so could widen the 'digital divide' even further.

The paper also addresses regulatory issues critical to the introduction and development of 3G that many governments and regulatory agencies are having to grapple with[6]. This is because the successful development of 3G will depend not only on licensing and market entry, but also on the extent to which a regulatory framework is established that promotes post-entry competition, safeguards new entrants, both facilities-based and resellers (including Mobile Virtual Network Operators – MVNOs), from possible anti-competitive practices applied by existing network operators, and ensures seamless connectivity between 3G and other domestic and international networks.

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[2] For more information on the workshop, including case studies and presentations, see the website at http://www.itu.int/3G.

[3] Fred Donovan, "Governments Botched 3G Licensing, Say Eurocrats", *Wireless Insider,* 23 April 2001.

[4] Keith Nutall, "ÉC presses for unified 3G regulation", *Total Telecom,* 20 March 2001.

[5] See, for example, US Council of Economic Advisers, "The Economic Impact of Third-Generation Wireless Technology", November 2000.

[6] European Commission, The Introduction of Third Generation Mobile Communications in the European Union: State of Play and the Way Forward, COM(2001)141 final, Brussels, 20.3.2001.

1.2 Structure of the paper

Following this introduction, Section 2 of the paper discusses some technical elements relating to spectrum usage that establishes the context of 3G development issues, including standardization issues, the number of licenses allocable, and the migration path from 2G to 2.5G to 3G. Section 3 focuses on the potential for 3G services, including prospective market demand. Then Section 4 discusses various approaches to licensing 3G operators, including auctions, "beauty contests" and hybrid approaches. The aim here is to highlight the need to identify guidelines for countries yet to engage in 3G licensing, but also for any further licensing activity countries engage in.

Section 5 considers a number of issues impacting on the competitive landscape within which 3G will operate, including the interconnection arrangements crucial to the development of effective competition in 3G operations. Discussed here is the infrastructure sharing issue, and the recent emergence in mobile markets of so-called 'Mobile Virtual Network Operators' (MVNOs). Regulators are under pressure to decide whether industry-specific regulatory provisions (such as mandatory 'unbundling' of 3G networks) are warranted or whether the development of MVNOs should be determined by market forces (protected by general competition law). Section 6 is concerned with tasks to be addressed if global roaming is to become a reality. These tasks include the global circulation of 3G terminals and further international co-operation and policy 'harmonisation'. Finally, Section 7 presents the paper's conclusions.

2 Technical issues in the evolution to third-generation networks

The impact of technological change on mobile telecommunications is often described in terms of "generations". Thus, "first generation" mobile technology has referred to the analogue cellular systems that characterised the 1980s and early 1990s, while "second generation" refers to today's digital cellular systems, such as the widely-used Global System for Mobile Communications (GSM).

So-called "Third Generation" (3G) systems or IMT-2000[7] include high-speed data, mobile Internet access and entertainment such as games, music and video programs using image, video and sound to mobile users. These 3G systems will provide support for:

- high data rates at a minimum of 144 kbit/s[8] for all radio environments and 2 Mbit/s in low-mobility and indoor environments;
- symmetrical and asymmetrical data transmission;
- circuit-switched and packet-switched services, such as Internet Protocol (IP) traffic and real-time video;
- improved voice quality;
- greater capacity and improved spectrum efficiency;
- several simultaneous services to end-users and terminals, for multimedia services;
- seamless incorporation of 2G cellular systems; and
- global roaming between different 3G operational environments; and economies of scale and an open international standard that promises to meet the needs of the mass market[9].

Table 2.1 indicates the new 3G services deriving from the 'convergence' of the Internet and mobile communications. 2G mobile phones can currently be used to transmit short messages (up to 160 characters) and slow speed data (in theory up to 14.4 kbit/s but in practice no faster than 9.6 kbit/s) - significantly slower than the 56 kbit/s achieved on dial-up modems on fixed-line networks. While 3G offers little improvement in regard to basic voice transmission, it will effect a significant improvement in terms of data transmission, not only over today's 2G mobile but also over most residential fixed-line networks.

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[7] IMT stands for "International Mobile Telecommunications" and "Imagination Meeting Technology". Work is currently being carried out under the banner "IMT-2000 and Beyond". For more information, see the website at: http://www.itu.int/imt/.

[8] In this paper, transmission capacity or "bandwidth" is measured in terms of kilobits per second (kbit/s) or Megabits per second (Mbit/s)

[9] "ITU-R:IMT-2000, 3rd generation mobile services and applications", International Telecommunication Union, http://www.itu.int/imt/what_is/3rdgen/index.html.

Table 2.1: New 3G services

Type of service	Downstream	Upstream
Asymmetrical multimedia services	Asymmetric multimedia services are characterised by more traffic flowing in one direction than the other. Examples include Internet browsing, full motion video	
Medium multimedia	384 kbit/s	64 kbit/s
High multimedia	2 Mbit/s	128 kbit/s
Symmetrical multimedia services	Symmetrical multimedia services are characterised by an equal amount of traffic flowing in both directions. Examples include videoconferencing and telemedicine	
High multimedia	User bit rate of 128 kbit/s in each direction	

Source: ITU

The increase in the data-transfer rate will allow mobile phones, hand-held computers, and other products to become multimedia access devices, enabling multitasking and the transmission of multimedia services such as high-quality audio, video and graphics, Internet browsing, e-commerce, e-mail and bandwidth on demand. Further, international roaming will become a distinct prospect with the development of standards to allow 3G global roaming with a single device.

2.1 Standardization issues

One of the inherent advantages of 3G networks is the provision of seamless global roaming, enabling users to move across borders while using the same number and handset. The promise of 3G networks also lies in the seamless delivery of services, over a number of media (satellite, fixed, etc...).

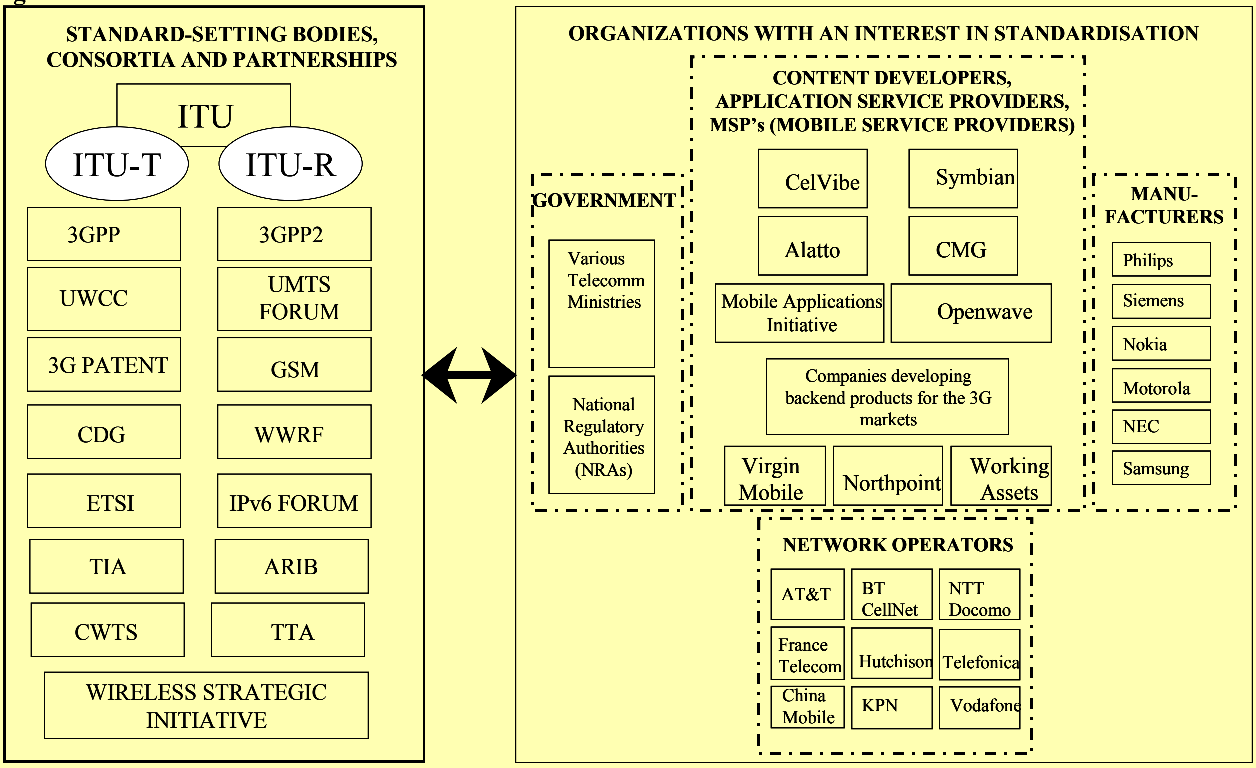
In the mid-1980 s, the International Telecommunication Union (ITU)[10] developed the concept of IMT-2000 (where IMT stands for 'International Mobile Telecommunications') and in 2000 unanimous approval was given to the technical specifications for 3G systems under this brand name (i.e. IMT-2000). This approval, which resulted from the collaboration of many entities, both inside and outside the ITU (ITU-R and ITU-T, and 3GPP, 3GPP2, UWCC, etc.), meant that for the first time there was a promise of full interoperability and interworking of mobile systems on the basis of a single standard, without the fragmentation that had characterized the mobile market. However, there are strong proponents of different approaches to 3G technology - CDMA2000 (US, Korea), and UMTS (Europe, Japan) who were not able to agree on a single standard. This resulted in a variety of approaches to 3G technology, with IMT-2000 consisting of a family of standards (or flavors), implying the need for multiple mode and multiple band handsets capable of handling various optional mode and frequency bands. More specifically, the IMT-2000 standard accommodates five possible radio interfaces (or flavors) based on three different access technologies (FDMA, TDMA and CDMA). Two of these technologies fall under the wideband-CDMA category (W-CDMA and CDMA2000, which is a Telecommunications Industry Association (TIA) standard for third-generation technology, one of them falls under the TDMA category (Universal Wireless Communications 136), and the last one falls under the TD-CDMA category (Time-Division Duplex), and the last one under FD-TDMA (DECT+).

Difficulties experienced in reaching a decision on a single standard are due in part to the variety of stakeholders and players involved in the standardization process, each with its own set of interests for promoting the adoption of a particular standard. Some of these organizations are indicated in Figure 2.1: the list is not meant to be exhaustive, but rather illustrative of the kinds of organizations implicated in the process.

An example of the role of standardization in the license allocation process is provided by the case of South Korea, discussed in Box 2.1.

[10] See www.itu.int

Figure 2.1: IMT-2000 STANDARDISATION



Note: This list is not exhaustive but illustrative in nature. Those organizations depicted on the left are key standard-setting bodies – consisting of various consortia and partnerships that bring together entities with a stake in the development of IMT-2000. Organizations depicted on the right consist of 'private sector' and government players that contribute to the standardisation process. The inter-play between these two larger groupings is characterized by different kinds of membership, subscribership and other channels through which industry and government players exert influence upon standard-setting organisations.

Source: ITU

Box 2.1: The 3G standard issue in South Korean license allocation

The South Korean government had intended to make Korea a rival to Japan as a showcase for 3G technology, and a showcase based on IS-2000 technology. The government, through the Ministry of Information and Communications (MIC) announced that three licenses would be awarded, two based on WCDMA and one on CDMA2000, the migration path based on IS-95.

The MIC's plan was not readily accepted by the country's three largest operators who all said they would rather install 3G networks using WCDMA technology (because of the greater expense and the risk of backing CDMA2000 which might not be accepted as a global standard). This posed a problem for the government which was pursuing a policy of making Korea's telecommunications industry the world's leading IS-95 manufacturer.

Korea's two largest mobile operators, Korea Telecom (KT) and SK Telecom, were subsequently awarded licences to launch WCDMA networks. Meanwhile, the third largest operator, LG Telecom backed out of the process and the MIC was left with no one wanting the CDMA2000 license.

The MIC announced that to attract a licensee, it would reduce the licence fee for a CDMA2000 operator. KT and SK Telecom quickly threatened legal action. The communications minister resigned, apologising for the 3G licensing problems.

On 7 July 2001, LG Telecom finally agreed with Hanaro Telecom, Powercomm, a unit of state utility Korea Electric Power Corp, and Canada's Teleststem International Wireless (TIW) to form a consortium to bid for the country's third licence based on CDMA2000. The agreement came after repeated calls from the MIC for the two companies to co-operate.

KT Telecom warned that if 3G mobile service operators were required to provide dual-band and dual-mode handsets and services, there could be further delays in the commencement of services.

Source: Exchange, 13/27, 20 July 2001.

2.2 The migration path from 2G to 3G

Just as there has been a continued migration of voice from fixed line to cellular, it is expected that data traffic too will migrate from fixed to mobile. Box 2.2 compares the migration path from 1G to 2G with that of the migration path from 2G to 3G. Present 2G networks are the result of the migration from analogue to digital networks. The conversion from 1G analogue networks like AMPS and TACS to 2G digital networks like GSM, TDMA and CDMA, has allowed carriers to increase network capacity, provide value-added services like caller identification, short messaging, call-waiting, and increased functionality.

The evolution of networks from 2G to 2.5G and then to 3G (or straight from 2G to 3G) will enable users to send and receive data over a wireless platform. 2.5G solutions, such as GPRS (General Packet Radio Service or EDGE (Enhanced Data rates for GSM Evolution) offer mobile data services at rates between 56 kbit/s and 144 kbit/s, the speed of conventional modems and ISDN lines, respectively. With 3G will come full broadband applications at transmission rates that will eventually reach 2Mbit/s.

Box 2.2: Migration Comparaison

1st Generation → 2nd Generation	2nd Generation → 3nd Generation
• AMPS/TACS → GSM, TDMA, CDMA	• GPRS, EDGE, HSDSC → WCDMA flavours
• Demand for Voice Services	• Demand for Data Services
• “Exclusive” Mobile Services	• “Mass Market” for Mobile Services
• Fragmented Systems	• Interoperable Service
• Operators under Monopoly	• Private Operators Compete
• Slow ‘time to market’	• Quick expected ‘time to market’
• Regional Standardization	• Global Standardization

Source: ITU.

2.2.1 From Circuit to Packet

Data can be sent over a cellular network either through circuit-switched or packet switched transmission methods. Circuit-switched transmission, which is the technology used in today’s fixed-line telephone networks, was designed primarily to carry voice, not data, and at relatively low bandwidth. Wireless data can be sent over circuit-switched transmission but at low speed of about 9.6 kbit/s.. Moreover, using circuit-switched networks for data is inefficient and expensive because the user occupies the full circuit irrespective of whether data is actually flowing through the circuit.

The packet-switching technology -- upon which 2.5G and 3G service is based -- create connections by breaking up the information to be sent into packets of bytes, sending them along a network with other information (over different routes) and reassembling the original information at the other end. Packet-switching enables users to send data at a far more economical rate, since users are charged only for the number of packets (i.e., the volume of data) sent[11] (as opposed to the length of a call for circuit-switched).

[11] The majority of Japan’s current mobile Internet services already bill per packet or kilobyte (e.g., i-mode and J-Sky), though speeds are generally low.

2.2.2 2.5G Services and Networks

Depending on the existing network, there are two different routes a cellular carrier can take to migrate from 2G to 2.5G. For GSM providers, a logical extension to 2.5G would be either GPRS or HSCSD[12] and EDGE[13]. For CDMA operators, the likely route is via IXRTT[14] or High Data Rate (HDR)[15] (introduced by Qualcomm in late 1999).

GPRS is a packet-switched technology that delivers speeds of up to (theoretically) 115 kbit/s (compared against circuit-switched GSM data transmission at only 9.6Kbit/s so that, for example, SMS messages are limited to 160 characters). The significant advantage of GPRS is that it can be provided on the basis of an 'always-on' permanent connection to the Internet, thereby avoiding the dialup delays (that was one of the reasons hindering the take up of WAP). GPRS allows GSM networks to be more compatible with the Internet by using a packet-switched technique to transfer the 'bursty' traffic of data applications in a more efficient manner.

However, GPRS faces some problems. GSM transmitters are segmented into eight distinct voice time slots. GPRS networks take the full channel of eight time-divisioned circuits, running at 14.4 kbit/s each to create one packet channel of 115 kbit/s. This means that to obtain a 115 kbit/s connection, each user would theoretically be occupying network resources equivalent to eight voice circuits. Therefore, if GPRS services do take off, considerable strain might be placed on the existing systems.

Another factor that may slow down the take up of GPRS is the need for subscribers to buy GPRS-enabled handsets. Aside from the cost of these handsets, there have been reports that manufacturers are still grappling with problems of overheating, battery life and software operability of the GPRS handsets, and that their commercial availability on a large scale will be subject to considerable delay.

EDGE (enhanced data for GSM/global evolution) is regarded as a cost-efficient way of migrating to full-blown 3G services. It concentrates on improving the capacity and efficiency of wireless interface by introducing a more advanced coding scheme whereby every time slot can transport more data to bring higher maximum data rates (384kbps) and increased spectral efficiency. EDGE is applicable to both GPRS traffic (EGPRS), and circuit-switched data traffic (ECSD). A key feature of EDGE is that commonly no additional spectrum is necessary and EDGE boosts capacity and bit rates of existing GSM/GPRS as well as TDMA systems.

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[12] HSCSD (High Speed Circuit Switched Data) is another GSM technology introduced in 1999 to enable GSM technologies to increase data speeds to as high as 57.6Kbit/s by aggregating four voice channels running at 14.4Kbit/s. The benefit of HSCSD is that it utilises the existing network and requires only a software upgrade thereby minimizing expense. The disadvantage is that users on a HSCSD network will still need to dial up to the service.

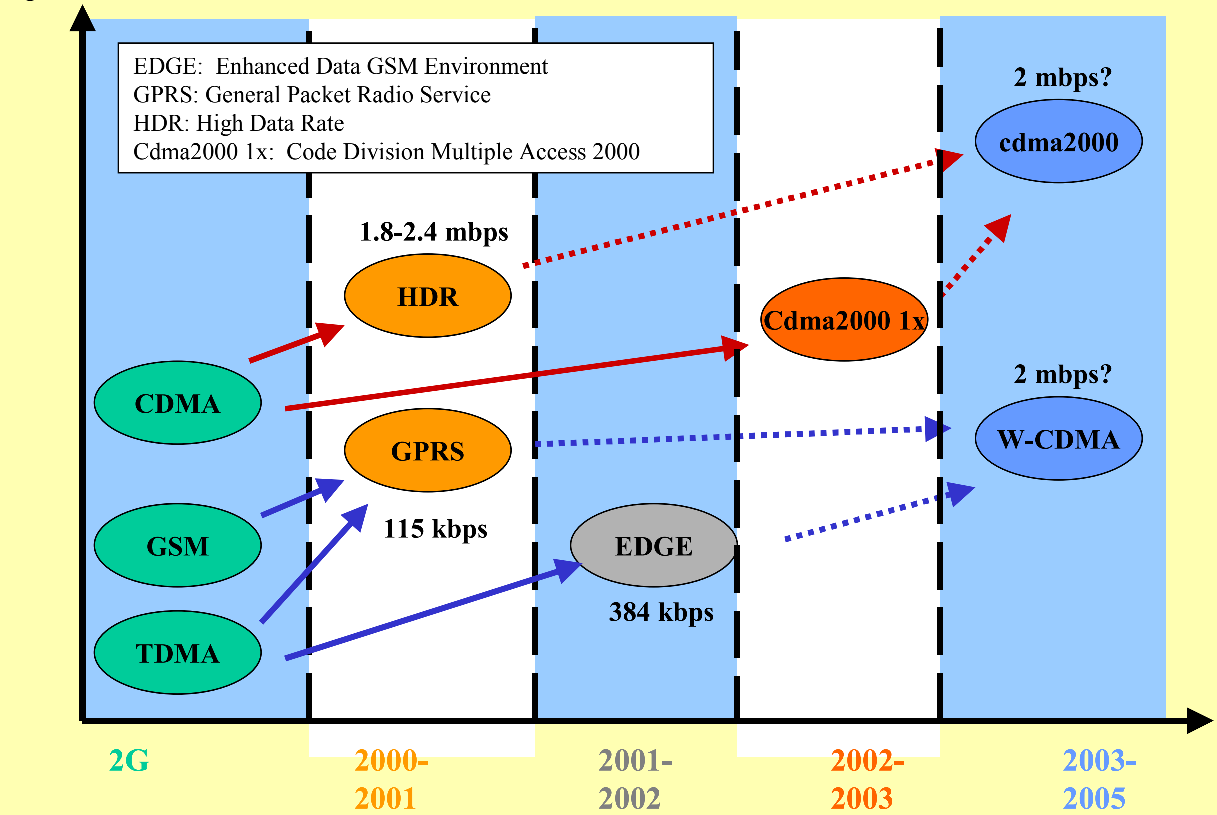
[13] EDGE (Enhanced Data over GSM Evolution) is part of a step-by-step, low impact approach to migrating to 3G services while protecting operators' investments by allowing them to reuse their existing network equipment and radio systems. Using a more efficient technology optimised for data communication, EDGE increases end-user data rates up to 384Kbit/s – and potentially higher in good quality radio environments. It does this within the existing GSM radio spectrum, bandwidth, carrier structure and cell planning process. EDGE is regarded as the final network-upgrade stage technology that operators will seek to deploy before the launch of full broadband services. It is considered likely to be attractive to some operators as an efficient fill-in technology that can be used to fill the gaps in coverage between 3G systems. At present, EDGE appears to be still in development stage, with no Europe-wide technical standard agreed upon.

[14] CDMA-1XRTT. Operators in Asia and the US that employ CDMA systems will use their own family of technologies known as CDMA2000 as the basis for their upgrade path to broadband systems. Most CDMA companies currently run their networks off a standard known as IS-95A, which has a capacity of 14.4Kbit/s, similar to GSM. Many are currently undertaking a transition toward a standard known as IS-95B, which will enhance network carrying capacity by roughly 10 times. The next step in the development of the standard will involve the launch of a technology known as 1XRtt. 1X refers to 1X the number of 1.25MHz channels – which can support data rates of 144Kbit/s and will double voice channel capacity. This technology should enable speeds in the range of 115-144Kbit/s. 1XRTT will carry out a function similar to GPRS for GSM.

[15] High Data Rate (HDR). The HDR system is optimised for packet services, with flexible architecture based on IP protocol. HDR can overlay an existing cellular network or work as a stand-alone. HDR has been referred to as Qualcomm's answer to EDGE. HDR is expected to provide speeds of up to 2.4Mbps for fixed cellular applications and 384Kbit/s for mobile applications, and is expected to be available in around 2002.

Figure 2.2 sets out the evolution of mobile systems from 2G to 3G diagrammatically, including the position of GPRS and EDGE in the evolution from 2.5G to 3G.[16]

Figure 2.2: Evolution from 2G to 3G



Source: IMT-2000 and Beyond Study Group.

2.3 Is 3G being squeezed?

Some commentators have raised warnings that 3G may be in danger of being squeezed between evolving technologies. On one side are the so-called 2.5G technologies (essentially 2G networks upgraded to handle data, but slower than 3G networks) such as GPRS, and on the other the advent of fourth generation (4G) technologies (operators in Japan are already working on defining specifications[17]) as well as wireless computer-networking technologies, such as BlueTooth[18] and 802.11b[19] (also known as Wi-Fi), that links laptop computers to office networks at high speeds.

One report, in pointing out that the high data rates promised by 3G operators are designed for video, which users are unlikely to want to watch on the move, suggests that lower-speed 2.5G service (such as GPRS) may turn out to be adequate to satisfy user requirements. However, it now seems that GPRS speed will be much

[16] A detailed discussion of this migration path is available in R. Downes, "Adopting the right evolution path to 3G profitability: Crtical choices for Latin American TDMA operators." Universal Wireless Communications Consortium; and Siemens, "The new path from GSM to UMTS "Soft Evolution" of mobile radio Networks." Both documents are available at http://3gnews.com/html/whitepaper/evolution.shtml.

[17] Michael Fitzpatrick, "Japan sets out 4G stall", *Total Telecom,* 23 October 2000; "NTT DoCoMo chairman urges quicker 4G mobile", *Total Telecom,* 4 April 2001; "Japan prepares for 4G", *Total Telecom,* 29 June 2001.

[18] Bluetooth enables the use of a wireless connection to link all kinds of devices together. Users can connect to the Internet or print documents without the inconvenience of using cables or lining up infra-red connections. Bluetooth offers the prospect of wire free offices. It can link laptops and handheld computers to the Internet via their mobile phones. See Roy Rubenstein, "Will Bluetooth be a blockbuster?", *Communications Week*, 19 March 2001.

[19] WLAN (Wireless local area networks) offer an unregulated spectrum by which laptop users can access the Internet. Laptop users insert a PCMCIA or USB card to connect to the Internet without having to search for a free telephone socket. A wLAN base station, which costs roughly US$800, has already been installed in the US in hotels, coffee shops and airport lounges as well as in offices. Starbucks, for instance, has recently put wireless LANs in its coffee shops world wide for use by customers.

slower than anticipated. At one time, GPRS transmission rates were reputed to be about 115 kbit/s, many times faster than WAP's 9.6 kbit/s. It is now considered that this is a theoretical optimum speed of GPRS and is unlikely to be reached. In practice, a top rate of 56 kbit/s is achievable, with many services operating at just 20 to 30 kbit/s[20]. This reassessment is notable because, to some extent, the much lower than expected transmission speed of 2.5G revalidates the case for 3G service.

Some analysts have pointed out also that 3G networks will be necessary because 2.5G networks will need more radio bandwidth than 2G networks, and that the required additional bandwidth has already been earmarked and sold to 3G operators. At any rate, most operators reportedly[21] plan to offer 3G services in densely populated areas to begin with, and to give customers hybrid handsets that can switch to 2.5G elsewhere. Operators can start with these so-called "thin and crispy" 3G networks, and if they wish, upgrade capacity later. This means that if the demand for high-bandwidth services fails to materialise, the upgrades will be unnecessary, and the cost of introducing 3G would be far less than expected.

3 The potential for 3G: services and market demand

3.1 The 2G Space and the Demand for Data

The 2G 'space' can be conceptualised in many different ways. The most basic relates to the deployment of networks that emerged as 'digital' rather than 'analogue' (the latter having dominated 1st generation networks). Naturally, digital technology offers an appealing combination of performance and spectral efficiency as well as the development of features like enhanced quality of service, security and high-speed data communications. Data transmission in the 2G space is mostly occurring over circuit-switched networks, although some regions have already made the switch to packet-based technologies.

The 2G 'space' also relates to current competing standards like TDMA and CDMA, and their direct precursors and cousins like Digital AMPS and IS-95 respectively. GSM, which has a combination FDMA/TDMA origin, is recognized as the most dominant and successful of these 2G standards, and is widespread in Europe. GSM relies chiefly on digital transmission between base stations and handsets, with high-speed connections to and from centres equipped with circuit switches. At 9.6 Kbps, transmission is slow, and the architecture itself is unsuitable for data traffic or streaming, mainly due to the use of a circuit-switched network. However, the very successful i-mode service available in Japan also runs at 9.6 Kpbs and has led to a much more positive perception of its service capabilities. This stems chiefly from the differences in the performance of packet-switched infrastructures. Despite these shortcomings, GSM has and is continuing to be implemented by countries who seek to use it as a core starting point towards deploying data-bearing wireless technologies; the uniformity and coherence of GSM's development and deployment worldwide remains as yet unparalleled.

2G systems have been the foundation of current wireless service offerings in different parts of the world, and most countries are choosing a migration path through a variety of 2.5G 'upgrades'. The main applications available in the wireless 2G space consist of voice telephony and basic data service offerings. The most popular data services are the 'short message service' (SMS) and mobile Internet access technologies like WAP and i-mode.

3.1.1 Messaging

One of the best ways to assess the likelihood of success in the 3G space is to look at the popularity of data services in the 2G space. One of the most widely used 2G data services is text messaging, particularly in regions where the GSM standard is prevalent. The Short Message Service (SMS) on the GSM platform has been extremely popular in Europe and contributed significantly to mobile data revenues over the past two years. SMS is a two-way simple text service for sending short (120 characters) alphanumeric messages in a 'store-and-forward' process, which can be used for both 'point-to-point' as well as cell-broadcast modes.

The GSM Association[22] estimates that GSM networks transported one billion messages worldwide in October 1999, and that SMS revenues comprised a significant portion of overall service revenue figures in

[20] One reason for this is that handsets will normally employ only two or three of the eight available timeslots for transmitting packets of data. There have also been fears of handsets overheating.

[21] The Economist, 9 June 2001, p. 92.

[22] See http://www.gsmworld.com/

mature markets such as Finland and Norway. By December 1999, the volume was up to two billion, and by March 2000 it was over three billion. In the first three months of 2001, some 50 billion test messages were sent worldwide. Some 25.3 billion SMS text messages were sent in the first twenty-seven days of June [2001] alone."[23] Gartner's Dataquest expects SMS usage and revenue to continue to grow strongly across Western Europe during the next two years. Global income from text and messages in 2001 is expected to reach $18.9 billion on total mobile phone revenues of $400 billion, according to research group Ovum. European messaging sales in particular could reach $16.7 billion on total mobile revenues of $166 billion.[24]

3.1.2 Mobile Internet

Mobile Internet services for 2G, on the other hand, have not had as resounding a success as SMS. Nevertheless, Forrester sees the long-term gloom associated with it as misguided, citing 54% of all Western Europeans as regular mobile Internet users by 2005.[25] WAP (Wireless Application Protocol) and i-Mode (a Japanese standard) are the two main competing standards for access to the Internet via 2G mobile phones.

Mobile Internet access on GSM is slow and inconvenient, as it was never designed for the Internet and information services. GSM's 9.6 Kbit/s circuit-switched links are responsible for connection times that last up to 30 seconds, and extended waiting times for loading: "also, in contrast to Japan's NTT DoCoMo, which made it easy for content providers to build an open network of useful sites, European operators like France Telecom and BT have built poorly supported, tightly restricted "walled gardens" -- ensuring discontent."[26]

Figure 3.1: Comparison of Fixed and Mobile Internet Services, Content Standards, and Network Technology

	Fixed Internet	Mobile Internet, circa 2000	Mobile Internet, circa 2002
Services	- Open global network - - anyone can build a site - Robust road-tested sites - Everything is available: News, shopping, finance…	Closed offerings restrict consumer choice - Buggy, first-generation sites - Services take little advantage of mobility	- Open networks let any consumer easily reach any site - Reliable second- generation sites - Location-based services mobility into added value
Contents Standards	**HTTP/HTML** -Displays rich, graphical pages -No push capabilities - users must come to the site - No user authentication – usernames and passwords needed	**WAP 1.1** - Displays small, simple pages - No push capabilities - users must come to the sites - No user authentication - usernames and passwords needed	**WAP X.Y** - Display small, simple pages - Push capabilities - sites come to users - User authentication in the phone – no usernames or passwords needed
Network Technology	**Analog dial-up** - Slow – 56 Kbps - Not always-on-10-to-30 Second connection time **Cable modem/ADSL** - Fast – up to 2 Mbps - Always-on	**GSM** Slow – 9,6 kbps -Not always-on-5 to 30 second connection time	**GRPS** - Fast – up to 115 Kbps - Always – on- - user il instantly connected

Problem   Doing fine

Source: Forrester Research

[23] Van Grinsven, Lucas. "Mobile & Satellite: Nokia 3G guru cites SMS as key to wireless web success". Reuters, June 28, 2001.

[24] Van Grinsven, Lucas. "Mobile & Satellite: Nokia 3G guru cites SMS as key to wireless web success". Reuters, June 28, 2001.

[25] Godell, Lars. "The European Mobile Internet's Uneven Takeoff", Forrester Brief. January 3, 2001.

[26] Nordan, Matthew. "Europe's Mobile Internet Beyond The WAP Backlash", Forrester Brief. September 2000

3.1.2.1 WAP

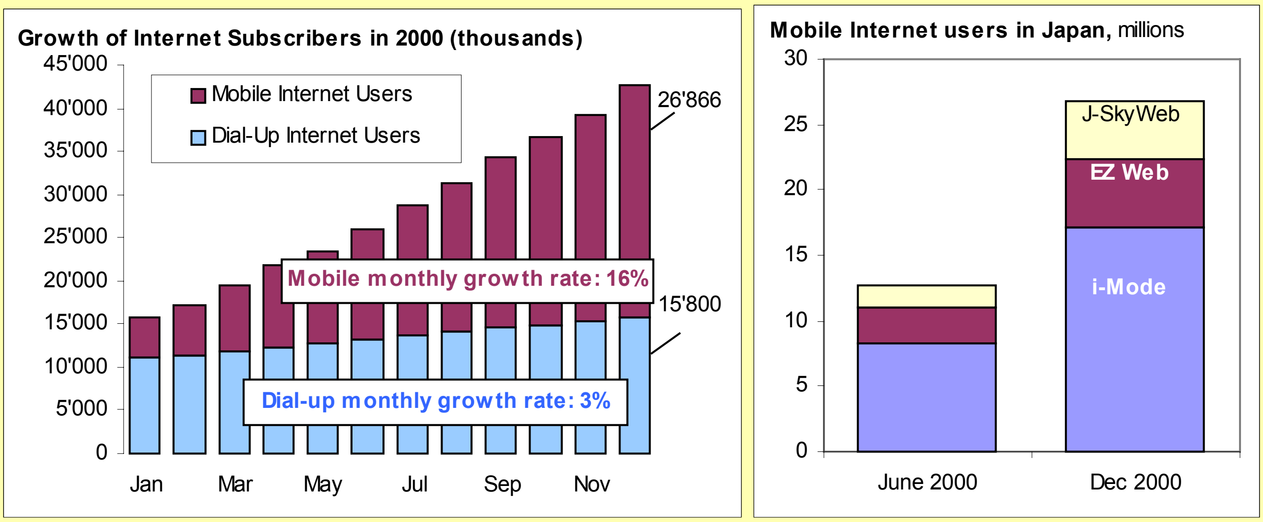
Motorola, Nokia, Ericsson and the US software company Phone.com (formerly Unwired Planet) were the initial partners that teamed up in mid 1997 to develop and deploy the Wireless Application Protocol (WAP). WAP was an attempt to define the standard for how content from the Internet should be filtered for mobile communications. WAP is the de facto standard in Europe and the United States, and is a protocol that runs on top of an underlying bearer. In Asia, apart from Singapore and Korea, there has been low uptake of mobile WAP Internet access. Commonly cited problems are that it is too expensive, unreliable, and there is not enough content or services. Argogroup, a provider of device intelligence for the mobile Internet industry, released a study in July 2001 showing that only 11 per cent of WAP sites are usable by handsets on the market, according to Industry usability guidelines.[27] In addition, there are translation problems due to the complexity of WML (wireless mark-up language), and many sites cannot be viewed using WAP-enabled phones. Security issues specific to WAP are also said to have inhibited use. Despite a huge vendor push to promote infrastructure and mobile devices, network infrastructure deployment for WAP was tentative. Most consumers perceived WAP as a technology looking for an application.[28]

Compared with number of Short Message Service (SMS) compliant phones, the number of handsets supporting WAP is insignificant. According to Forrester, firms spending little on WAP site marketing are adopting the correct strategy. They estimate that only 2% of Europeans own WAP phones, and less than half of this number use the mobile Internet regularly."[29]. WAP services, aside from suffering the consequences of premature technology "hype", are sub-optimal for Internet access given the circuit-switched network and billing systems.

3.1.2.2 i-Mode

The rapid increase in usage of mobile Internet in Japan presents a sharp contrast to the experience with WAP. As Figure 3.2 shows, mobile Internet subscribership increased by a monthly growth rate of about 16% over 2000.

Figure 3.2: PC Internet Access and Mobile Internet Access in Japan
By monthly growth and by market share



Source: ITU," 3G Mobile: The Case of Japan", July 2001,

[27] "Only 11% of WAP sites usable", July 21, 2001. Link: http://www.thewapgroup.com/cgi-bin/wapnews/viewnews.cgi?category=8&id=995707645.

[28] Johnson, Geoff. "Early Wireless Web Services -- WAP vs. i-mode", Gartner Group, July 12, 2001.

[29] Schmidt, Carsten. "Driving Mobile Site Traffic", Forrester Research Report, February 2001.

Mobile browsing services in Japan began in February 1999 hen NTT DoCoMo launched its Internet connection service, 'Information-mode' or 'i-mode',. i-Mode subscribers can access customized Internet content over a packet-based network through a special i-Mode enabled phone. Subscribers to i-Mode can download a range of items, including images of cartoon characters, weather reports, news and entertainment listings. However, the most popular services are still those that allow people to interact with each other. i-mode users can send e-mail to other i-mode users, other mobile phone users with compatible handsets, as well as PCs. Other transactional services include mobile banking and ticket reservations. The data is transmitted over a packet-based network at the transmission speed of 9.6 kbit/s, and billed on the basis of bits/packets transmitted.

By June 2001, there were over 25 million i-Mode mobile Internet subscribers in Japan. A variety of reasons have been advanced for i-Mode's relative success in Japan among which are: low street price and high demand from young users, micro-billing, low PC Internet access due to high fixed line charges, use of relatively simple web standard cHTML which encourages content development, and co-ordinated roll-out.

Until recently, there had been considerable optimism about the commercial prospects for 3G services. Some applications that were considered to be potential catalysts for 3G service growth are set out in Table 3.1.

During the course of the 12 months between mid 2000 and mid 2001, however, considerable uncertainty appears to have developed over the commercial viability of 3G services[30]. Industry players in many countries are currently deliberating issues that will need to be resolved in order to facilitate the successful materialisation of the 3G vision. A broad range of questions is being raised in the media. Is 3G technology ready? Will intermediate 2.5G solutions that improve upon 2G but fall short of the specifications suffice? When will 3G handsets be available in sufficient quantity? Will businesses and individual consumers really want mobile services that only 3G can support? What are the key drivers for wireless 3G? Will there be a "killer application"? Will the "killer application" vary in different businesses or regions or among different age groups? Will enough users be willing to pay for the services? Will wireless service operators be able to make a profit? Will there be enough spectrum to satisfy demand?

Table 3.1: Applications that could drive demand for mobile data

Product	**Service examples**
Communications	SMS, E-mail
Information	News, weather, sport, finance, timetables
Financial	Stock quotes, trading
Organisational	Personal organiser functions
Office services	Access to company networks
E-commerce	Electronic wallets, tickets, gambling
Advertising	TV-style, full-screen 'flash' adverts
Entertainment	Games, video, music

Source: ABN-AMRO, Telecom Sector Research, June 2001.

Insofar as the commercial viability of 3G is concerned, there seems to be a broad acknowledgement that while it is a critically important issue, the responsibility for developing commercial 3G markets resides with the telecommunications industry itself. In essence, it depends on the industry's ability to deliver services that the market wants profitably.

The popularity of NTT DoCoMo's i-mode mobile Internet system in Japan, with over 25 million data subscribers in June 2001, has been cited as evidence that consumers want the sort of 'always-on' services that 3G can offer and that 3G services will be commercially viable[31]. Indeed, out of the 65 million mobile subscribers in Japan at year-end 2000, the rapidly growing "browser" or "mobile Internet" subscriber base

[30] "Killer applications", *The Economist*, 26 August 2000, p.65.

[31] One of the main catalysts for growth of i-mode is seen to be the relatively affordable cost of using the services. The packet-switched nature of DoCoMo's PDC network allows users to be charged only for the volume of information they receive, after a flat fee of about US$3 per month. On average, users pay between US$9 to US$10 per month for accessing services.

accounts for over 31 million, or almost half. Other commentators believe that the i-mode business model is specifically Japanese[32] and cannot be easily replicated elsewhere[33]. They also point out that i-mode is not burdened by high licence fees.

On the other hand, there are analysts who maintain that even with high licence fees paid in countries such as the UK and Germany, 3G is a commercially viable service[34]. For instance, arguing that there is now too much pessimism over 3G, Spectrum Strategy consultants estimate that while a typical 3G operator in the UK would face cumulative costs of approximately US$10 billion in preparation for data services, this would still be exceeded by estimated revenues from these services (even on the basis of conservative assumptions)[35].

3.2 3G Services and Applications

Box 3.1 places 3G services within the context and timelines of the evolution of services/applications available with 2G, then 2.5G and 3G technology.

Box 3.1: Comparing services/applications provision under 2G , 2.5G and 3G

Period	Major Technology Introduction	New Internal/External Applications
Up to 2000	2 G	• Telephone • Email • SMS • Digital Text Delivery
2001 to 2002	2.5 G	• Mobile Banking • Voicemail • Web • Mobile Audio Player • Digital Newspaper Publishing • Digital Audio Delivery • Mobile Radio • Karaoke • Push Marketing/ Targeted programs • Location-based services • Mobile coupons
2003 and beyond	3 G	• Mobile videoconferencing • Video Phone/Mail • Remote Medical Diagnosis • Remote Education • Mobile TV/Video Player • Advanced Car Navigation/ City Guides • Digital Catalog Shopping • Digital Audio/Video Delivery • Collaborative B2B Applications

Source: ITU.

3.3 Market Demand – is there a need for 3G?

To place this issue in context, Box 3.2 presents a summary forecast of subscribership and revenue for mobile services in Western Europe. In addition, Box 3.3 provides a summary of the main mobile operators in Europe.

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[32] It is pointed out, for instance, that in Japan home PC penetration is relatively low, Internet and fixed phone fees are relatively high, workers spend hours each day with little else to do, and i-mode has little competition. See, for example, John Ure, "Licensing third-generation mobile: a poisoned chalice?, *Info*, vol 3, number 1, February 2001.

[33] Simon Dux, "DoCoMo's i-mode success: the basis for a 3G model?", *Communications Week,* 16 July 2001.

[34] A report by Telecompetition projects that revenues from mobile services will exceed the cost of 3G licenses and infrastructure build out in Europe. Cited in Elizabeth Biddlecombe, "Developing world a big opportunity for mobile data", *Total Telecom*, 28 June 2001.

[35] Bratton, W., Jameson, J and Pentland, S (Spectrum Strategy Consultants), "Analysis: 3G madness – time for some moderation!", *Total Telecom*, 16 July 2001.

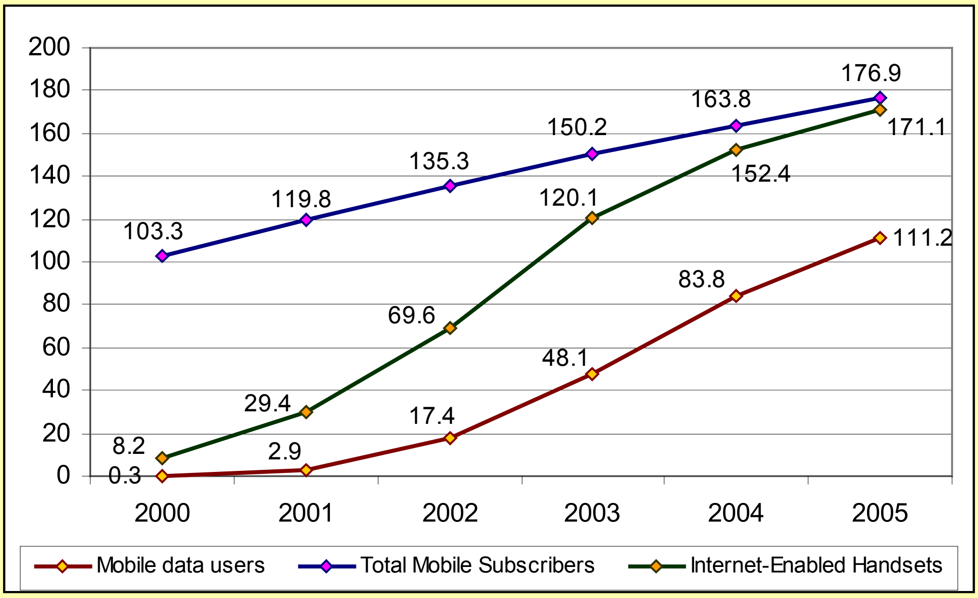
A study of revenue opportunities for 3G by the UMTS Forum (which includes forecast data produced by Telecompetition) assumes that by 2010, 3G will comprise 28 per cent of cellular subscribers worldwide, yielding revenue of $322 billion per year (based on assumptions regarded as conservative)[36]. The UMTS Forum study forecasts that revenue from non-voice services will compensate for the expected decline in average revenue per user from voice services, which is expected to fall sharply by 2010.

Work by Pyramid Research reinforces the UMTS Forum's predictions. Pyramid forecasts that by 2003, fewer than 10 per cent of mobile subscriptions will be for 3G service. This figure is predicted to exceed 20 per cent by 2005, suggesting that 3G will not take off until 2004 or 2005. At that time, mobile Internet-related revenues will account for approximately one-third of total revenue. In some regions, 3G will be slower to gain a foothold. In Brazil, for example, it is expected that by 2005 only 3 per cent of mobile subscriptions will be 3G, partly due to fact that licences were awarded later and partly because demand is less mature.

As Europe is concluding the process of spectrum allocation for 3G technologies, operators are facing a number of dilemmas relating to the high cost of licences (in some countries) and the large investment required for network deployment. Many analysts predict financial difficulties for 3G licensees. Though the valuation methods for spectrum auctions have been subject to considerable debate, metrics used by investors and analysts to valuate operators in the marketplace have not changed; the ROI (Return on Investment) continues to reign as the foremost preoccupation. Perceptions of the potential for 'recouping' investment varies depending on whether demand-pull or technology-push is considered the primary driver for 3G growth.

Many past observations have been discredited, as lessons from the 2G experience are coming to the forefront. Corporate strategy based solely on increasing the subscriber base, for example, has proven to be a double-edged sword for operators, since pushing subscriber levels past a 10-20% threshold[37] has actually led to increased subscriber acquisition costs. Some analysts believe that long before 3G networks are completed, alternative solutions in the range of 2.5G technologies will replace them; the ends may not necessarily justify the means (or the costs necessary to achieve 3G). More neutral observations point to waves or cycles of success, one being Forresters' prediction that operating profits will disappear in 2007 and take six years to return, leading to business failures and massive industry consolidation.[38]

Figure 3.3: Mobile By the Numbers: Subscriber Penetration 2000 – 2005



Source: Forrester Research

[36] The report, "UMTS Third Generation Market - Phase II: Structuring the Service Revenue Opportunities" 2001, can be downloaded at http://www.umts-forum.org/

[37] "Wireless: Riding its luck into 3G". Mobile Matters, February 2001. p. 49.

[38] Godell, Lars. "Europe's UMTS Meltdown". Forrester Research Report, December 2000. p.6.

On the other hand, now that over twenty countries have awarded 3G licenses and over 70 3G infrastructure contracts[39] have been signed, it would seem that Europe is well on its way to offering 3G services. Although anticipated infrastructure and handset delays are expected, coupled with incremental returns on investment for operators, these factors will only postpone the adoption of 3G rather than signal its end. Service launches have been postponed even by those expected to be the first to 'roll-out' 3G in 2001: Japan, South Korea and on the Isle of Man. However, most observers are confident that 3G will be deployed. The majority of carriers around the world expect to evaluate their own 3G options well into 2002 and begin deployment in late 2002 or early 2003.

Therefore, while there is widespread confidence that we are migrating to the 3G space, this will occur much later than first expected. (Section 3.5.2).

Box 3.2: Revenue Forecasts for mobile services

Despite its limited share of total service revenue to date, 1999 was a good year for mobile data in many markets. SMS growth was rapid, and while it is still a long way from being a mass market, many believe that the mobile data market will continue to grow. By 2004, mobile data in Western Europe will be a principal driver of increasing revenue, accounting for approximately 33% of mobile services revenue, up from 3% during 1999. A recent study into the service revenue opportunities over the next decade for the 3G mobile market, conducted by the UMTS Forum, predicts a Compound Annual Growth Rate for three key 3G services – namely Customized Infotainment, Mobile Intra/Extranet Access and Multimedia Messaging Service – of over 100% during the forecast period, with total revenues for these 3 forecast services of over US $164 billion by 2010.

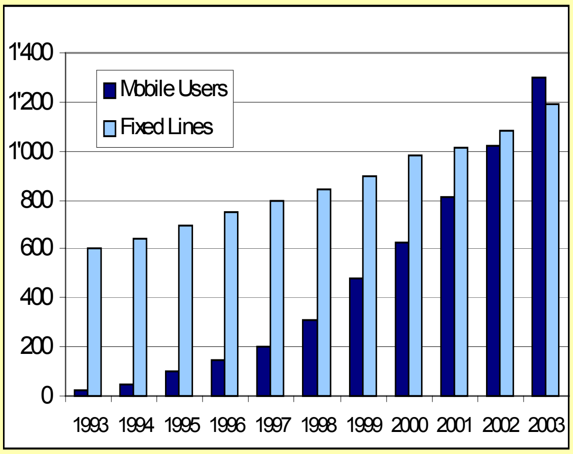
Further evidence of the strong growth of the market lies in the expanding user-base, as forecast by ITU. The number of mobile phone subscribers worldwide is forecast to reach almost one billion by 2001, and will exceed the number of fixed-lines worldwide during 2002 or early 2003.

Summary Forecast for Mobile Service in Western Europe:

	1999	2000	2004
Total Connections (thousands)	154'112.3	211'862.0	325'283.0
Analog Connections (thousands)	5'704.7	3'696.9	36.7
Digital Connections (thousands)	148'407.5	208'165.1	325'246.3
Prepaid Connections (thousands)	75'294.9	117'899.1	198'590.1
Postpaid Connections (thousands)	78'817.4	93'962.9	126'692.9
Total Service Revenue ($thousands)	$64,048,845.2	$84,558,884.5	$139,899,264.0
Total Data Revenues ($thousands)	$2,150,111.5	$6,142,510.1	$45,608,645.9
Total Average Revenue Per Unit	$521.4	$462.1	$439.4

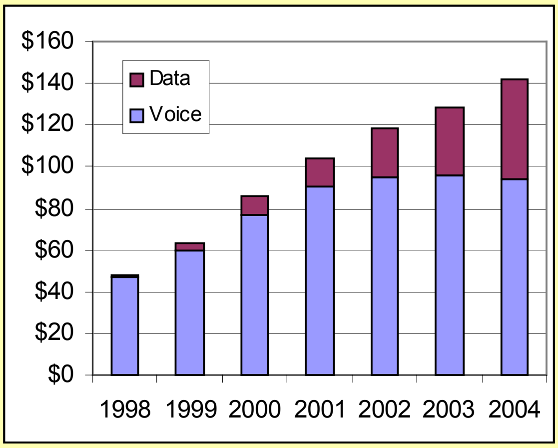
Source: Gartner Dataquest (May 2000)

Fixed lines and Mobile users (World, Millions)



Source: ITU.

Data and Voice Revenue Forecasts, Western Europe



Source: Gartner Dataquest

[39] Roberts, Simone. "3G in Europe: Expensive but Essential"; Wireless/Mobile Europe, The Yankee Group. Report Vol. 5, No. 8 – June 2001. p.2.

Box 3.3: Main Operators in the Market

Company		Countries of Presence	Associated Companies
	Vodafone – Airtouch	Spain, UK, Netherlands, Germany, Italy, Portugal, Switzerland, Poland, Sweden, Belgium, Austria	Airtel, Vodafone, Libertel, D2 (Mannesman Mobilfunk), Omnitel, Telecel, Swisscom, Polkomtel, Europolitan, Proximus, Tele.Ring
	France Telecom (w/Orange)	Netherlands, Germany, Italy, Austria, Portugal, Switzerland, Poland, Sweden, France, Belgium, UK	Dutchtone, Mobilkom, Wind, ONE (Connect), Optimus, Telecel, Orange, Centertel, Orange, Itineris, Mobistar, Orange
	Hutchison Whampoa	UK, Italy, Austria, Sweden	TIW, Andala , Hutchison, HI3G Access
	Telefonica	Spain, Germany, Italy, Austria, Switzerland	Telefonica, Group 3G, Ipse, Telefonica, Group 3G
	Deutsche Telecom	Netherlands, Germany, Austria, Poland, UK	BEN (3G Blue), T-Mobil, Max Mobil, PTC Era Plus, One2One
	British Telecom	UK, Netherlands, Germany	Cellnet, Telfort, Viag
	Sonera	Finland, Spain, Germany, Italy	Sonera, Xfera, Group 3G, Ipse
	KPN	Germany, Netherlands, Belgium	Eplus, KPN, KPN

Source: Cluster Consulting

Developing countries

As in developed countries, the development of appropriate business and revenue models for the delivery of 3G services will be the primary driver of the success or otherwise of 3G in developing countries. One problem for the successful introduction of 3G in developing countries is the relatively high cost of 3G service for consumers in those countries[40]. This is probably the largest single barrier to the effective development and use of new telecommunication technologies. Increasing the number of users on the new network (and thus sharing the high up-front cost of network development among the maximum number of users) is one means of reducing the average cost of the service through spreading the fixed costs of service. But this will not be easy to do in economic circumstances that are likely to support only limited market demand.

[40] "Developing world a big opportunity for mobile data", *Total telecom,* 28 June 2001.

The special problems of developing countries also make the appropriate licensing of 3G operators crucially important. How can governments ensure that the most suitable operators most qualified and able to develop the service cost-effectively are allocated the licences? Would a 'hybrid' system of licence allocation (discussed later) be relatively more suitable since this would allow the special developmental objectives of the country to be taken into account? The difficulties of developing countries in regard to the development of 3G services are examined further in the case studies that complement this paper.

Box 3.4: Case Study of 3G in Ghana

Despite being the eighth biggest cellular market in Africa, with 130,000 mobile subscribers at the end of 2001 (up from a figure of 70,000 in 1999), one of the biggest problems faced by operators planning to introduce 3G in Ghana is the low level of economic activity and the small scale of the domestic economy which makes it hard to justify the financial investment. With a per capita income of $390 per annum, only a few individuals and corporations are likely to subscribe to 3G to enable the operators to recoup their investments. Mobile subscribers comprise only 31 per cent of telephone subscribers and revenue from the telecommunications sector as a whole in 2000 was only $200million, less than 1 per cent of the cash generated from 3G auctions in the UK, for instance.

In the case of 3G, it is likely that content revenue will constitute a significant proportion of total revenue collected. However in Ghana and other African countries, content revenue can be expected to form a much smaller proportion of the total revenue for the services delivered to business users and other residential users. This is because the market for content development is still in its infancy in Ghana. Most African countries are more likely to depend on content developers in Europe and America until capacities and skills are developed to fill the shortage.

Source: ITU, Case Study of 3G in Ghana, July 2001

3.4 Billing issues for 2.5G and 3G Services

The introduction of 3G with the convergence of voice and data will require operators to upgrade billing systems[41]. The billing system for 'always-on' 2.5G services is of particular interest since it may be a forerunner of the billing that is required for 3G services. While current GSM connections are billed per second, because GPRS (and 3G) is packet-based and therefore 'always-on', billing by the byte may be necessary. In this context it is notable that a per-packet billing system is already in place in Japan for mobile Internet services. Unlike other mobile Internet services, i-Mode customers are charged on the basis of data transmitted rather than connection time. Users are charged a subscription fee of 300 Yen (around US$2.50) per month. In addition, they are billed 0.3 Yen per packet. Average i-Mode usage charges are around Y2,000/month (US$16), on top of voice revenues of Y8,000. Some content providers charge an additional fee of 200-300 Yen per month.

There are both "official" and "unofficial" i-mode sites. In the case of official sites, there is a contractual arrangement between DoCoMo and the content provider whereby DoCoMo collects the content charge on behalf of the content provider and keeps a commission of 9 per cent. In the case of unofficial web sites, users are required to pay the content provider directly. Unofficial sites that charge for access are therefore rare, since electronic payment methods are limited in Japan with only a relatively small number of credit cards in circulation. Currently, i-Mode users have access to about 1,000 content services.

An alternative pricing model could be to base charges on the value to the subscriber of the service provided[42]. A flat fee is considered suitable for content services like films where the user is charged per download, not the amount of data downloaded or the time it takes[43]. A flat-rate monthly subscription fee may

[41] Sanjima Dezoysa, "A 3G billing maze", *Telecommunications,* March 2001.

[42] Julian Bright, "Billing: Value vs volume - value", *Roam,* 1 April 2001.

[43] "The difference with data", *CI-Online*, 1 May 2000.

be more suitable for other services, such as frequently used ones like messaging. There may also be difficulties in initiating less technology-aware customers to a new pricing model. Thus, providing customer support for billing and technical problems may be an additional cost for 3G network operators.

A suitable approach may be a mixture of a flat-rate charge with an additional per-packet fee over and above a certain minimum, adequate perhaps to meet the needs of low-end consumers. An indication of how a mature GPRS — and subsequently a 3G — tariff structure might look like may be gleaned from the situation in Germany, where strong price competition broke out after the launch of rivals to T-Mobil's GPRS service[44].

T-Mobil itself offered three tariffs, ranging from a pay-as-you-go charge of $0.27 per 10 kilobytes and $0.19 per day, to a heavy user package costing $13.65 per month, but just $0.022 per 10 kilobytes. Mannesman Mobilfunk (D2 Vodafone) charged $9.11 per month, plus $0.087 per 10 kilobytes, with the first megabyte free. And E-Plus Mobilfunk did not levy a monthly charge but applied a tariff of $0.32 per 10 kilobytes, with the charge reducing as data volume increased.

3.5 Deployment

3.5.1 Costs of Deployment

In addition to paying for a license, network operators have to construct or expand their physical infrastructure to enable provision of 3G service. Operators will also have to invest heavily in network management, support services and handset subsidies, not to mention billing systems and marketing. For example, in the United Kingdom, Vodafone paid nearly £6 billion for its license and on top of this contracted with Ericsson to install infrastructure at a cost reported to be around £4 billion. Similarly, in Germany, Mannesmann committed to a DM10 billion network upgrade programme after paying DM16 billion for a 3G license.

A rough estimate made is that infrastructure costs can match the amount that some operators have paid for a 3G license. According to one estimate, building infrastructure for 3G services can cost around $5 billion per operator per country[45]. For instance, the cost of building a large number of incremental base stations is significant and poses a problem despite recent moves to share expenditure between operators.

It is expected that network operators will face changes in their cost structures by comparison with past experience with the cost of GSM systems. Spending on IT systems and billing systems will rise significantly. Other costs are also expected to increase due to mobile services moving from hierarchical architectures based on circuit switching, to distributed and layered architectures based on packet routing. Converging voice and data services will require a combination of the disciplines of voice telephony and IT networks. This will be new territory for many operators, and operators are expected to outsource more and more of their back-office applications.

It has been estimated that the incremental costs of servicing new subscribers could rise from an average of $200 per subscriber for a GSM network to around $350 per subscriber on a UMTS network. Physical infrastructure costs could shrink from 65 percent of the total to 59 percent but other costs could double. Table 3.2 sets out further details of estimates comparing the costs of supporting clients in GSM and 3G/UMTS networks. The highest costs are for the network (29%) and transmission links (23%).

3.5.2 Delays in the Introduction of 3G Services

NTT DoCoMo is expected to be the first operator to launch 3G service in Japan. The service, known as FOMA[46], will be based on the W-CDMA standard. The full-scale commercial launch of FOMA was initially scheduled for 30 May 2001 but in April 2001, DoCoMo announced a postponement until 1 October 2001.

44 Barnaby Page, "Mobile Internet: GPRS – more than a quick fix?", *Roam*, 1 June 2001.

45 Dirk M. Bout *et al.*, "The Next Generation of Mobile Networks Poses a $100 Billion Challenge for Europe", Note Number: R-11-5053, Gartner Group, 19 September 2000.

46 FOMA stands for Freedom of Mobil Multimedia Access.

However, the operator proceeded with plans for an "introductory" trial service to a select group of users starting on 31 May 2001. According to DoCoMo, the "introductory service" will be used to assess system performance and to provide customer feedback in anticipation of the October 2001 launch of 3G service. The selected users or "monitors" have received a free handset, are exempt from paying monthly subscription fees and are required to pay only communication charges.

Table 3.2: Estimated cost of GSM and UMTS networks

	Cost per Subscribers		Percent Change	GSM (percent)	UMTS (percent)
	GSM	UMTS			
Core Network	$20.00	$24.50	22.5%	10	7
Radio Network	$70.00	$101.50	45.0%	35	29
Transmission Links	$40.00	$80.50	101.3%	20	23
Network Maintenance	$22.00	$38.50	75.0%	11	11
Sales and Marketing	$16.00	$35.00	118.8%	8	10
Customer Care and Billing	$20.00	$42.00	110.0%	10	12
IT Management Services	$12.00	$28.00	133.3%	6	8
Total	**$200.00**	**$350.00**	**75.0%**	**100**	**100**

Source: Gartner Dataquest.

In Japan, J-Phone has also announced a delay of 6 months in the introduction of 3G service. However, the delays in the introduction of 3G are not confined to Japan. In Korea, SK Telecom has announced that the company is likely to delay the launch of 3G services until as late as May 2003 due to changed circumstances, including delays in the manufacture of handsets and other equipment[47]. Korea Telecom has also indicated that there would be a possible delay in the company's introduction of 3G services as a result of the failure of handset and systems manufacturers to produce equipment on time.

In Europe, Spain, which was expected to be one of the first European countries to launch 3G services (along with Finland and the Isle of Man), has postponed its launch from August 2001 to June 2002[48]. Operators in a number of other countries have also announced delays in introducing 3G service, including BT's Manx Telecom 3G service on the Isle of Man[49], that was intended to be the world's first. These announced delays in the introduction of 3G have led to considerable uncertainty and some pessimistic reports over just when 3G services will become available. However, a report from Nokia maintains that reports suggesting that 3G may not be a reality before 2004 or 2005 are too pessimistic[50]. Nokia points out that operators have already taken the first key steps, with GPRS leading the migration process to 3G. Nokia expects the mass market for GPRS to take off in early 2002, followed by 3G W-CDMA later[51].

The Nokia report pointed out that there is usually a lag between delivery of infrastructure and the availability of mass market terminals, as was the case with GSM. Indeed, Nokia believes there is early evidence that some WAP portals, from BT Genie, Sonera Zed, n-Top in Korea and J-Phone in Japan, are exhibiting user behaviour similar to that of i-Mode subscribers.

[47] "SK Telecom to delay 3G and cut fixed-line business", *Total Telecom,* 4 July 2001.

[48] "Portugal mulls UMTS delay as Spain extends deadline", *Total Telecom,* 3 August 2001.

[49] See http://www.tax-news.com/asp/story/story.asp?storyname=3551, http://www.totaltele.com/view.asp?articleID=39928&Pub=TT&categoryid=625&kw=isle+of+man and Manx Telecom's 3G site at http://www.worldsfirst3g.com.

[50] "Nokia remains optimistic on 3G" *Roam,* 1 June 2001.

[51] Nokia, "Correcting 3G Market Misconceptions - the Truth about Timing and Market Share", 2001. Cited in "Nokia remains optimistic on 3G", *Roam,* 01 June 2001.

It should also be noted that delays in the deployment of 3G can occur because of a failure to release spectrum, as in the case of the US [52] where 3G service is not expected until 2004[53].

4 Licensing policies

Licensing policies and procedures must be applied judiciously since not only can they influence market entry but also the post-entry conditions affecting competitiveness and market development. Licensing may impose barriers to entry, whether through licence costs or through procedures which inadvertently permit increased scope for collusive behaviour by existing operators and service providers.

While telecommunications is globalising, with technology making national borders irrelevant in the design and delivery of services, licensing of 3G operators remains highly fragmented along national lines. With technological and commercial 'convergence' it is even more important to be vigilant that unnecessary licensing requirements do not constitute barriers to the development of new global innovative services, including global roaming.

Indeed, there may well be a disposition to continue the practice of limiting licence numbers since, after all, a relatively small supply in relation to the demand for such licences will support higher auction receipts for government. Certainly, a limitation in the number of licences awarded will boost the scarcity value of a licence. Also there is the related concern that a high licence fee imposes a substantial tax (since no cost is involved in supplying the spectrum) on end-users (to the extent that the fee is passed on).

An effective framework for licensing 3G operators is crucial to the successful introduction and development of 3G services[54]. A licensing framework must recognise and reflect the high levels of investment required for 3G network rollout and the significant uncertainty associated with the 3G business case. The licensing framework should assist the development of new and innovative services rather than act merely as a means of raising revenue.

4.1 Approaches to 3G Licence Allocation

4.1.1 Principal Methods

4.1.1.1 Auctions

Auctioning of 3G spectrum licenses has, since mid-2000, raised substantial amounts of revenue for governments and has given rise to a fierce debate concerning the efficiency, competitive impact and social implications of this form of allocating 3G spectrum. Supporters of the auctioning approach argue that it allocates 3G spectrum to those operators that value the spectrum most highly and who can thus be expected to make the most economically efficient use of the spectrum. Auctions require that bidders estimate for themselves the true value to them of owning the relevant spectrum. Thus, assuming an environment of well-informed bidders, the winning bids should come from the companies that can find ways of maximising the stream of future benefits.

It is true that an operator with the greatest capacity for monopolization might also be prepared to place a relatively high value on a mobile licence. Thus, if three mobile licences were up for auction, they would probably be perceived to be of the highest value by a single operator who could bid for all three in order to have the monopoly of the service. This would obviously be an undesirable outcome. It can however, be

[52] Harter, Betsy. "Spectrum Squeeze", Wireless Review, Overland Park. Volume 18, Issue 12. June 15, 2001, p.19; Goodman, P. S, "A Push for More Frequencies: Wireless Firms Say They Can't Advance Until Government Opens Up the Airwaves". Washington Post, Feburary 28, 2001, p. G12.

[53] Unlike Europe, the US did not designate particular blocks of spectrum for 3G wireless networks. The problem is that radio bands in the US thought to be most suitable for 3G are controlled in part by the Pentagon, which uses them for a variety of purposes, including communications with intelligence-gathering satellites. Coaxing current occupants of these slices of radio spectrum has proven to be a difficult task. In April 2001, the Department of Defense reported that it would take "as long as 2010 for non-space systems and beyond 2017 for legacy space systems to vacate the relevant spectrum band-sharing is not an option (for security and interference reasons), nor is relocation unless the wireless industry makes comparable spectrum available and bears the significant moving costs (which, according to one estimate, could total $4.3 billion).

[54] A useful discussion of major issues in designing a licensing framework for 3G services is available on the web site of the Hong Kong Office of the Telecommunications Authority (OFTA) at http://ofta.gov.hk

simply remedied through appropriate auction design – in this case, a rule that any operator can only control one licence and that a reasonable number of licences are awarded (thereby minimising scope for cartel-like behaviour).

There has been concern that incumbent operators would be 'locked-in' to bid large amounts to win a 3G licence if they take the view that their existing businesses would be unsustainable over the longer term without one. One response to this concern has been that since incumbent operators may also benefit from cheaper network construction costs, "…*it may thus be entirely rational for incumbents to be prepared to bid more than a new entrant for the 3G licence – it is worth more to an incumbent operator. This merely illustrates again the advantages of the auction system, which will automatically take these specific differences into account*."[55]

The outcome of an auction is easy to understand and the process avoids putting the onus on officials or even appointed 'experts' to out-guess the market as to how new technologies and services will develop. Officials are not required to make difficult decisions that can have significant repercussions on the future prosperity of major corporations. They are freed from pressures to favour local or national bidders. They will also be freed from confusion of objectives e.g. regional employment policy, backing 'national technology champions, etc.

Auctions can be applied flexibly, with auction rules designed to achieve a range of policy objectives. For example, if there is a desire to bring in new entrants into the market, some licences can be reserved for them, or they might receive special benefits in the auction process (for example, by adding a notional monetary sum to their bids[56]). If it is a policy objective to accelerate infrastructure deployment, a licence could be allocated subject to a range of deployment conditions. Even the bidding rules can be made to suit circumstances. For instance, concern that large up front auction prices could impede 3G infrastructure deployment led the Hong Kong SAR regulator to devise a scheme with staged payment based initially on 5 per cent of network turnover but then rising over the 15 year term of a license[57]. Where the auction rules and any licence conditions included are made explicit, auctions are also a transparent and 'objective' approach. Potential bidders know in advance the basis upon which they are competing, and this is not only efficient, because it encourages more bidders to participate, but also equitable, because they are treated equally.

Concerns over auctions

Despite their theoretical attraction, auctions must in fact meet a set of stringent preconditions before they can be considered to contribute positively to economic welfare[58]. One of the key preconditions for auctions to function properly is that all potential bidders be fully informed as to market conditions, the regulatory environment, demand characteristics and the pricing structures that are likely to prevail in the market. However, full information on 3G market characteristics is far from available since many of the issues surrounding market demand, service functionality, pricing and technical development have not been fully or even partially resolved. Also, the perceived value of spectrum has fallen markedly over time, as the trading conditions in the telecommunications sector have changed and as the financial markets have re-evaluated the value of 3G licences.

A further concern associated with the spectrum auctions that have so far been conducted is that many commentators have alleged that governments have been preoccupied with revenue raising and have artificially manipulated the auctions. The argument is that governments have, by design, restricted the amount of spectrum available for 3G services in order to create market conditions that would be most

[55] Patricia Hewitt, "3G licence allocation: why an auction was best for the UK," Info, vol. 2, no.4, August 2000, p.343

[56] Martin Cave and Tommaso Valletti, "Are spectrum auctions ruining our grandchildren's future?", info, vol. 2, no.4, August 2000, p. 348.

[57] "Hong Kong unveils rules for 3G auction", *Total Telecom,* 18 July 2001.

[58] Klemperer, P, "Auction Theory: A guide to the literature", *Journal of Economic Surveys*, 2000, 13(3): pp. 227-86. Klemperer, P, "What really matters in auction design", 2000, mimeo, Nuffield College, Oxford, available from http://www.nuff.ox.ac.uk/users/klemperer/papers.html.

favourable to extracting huge economic rents from industry. In addition, some countries have designed auctions which employed multi-round transparent and publicly known bids further inducing potential operators to bid higher amounts than what they may have intended in response to bids from other players.

The conclusion of one commentator[59] is that: *"...despite rhetoric to the contrary, the early 3G auctions in Europe have been framed, designed and implemented to extract maximum monopoly rents from an arbitrarily restricted incumbent and new 3G mobile operators in national markets*"

Box 4.1: Czech Republic 3G licensing

In mid-February 2001, the Czech government reiterated its plans to sell third-generation mobile telecommunications licenses to the country's three existing mobile GSM operators (EuroTel, RadioMobil and Cesky Mobil) between July and September 2001 at a fixed price of 5 billion crowns (US$110 million) each. The fourth license is to be auctioned off at an unspecified date, with a minimum bid of 5 billion crowns. The new entrant would be given national roaming rights.

The existing mobile operators confirmed they were interested in obtaining a UMTS licence but have argued that the government's expectation that it will receive five billion crowns per licence is unrealistic in the light of recent UMTS tender results in other European countries and the market reassessment of wireless operators and to the funding of UMTS in particular. EuroTel suggested that a price of 2.8 billion crowns might be more appropriate, based on average European prices. Cesky Mobil declared that a reasonable price for the UMTS license would be between 1.5 billion to 2 billion Czech Crowns.

The Czech government was somewhat 'locked in' to the price of the UMTS licenses because it had already included a revenue item of CZK 20 billion (about US$535 million) in the budget 2001 to be collected in fees from the telecommunication service sector. The most obvious source of such funds would be from 3G licences, forcing the licensing framework to focus on the need to raise the 20 billion Czech crowns rather than the effective allocation of UMTS licences.

Source: Czech operators interested in UMTS, but at what cost? Reuters News Service, 5 February 2001

Governments should not focus primarily on the use of the telecommunications sector to raise general revenues. This is incompatible with policies for creating conditions of competition and creating a telecommunication market that can be treated on the same basis as other industry markets. If the government wants to obtain economic rent from a scarce resource then it should let the market decide, through auctions, what the appropriate value for this resource is.

While some analysts have argued that the amount paid for a licence would not affect prices customers are charged for 3G service[60], others argue that, wherever possible, 3G operators would attempt to pass on to customers as much as possible of the up-front costs licence costs, resulting in retail prices being higher than they would have been. This would result in demand for 3G services being artificially restricted since some consumers (especially non-business customers) who would otherwise have bought 3G services would be priced out of the market.

High up-front licence charges would make it more difficult for winning bidders to attract or raise funds necessary for network rollout and for service development. This has raised uncertainties in capital markets as to the risks and likely success of 3G operators. As a result, technology choices and decisions about the range of services to be made available on 3G networks may be driven by short-term considerations centred on the quickest possible recovery of up-front license fees, rather than a long-term focus on over-all growth of the industry.

[59] Melody, W H, "Spectrum auctions and efficient resource allocation: learning from the 3G experience in Europe", *Info*, vol 3, No. 1, February 2001, pp. 005-010.

[60] Cave M and Valletti, T, "Are spectrum auctions ruining our grandchildren's future?" *Info*, vol 2, No. 4, August 2000, pp.347-350: "*As far as the firm and its competitors are concerned, the licence fee is an irrevocable sunk cost. When deciding how to set prices, the firm rationally only takes account of its own forward looking costs and revenues and the likely behaviour of other firms. Since the licence fee is a sunk cost for all firms, it falls out of the pricing equation for all of them. Hence the size of the licence fee does not affect prices*. " (p. 349).

The barriers to entry and to effective competition resulting from high up-front license fees are exacerbated in a situation where 3G operators are required to pay high license fees for the use of spectrum, while other broadband providers, such as existing fixed line or mobile carriers or broadcasting operators, are able to offer similar services without the need to pay high prices for spectrum or for licenses. Even where existing operators have been required to purchase spectrum to provide 3G services, they are still at a competitive advantage over new 3G providers because they will generally be able to utilize existing fixed or mobile infrastructure to rollout their networks. This allows existing fixed or mobile operators to offer 3G services at a lower cost and within a quicker timeframe than those operators entering the market for the first time.

4.1.1.2 Comparative selection ('Beauty contests')

The beauty contest approach is quite different. Typically, the government invites applications that are rated according to some pre-set criteria. Licences are allocated to those whom the government believes best meet the stated requirements. This is widely seen to have several disadvantages in terms of process and efficiency. In Sweden, the initial criteria were that sufficient capital must be available; technical plans must demonstrate reliability, access, speech quality and other service guarantees; business plans must be commercially feasible; and applicants must have suitable experience and expertise.

Concerns over beauty contests

A number of concerns have been raised regarding the use of beauty contests. How could a government – even using leading technical experts – confidently choose between alternative business plans stretching well into the future, and relating to new products and services that have not yet been developed, let alone test marketed? Can this method ever be fully transparent? If so, will bidders be required to divulge their business plans in full detail? If not, how can the decision be open and transparent? These and other doubts can lead to suspicions and dissatisfaction with the outcome of beauty contests. For instance, in Sweden, Telia finding itself without a licence mounted a legal challenge against the licence allocation (unsuccessfully)[61].

4.1.1.3 Hybrid

Table 4.1 provides a summary of the number of licences allocated in various countries, the method and date of allocation and the sum paid for each licence, and also shows that a number of countries, including Austria, Italy, France and Hong Kong adopted a 'hybrid' approach to 3G licence allocation. Tenderers have to pre-qualify in terms of criteria similar to those established for straight out 'beauty contests' to bid. Licences are then allocated on the basis of an auction.

Pre-qualification of potential operators involves the authorities screening potential license bidders prior to the auction according to qualitative non-financial and financial criteria determined by the government. Numerous policy goals including social, employment, technology transfer and environmental objectives could potentially be pursued under this approach with candidates being judged on their ability to fulfil policy objectives.

Observations made earlier in regard to auctions and beauty contests pertain also to this 'hybrid' approach. By their nature such pre-qualification processes can potentially be complex, time-consuming and contentious. Because selection at the pre-bidding stage is not solely based on quantifiable and objective financial and technical criteria the scope for subjective interpretation of the rules and requirements of the assessment process increases the risk of litigation and delay in introduction of the new service. Nevertheless, such processes can be used to help ensure that potential holders of 3G licenses have the expertise, capability and will to meet social and policy objectives required by Government.

[61] See http://www.totaltele.com/view.asp?articleID=35392&Pub=TT&categoryid=625&kw=sweden+3G+

Table 4.1: Allocation of 3G mobile licences around the world

Country	No of licences	Mobile Incumbents	Method	Date awarded	Sum paid US$ million
Austria	6	4	Hybrid	11/2000	610
Australia	6	4	Auction	March 2001	351.7
Belgium	4	3	Auction	09/2001	418.8
Canada	5	4	Auction	January 2001	1,482
Denmark	5	4	Auction	10/2001	
Finland	4	3	Beauty contest + nominal fee	03/1999	Nominal
France	4 (2 still to be issued)	3 (2 still to be issued)	Beauty contest + fee	07/2001	4520
Germany	6	4	Auction	07/2000	About 7690 each
Greece	4 or more	3	Auction	mid-2001	
Ireland	4	3	Beauty contest + fee	04/2001	Estimated between 116 and 140 each
Italy	5	4	Hybrid	10/2000	10,070
Korea	3	2	Beauty Contest + fee	End 2000	3,080
Luxembourg	4	2	Beauty Contest	By 6/2001	
Netherlands	5	5	Auction	July 2000	369 to 667 each
New Zealand	4	2	Auction	January 2001	51.4
Norway	4	2	Beauty contest + fee		22 each
Portugal	4	3	Beauty contest + fee		360
Spain	4	3	Beauty contest + fee	March 2000	120 each
Sweden	4	3	Beauty contest	12/2000	44.08
Switzerland	4	2	Auction		116
UK	5	4	Auction	April 2000	6100 to 9100

Source: ITU, European Commission, The Introduction of 3G Mobile Communications in the European Union: State of Play and the Way Forward, Brussels 20.3.2001 COM(2001)141final.

Box 4.2: A modified auction approach – licensing in Hongkong SAR through a 'royalty-based' system

The Office of the Telecommunications Authority (OFTA) in Hong Kong has released the rules for the auctioning of four 3G licences in September 2001. OFTA has adopted a hybrid approach that requires bidders to pass a pre-qualification round prior to bidding for the licenses. In order to reduce the upfront financial burden on operators, the framework adopted involves a 'royalty-based' payment scheme. Each licensee would pay a percentage of its network turnover, and would also be subject to a schedule of minimum payments. The initial reserve price would be 5 per cent of network turnover, with an annual minimum payment of $HK50 million (US$ 6.4 million) for the first five years. This minimum payment will then rise from year six over the remaining term of the 15-year licenses. The identity of bidders would be kept hidden during the main bidding stage in order to minimise opportunities for collusion.

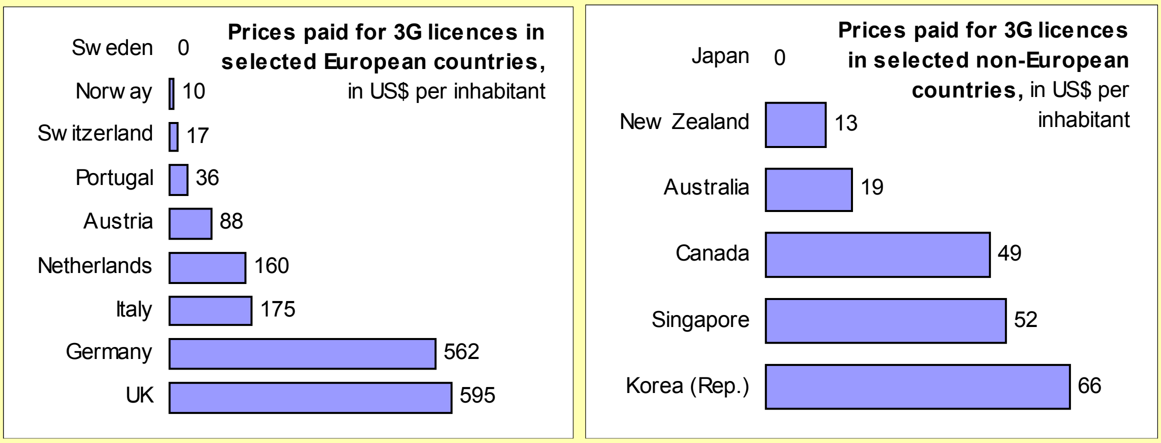
Notably, the auction rules include the condition that licensees must set aside at least 30 percent of their network capacity for mobile virtual network operators (MVNOs). This condition caused controversy when first announced because operators said that no more than 20 percent of a licensee's network should be reserved, to avoid a situation whereby an MVNO could obtain more overall capacity than a licence holder by aggregating capacity from different network owners. Another license condition is that a 3G license winner which is also a 2G operator must offer domestic roaming services to new entrants.

Source: Total Telecom, "HK operators to bid for 3G licenses despite complaints", 19 July 2001.

4.1.1.4 Licensing Fees

Auctions have resulted in sharply varying prices paid for a 3G licence. As Figure 4.1 indicates, the price of 3G spectrum in terms of price per head of population has varied greatly, from US$598 in the UK and US$559 in Germany to US$30 per head in Australia, US$14 in New Zealand and zero in Sweden and Japan.

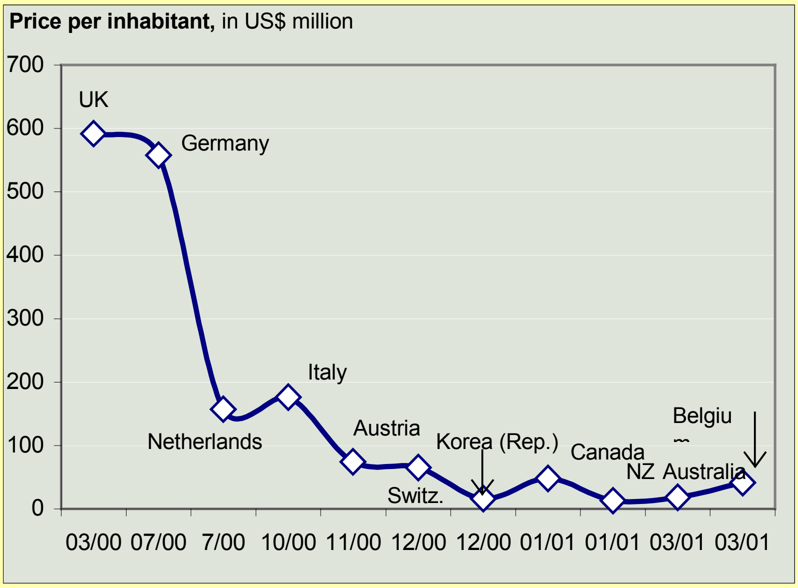
Figure 4.1: Significantly varying prices of 3G licences, in Europe and the rest of the world
In US$ per inhabitan



Source: ITU research.

Figure 4.2 shows how the auction price has varied in time. From a peak in March 2000 (UK) and 2000 (Germany), the auction price per head of population has fallen sharply during the early months of 2001. Moreover, Figure 4.2 also shows the falling global price trend for 3G licences.

Figure 4.2: The 3G rollercoaster
Trends in the price per inhabitant of 3G license prices obtained through auction, in US$



Note: Excludes beauty contests and hybrids. Horizontal access is not linear.
Source: ITU research.

4.1.2 Who are the winners?

It is frequently argued that incumbent mobile operators have a significant advantage and are the winners of an auction approach since they have 'deeper' pockets and moreover have the advantages of an established 2G networks and a subscriber/revenue base. New entrants in this sector, according to some analysts, face severe financial pressures before they even begin providing service. And there are fears that this could place incumbent operators in a position of significant market power.

On the other hand, there are claims typified by the (reported) exclamation of Bouygues Telecom's CEO that incumbent mobile operators faced a choice between a fast death and a slow death:

"... if they don't secure a license regardless of their price, the stock market decimates the company; if they win, the company bleeds itself over the license's lifetime (usually 15 to 20 years) as it struggles to make a profit."[62]

Indeed, such concerns over the ability of telecommunications operators to make reasonable profits appear supported by the significant reduction in the availability of funding for 3G operators, which has further accentuated the problems they are perceived to be facing.

To what extent are operators in countries adopting beauty contests the winners? It is notable that in countries where licenses were awarded on merit, services appear set to start sooner. Such countries include Finland, Sweden, Japan, and Korea. Japan allocated all three 3G licenses to its three incumbent operators – Japan Telecom, IDO, and NTT DoCoMo. None of these operators had to pay up-front fees, being required to pay only radio-usage fees of approximately US$5 per subscriber per year, which is a fraction of the price some operators paid at 3G auctions in some European countries.

This can turn out to be a significant advantage since, as noted above, financiers are now wary of 3G projects. Thus operators in these countries will be able to use the financial resources they did not have to expend on the acquisition of licenses, to roll out infrastructure for 3G services. (Costs of deployment were discussed earlier).

[62] Dirk M. Bout, et al', "The Next Generation of Mobile Networks Poses a $100 Billion Challenge for Europe", Note Number: R-11-5053, Gartner Group, 19 September 2000.

But to what extent will the impact of high licenses prices in some countries be contained to those countries? To what extent will the pressure to recover costs spill over into business and pricing strategies even in countries that allocated spectrum at lower prices?

Are governments receiving high auction receipts the winners? In terms of revenue receipts, no doubt they are. But what about the impact on the governments' broader responsibilities concerning the introduction and development of 3G service? To what extent will operators be pressured to join forces in order to ameliorate the burden of paying for spectrum? And to what extent will governments/regulators be pressured to allow them to do so? What implications would this have for the goal of creating a competitive and 'healthy' sector? Certainly the signs of major operator consolidation are already discernible, as successful bidders struggle to limit commercial rivalry. In July 2000, Dutch operator KPN embarked upon a joint venture with Japan's DoCoMo, and Hong Kong-based Hutchison Whampoa.

And finally, what about customers? Are customers the losers? To what extent will they be made to pay higher prices to defray the cost of licences? But there are those who argue that customers do not have to purchase 3G services and indeed will not pay the prices asked unless they perceive value in the services offered.

4.1.3 "Re-farming" 2G spectrum

2G and 3G will co-exist for a considerable period, as many mobile service customers will not see an immediate need for the full range of 3G services. But as the coverage and penetration of 3G services increase, 2G services might be expected to be progressively withdrawn if significant user migration occurs, allowing the 2G spectrum to be re-allocated for use by 3G services. Thus a further consideration is whether operators will be allowed to 're-farm' their 2G spectrum to support 3G services, thereby improving the efficiency of that spectrum. In view of the implications for international roaming (one of the key selling points of GSM), governments are waiting for international co-ordination before moving in this direction.

To explain a little further, re-farming of second generation spectrum and upgrades of GSM standards means the re-designation of spectrum in a specified band for a different technology from that for which it was originally licensed. Re-farming of second generation spectrum would mean changing the use of some or all of the spectrum at 900 and 1800 MHz from GSM/PCN technology to UMTS technology.

The situation with UMTS technology in second generation operators' existing spectrum is somewhat different. UMTS will be part of the world-wide third generation IMT 2000 family of standards, and it is intended that UMTS should be compatible with IMT 2000 to allow global roaming. Notably, with this in mind, the UK government concluded that it would not be appropriate to license the use of UMTS technology outside internationally agreed UMTS bands. It is therefore decided not to consider the re-farming of GSM spectrum for UMTS unless that spectrum has been re-allocated to UMTS by international agreement[63].

4.1.4 Conditions and Obligations on License Holders

Governments need to determine the nature and extent of any obligations that imposed on 3G license holders. These obligations should be set out clearly prior to potential license holders applying for available licenses. This will ensure that prospective operators' business plans are developed and decisions on the value of licenses are made on the basis of such information.

Governments may be keen to impose network roll out, geographic or population coverage and domestic industry partnership and development obligations in order to achieve political, social and economic objectives. In addition, governments may impose obligations on license holders relating to efficient use of the spectrum, access to infrastructure and essential or bottleneck facilities, retail pricing constraints and responsibilities and requirements for contributions towards universal service or other social obligations.

In developing countries where social developmental and coverage concerns are paramount, governments can ensure that that these priorities are recognised in the form of clear, transparent and explicit requirements which are known to all potential license bidders prior to the auction. This will help prevent subsequent resistance from operators in fulfilling these obligations and will limit arguments by operators that the rules were not known up front.

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[63] Link: http://www.spectrumauctions.gov.uk/uacg/documents/uacg1.htm

4.2 Cost Sharing

Cost sharing has become a topical issue as the high auction prices paid for 3G licences together with expected infrastructure deployment costs combine to exert financial pressure on intending 3G operators[64]. However cost sharing is controversial because of its potential to restrict competition. Cost sharing should be distinguished from infrastructure sharing. Under cost sharing, operators jointly construct and own network components while under infrastructure sharing one operator pays for the right to use another operator's infrastructure.

There is concern that two operators building a network together are unlikely to compete as vigorously against each other as they would against other operators. Another concern is that by allowing cost sharing, regulators will, in effect, be rewriting the terms of the 3G licences already granted and that such changes in the rules retrospectively would set a disconcerting precedent.

In response to such concerns, in June 2001, RegTP, Germany's telecommunication regulator, clarified its earlier announcement of support for cost sharing, making it clear that 3G operators would be allowed to share only certain parts of their network infrastructure, such as towers and antennae[65]. In fact, some of these parts are already shared on today's 2G networks. RegTP declared that each operator would still have to build its own "backbone" network linking base stations together. And sharing would be permitted only in such a way that, if one operator's network malfunctions or is shut down, other operators are not affected. Nevertheless, despite such restrictions on cost sharing arrangements, since towers and antennae account for a significant portion of overall costs, sharing these physical items can lead to savings of around 20%-40% of total deployment costs[66] and this is a considerable saving.

The stance taken by Germany's regulator seems to occupy the pragmatic middle ground between the position in the Netherlands, where cost sharing is prohibited altogether, and in Sweden, where even closer co-operation between operators is allowed.

4.3 Spectrum Trading

Another issue relating to spectrum management is whether spectrum trading should be permitted? Under new legislation proposed by the European Commission[67] secondary trading of radio spectrum would be allowed in order to provide for improved usage of this scarce resource.

Economists have long argued that spectrum trading has the potential to increase economic efficiency[68] and accordingly should be permitted. They point out that if trade occurs, this signals that some gains are being made by both parties. Thus spectrum trading should be prohibited only when it would lead to market failure. Otherwise there seems little reason for opposing it.

4.4 Roaming between Networks

3G operators will roll out their networks against a background of a range of competing GPRS and GSM services. Third-generation handsets will therefore 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. W-CDMA is the radio access technology selected by ETSI (European Telecommunications Standards Institute) in January 1998 for wideband radio access to support third generation multimedia services in Europe. Handset companies wishing to break into new regions will therefore still need to acquire technology compatible with the second-generation networks to operate in their new target markets. Unlike

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[64] "Telefonica, KPN in talks to share 3G network costs", *Total Telecom,* 6 July 2001.

[65] "German regulator gives nod to network sharing", *total Telecom,* 5 June 2001

[66] "BT and Deutsche Telekom to jointly build 3G networks", *Total Telecom,* 12 June 2001.

[67] Proposal for a directive of the European Parliament and of the Council on a common regulatory framework for electronic communications and services. COM(2000)393, July 12th, 2000.

[68] Cramton, P and Schwartz, J "Collusive Bidding: Lessons from the FCC Spectrum Auctions", Journal of Regulatory Economics, 17(3): 229-252.

the 2G handset market where manufacturers are strong only in regions deploying specific network standards (e.g., GSM, CDMA or PDC), the 3G system even provides the potential for players to operate on a global basis, although not without having to resolve a number of problems (discussed in section 6). For instance, Japanese and European manufacturers will need access to each other's 2G technologies if they are to succeed in each other's markets.

National roaming is a key requirement for the success of 3G systems. Guaranteed access of a new entrant 3G operator to an existing mobile operator's 2G networks would allow the new entrant to compete on a more equal footing with the existing mobile operators while providing the necessary commercial incentive to roll out its 3G network. Most EU Member States are planning to mandate national roaming between third-generation and second-generation networks, in order to facilitate the establishment of competitive networks by 3G operators who do not own a second-generation network in the same territory. However, some countries, for example, Germany and the Netherlands, have not provided for this as a matter of law but will leave it to commercial negotiation. Most of these national roaming obligations will be for a limited time, reflecting the anticipated roll-out period for third-generation networks. They are normally applicable only to national roaming from 3G to 2G networks (and *vice versa*), rather than also between 2G networks. However, in Denmark and Italy, regulatory provision does exist to require national roaming between second-generation networks in certain circumstances, while in Sweden, a new entrant with a combined second-generation and third-generation licence would also have national roaming rights.

In addition to mandated national roaming, additional regulatory requirements (e.g., concerning roaming pricing and conditions), are likely to be necessary to ensure effective roaming conditions to enable customers to get the benefits of 3G service at realistic and affordable prices.

Rigorous implementation of regulatory policy

Establishing licence conditions is necessary but not enough. Also required are the regulatory rules to implement the licence conditions and their implementation promptly, vigorously and pro-competitively.

The development of appropriate pricing principles that can be used by arbitrators in resolving disputes on the wholesale pricing of 3G roaming services is essential for the successful implementation of 3G roaming arrangements. Roaming is essentially the resale by one operator of network capacity owned by another operator. As such it should be distinguished from interconnection which involves the physical connection of networks and the purchase by one operator of network functionality which it then combines with its own network functionality to deliver services.

One approach that has been used widely for the wholesale pricing of resale services involves establishing a price based on retail prices less avoidable costs. This retail-minus approach ensures that when a 3G operator acquires the roaming service, it does not incur any of the costs of the retail functions associated with the supply of the service. This is achieved by subtracting, from the retail price of a mobile call, the 'avoidable cost' the network owner would avoid in the long run if it ceased supplying mobile services in the retail market. In implementing the retail-minus pricing approach, it would be necessary to determine an appropriate basis for both the retail starting price and the costs that should be deducted from it.

Determining the appropriate retail price to be used as the basis of the 'retail price minus avoidable cost' methodology is a difficult exercise since in practice there will be a range of prices in the market for the supply of mobile services. These prices will depend on the monthly fee versus airtime package selected by the customer and will also depend on the value added services being provided as part of the package. One method to overcome this problem is to establish the retail price with reference to the average revenue from providing to all customers those services that would be available to a competitor as part of the roaming package. This will include revenues from connections, rentals and calls. Retail revenues for the services provided under a roaming agreement would, in practice, be calculated separately for different services and for peak and off-peak periods.

Governments also need to consider whether it would appropriate to introduce an integrated package of competitive safeguards that are designed to promote sustainable competition. These safeguards are primarily aimed at ensuring that dominant or incumbent carriers do not abuse their position to unfairly restrict the operation of new entrants. These anti-competitive provisions can act as safeguards to ensure that roaming charges are not used by incumbent operators to increase barriers to entry faced by 3G operators in both domestic and international markets. They can also be used more generally to prevent incumbent fixed and mobile operators from engaging in behaviour aimed at damaging 3G competitors.

Anti-competitive provisions can include:

- imposing restrictions on incumbent carriers from discriminating between wholesale customers except where this can be justified on cost grounds and requiring such a carrier to price strictly in accordance with publicly known (filed) charges
- a broader competition test which assesses whether practices such as service bundling and tying are adversely affecting competition. Governments will need to develop analytical tools containing both qualitative and quantitative tests to assess whether competition has been damaged. Structural and behavioural tests are appropriate for this purpose.

These rules are designed to limit the opportunities for a dominant carrier to selectively target individual customers at special prices not available or known to anyone else. Discriminatory discounts could be permitted if they are cost justified and are not otherwise affecting competition. General discounts could also be permitted if they are available to a broad group or class of customers.

4.5 Principles for 3G Licensing

Requirements of an effective licensing framework

As noted earlier, clear and stable licensing conditions and policy parameters that are well known to potential bidders prior to the commencement of the licensing process are key requirements of an effective licensing framework. Issues that need to be determined prior to the commencement of the 3G licensing process include:

- the number of licenses to be awarded
- the conditions, if any, to be attached to the licenses
- the method by which licenses will be allocated to prospective operators of 3G services
- clear terms for payment of monies tendered at auction.

Having such information available is necessary in enabling potential bidders of 3G licenses to determine the value of a license and to develop viable business plans.

Number of licenses to be awarded

The number of licences to be awarded is an element of competition policy and can critically determine the success or failure of the 3G regulatory framework and of 3G service provision in general.

The ITU has nominated the bands 1885-2025MHz and 2110-2200MHz for the implementation of IMT-2000. Within these bands, each national government selects the amount of spectrum to be made available for 3G services, taking into account competing demands and uses for the spectrum. Across most of Europe, the full 155MHz of spectrum has been allocated for 3G or UMTS as it is known in Europe.

The ITU's World Radio Conference (WRC) – the international body responsible for radio spectrum allocation – has identified *additional* spectrum bands for the provision of UMTS (1710-1885MHz, 2500-2690MHz and 806-960MHz). For the most part, this spectrum has not yet been made available in licences awarded, or auctioned. When it is made available, it may have the effect of reducing the per MHZ value of existing licences. The World Radiocommunication Conference (WRC), held every two to three years by the ITU establishes a global framework for the use of the radio spectrum. Global coordination ensures that services are not impaired by interference of competing signals and transmissions. The 1992 World Radio Conference (WRC) identified the 2 GHz frequency for IMT-2000 on a global basis. But this was not sufficient, particularly in the US where most of the 2 GHz frequency is still limited to military use. The last conference, held in Istanbul in May-June 2000 (WRC 2000), allocated additional spectrum for 3G services: the three bands identified for use for 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 3G, and a third band in the 2.5 GHz range. Decisions about the extra spectrum needed were based on three main considerations: the growing number of mobile users (which is expected to reach an estimated 2 billion worldwide by 2010), the rapid growth of mobile data services, mobile e-commerce, wireless internet access and mobile video-based services, and the need to secure common spectrum worldwide for global roaming.

Box 4.3: Spectrum allocation for 3G service in Europe

The UMTS Forum (www.umts-forum.org), a trade body, has recommended that the minimum spectrum requirement per operator be 2 x 15 MHz paired with 5MHz unpaired. Paired spectrum uses two frequencies to allow information to be transmitted and received by a mobile device simultaneously. Unpaired spectrum uses one channel that is used alternately to transmit and receive. The ratio of data transmitted and received can be varied, so unpaired spectrum is well suited for asymmetric applications such as web browsing. However, the unpaired spectrum signal has limited range and therefore can only be used in short-range urban environment and indoors.

Given current spectrum availability, the UMTS Forum recommendation allows four UMTS lots to be licensed. However, neither governments nor operators have consistently agreed on this number of licences, For instance, in Europe, the UK government originally proposed to offer four licences, but under pressure from new entrants, it divided the spectrum into five (unequal) lots. With five existing operators, the Dutch also decided upon five licences. Germany offered 12 smaller lots, allowing bidders to bid for two or three lots each, allowing for between four and five licences, Italy offered five identical lots.

The number of licences is, in fact, decided upon with regard to each government's perspective on competition, and the trade-off between rewarding incumbents and providing incentives for new entrants. In most European countries at least one new entrant is to be licensed. As a result, competition in European mobile markets is set to intensify.

So far, the most active competition that has developed is in countries wherein the new mobile markets have at least four operators competing and where a degree of competition with fixed line services has occurred. This contrasts with the relatively slow development of competitive fixed-line networks, especially networks that could provide competitive alternatives for residential consumers.

One conclusion that might be drawn from a review of licensing experience (thus far) is that while auctions are in practice, not without deficiencies, this approach is nonetheless preferable to the inherently subjective 'beauty contest' approach. In this view, the task is in essence to improve auction design[69] and apply competition policy vigorously.

Governments should adopt licensing practices that encourage new investments in telecommunication infrastructures and facilitate competition within the sector; encourage innovation; and enhance consumer interests.

Spectrum should be allocated on the basis of achieving economically efficient, competitive and structurally desirable outcomes rather than to extract monopoly rents from industry. To achieve this objective, the licensing authorities must at a minimum clearly specify, prior to the invitation of bids for spectrum, the framework within which the 3G industry would operate in order to provide as much information as possible to potential bidders. This framework could include:

- an explicit reaffirmation by the government that the primary objective of telecommunications policy is to increase competition and provide benefits to consumers and that this may require issuing additional 3G licenses in the future and the imposition of pro-competitive and pro-consumer regulation of the 3G industry;
- a clear statement that the government will auction all available spectrum that can potentially be used by 3G networks and is not allocated to other uses;
- a clear statement that there is no artificially created limit on the number of licenses to be awarded and that the only determining factor is the amount of spectrum required by operators versus the total amount of spectrum available;

[69] On the subject of auction design, see for example, Paul Klemperer, "What really matters in auction design", February 2001 (see above).

- a clear statement of the obligations on winning bidders in regard to network development[70], interconnection with other networks, the provision of network capacity for resale by MVNOs, the provision of roaming services to competitors, and the extent of infrastructure sharing between 3G competitors;
- a clear statement about the terms of payment of money tendered at auction;
- a well defined statement of the processes that regulatory authorities will employ in resolving disputes between new 3G operators and existing carriers, of the pricing approaches that will be employed in establishing wholesale prices for the use of key network elements required by 3G operators, and of any pricing constraints that may be imposed on services such as roaming and spectrum resale provided by 3G operators to other competitors; and
- a clear indication of any other public policy obligations that 3G operators will be required to meet, including network rollout and network coverage requirements and universal service obligations.

5 Enhancing the competitive landscape

5.1 The introduction of Mobile Virtual Network Operators (MVNOs)

The MVNO issue is a relatively new one with regulators in many countries still considering whether (and if so to what extent) regulatory intervention including the regulation of access price and conditions is necessary. Some analysts argue that regulation should facilitate the operations of MVNOs since MVNOs offer consumers a wider choice of services and applications at a lower price, and thereby result in a more efficient use of the spectrum. Others argue that the mobile environment is sufficiently competitive, the advent of 3G operators will further increase competition and that regulatory intervention in support of MVNOs is unnecessary[71].

5.1.1 What are MVNOs?

There are different definitions about what constitutes an MVNO[72]. The ITU defines an MVNO as an operator that offers mobile services but that does not own its own radio frequency[73]. The MVNO can be a mobile service provider or a value-added service provider[74]. It can have its own network code and in many cases issues its own SIM card. The UK regulator, Oftel, defines MVNOs to cover activities undertaken by organisations that offer mobile services but do not issue their own SIM card. Ovum refers to such organisations as ‘enhanced service providers’[75]. Ovum defines a MVNO as an organisation without its own

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[70] This should also cover any return of 3G licenses. In August 2001, Sonera's Norwegian subsidiary Broadband Mobile ASA (Sonera 50%, Enitel ASA 50%) has decided to liquidate the company and hand back its 3G license to the Norwegian government. The move is based on Enitel's decision to focus on its core business and to divest its shares in 3G business. Enitel’s decision to apply for a 3G license in the relatively small Norwegian market was based on a strategy aimed at gaining a 3G license in Finland, Norway and Sweden. However, the company was not successful in obtaining a license in Sweden. Thus the economies of scale and synergies expected with geographically adjoining mobile communications markets were not realisable. The US$11.2 million license fee has been settled and reportedly no penalties would be incurred in returning the license to the State of Norway. It is not known whether the government will re-auction the license.

[71] Joanne Taaffe, Mobile Virtual Network Operators – Marking out their territory”, *CWI onLine*, 5 March 2001.

[72] Ray Maistre, “Operators: MVNOs - not all Virgins”, *Total Telecom*, 1 June 2001.

[73] There are differing views on how to define a MVNO. One definition of an MVNO (eg. Pyramid Research) is that it is a company that provides mobile voice and data services to end users through a subscription agreement, without having access to the spectrum. Through commercial agreements with licensed mobile network operators, an MVNO negotiates to buy excess capacity for re-sale to customers.

[74] "Virtual Reality: from resellers to MVNOs. Are virtual operators here to stay? Business Services, 27 Feb 01 by: Veronika Bocarova, edgecom. Available at http://www.mobilestart.com/articles.asp?internal=894

[75] Ovum defines ‘enhanced service providers’ to be organisations that resell the service of a mobile operator and provide additional services, but do not issue their own SIM cards (although they may re-badge the operator’s SIM cards). Enhanced service providers must have a partnership with a physical network operator. They can issue that operator’s SIM cards although they market services independently of it.

radio frequency (spectrum) allocation that: offers mobile services to customers; has its own mobile network code; issues its own SIM card; and that operates its own mobile switching centre (including HLR).

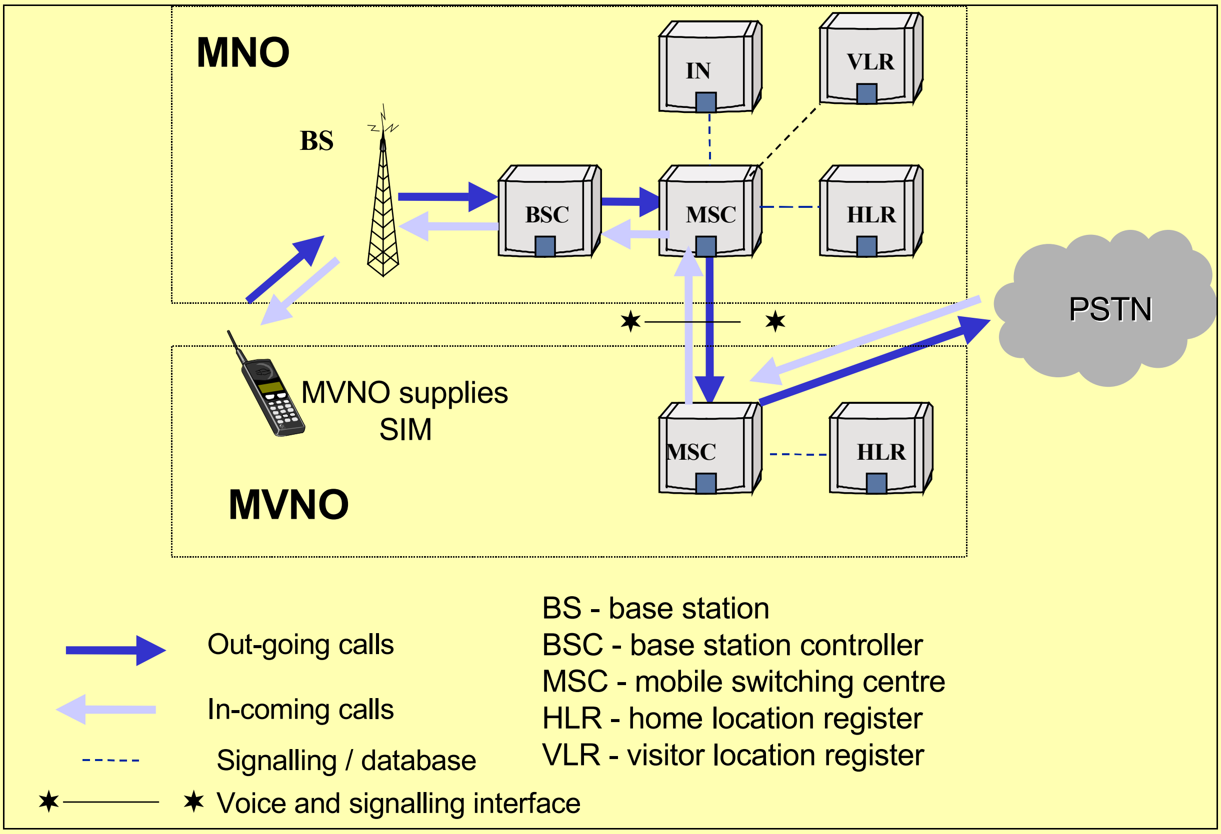
Figure 5.1 indicates diagrammatically the interface between a MVNO and the telecommunications network.

5.1.2 Are MVNOs desirable/necessary?

3G MVNOs can potentially offer:

- an expanded range of service providers from which 3G customers can choose
- better utilisation of network capacity (including capacity on 3G networks that would otherwise have remained idle) thus enabling network operators to spread network costs and reduce the average costs of service provision
- new and innovative services since, in order to compete with 3G operators, MVNOs need to develop innovative product and customer service offerings
- enhanced incentives for price competition since, in order to sufficiently differentiate their product offerings from those of network operators, MVNOs will need to offer customers attractive pricing packages
- greater incentives for competition more generally between network operators to supply network capacity to the MVNOs.

Figure 5.1: An MVNO customer making and receiving calls



Source: Ovum, 3G Management Summary, 2000, p. 2

Box 5.1: Virgin Mobile --an example of an MVNO

A typical example is Virgin Mobile which emerged as a 50:50 joint venture between the Virgin Group and One2One. Virgin buys airtime and network capacity from One2One on a wholesale basis, then packages and sells it to its target customer base. Unlike a pure reseller, Virgin assumes roles and responsibilities traditionally associated with a full network operator including SIM card allocation. Virgin Mobile offers both traditional mobile voice and value added services together with 'extras' which, via an SMS toolkit, can provide access to products and services offered by Virgin Group companies: music, travel, etc. A key factor in Virgin's success has been the integrated distribution and sales platform it has built: the call centre, the web and numerous Virgin distribution outlets.

Virgin Mobile has about 675,000 customers in the UK filling about 8 percent of One2One's network and it is seeking to expand its operations internationally. Since the UK launch, a number of operators from around the world have approached Virgin with a view to establish joint ventures to operate in various markets. Virgin Mobile has already established a presence in the US, Australia and Singapore and by the end of 2002, intends to be in all major European countries.

5.1.3 Current regulatory positions regarding MVNOs

The attitude of regulators towards MVNOs varies significantly at present as shown in Table 5.1. Even within the European Union, EU directives on telecommunications regulation currently do not mandate MVNOs access to a licensed 3G operator’s network. Indeed, the Italian regulator has declared them illegal, while in the UK Oftel’s current position is there is not enough evidence to justify intervention.

There have been arguments both for and against MVNO regulation. Those in favour of regulation posit that the mobile network operators control the available radio spectrum, which is a bottleneck facility and an entry barrier for new mobile network operators. Also, mobile network operators are less likely to provide MVNO access unless it is a regulatory requirement. MVNOs can provide a wider choice of services and prices to consumers, and could also potentially ensure more efficient use of spectrum. Regulation of the mobile market is failing, which is another reason why MVNO regulation maybe a good idea. Mobile operators have very high profit margins of 25%, in some cases significantly over costs. Current regulation (as interpreted by some NRAs) already gives NRAs the power to enforce an access obligation on existing operators.

The arguments against regulatory intervention are based on the fact that the benefits of MVNOs are as yet unproven, and that there is inadequate evidence that market failure has occurred. The mobile market is competitive by nature and therefore does not require regulation. There is no industry consensus that MVNO access is necessary, and the bleak possibility that MVNO’s could even discourage investment in mobile networks (both 2G and 3G). Anti-regulatory intervention stances also posit that regulatory measures such as indirect access or third generation networks will improve the competitive situation. This line of argumentation supports the belief that rather than be incrased, sector specific regulation should be reduced in faovr of more emphasis on competition law.

Comparison with local loop unbundling

Those against mandating MVNO access to 3G networks argue that it is not the same as ‘local loop unbundling’ in the fixed network. Several operators and regulators have begun to think about aligning MVNO access in the mobile network to local loop unbundling in the fixed network. They point out that local loop unbundling was introduced to provide competition to the local and access markets so that the incumbent would not in the long term be the only operator (aside from cable operators) to control future broadband markets. They argue that MVNO access is a far more complex issue.

Table 5.1: Regulatory Attitudes to 3G Mobile Virtual Mobile Services

In selected ITU Member sites

	Do regulatory measures exist for subleasing of spectrum?	Are virtual mobile services (resale of services) permitted?	Specific regulation of virtual mobile services	Existence of an informal regulatory network?	Websites with information on 3G
Australia	Yes	Yes	Yes	Radiocommunications Act 1992	http://auction2.aca.gov.au
Austria	No	Yes	No	No	http://www.tkc.at
Botswana	No	Yes	No	No	
Burindi	No	No			
Canada	No	Yes	Yes		
Croatia	No	No	No	No	
Cuba	No	No	No	No	
Czech Republic	Yes	Yes	No	Yes	
Denmark	No	Yes	No	No	http://www.tst.dk
Espana	No	Yes	No	No	
Estonia	No	Yes	Yes	As regular mobile service	
France	No		No	No	http://www.telecom.gouv.fr
Greece	No				http://www.eett.gr/umts
India	No	No			
Ireland	No	Yes	No	No	http://www.odtr.ie
Italy	Yes	No	Yes	Allowed on a commercial basis	http://www.agcom.it
Japan	No	No			http://www.mpt.go.jp/eng/
Jordan	No	No	No	No	
Rep Korea	No	No	No	No	http://www.mic.go.kr
Kuwait	No	No	No	No	
Kyrgyzstan	No	No	No	No	
Maldives	No	No	No	No	
Monaco	No	No	No	No	
Maroc	No	No	No	No	
Nepal	No	No	No	No	
Poland	No	No			
Portugal	No	No	No	No	http://www.icp.pt/indexuk.html
Qatar	Yes	No	Yes		
Romania	No	No	No	No	
Singapore	Yes	Yes	Yes		http://www.ida.gov.sg
Slovak Republic	No	No	No		
Switzerland	No	Yes	Yes		http://www.ofcom.ch
Turkey	Yes	No	No	No	
Tuvalu	No	No	No	No	
Zambia	No	Yes	Yes		

Source: ITU World Telecommunication Regulatory Database.

The extent of price competition resulting from the entry of MVNOs will depend on the terms and conditions with which MVNOs gain access to mobile networks. It is likely that regulatory intervention will be required in determining the prices, terms and conditions for the access by MVNOs to licensed operators networks since the early indications are that commercial negotiation will not be easy to conclude. For instance, in Scandinavia, Sense attempted to negotiate access to airtime from the existing operators that were reluctant to grant it, particularly as Sense wanted to use its own mobile network code and SIM card[76].

Pricing principles

There are a number of strategies that could be employed by an MVNO entering the 3G market. At one end are MVNOs that have installed substantial investments in infrastructure and facilities for the provision of 3G services. Such MVNOs would require extensive interconnection with fixed and mobile networks and would depend on the mobile networks only for the minimum services that they would not be able to supply themselves because they do not have licences to use spectrum. Such MVNOs would be likely to require the use of the radio elements of the 3G operators' networks and such fixed parts of networks necessary to route calls between the radio elements of the licensed operator and a point of interconnection from which calls can be passed on to the MVNO's network.

At the other end are MVNOs that are primarily resellers of wholesale 3G network capacity. These MVNOs would have minimal investment in network infrastructure and would concentrate their activities and investments in marketing, customer service and billing. Licensed operators would be responsible for undertaking the verification operations and database functions required for the carriage of a call by an MVNO customer. This would include the transport and delivery of calls to a terminating network. Licensed operators would then need to pass on billing and service performance information to the MVNO that would then package this information and bill the customer accordingly.

MVNOs ability to offer effective and sustainable competition against 3G network providers will be severely limited if network providers, who effectively control near monopoly 'bottleneck' facilities, are in a position to charge monopoly prices for their services. Because network providers are vertically integrated into the competitive upstream or downstream markets for the provision of 3G services they may also have incentives to restrict access to the facilities required by competitors through the imposition of prices which make it uneconomic for MVNOs to enter the market and effectively compete for 3G customers[77].

The pricing principles that apply to the provision of services to MVNOs should reflect the nature of an MVNO and the extent to which it is engaging in interconnection or pure resale of network capacity. MVNOs with extensive networks of their own that make only minimum use of the licensed operators facilities are identical to other network service providers and should be entitled to interconnection on the same basis as that adopted for licensed operators.

It has been argued that such cost based charging for access to a 3G operator's network by MVNOs would become less necessary as the market becomes more competitive. It has also been claimed that cost based access charges for MVNOs could damage incentives to invest in infrastructure, particularly in the early stages of investment in 3G systems. These arguments should be assessed within the context of the overall objective of promoting and strengthening the competitive framework for mobile services which is the prime rationale for allowing MVNOs to operate in the market in the first place.

3G mobile services resale, full network interconnection and full facilities-based competition are complementary rather than alternative market entry strategies. Market factors such as population density, customer type, timing of entry and penetration levels by new entrants will determine which strategy is used in different areas and at different stages of market development. Relying solely on full facilities-based competition to deliver competing 3G services may not provide 3G service competition to all end users given the costs involved in duplicating a full network throughout all areas of a country. As such, service based competition through the resale of network capacity will be an important element of the overall state of competition in the 3G market.

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[76] Ovum, 3G Report -- Management Summary, 2000.

[77] "Who will win the race for mobile revenues?", *Communications Week*, 4 June 2001.

Relying solely on full facilities-based competition to deliver competing 3G services may not provide 3G service competition to all end users in view of the costs involved in duplicating a full network throughout all areas of a country. Market factors such as population density, customer type, timing of entry and penetration levels will determine which strategy is used in different areas and at different stages of market development. As such, service based competition through the resale of network capacity could be an important element of the overall state of competition in the 3G market.

Currently the EU obliges companies with a market share of over 50% to open their networks to other users at a cost-plus-margin-based price and for the moment, only KPN Mobile is in this position. Other licensed operators with market shares of more than 35% do not have to charge on a cost-plus-margin basis, so leasing from them could be more expensive.

A retail minus avoidable cost[78] approach may be more appropriate in situations wherein the MVNO does not employ a significant network of its own in the delivery of services, relying instead on pure resale of the network operator's 3G services. Even though this form of resale is not based on facility competition, it can be an important component of the competitive environment in the 3G market. Such resale would facilitate market entry and enable MVNOs to obtain information about demand characteristics and the likely response of competitors in the 3G market. This would reduce the risks associated with infrastructure deployment and thereby assist an MVNO in making efficient build or buy decisions and about if and when to deploy its own infrastructure. In this way, simple resale of 3G capacity can encourage entry of efficient service providers of retail 3G services.

Non-price requirements

In addition to pricing issues, network operators can discriminate against MVNOs in respect to the quality, functionality and availability of the services offered them. Measures that can help ensure that licensed operators do not discriminate against MVNOs include:

- licensed operators being required to publish specifications and standards for all carrier services used by MVNOs in respect to: service functionality, quality and performance; and the terms and conditions of service provision, operation and maintenance
- implementation of measures to ensure that licensed operators do not discriminate between their own retail operations and MVNOs in the timing of service delivery and the provision of information not generally available to all MVNOs
- measures to ensure that proprietary MVNO commercial information such as marketing and business plans, forecast capacity requirements and intentions as to the provision of value added services which may need to be passed over to network operators for network dimensioning and network conditioning purposes is not used by operators for competitive advantage
- development of safeguards to ensure that customer information which is captured in the network of the licensed operator as part of service provision to MVNOs is not used by the operator for competitive advantage
- development of procedures for the identification and assessment of any actual or claimed spectrum capacity constraints which would prevent MVNOs from acquiring the capacity they require to effectively compete in the 3G services market
- ensuring that the regulatory authority has sufficient powers to enforce these anti-discriminatory provisions and is capable of arbitrating disputes between MVNOs and network operators.

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[78] The retail-minus avoidable cost approach can be designed to promote efficiency, by removing from the wholesale price, retail costs that can be expected to be avoidable over the long run if the network owner was not providing a retail service. Conceptually, such avoided costs consist of three basic components:

the long run incremental costs that an efficient provider of the retail function would incur including, among other things, elements of the retail price for the network subscription, the cost of the radio facilities linking the handset to the base station and any fixed network components which provide services allowing any-to-any connectivity between mobile customers and fixed network customers, such as the local loop

any additional costs the network owner incurs in the provision of retail services that are attributable to production inefficiencies

any excess economic profit (i.e. monopoly mark up) earned by the network owner at the retail stage in the provision of the retail service.

5.2 Infrastructure Sharing

An important consideration is the extent to which infrastructure sharing will be an obligation imposed on 3G license holders. The sharing of existing or new network infrastructure: can promote economic efficiency and, by ensuring that new entrants are able to compete effectively against existing infrastructure owners offering 3G or competing broadband or mobile services; can prevent wasteful duplication of resources. In addition, network sharing can reduce infrastructure cost and consequently the up front investment burden on new entrants thereby enabling new entrants to compete more effectively; and can offer services quicker than would otherwise be the case.

The European Commission intends to launch without delay, within the scope of legislation in force, a dialogue with the Member States and the operators and equipment manufacturers, in order to explore concrete means to facilitate deployment of 3G networks and services. The issues to be addressed include, inter alia: legal treatment of delays in 3G deployment with respect to deployment obligations; licence duration and the impact of simultaneous roll-out requirements in several Member States. Also to be addressed are conditions to be met in order to permit network infrastructure sharing79, which the Commission considers in principle positively due to its potential economic gains, on the condition that the competition rules and the provisions of other relevant Community law are respected.

It is sometimes argued that infrastructure sharing runs contrary to the objective of infrastructure competition between network providers[80]. This depends on the type of infrastructure being shared and the terms and conditions, including the time period for which infrastructure sharing to be made available. Most network operators currently share site facilities in order to co-locate network equipment. This is increasingly common for fixed networks where ducts and exchanges are being used to house competitor’s equipment or cabling. For mobile operators, site and tower sharing has been commonplace for several years and has generally been considered to have promoted new entrant ability to compete against incumbent operators who already have the facilities available, usually having occupied the best available sites. Such site and facility sharing has also prevented wasteful facility duplication and from an environmental perspective has had a positive impact.

Another important issue that may need to be explicitly set out as part of the license conditions on 3G operators is the billing and settlement arrangements to apply between 3G operators. Regulatory bodies could make standardised billing a requirement in its licensing conditions for bidders of 3G licenses since this may also help provide data necessary for monitoring the development and growth of the market.

Telecommunications operators are preparing for the exchange of increasingly complex and diverse billing data, to deal with 3G communications and other vast arrays of future wireless/fixed services. To manage these changes and developments, operators are ensuring they are fully prepared for the new worldwide industry standard for the exchange of billing information known as TAP3[81].

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[79] European Commission, *The Introduction of Third Generation Mobile Communications in the European Union: State of Play and the Way Forward*, COM(2001)141 final, Brussels, 20.3.2001.

[80] “EU’s Monti repeats concerns over 3G network sharing”, *Mobile & Satellite,* 9 May 2001.

[81] TAP3 has special characteristics to make it simpler and easier for global roaming operators to exchange billing information between them. Some special features of the new billing exchange include the following:

Internet services of Fixed Line type quality (GPRS and HSCSD)

Pre-paid roaming and short codes translation (CAMEL)

Separation of business and private billing profile (MSP)

Support of Private Numbering Plans (SPNP)

SIM Application Toolkit

Enhanced Full Rate Codec (EFR)

Fraud Information Gathering System (FIGS)

Home Network repricing

Call Level Discounts

Additional charging parameters

5.3 The evolving 3G value chain

The UMTS forum has identified 3 generic business models for the provision of 3G services[82].

Under the 'access focused' model, the 3G services operator provides mobile and IP network access and other services, maintaining a direct relationship with the end user, but does not provide third-party billing or content aggregation services. In this situation the Access Focused operator does not receive a share of the additional revenue opportunities such as advertising, premium subscription or transaction fees. The Access Focused services provider can be an existing mobile network operator or a new entrant (e.g., Mobile Virtual Network Operator) from either the mobile or fixed Internet industry.

The 3G services provider utilising the 'portal focused' model provides access to the mobile network and the IP network, as well as direct end-user billing. The portal focused services provider includes access to selected partners' content through content aggregation and third-party billing. Therefore, they are able to share in new revenue streams eg., from m-commerce transactions, advertising fees and content based subscription fees.

In the 'mobile specialised services' model, the 3G service provider can offer user-to-user services that are not necessarily Internet-centric and can include Customised Infotainment, Mobile Internet Access or Mobile Intranet/Extranet Access. Mobile Specialised Services can be offered by either Access Focused or Portal Focused 3G services providers.

The three business models can be characterised by their positioning along the 3G services value chain shown in Figure 5.2. A Portal Focused 3G service provider aggregates and customises portal content, providing third-party billing as well as mobile and IP network access with end-user billing. An Access Focused 3G services provider only provides the mobile and IP network access with end-user billing. Mobile Specialised Services can be offered by any type of service provider at any point in the value chain.

Analysts expect the market opportunities throughout the value chain to be considerable. As noted earlier, there are expected to be more than a billion mobile users by the year 2003, and more than 2 billion in the next ten years; some industry reports predict such dimensions of subscribership to translate to about US$600 billion or 70% of forecasted total cellular service revenues. Analysts also expect that declining equipment costs and falling airtime price will enhance the take up of 3G service to make it the prime driver in customer usage.

There are predictions of significant revenue opportunities in various parts of the value chain for mobile services, from network operators and services providers to infrastructure and device manufacturers, applications developers and content providers. The multimedia service provider is expected to be one of the key players in the multimedia value chain. Analysts expect that revenue will be increasingly diverted from the traditional operators to other market players in the value chain, and many network operators are already adopting new business strategies to broaden their role and to defend their competitive position.

5.4 Network Interconnection

Competition is not assured without proper frameworks for interconnection. Interconnection is perhaps the most contentious regulatory issue in telecommunications. And indeed, the terms and conditions associated with interconnection of 3G services to existing networks can be expected to be a very important determinant of the success or otherwise of 3G.

Experience indicates that issues surrounding the pricing and development of terms and conditions for interconnection are complicated, time consuming and difficult to resolve[83]. Disputes between operators involving interconnection pricing are common and can frustrate the introduction of new services. In many cases interconnection disputes are used by incumbent operators as a strategy to frustrate the introduction of new services, to allow time for competitive positioning of their own services, and to damage new competitors through (a 'price-squeezing') imposition of high interconnection rates.

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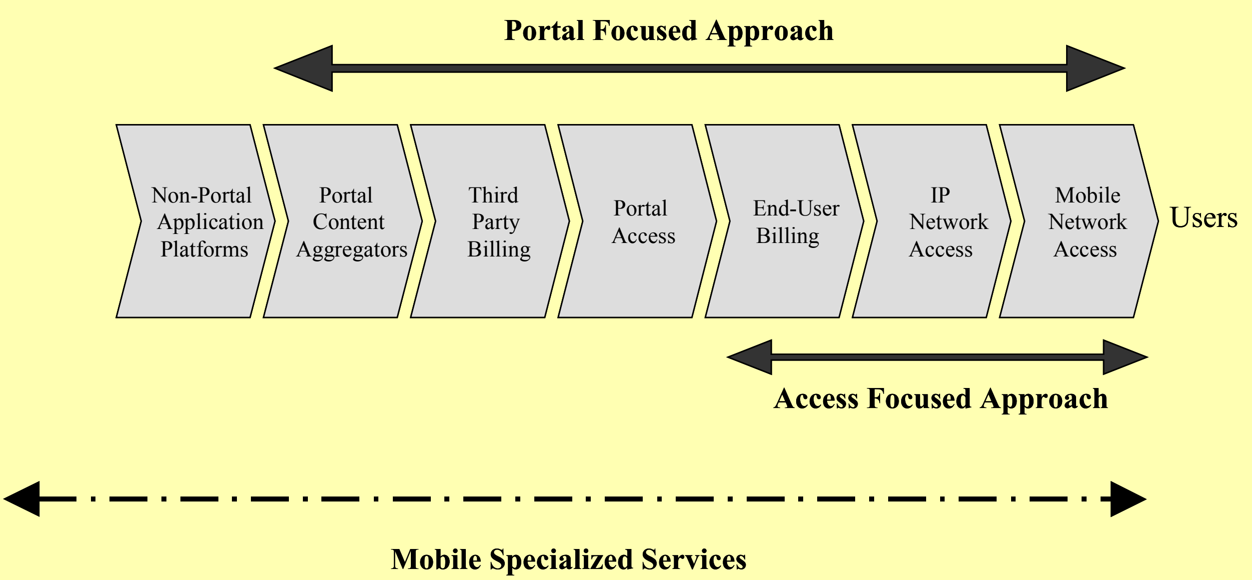
[82] UMTS Forum Report No.13 "The UMTS Third Generation Market - Phase ii: Structuring the Service Revenue Opportunities" 2001.

[83] See for instance, ITU Briefing Paper, Fixed-Mobile Interconnection Workshop, ITU New Initiatives Programme, 20-22 September 2000, Geneva, Document: WFMI/04.

Figure 5.2: The 3G value chain[84]



Source: Telecompetition Inc., February 2001

Irrespective of the packet-switched transmission functionality built into 3G networks, 3G operators will require access to content providers connected to fixed line PSTN switch-based networks. 3G operators will also require access to customers on fixed line PSTN and mobile networks to terminate voice and data calls made by their customers. The PSTN and mobile networks with which 3G operators will need to interconnect do not in the main utilise packet switching or IP based protocols for the carriage of traffic through their networks. As a result, 3G operators will face identical problems to those currently being faced by operators throughout the world in regard to Internet and data traffic.

There are essentially two possible generic models that can govern the interconnection relationships between 3G operators and other network infrastructure providers. These models are essentially the same models that define the interconnection relationships between fixed network operators and current 2G mobile operators. These are:

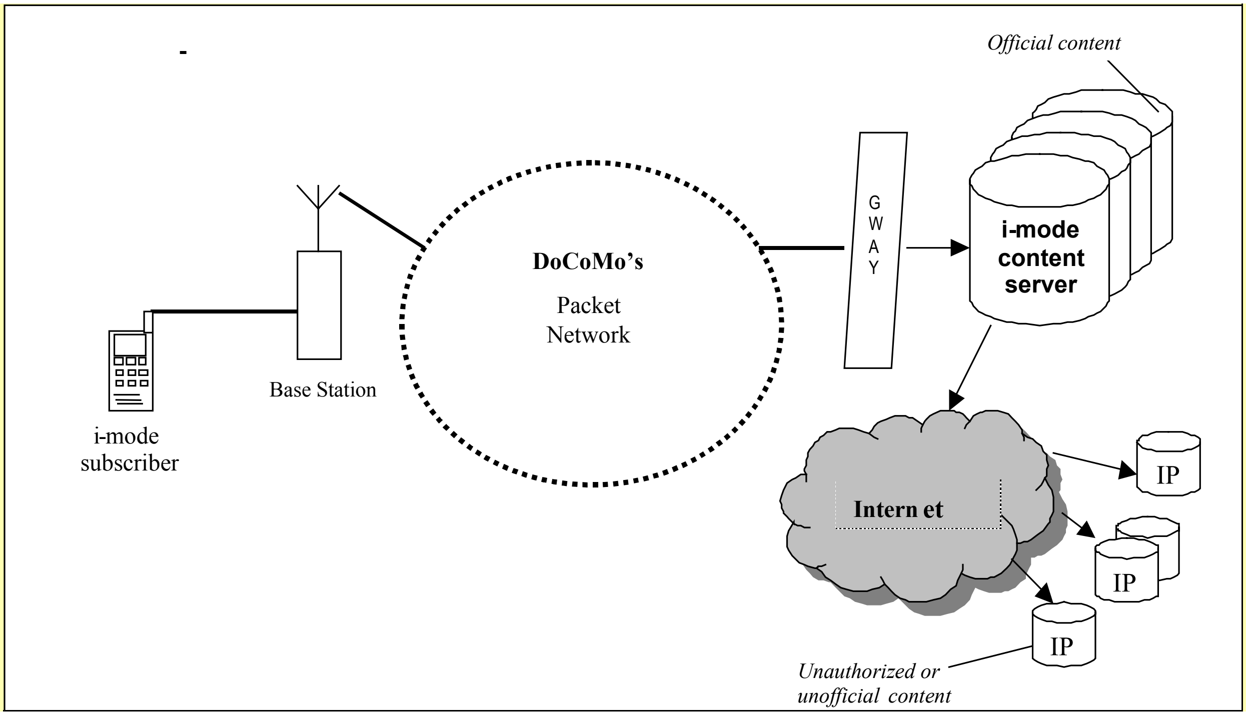
- a 'termination access' model whereby the 3G operator terminates a 3G call on a fixed or mobile network and "buys" a terminating service for this purpose; and
- a 'bill and keep' arrangement whereby each network meets the costs of a call transported through its own network.

One of the outcomes of the terminating access model as it has applied in Europe has been the extraordinarily high mobile termination rates imposed by carriers which are subsequently reflected in retail prices paid by customers. As discussed earlier, the bottleneck nature of the mobile terminating service has meant that mobile operators can impose unconstrained charges on competitors requiring terminating services.

It appears that high termination rates and the danger that operators will face losses if customers make long held Internet or data calls while paying flat rate untimed usage charges has been at least part of the reason why the i-mode network in Japan has been configured as a "closed" network. Although current content providers on the i-mode platform provide content directly to users, they are not necessarily acting as Internet Service Providers. They offer a pure content service and in this regard, they have been referred to as content aggregators. For i-mode and EZWeb, traffic is routed to the operator's ISP gateway and users are not permitted to choose their own ISP. Furthermore, content providers, be they ISPs or not, do not have access to the operator's network. In order for them to provide content, they must seek approval by DoCoMo. The i-mode configuration is shown diagrammatically in Figure 5.3.

[84] UMTS Forum Report No 13, pg 14

Figure 5.3: The i-mode network and access to ISPs



Source: ITU, "3G: Japan Case Study", July 2001.

This means that, in effect, DoCoMo's packet-based network is "closed" to other ISPs. For mobile users to browse i-mode sites, they must use DoCoMo's ISP service.

However, in March 2001, DoCoMo announced that it is considering opening up access to its packet-based network by opening up the specifications for its i-mode server and access gateway. The interconnection arrangements between these operators and ISPs will be a key issue prior to the opening up of the i-mode networks to additional ISPs.

In this context, it is pertinent to note that a Japanese government Study Group which was set up in July 2000 and which released its final report in June 2001 (on "Business Models for Next Generation Mobilephones") endorsed DoCoMo's plans to open its network to other ISPs by 2003. The report also mentions KDDI's plans to open its mobile "EZ-web" network on a case-by-case basis but does not confirm a date. J-phone has yet to declare an open network strategy but is considering the possibility. The report emphasizes the importance of open network access to the expansion and success of future mobile services. It argues that an open network policy will allow new players to enter the mobile browsing market and provide a basis for the development of mobile virtual network operators and alternative information providers.

The constraints and tensions of the terminating access model for the interconnection and delivery of broadband services is currently being highlighted in interconnection disputes (e.g. in the UK, US and Australia) concerning the provision of Internet services to fixed line customers. The issues arising in these disputes will be identical to those that will be faced by 3G, GPRS and i-mode operators requiring access to content services from ISPs directly connected to fixed line networks.

The limitations of the terminating access model, noted above, makes its use in a broadband environment Nproblematic. Even where it has been determined that the model will be used to define the interconnection relationships between 3G and other operators, difficult and complicated decisions as to the pricing of interconnection services will still be required where the operators cannot reach a negotiated commercial resolution. These pricing decisions are likely to be particularly complex in a 3G broadband environment within which new allocation rules will need to be developed to allocate the common costs of the traditional PSTN network to multimedia, interactive and data services.

These issues could be overcome through the introduction of the “bill and keep” approach to interconnection. Under the bill and keep model each carrier is responsible for carrying the call through its network and for charging its customer (either the A party or B party) appropriate retail charges which reflect network usage costs and other commercial considerations. In this situation, no interconnection payments are made by either carrier. In this context it is worth noting that interconnection in SMS is already generally based on a sender-keeps-all ‘bill and keep’ approach, partly because an SMS message is registered only at the point at which it enters the network (and perhaps partly because SMS traffic is relatively new and has not been significant until recently).

In order for the bill and keep model to operate successfully, the 3G operator must be able to interconnect as close as possible to the ISP at the local exchange. This can only be achieved if appropriate unbundling arrangements are in place to ensure that the 3G operator is not charged for network elements it does not use to acquire interconnection. At a minimum, a number of network elements must be made available to the interconnecting carrier in order for the bill and keep model to operate effectively: an unconditioned local loop service, which involves the use of unconditioned (copper) communications wire between the network boundary (on the end-user's side) and a point at which the wire terminates; local PSTN originating and terminating services, which involve the carriage of communications between customer premises equipment and a point on the trunk side of the local switch. The introduction of “bill and keep” for interconnection is especially relevant where the call charges that a carrier applies is unmeasured or ‘flat’. In this situation, it is not viable for a new entrant to provide services through interconnection with the incumbent for both call termination and call origination if interconnection charges are levied on a timed basis. In the early years of 3G operation, it is likely that 3G operators will utilise such flat rate or unmetered pricing structures to attract customers. As a consequence, the bill and keep approach to interconnection may be particularly suited to interconnection with fixed networks.

6 Globalizing 3G and the role of international agencies

An important part of the vision of 3G service is seamless international roaming capability[85]. But such global roaming will require resolution of a number of technical as well as commercial and regulatory issues. It will also necessitate harmonisation of policies based on international cooperation.

6.1 International Roaming

Significant technical complexities need to be resolved to enable 3G global roaming. There are currently five frequency bands approved for 3G and three different technologies. With different systems in different countries, for 3G services to have full interoperability, a number of interface issues affecting global roaming need to be resolved, including network-to-network interface, radio and user identity[86]. Another difficulty facing global roaming is that ‘frequency bridging’ of the same band ranges among different countries[87]. Adding to the difficulties, mobile handsets need to be either multi-mode if the interface issues are not resolved, or multi-band if there is no frequency bridging. Moreover, to enable effective inter-carrier roaming, a minimum set of services must be determined with other services progressively implemented by all 3G networks, including: Mobile Terminated SMS; Call Forwarding; International Call Forward; Mobile Originated Circuit Switched Data; Mobile Originated SMS; Mobile Terminated Circuit Switched Data; and M-commerce applications.

[85] A generic definition of the 3G inter-carrier roaming service is a customer’s ability to automatically access basic and enhanced multimedia services from another network when out of coverage of their home network using their same handset on the same access number.

[86] The network-to-network interface for inter-working among the different standards is necessary to enable network management, customer care and billing and service creation functions. The radio interface requires some form of global harmonisation to allow global roaming, but there are questions about the extent of full interoperability since there appear to be a number of competing optional modes. The third interface involves a User Identity Module (UIM) (similar to the current Subscriber Identity Module (SIM) card), which can be removable or fixed in a handset. The interoperability of UIM would allow over the air programming of services and applications among the different standards. The resolution of these interface issues will enable the possibility of global roaming among the three optional modes.

[87] ABN AMRO, Telecoms Sector Research, June, p 44

The Scandinavian countries were the first to develop a common standard, the Nordic Mobil Telephone (NMT) system. This allowed the introduction of international mobile roaming in the late 1980s between Denmark, Finland, Norway and Sweden.

In the 1990s there was widespread adoption of the GSM standard. This allowed international roaming to spread out from Europe to cover much of Africa, Asia and Oceania. Initially, this used only the 900MHz band. However, as 1800 MHz services came into operation and as dual-band telephones became more common, roaming using both frequency bands became possible. A customer of a 900MHz operator in one country could roam into the network of an 1800 MHz operator in another country and vice versa.

GSM roaming excluded the Americas and some parts of Asia, notably Japan and South Korea. In those countries different standards were used that are incompatible with GSM. Some users solved this by hiring phones on arrival in the foreign country. For some networks in North America, it was possible to take a standard GSM SIM card and put it in a local phone allowing roaming on the other protocol.

A more satisfactory solution was found by developing new handsets. GSM handsets are available which support the PCS-1900 standard used in the Americas. These are either dual-band (900 and 1900) or, increasingly, tri-band (900, 1800 and 1900) and work in all the GSM countries, plus the USA, Canada and some countries in South America. Additionally, some handsets have been developed which support both GSM and the PHS standard used in Japan.

Thus INTUG has concluded that there are now few technical obstacles to international roaming[88]. However, for several years INTUG has been expressing concern at the very high costs on international mobile roaming. While telecommunications charges have generally declined, roaming bills have increased. Although other telecommunications costs are predictable and under control, roaming bills are not and this has been inhibiting use of mobile telephones during international travel.

To facilitate international mobile roaming the GSM Association created a framework in the Standard Terms for International Roaming Agreements (STIRA) that considerably simplifies negotiations between operators. With over two hundred GSM operators around the world, a dependence on bi-lateral agreements could be extremely onerous. In 2000, the GSM Association created the GSM Global Roaming Forum (GGRF) which allows the participation of non-GSM operators in the development of global roaming services. In particular the GGRF endeavoured to be part of the preparation to facilitate global 3G roaming.

Customer Protection Issues

Complex data protection issues will need to be resolved. Uniform and transparent data protection and privacy frameworks will need to be implemented among countries providing 3G roaming capabilities, including a clear definition of the responsibilities of the home and the visiting network in the protection of customer information and data.

6.2 Global circulation of IMT-2000 Terminals

Most countries employ a system of product certification or type approval for radio handsets. This ensures that terminals sold in a particular country conform to prescribed domestic standards and regulations, e.g. consumer protection legislation and technical interference. However, such systems are not designed to facilitate the circulation of radio handsets in foreign jurisdictions. Since international roaming is one of the key visions of IMT-2000, developing a framework for the efficient global circulation of handsets has become a priority for both industry and governments.

There are two requirements for global circulation. The first relates to a subscriber's right to carry a personal handset into foreign countries and to use it subject only to network coverage and commercial roaming arrangements between operators. This issue is currently being considered by the ITU-T, which is soliciting agreement on the following aspects: type approval, licensing requirements and customs/duties for visiting terminals[89]. This aspect deals with the temporary entry of pre-established terminals and their exemption from regulation, and has the following fundamental principles:

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[88] International Telecommunications Users Group (INTUG), "International mobile roaming and competition law", Version 2 – draft, July 2001.

[89] See ITU Circular Letter No. 97 available at http://www.itu.int/osg/imt-project/circulation.html.

1. The personal use by visitors of IMT-2000 terminals should not require any individual licence.
2. Such terminals should not be subject to additional certification or type approval procedures.
3. National Customs Authorities should exempt IMT-2000 terminals, intended for personal use by visitors.

The second requirement concerns restrictions imposed on foreign manufacturers for the import of handsets in a given country. This will most likely be dealt with through Mutual Recognition Agreements (MRAs), which are negotiated bilaterally and are measures for the mutual certification of radio equipment imported or exported for the purpose of conventional and permanent use.

Both requirements need to be addressed. Since resolution of the visiting terminal issue requires international agreement, the ITU has prioritised the issue and is currently receiving proposals and comments from member states.

Box 6.1: Barriers to Global Circulation --The Case of Japan

In Japan, global circulation for visiting terminals is covered under the *Radio Law* under which each radio station requires a license to operate. Since a handset is defined as a "radio station", each handset in Japan requires a radio license under the Radio Law. However, handsets can be covered by an operator's comprehensive or blanket license such that all the operator's handsets in circulation are deemed to be licensed. The comprehensive license is valid for a period of 5 years and for a limited number of handsets.

The *Radio Law* also covers the issue of foreign radio stations. To be granted entry to operate within Japan, foreign radio stations, including 3G stations, must comply with the technical standards set out in the *Radio Law*. However, the actual procedures for demonstrating such compliance are not yet in place and indeed have yet to be determined. Japan is apparently hoping for the possibility of a 3G MOU (similar to the GMPCS MOU[90]), before determining which procedures need to be followed for foreign handsets.

In April 2001, a significant breakthrough was made when the European Union and Japan signed a mutual recognition agreement (MRA) for equipment standards on a limited range of products. This will facilitate trade between the EU and Japan because manufacturers will not have to demonstrate that their equipment meet domestic standards prior to export. However, the MRA only covers a few countries and does not address the issue of visiting terminals. Thus, considerable work remains to be done to enable 3G users to roam freely from country to country.

Source: ITU, "3G: Japan Case Study", July 2001.

6.3 International policies and the role of international agencies

There has been surprisingly limited attention given to establishing internationally co-ordinated policies relating to the licensing of telecommunications operators[91]. While the regulatory principles attached to the February 1997 WTO agreement on basic telecommunications recognises the importance of licensing, it refers to it only in the following very broad terms:

"Where a licence is required, the following will be made publicly available:

(a) all the licensing criteria and the period of time normally required to reach a decision concerning an application for a licence; and

(b) the terms and conditions of individual licences.

The reasons for the denial of a licence will be made known to the applicant on request."

The European Commission's April 1997 Directive on Licensing[92], designed to simplify and harmonise licensing within the European Community, was the first initiative to harmonise licensing policy at an international level. The EU directives argued cogently for harmonisation based on minimum licence conditions. However, in the case of allocating scarce spectrum resources, the EU directive left it to individual member countries to determine the licensing method to be used.

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[90] See http://www.itu.int/GMPCS/gmpcs-mou/.

[91] For a detailed discussion on the need for international harmonisation of licensing, see P. Xavier, "The licensing of telecommunication suppliers: Beyond the EU's Directive", Telecommunications Policy, vol.22, no. 6, July 1998, pp. 483-492.

[92] Directive No 13/1997/EC of the European Parliament and of the Council of 10 April 1997 on a common framework for general authorisations and individual licences in the field of telecommunications services.

In 1999 the EC released another document aimed at a co-ordinated introduction of a 3G system[93]. In July 2000, the EC proposed a new regulatory framework for electronic communications services and this is an indication that the need for more consistent policies at an international level is being recognised. One of the aims of the EU's proposed legislation[94] is that national authorities be required to consult each other prior to licensing so as to ensure consistency in the licensing methods and conditions for services that are offered by operators in several parts of the Single Market. Under the proposed Framework Directive, the measures related to the use of radio spectrum envisaged by a Member State would have to go through a consultation process with the responsible authorities of other Member States and the European Commission. The Commission would retain the ultimate power to require a Member State to amend or withdraw the proposed measure if it were in contradiction with the policy objectives of the new framework.

The Commission also proposed a Decision on a regulatory framework for radio spectrum policy. This Decision would provide for an EC level policy platform for addressing all issues relating to the use of radio spectrum. It foresees a mechanism to harmonise the allocation, assignment and conditions of use of radio spectrum.

International initiatives to co-ordinate 3G development

Can 3G development that provides global interoperability and inter-working be left to industry initiatives? GSM roaming currently depends on bilateral agreements among individual operators using leased lines. With the growth in the number of GSM operators, the arrangement has proven to be unwieldy.

The difficulties in achieving global harmonization of different technology proposals for 3G pose risks to the vision of global roaming. In Europe, the European Telecommunications Standards Institute (ETSI) is responsible for progressing the standardisation process in Europe. In recognition that a global rather than regional approach is necessary, the Third Generation Global Partnership (3GPP) was formed in late 1998, designed to spur efforts to facilitate a standardized transition to 3G mobile.

There are indications that views (e.g. in the European Commission[95]) are changing towards an acceptance of interoperability through inter-working technologies rather than any insistence on standardisation based on an enforced single technology.

Of course, the deliberations in regard to 'harmonised' policies would need to go beyond the EU's 15 Member countries to cover the wider international community. International cooperation will be useful not only in terms of finding immediate solutions for 3G services. It may also help in defining future licensing principles aimed at minimising the negative effects of fragmentation and to tackle issues related to the organization of further licensing rounds. These subsequent licensing rounds will be required in order to assign additional radio spectrum identified at WRC-2000 for IMT-2000 applications and the additional spectrum needed between 2005 and 2010 to accommodate the expected increase of 3G traffic.

7 Conclusion

The successful development of 3G service will depend primarily on the private sector. However it can also be crucially influenced by the extent to which a regulatory environment facilitates market entry by appropriate licensing policies but also post-entry competitive conditions. It is important for governments to ensure that the licensing framework is used positively to assist the development of effective competition and the generation of new and innovative 3G services rather than be preoccupied with the amount of revenue raised.

Indeed, the problems being faced by some operators that were successful in obtaining a 3G licence at a high auction price is underlining this point. Not surprisingly, in view of the 3G licence and infrastructure development costs, the operators are keen to launch 3G services in order to start generating revenue as soon as possible. But the financial burden of licence prices, compounded by the market uncertainties and downward assessment of the value of telecommunications shares, has made it harder for operators to raise loans. This situation is contributing to delays in the introduction of 3G service.

[93] Decision No 128/1999/EC of the European Parliament and of the Council of 14 December 1998 on the co-ordinated introduction of a third-generation mobile and wireless communications system (UMTS) in the Community (OJ L 17, 22.01.1999, p.1).

[94] Proposal for a directive of the European Parliament and of the Council on a common regulatory framework for electronic communications and services. COM(2000)393, July 12th, 2000.

[95] J. Lembke, "Harmonisation and globalisation: UMTS and the single market", info, vol. 3, No. 1, February 2001, pp. 015-026.

Clear and stable licensing conditions and policy parameters well known to potential bidders prior to the commencement of the licensing process are key requirements for efficient implementation of a licensing framework. This will allow potential bidders of 3G licenses to develop business plans and determine the value of licenses with the maximum amount of available information.

This is particularly important in developing countries where social developmental and coverage concerns are paramount. Governments can ensure that that these priorities are recognised in the form of clear, transparent and explicit requirements which are known to all potential license bidders prior to the auction. This will help prevent subsequent resistance from operators in fulfilling these obligations and will limit arguments by operators that the rules were not known up front.

In this context, there are significant concerns about licensing practices for 3G operators. Different license allocation procedures have been used, with some countries using auctions and others, comparative selection ('beauty contests'), or a mixture of the two. The number of licences awarded has also varied between countries (commonly from four to six), and the charges paid for the licences have been strikingly different. In addition, licences awarded in some countries have had more demanding infrastructure and service rollout conditions attached than in other countries. Moreover, access conditions to 2G mobile networks to enable 'national roaming' also varies from country to country. This discord in licensing practice could significantly fragment 3G markets.

The high auction prices as well as the high infrastructure roll-out costs have drawn attention to the question of whether 'cost sharing' should be permitted. Here again, country positions differ and the issue warrants attention to provide principles/ guidelines to establish conditions under which the costs of 'cost sharing' (in regard to any erosion of competition) can be minimised and its benefits maximised.

There are also a number of important 3G issues that will need to be resolved after market entry has been effected and infrastructure deployed. Interconnection arrangements are among the most important of these issues. Simply mandating access to roaming as part of the license conditions of a successful 3G licensee is unlikely to be adequate. There will be need for regulatory safeguards to ensure conditions enabling effective roaming so that customers get the full benefits of 3G services. These regulatory safeguards should form an integral part of a regulatory framework applying to 3G roaming, including pricing guidelines and provisions preventing anti-competitive collusive behaviour.

MVNOs, like other service providers offering resale of network capacity on fixed or mobile networks, can potentially offer better utilisation of network capacity, an innovative expanded range of services and greater incentives for price competition. However, experience thus far (in the UK, Sweden, Norway, Finland and Denmark) indicates that mobile operators are likely to be reluctant to provide MVNOs access thus far to their networks. Thus, commercially negotiated outcomes are likely to be slow to arrive at. In such circumstances it is doubtful whether MVNOs can survive in the longer term without regulatory intervention. Where Governments consider MVNOs to be an appropriate means of promoting competition and service delivery, regulatory intervention to set prices and conditions of access and to restrict anti-competitive behaviour by licensed operators towards MVNOs is likely to be necessary.

The paper draws attention to significant changes that will be required in interconnection arrangements relating to 'always-on' 3G services, and points to the need for further careful examination of 3G interconnection issues. The currently used terminating access model of interconnection is likely to be inappropriate as the basis of interconnection for 3G service to other networks. This is because time based interconnection charges for 'always on' interconnection, especially where customers are charged on a flat rate basis, can potentially create significant losses for 3G operators.

Under a 'bill and keep' approach, 3G operators can price their services to promote rapid take-up of 3G by consumers while avoiding the danger of a squeeze on profit margins because of the need for access to bottleneck PSTN access services. However, there is need for further investigation of 'bill and keep' and other approaches to 3G interconnection.

The desire for roaming goes beyond national boundaries. Indeed, as noted earlier, part of the vision of 3G service is for a seamless international roaming capability. But such global roaming will require resolution of a number of technical as well as regulatory issues to effect interoperability and inter-working. It will also necessitate resolution of standardisation issues and harmonisation of policies. The need for international cooperation to expedite this is pressing. In this regard, the role played by international agencies such as the ITU will be of critical importance.

ANNEX 1:

3G LICENSING IN VARIOUS ECONOMIES

Country	Licence Process	Date of Licencing		Initial Cost(US$)		Operator
Argentina		end	2001	between US$500 and US$600 m from the licenses		
TOTAL						
Australia	A	March	2001	$148.0		Telstra
Australia	A			$12.2		C&W Optus
Australia	A			$96.4		Hutchison
Australia	A			$12.4		Vodafone Pacific
Australia	A			$4.6		CKW Wireless
Australia	A			$78.1		3G Investments Australia
TOTAL				**$351.7**	million	
Austria	A	November	2000	$104.0		Connect Austria
Austria	A			$99.0		Hutchison 3G
Austria	A			$103.0		max.mobil
Austria	A			$98.0		Mannesmann 3G
Austria	A			$105.0		Mobilkom Austria
Austria	A			$101.0		Telefonica 3G
TOTAL				**$610.0**	million	
Belgium	A	February	2001	$139.6		Mobistar
Belgium	A			$139.6		KPN Orange
Belgium	A			$139.6		Proximus
Belgium	A					fourth license will be issued later
TOTAL				**$418.8**	million	
Canada	A	January	2001	$720.50		Bell Mobility
Canada	A			$393.50		Rogers Wireless
Canada	A			$356.00		Telus
Canada	A			$11.40		W2N
Canada	A			$0.60		Thunder Bay Telephone
TOTAL				**$1'482.00**	million	
Chile	B	September?	2001			Entel PCS has announced plans to introduce IMT2000 services by end 2001
TOTAL						
China	B	Q4	2002			
TOTAL						
Croatia	A & B	Q4	2001			The GSM network, VIPnet has a guarantee that no licenses would be offered until 2003 -so this will have to be resolved before the 3G licenses can be awarded
TOTAL						
Czech	A	Second half	2001			3 incumbent GSM operator + one new operator by auction
TOTAL						
Denmark	A	October	2001			Bidders will submit sealed bids, and the winners will all pay the lowest of the winning bids. The licenses will last 20 years
TOTAL						
Estonia	B	To be confirmed	2001			An advisory commission is recommending that there will be four licenses, with a single fixed fee of between US$4 and 8m
TOTAL						
Finland	B & F	March	2000	Euro 1000 per 25KHz license admin. Fee		Sonera
Finland						Suomen 3G
Finland						Radiolinja
Finland						Telia
TOTAL						
France	B & F	July	2001	Fixed fee of US$4.5b per license		Orange
France						SFR
TOTAL						

Country	Licence Process	Date of Licencing		Initial Cost(US$)		Operator
Germany	A	July	2000	$7.70		E-Plus
Germany				$7.62		Group 3G
Germany				$7.63		Mannesmann
Germany				$7.65		MobilCom
Germany				$7.60		T-Mobile
Germany				$7.67		VIAG Interkom
TOTAL				**$45.87**	billion	
Greece	A	July	2001			Participants expected to include Orange, H3G Europe, Wind, DEH, Cosmote, Stet Hellas, Panafon Vodafone.
TOTAL						
Hong Kong	F	September		See Comment		There will be a beauty contest - followed by an auction.
TOTAL						
Hungary		Q4	2001			
TOTAL						
India	A		2001			
TOTAL						
Indonesia	B		2002			
TOTAL						
Ireland	B	Early	2001	licenses with an estimated price of US$116 - $140m		
TOTAL						
Isle of Man	-			-		Manx Telecom
TOTAL						
Israel	A	July	2001	minimum 100m bid per license		
TOTAL						
Italy	A	October	2000	$2.01		H3G
Italy				$2.02		Ipse
Italy				$2.01		Wind
Italy				$2.03		Omnitel
Italy				$2.00		Telecom Italia Mobile
TOTAL				**$10.07**	billion	
Jamaica	?	Early	2002			2 licenses will be auctioned
TOTAL						
Japan	B	June	2000	-		NTT DoCoMo
Japan				-		J-Phone
Japan				-		KDDI
TOTAL						
Korea (Rep of)	B & F	Q4	2000	$1.10		KTICOM
Korea (Rep of)				$1.10		SK Telecom
Korea (Rep of)				$0.88		LG Telecom
TOTAL				**$3.08**	billion	
Latvia		sometime	2001	est. around US$3.5m per license		
TOTAL						
Liechtenstein	-	February	2000	-		VIAG EuroPlattform
TOTAL						
Luxembourg	B	Q$	2001			
TOTAL						

Country	Licence Process	Date of Licencing		Initial Cost(US$)		Operator
Malaysia	B	End	2001			
TOTAL						
Monaco	-	June	2000	-		Monaco Telecom
TOTAL						
New Zealand	A	January	2001	$16.70		Telecom NZ
New Zealand				$13.20		Vodafone Mobile NZ
New Zealand				$11.20		Clear
New Zealand				$10.30		Telstra Saturn
TOTAL				**$51.40**	million	
Norway	B	November	2000	$11.20	*(11.2m per year)*	Telenor
Norway				$11.20	"	NetCom
Norway				$11.20	"	Broadband Mobile
Norway				$11.20	"	Tele2 Norge
TOTAL				**$44.80**	million	
Poland	A	December	2000	$223.00		Plus GSM
Poland				$223.00		Center Tel
Poland				$223.00		ERA
TOTAL				**$669.00**	million	
Portugal	B & F	December	2000	$90.00	Licence Fee	Telecel
Portugal				$90.00	Licence Fee	TMN
Portugal				$90.00	Licence Fee	Optimus
Portugal				$90.00	Licence Fee	Ony Way
TOTAL				**$360.00**	million	
Russia		Q3	2001			
TOTAL						
Singapore	-	April	2001	$55.20		MobileOne
Singapore				$55.20		SingTel
Singapore				$55.20		StarHub
TOTAL				**$165.60**	million	
Slovakia	B	Q4	2001			two guaranteed to the two existingGSM networks
TOTAL						
Slovenia	B + A	Middle	2001	$113.00	(reserve price)	
TOTAL				**$113.00**	million	
South Africa		sometime	2001			3 for incumbents, 2 for fixed line
TOTAL						
Spain	B & F	March	2000	$111.00		Airtel
Spain				$111.00		Amena
Spain				$111.00		Telefonica
Spain				$111.00		Xfera
TOTAL				**$444.00**	million	
Sweden	B	December	2000	$11.02	Fee plus	HI3G Access
Sweden				$11.02	Fee plus	Europolitan
Sweden				$11.02	Fee plus	Tele2
Sweden				$11.02	Fee plus	Orange Sverige consortium
TOTAL				**$44.08**	million	
Switzerland	A	December	2000	$29.00		Swisscom
Switzerland				$29.00		diAx
Switzerland				$29.00		Orange
Switzerland				$29.00		Team 3G
TOTAL				**$116.00**	million	
Taiwan	A	Q$	2001			
TOTAL						

Country	Licence Process	Date of Licencing		Initial Cost(US$)		Operator
Thailand						TOT (Telecommunication Organisation of Thailand) CAT (Communications Authority of Thailand)
TOTAL						
The Netherlands	A	July	2000	$666.80		Libertel
The Netherlands				$664.30		KPN mobile
The Netherlands				$407.00		Dutchtone
The Netherlands				$401.00		Telfort
The Netherlands				$369.00		3G Blue
TOTAL				**$2'508.10**	million	
The Philippines						
TOTAL						
U.A.E.						
TOTAL						
U.K.	A	April	2000	$6.90		Hutchison 3G
U.K.				$6.44		Orange
U.K.				$9.40		Vodafone
U.K.				$6.30		One 2 One
U.K.				$6.35		BT3G
TOTAL				**$35.39**	billion	
USA	A?	June	2002			
TOTAL						
Venezuela	A	June	2001	There will be a reserve price of US$100m per license		
TOTAL						

Legend: A: auctions; B: beauty contest; F: fixed fee.
Source: ITU.

ANNEX 2:

LIST OF ISSUES FOR THE WORKSHOP TO CONSIDER

A. Technical issues

A1. How stable is the definition of 3G mobile? How can the remaining 'standardization' issues relating to 3G be resolved?

A2. What are the technical issues generating concerns over a smooth migration of 2G to 2.5G to 3G mobile services? What measures can be adopted to resolve these problems?

A3. In what ways do technical issues affect the licensing process? To what extent should there be flexibility for licensed operators to choose their preferred technical platform to deliver 3G wireless services?

B The demand for 3G services

B1. Will the absence of a single global technology affect the speed of 3G roll-out? Will regional-national markets for hardware and applications/services develop? If so, will this have any effect on the deployment of 3G in small and low-income economies?

B2. How big is the market for 3G likely to become and do these forecasts justify the high prices paid for 3G licences and network roll-out? (For example, to what extent does the experience with NTT DoCoMo's *i-mode* service provide evidence of market demand and will this apply also outside Japan?)

B3. Market take-up of 3G mobile Internet will obviously depend on attractive pricing which in turn depends on flexible billing systems. What sort of pricing packages are likely to appeal to different types of consumers?

B4. Are the costs of deploying 3G likely to be an impediment to roll-out? Under what conditions should cost sharing be permitted/encouraged?

B5. To what extent have delays in the introduction of 3G services been a major problem? Are delays only to be expected (since delays in the introduction of new technologies are common)?

C. Licensing policies

C1. What are the relative advantages of auctions and beauty contests? Is it feasible to construct a 'hybrid' approach that optimises the advantages of each?

C2. What broad principles should guide 3G licensing (e.g., transparency, non-discrimination, efficient resource allocation etc…)?

C3. How might the special circumstances prevailing in developing countries be recognised in 3G licensing?

C4. What sort of obligations might be placed on 3G licensees (e.g, network deployment, social obligations, environmental obligations etc)? How should possible delays in deployment be handled by regulators?

C5. Do the potential gains of infrastructure sharing exceed its costs? What conditions should be met in order to help ensure that the gains of infrastructure sharing are maximised and costs minimised?

C6. Should spectrum trading be permitted? Under what conditions?

C7. How should radio spectrum left unused after the first round of issuing 3G licences be dealt with? What factors should determine the organization of subsequent licensing rounds (e.g. in order to assign the additional radio spectrum identified at WRC-2000 for IMT-2000 applications; additional spectrum will be needed between 2005 and 2010 to accommodate the expected increase of the 3G traffic)?

C8. Should national and international roaming be part of a 3G licence condition or left to market conditions? What further regulatory safeguards are necessary to ensure terms and conditions that allow effective and affordable roaming?

C9. Given that is quite likely that existing incumbent carriers will gain control of licenses to be granted, should one or more of those license be reserved for new entrants? If yes, under what conditions?

D Enhancing the competitive landscape

D1. What regulatory provision should be made for resale of 3G services and network capacity?

D2. Should access by Mobile Virtual Network Operators (MVNOs) to 3G networks be inscribed as a license condition (e.g. as in Hong Kong) or left to the market?

D3. Under what conditions should infrastructure sharing be permitted/encouraged?

D4. What are the implications of 3G mobile Internet for interconnection arrangements? Is this an area for regulatory intervention?

D5. In what ways will the different usage patterns engendered by the use of 3G mobile handsets for voice, information retrieval, as well as messaging require changes from today's regime for interconnection arrangements, for instance to accommodate "always on" connections?

D6. What characteristics in the licensing of 3G mobile operators are likely to contribute to a reduction in interconnection rates and retail tariffs?

E Globalising 3G and the role of international agencies

E1. What measures can be adopted to address impediments to international roaming?

E2. What measures can be adopted to facilitate the global circulation of IMT-2000 terminals?

E3. In what areas would closer international co-ordination help in resolving the regulatory and economic issues raised by 3G mobile services? What roles are international agencies/organisations playing? What roles should they be playing?

E4. What role, if any, should the ITU play in regard to the regulatory and economic issues raised by 3G mobile service?

E5. Is there a role for the ITU in efforts to resolve 3G issues of an international nature, including interconnection disputes, roaming, and global circulation of 3G terminals