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COMMUNICATION FROM THE COMMISSION

**TO THE COUNCIL, THE EUROPEAN PARLIAMENT,
THE ECONOMIC AND SOCIAL COMMITTEE
AND THE COMMITTEE OF THE REGIONS**

ON THE FURTHER DEVELOPMENT OF MOBILE

AND WIRELESS COMMUNICATIONS

Challenges and choices for the European Union

EXECUTIVE SUMMARY

This Communication presents an overview of developments in the mobile and wireless communications market within the European Community since the 1994 Green Paper on mobile and personal communications¹ and examines the future direction of mobile and wireless communications. It responds to the specific call following the Green Paper from the Council and from the European Parliament for the Commission to report on the development of mobile communications². It does this against the background of the market success of GSM and related digital communications services within the EC and world-wide; the increasing use of mobile communications to connect computers and to access the Internet; the development of satellite-based personal communications systems; the substantial regulatory progress made towards the full opening to competition of telecommunications markets in most Member States from 1 January 1998 and the successful conclusion of the WTO deal on basic telecommunications.

Building on these current developments, the communications industry is developing a strategic vision of the next generation of digital mobile systems referred to in Europe as the Universal Mobile Telecommunications System (UMTS). Details of future service concepts and of future user requirements need to be addressed in order to formulate regulatory, frequency and standardisation responses at a European and national level.

Against the background of the expected high growth of the mobile communications sector, its convergence with intelligent networking, multi-media content provision, and navigation and positioning and related value-added services, but also its future position in the world-wide telecommunications landscape, the resulting formidable export opportunities, the impact on overall economic performances, as well as the employment opportunities and the broader social and societal impact, **the political interests in the development of the “wireless information society” are multi-faceted and of considerable importance.**

This Communication seeks to assist in the political debate by inviting responses to key questions touching on both the shape of future third generation systems and on the accompanying environment in which such systems should emerge. These key questions are summarised below :

- Is this the right moment to define a strategy for the introduction of UMTS or would regulatory action today be premature?
- Is there a consensus in Europe on the notion of UMTS or third generation mobile communications? Will it be a new single technology, or a number of interoperable solutions based on different technologies ?

¹ Green Paper on a common approach to mobile and personal communications in the European Union, COM(94) 145 final, 27.04.94

² European Parliament Resolution of 19 May 1995 (A4-0097/95; OJ C 151/473, 19.06.95) and Council Resolution of 29 June 1995 on the further development of the mobile and personal communications sector in the European Union (95/C 188/02; OJ C 188/3, 22.07.1995)

- What should be the respective roles of the private sector and of public authorities in the transition towards UMTS?
- How can UMTS impact on the competitiveness of Europe's industry?
- How do we ensure that the broader social and societal interests are secured in the development of the "wireless information society"?

On the basis of the response to this Communication and other relevant factors, the Commission will propose, if and where appropriate, measures for adoption by the European Parliament and the Council. Comments should be sent at the latest by **15 July 1997** to the European Commission, DG XIII/A/1, rue de la Loi 200, B-1049 Brussels, to the attention of Mr. de Cockborne (fax + 32 2 296 8391) or by e-mail to: umts@bxl.dg13.cec.be.

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1. INTRODUCTION

Europe today has created an environment within which mobile communications can flourish and has positioned itself at the forefront of mobile communications world-wide

Mobile Communications has been one of the fastest growing segments of the telecommunications market over the last five years. This is evidenced by the spectacular growth in GSM³ subscribers and investment. Since its commercial launch in 1992, GSM, and its related technologies, DCS-1800 and PCS-1900, have emerged as a world standard for mobile communications with services provided through nearly 200 networks to more than 30 million users in over 100 countries. Asia is becoming one of the biggest customers for GSM systems whilst in the USA PCS-1900 is enjoying early success.

By providing pan-European coverage through a single subscription, GSM is a concrete example of a trans-European network in action. It has developed through industry-led efforts, backed up by an appropriate regulatory framework and timely standardisation decisions.

GSM growth is mirrored by the continuing uptake of other mobile and wireless technologies in Europe and in other parts of the World. These systems include cordless telephony, wireless networks for phones and computers within buildings, paging and the use of wireless technologies to compete with the fixed public network in the local loop.

Satellite-based personal communications systems will offer a further stimulus to the take up of mobile communications⁴. Satellite systems allow for the delivery of advanced communications services, often requiring high capacity transmission, in parts of the World where terrestrial networks are underdeveloped. They may also offer cost effective coverage of more remote regions of Europe.

European citizens are feeling the benefits of mobile systems and of competition between mobile networks

Today users can remain in contact wherever they are. Mobile communications is no longer the privilege of the businessman or the traveller. They offer everyone the ability to make phone calls, receive faxes, check e-mail or use the Internet whilst on the move. Mobile communications has become an essential tool for businesses of every size, but are also reaching an increasing number of homes and as such has now an important social

³ The term GSM is taken in this Communication to cover a family of technologies, namely : GSM 900, DCS 1800 and PCS 1900, all of which support the same features and services.

⁴ In order to promote a more proactive role and consistent approach in satellite communications, the Commission recently adopted an EU Action Plan: Satellite communications in the Information Society, Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, COM(97) 91 final, Brussels, 05.03.1997

economic function⁵. In Scandinavia more than one in four people has a mobile phone, sometimes instead of having a fixed connection.

Mobile and wireless networks are also providing alternatives to the fixed network for telephone companies, particularly for new entrants seeking to provide a cost-effective route into businesses and homes. In this way mobile and wireless systems can carry competition right down to the local loop.

Towards a “wireless information society” for every citizen and business

The potential benefits of the “wireless information society” are manifest⁶. The Commission in its Communication on universal service⁷ stressed that “*new inter-active services should be accessible to every citizen in the Community so that the benefits of new technologies and services are felt in areas, such as education and training, health care and access to public information*”. UMTS can help to bring this vision about.

UMTS holds potential for Europeans both as citizens, consumers and in their work, providing for greater choice, lower prices and full mobility. This will allow wider access to entertainment services, support to the elderly and the disabled, as well as public information and transactional services such as home-shopping and banking.

The use of mobile communications for teleworking will stimulate increased employment, mobility and development in rural and remote areas, as well as increasing the competitiveness of European industry more generally. This should have an important impact in further stimulating employment in all regions of the European Community.

At the same time, UMTS, as a stepping stone towards the “wireless information society”, raises challenges of a social and societal nature which need to be addressed in parallel to the technological issues.

The challenge of the third generation mobile systems.

The convergence between telecommunications, information technology and publishing, evidenced by the development of Internet, is accompanied by a convergence between fixed and mobile services. This is happening at the same time as an increasing globalisation of telecommunications, as shown by the almost world-wide roaming capability of GSM. This will result in increasing demand for services covering the transmission of data, sound and images both in the fixed and in the mobile networks.

⁵ For example, mobile communications may facilitate teleworking or access to ones home base whilst on the move.

⁶ See Green Paper on Living and Working in the Information Society: People First, COM(96) 389, 24.07.96; and The Information Society: the role of the European Union, Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, COM(97)...to be adopted shortly

⁷ Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on Universal service for telecommunications in the perspective of a fully liberalised market, COM(96) 73 final, 13.03.1996

The telecommunications industry is currently developing a strategic vision of third generation digital mobile systems⁸. This reflection in Europe focuses both on the concept of Universal Mobile Telecommunications Systems or UMTS and on the idea of Global Multimedia Mobility (GMM). This vision is central to the further development of mobile and wireless communications in Europe, to the transition from mobile communications to mass market deployment in direct competition with today's fixed network operators, and to the possible integration of fixed and wireless networks within a personal communications environment. Whilst much of the detail of UMTS remains to be worked out, certain broad objectives for UMTS have been identified by ETSI in its Report on a standardisation framework for GMM⁹. ETSI describes UMTS as providing "*personalised globally accessible high quality mobile communications services*" meeting such objectives as integration of fixed and mobile services allowing use of a single terminal, multimedia capability, low cost, and high frequency spectrum efficiency¹⁰.

While the main thrust for the development of UMTS must come from the industry in response to users' needs, a major challenge for the European Community and its Member States is ensuring a favourable environment within which these initiatives can develop and extend the success of GSM in the third generation systems. This represents a major opportunity for the European industry, given the globalisation of the market for mobile equipment and services. It must be seen against the general evolution of the telecommunications sector in Europe towards full competition from 1 January 1998, as well as in the context of the successful conclusion of WTO negotiations on the opening up of the world-wide market for basic telecommunications services and on the phasing out of custom duties for information technology products¹¹.

In determining the appropriate response at an EC and national level to these expected characteristics of UMTS, a number of factors need to be taken into account which reflect varying, and sometimes conflicting, interests of the different players concerned, such as incumbent mobile operators and potential new entrants, equipment manufacturers and users. This should include *inter alia* the broader social and societal aspects of the "wireless information society", and global standards developments.

In this Communication, the Commission responds to the call from the Council and from the European Parliament following the consultation on the Green Paper on Mobile and Personal Communications to report on the further development of mobile communications and the evolution towards the UMTS¹². Section 2 presents an overview

⁸ Analogue mobile systems is considered to be first generation technology, whilst digital technologies such as GSM in Europe or D-AMPS and PCS 1900 in the USA represents the second generation.

⁹ Global Multimedia Mobility (GMM) - A Standardisation Framework, ETSI document ETSI/TA24(96)45, October 1996

¹⁰ See below, part 2.4.

¹¹ WTO GATS GBT (Basic Telecommunications) of 14 February 1997; Information Technology Agreement (ITA) on the basis of the Ministerial Declaration (WTO Ministerial Meeting Singapore, 13 December 1996) endorsed by the ITA negotiating parties in Geneva on 26 March 1997.

¹² European Parliament Resolution of 19 May 1995 (A4-0097/95; OJ C 151/473, 19.06.95) and Council Resolution of 29 June 1995 on the further development of the mobile and personal communications sector in the European Union (95/C 188/02; OJ C 188/3, 22.07.1995)

of market, regulatory and technological trends. Section 3 invites comments on a range of issues which will help to identify better the future UMTS concept and the actions necessary to foster its development.

2. WHERE DO WE STAND TODAY?

2.1. Mobile Communication today in Europe and in the rest of the world

Today there are more than 37 million users of mobile communications in Europe (figure I.1). Of these 25 million use digital (GSM) and 12 million use analogue systems. Additionally there are around 4.5 million users of analogue and digital paging systems. The use of mobile data in Europe is growing rapidly, with estimates that from a base of around 3 million mobile data users today (around 1% of the population) that figure will grow to 8 million by 2000. Currently mobile subscriber lines represent around 14% of the total number of lines within Europe. Penetration rates of cellular mobile services have already reached 30% in some EU countries (figure I.2). Within Europe, it is anticipated that they will rise to 40-50% of the population by 2005¹³.

Today there are at least two digital mobile systems operating in each EC Member State (except Luxembourg which will soon issue a second license), with additional DCS 1800 systems licensed in 6 Member States and a requirement for licences for DCS 1800 to be granted on request in other Member States from 1 January 1998. These digital systems are in addition to the 20 analogue networks which continue to operate in the Community and which still retain almost one third of mobile telephony subscriptions.

There is a gradual but accelerating shift from analogue to digital based services for mobile voice and data communications, as well as for paging. Nevertheless, in a few countries analogue networks continue to grow steadily, taking account of the relatively limited needs for roaming of residential users and the attraction of lower priced service packages for analogue systems. However, GSM has already surpassed analogue as a whole in terms of the number of users in Europe (figure I.3).

Since its commercial launch in 1992, GSM has emerged as a World standard for mobile communications. GSM and its related technologies, DCS-1800 and PCS-1900, provide coverage through 187 networks in 103 countries and have a subscriber base of 32.7 million users. Asia is becoming one of the biggest customers for GSM systems with China on top in size of market and contracts. In the USA, PCS-1900 is enjoying early success, with the licensed networks potentially offering near 100 % population coverage.

With the quasi-exception of Europe where GSM stands as the single digital system today, the situation in terms of cellular systems world-wide is characterised by a diversity of technologies, both analogue and digital, that compete for customers. As a result global roaming outside of the GSM system is practically impossible and sometimes difficult even at national level. A user, when travelling, is obliged to rent a suitable terminal at the destination, but he or she may find it difficult to remain in touch. Such competition between systems, has lead to present efforts in the areas of multi-mode and multi-band terminals, capable of "talking" the different regional "languages".

¹³ Detailed market information and forecast can be found in two studies realised for the Commission: "Mobile Market Review", KPMG, November 1996 and "UMTS Market Forecast, Analysys/Intercai, February 1997

2.2. The regulatory environment and the standardisation framework have been key factors in supporting mobile market developments

Fostering the development of mobile services has been a central theme of Community telecommunications policy since its inception. The agreement in the 1980s on the frequency allocation for GSM services and on the timetable for its co-ordinated introduction into the Community¹⁴ were key to creating an appropriate environment for the take off of GSM and DCS-1800 services within Europe. These decisions went hand in hand with the detailed standardisation work completed by ETSI on the basis of the work of the CEPT¹⁵ and the GSM Memorandum of Understanding Association.

Furthermore, the Commission has been proactive in ensuring the competitive provision of digital mobile equipment and services since their introduction in 1992¹⁶. This has involved ensuring that there are at least two operators of digital cellular systems in most Member States; that licensing procedures have been open, transparent and non-discriminatory and; that licences have created fair market conditions for competitors, particularly, where they have entered the market later than the first licensee which in most Member States was granted automatically to the fixed network operator¹⁷ (see also Annex II).

Most Governments now favour such competition. Increasingly they are making use of market-based mechanisms to ensure the best balance between service quality, promotion of the public interest and income for the State. Spectrum auctioning for radio-frequency has been used notably in the USA to promote economically efficient allocation of what is recognised to be a valuable resource¹⁸. Community law recognises the possibility of

¹⁴ See Council Directive on the frequency bands to be reserved for the co-ordinated introduction of public pan-European cellular digital land-based mobile communications in the European Community, 25 June 1987, 87/372/EEC, OJ L196/85, 17.07.87. This directive was adopted in combination with a Council Recommendation on the co-ordinated introduction of public pan-European cellular digital land-based mobile communications in the Community, 87/371/EEC, OJ L196/81, 17.07.87

¹⁵ Conférence Européenne des Postes et Télécommunications

¹⁶ A further factor in some Member States has been the sophisticated structure of marketing structures put in place. The existence of independent service providers in addition to network operators has contributed to high levels of service penetration and to the development of an innovative range of pricing packages.

¹⁷ In a number of cases, the Commission has intervened to ensure that where licensing conditions were not fair, compensatory mechanisms were put in place in favour of the competitor. See Commission Decision of 18 December 1996 concerning the conditions imposed on the second operator of GSM radiotelephony services in Spain, OJ L76, 18.3.97 and Commission Decision of 4 October 1995 concerning the conditions imposed on the second operator of GSM radiotelephony services in Italy, OJ L280, 23.11.95

¹⁸ In the USA auctioning of spectrum for personal communications services did not link the frequency awarded to a choice of a specific technology. This can be perceived as allowing market players greater freedom in determining the use of allocated spectrum. The result is that at least three digital technologies (PCS 1800, D-AMPS and IS-95/IS-54 CDMA) are being deployed in different areas but with no guarantee for solutions that offer country-wide roaming.

charges within national licensing regimes (i.e. for spectrum allocation) which reflect the need to ensure the optimal use of these resources, as far as these changes are non-discriminatory and take into account the need to foster the development of innovative services and competition¹⁹.

2.3. Markets and technology are rapidly evolving

Cordless telephone systems overlap with mobile cellular systems for key applications

In addition to the shift towards digital mobile communications based on GSM, cordless services providing limited mobility have rapidly taken up momentum. As a result the overlap between applications of cordless systems and cellular mobile systems is increasing.

In Europe the Digital Enhanced Cordless Telephone (DECT) system has been developed and is now commercially available (figure I.4). These systems are now rapidly gaining recognition as much more than a system offering limited mobility at the customer premises level (home cordless telephone, wireless PBX), since they can also be used as a key component within the fixed network as a wireless local loop (WLL). Wireless local loops are coming into their own in Central and Eastern Europe where they are seen as a cost-effective way of extending the fixed network service in urban areas to shorten waiting lists from years to months and weeks. In Hungary, for example, more than 200,000 homes are being connected via WLL systems. Mobile technologies have also been used in sparsely populated regions of the Community, for example in parts of Spain, to complete network build out by providing a fixed telephone link via a wireless connection. Moreover, GSM-based solutions are being considered in certain countries of Central and Eastern Europe as an alternative to wired local loop.

Furthermore, digital wireless systems such as DECT can also provide the public with limited mobility services (e.g. limited range, some system are also limited in their capability to hand over calls between network cells) as a low cost alternative to full-fledged cellular mobile systems. This may be attractive in densely populated areas. In other parts of the World, the Public Access Cordless System (PACS) and the Personal Handyphone System (PHS) are enjoying considerable success. This is particularly noticeable for the PHS system in Japan which was introduced in 1995 and which now has close to 6 million users. It is principally used as a low cost public limited mobility service (figure I.5).

A combination of mobile communications and wireless technologies offers the prospect of real competition in the local loop

Beyond a role in extending universal service in both remote and urban areas, the combination of mobile services priced to compete more directly with services offered on

¹⁹ See Article 11(2) of Directive 97/13/EC of the European Parliament and the Council on a common framework for general authorization and individual licenses in the field of telecommunications services, 10.04.1997, OJ L117, 7.5.97

the public fixed network and the use of wireless connections into homes and businesses provides a means of extending competition into the local loop.

In several OECD countries, new subscriptions to mobile telephony now exceed those for the fixed network, reflecting high penetration of both mobile and fixed services. Increasingly, users can be expected to replace their fixed connection with a mobile phone. In the near future, mobile and wireless-based networks alongside cable TV infrastructure, where it exists, could therefore offer users real alternatives to using the incumbent's network today.

Satellite-based mobile systems offer the prospect of world-wide roaming and can complete the gaps in regions with less developed communications networks

The prospect of global mobility is now offered by Satellite-based Personal Communications Systems (S-PCS) which will be launched over the next two years, in many cases using hybrid terminals, which support both the satellite service and terrestrial mobile services. These systems not only provide the possibility for users to remain in contact whilst travelling in parts of the World with relatively undeveloped telecommunications networks, but also offer users a potential means of accessing broadband capacity.

Digital Mobile Services are evolving in response to user needs

The GSM family of technologies is continuing to evolve to meet users needs for further mobility and greater support for data and Internet based services²⁰:

- The GSM Triband phone - a hybrid terminal that can operate on GSM-900, DCS-1800 and PCS-1900 environments - is currently under development. It will allow users to communicate via any of these networks providing that the appropriate roaming agreements are in place.
- Hybrid GSM/PHS and GSM/CDMA handsets have already been developed and demonstrated. Moreover, Japanese industry is developing a GSM/PHS convergent approach on infrastructure.
- New multimedia functionality is being developed for GSM beyond the present applications of voice and data transmission at 9.6 kbit/s²¹. One such development is High Speed Circuit-Switched Data (HSCSD), recently standardised, and with equipment due in 1999.
- The development of "Mobile Internet" is central to the further take up of mobile and wireless services. Work is underway to extend mobile multimedia capabilities²² and

²⁰ See for instance "UMTS Market Forecast", Analysys / Intercai Report, February 1997

²¹ Higher rates are possible with the use of multiple time slots, but such developments would require considerable additional bandwidth. Multi-slot GSM is currently under development.

²² The Mobile Data Initiative (MDI) has been joined by many manufacturers and operators. Its aim is to test protocols for data communications between PC's including hand-held PC's over the GSM infrastructure.

to improve the support for Internet-based services within the Internet Protocol²³. A merging of IP technologies into wireless services is foreseen in the new General Packet Radio Service (GPRS) due out from ETSI in 1998, with products anticipated for 2000.

Global developments serve the broad strategic interests of the different parts of the World

The developments around the World in mobile and wireless communications and satellite-PCS do not stand by themselves but must be seen in a wider strategic context.

The anticipated shift of market paradigm from a mobile communications market focused on business and niche users to a mass consumer market is already visible. In Japan this has led consumer electronics companies, who traditionally have strength in consumer markets, to embrace mobile and wireless communications. They are now engaged in large scale production of new communications systems (e.g. PHS), equipment and handheld devices that will eventually be targeted at the World's mass markets.

The US enjoys a position of strength in satellite communications, mainly due to the large defence spendings in this area over the last decades. New commercial initiatives such as Iridium and Teledesic build on this strength and are already under construction or are in the planning phase. Where Iridium, planned for commercial operation by 1998, aims mainly at the mobile user, the ambitions of Teledesic reach much further as it aims to create a satellite-based information super highway around the globe that potentially makes terrestrial networks superfluous.

Europe must keep abreast of these global developments and exploit its strengths, such as the near global reach of GSM technology and its traditional capabilities in the area of communications system integration.

2.4. Activities at global and regional level are supporting this evolution

Action at global level (ITU)

- At the WARC 92, a range of 230 MHz of spectrum in the 1885-2025 and 2110-2200 MHz bands was identified for FPLMTS²⁴, including its satellite-based component. As a result, Europe and Japan today are considering identical spectrum allocations for the third generation terrestrial mobile services whereas the US allocation differs from this choice. However, WARC 92 identified spectrum for mobile services *in general* rather than linking specific frequencies to designated technologies. This has allowed some of that spectrum in the USA to be awarded to second generation systems, commonly referred to in the USA as PCS systems. This evolution is likely to impact on the ability to designate a common frequency band for UMTS throughout the World. This

²³ There seems to be a consensus emerging among industry players that the Internet Protocol (TCP/IP) on which Internet services are based already today could become the leading transport protocol for future multimedia services and applications.

²⁴ FPLMTS: Future Public Land Mobile Telecommunications System. Within ITU standardisation activities, this acronym is now replaced by IMT2000 (International Mobile Telecommunications 2000)

may lead to fragmentation of the World market, hindering the development of UMTS as a global system.

- Work at an international level within the International Telecommunications Union (ITU) is underway on the development of International Mobile Telecommunications 2000 (IMT2000), previously designated as FPLMTS. A special task group (TG8/1) has been constituted, where proposals for future mobile communications systems, emanating from different World regions are discussed. The European voice within this framework suffers however from a lack of coherence and common perspective, given some of the uncertainties surrounding the precise definition of third generation mobile communication systems.
- A regular dialogue on future mobile systems between regulators and industry from the European Community, the USA and Japan has continued within the framework of the FAMOUS²⁵ meetings.

Action at European level

- In the context of the world-wide growth of mobile wireless markets, manufacturers, operators, research institutes and academia have carried out significant research and development activities, particularly in the framework of the European Community Research Programmes such as RACE (Research and Technology Development in Advanced Communications Technologies in Europe) and ACTS (Advanced Communications Technologies and Services). In the period 1991-1998, some 180 MECUs of Community funding will be devoted R&D on mobile, wireless and personal communications including both terrestrial and satellite based systems.
- Within Europe, building on broad industry support and with the assistance of the Commission, the UMTS Forum has been set up to involve a wide spectrum of interested parties in developing strategies for UMTS²⁶. The Forum is developing a common vision of UMTS and seeking to identify precise industry and user requirements, including specific needs with regard to frequency spectrum. A first report is to be issued by June 1997.
- The European Radiocommunications Committee has recently published a draft decision for public consultation on the frequency bands for the introduction of the UMTS, within the CEPT countries. The draft decision proposes to designate the 1900-1980 MHz, 2010-2025 MHz and 2110-2170 MHz bands to terrestrial UMTS applications. It also proposes that at least two blocks of 30 MHz of spectrum are made available by 1 January 2002. Requirements to make additional frequency available within those bands are made subject to market demand.

²⁵ FAMOUS: Future Advanced Mobile Universal System, established in 1991 annual meetings between US, Japan and the EU administration representatives to exchange about future mobile systems in particular in view of ensuring interoperability.

²⁶ The UMTS Forum was formally inaugurated on 16 December 1996 building on the existing work of the UMTS Task Force. The Forum brings together regulators, operators, manufacturers, satellite operators and other interested parties and associations such as ETSI, ERO and ETO. It is financed via its 70 members and has an annual budget of about 500,000 ECU.

The consultation period on the decision closes on 30 May 1997 and a final decision, taking account of comments made, is expected to be taken in June. That decision is only binding on those countries which decide to sign up to it.

- ETSI has defined certain broad characteristics for third generation terminals and networks. Work on the definition of UMTS has been carried out for a number of years. Recently ETSI published its Global Multimedia Mobility (GMM) concept. That concept makes an important contribution to the process of definition of UMTS. A work plan has been proposed that calls for the development of two phases of UMTS with a first phase leading to the introduction of UMTS services by 2002. Major decisions are expected to be taken early next year on the air-interfaces to be adopted for UMTS.

ETSI Objectives for UMTS

1. Integration of residential, office and cellular services into a single system and one user equipment (terminal)	9. Radio resource flexibility to multiple networks and traffic types within a frequency band
2. Speech and service quality at least comparable to current fixed networks, including security that cannot be compromised in mobile use	10. High frequency spectrum efficiency
3. Service capability up to multimedia	11. Creation of direct satellite access for a mass user base
4. Separation of service provision and network operation	12. Use of WARC '92 frequency bands(1885-2025 and 2110-2200 MHz)
5. UMTS user number independent of network or service provider	13. Low cost of services and terminals
6. Capacity and capability to service the whole population	14. Flexible personalization, ease of use
7. Seamless and global radio coverage achievable	15. Flexibility for the introduction of new services and technical capabilities
8. Radio bearer capabilities up to 2 Mbit/s	16. Applicability to different needs; public, private, basic telephony for simple telecommunications; broadband multimedia for advanced telecommunications

Source: ETSI TA 24, report on Global Multimedia Mobility (GMM)

3. THE FURTHER DEVELOPMENT OF MOBILE COMMUNICATIONS: KEY CHALLENGES AND QUESTIONS

3.1. Major challenges for future mobile communications

The information and communication technologies industries are a critical component of the European economy in that they are a major and growing part of industrial activity. They are also one of the keys to future competitiveness of industrial processes, products and services and a platform for the emerging Information Society. If Europe is to build on the success of GSM, two challenges need to be addressed:

- Meeting the changing user needs for mobile services
- Further developing the conditions for industrial competitiveness within the mobile communications sector

Achieving these goals will be important not only for the telecommunications sector, but also for the broader economy. Improving the competitiveness of the European mobile industry will also help it to build further on its leading position in global markets for mobile communications technology and services.

3.2. A new environment for UMTS

<i>Environment when GSM was introduced (late 80ies)</i>	<i>Environment today (late 90ies)</i>
small market niche market for specific users mobile voice transmission only monopoly network operators mobile as stand-alone service (terrestrial only) regional market limited technological innovation resulting in high cost and limited service offering	major market mass market, common service diversified services (still increasing) competition (two to three national networks in most Member States and increasing) integration of services (fixed, terrestrial mobile, satellite) globally competitive market vast range of new technological possibilities (higher integration, compression technologies, efficient frequency usage, low energy innovations) resulting in lower cost of services and equipment

In attempting to chart out a path for the successful transition from second to third generation mobile technologies, lessons can be learned from the early transition from

analogue systems to GSM. At the same time, it is essential to recognise the radical reshaping of the environment for mobile communications over the last 5 years against which any strategy for transition must be planned.

The changed environment means that there are a range of possible scenarios for the evolution towards third generation systems which may present alternative or complementary routes to shape the future mobile sector.

Timely decisions by industry (i.e. what investments to make, which services to offer, which markets to target, whether to focus on developing existing services or to move towards more innovative approaches?) will be fundamental in determining the actual evolution which will take place. Given the specificity of the telecommunications sector (e.g. need for interoperability of networks, allocation of scarce resources) public authorities have a particular responsibility to ensure that appropriate decisions are taken in order to foster the development of those services and help establish a competitive European industry.

A clear and relatively detailed picture of future developments is needed before it will be possible to fully define what action, if any, may be required at a European level to make a positive contribution to the future development of mobile and wireless technologies.

3.3. Core issues for future decisions : key questions
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Five key questions underpin the decisions on an appropriate regulatory response to UMTS. They relate in particular to timing, method to be followed and consequences that decisions might have on Europe's industrial competitiveness.

- | |
|---|
| <ul style="list-style-type: none">• Is this the right moment to define a strategy for the introduction of UMTS or would regulatory action today be premature?

<i>It seems clear that changing user expectations, particularly in areas such as multimedia services, will add a new dimension to the services that will be required. At the same time, the fact that new technologies exist and can be demonstrated today, is no guarantee that new services will be accepted by the market or even needed by users. This would suggest avoiding a regulatory action at too early a stage. However, delaying action may jeopardise the evolution towards UMTS and potentially endanger the leadership currently enjoyed by European industry.</i>• Is there a consensus in Europe on the notion of UMTS or third generation mobile communications ? Will it be a new single technology, or a number of interoperable solutions based on different technologies ?

<i>The current GSM generation is still evolving to offer users improved and diversified services within an existing technological framework, as new technological possibilities are gradually exploited. Will the transition towards the next generation of mobile services take place through step by step improvements in GSM technology or will it at some stage require a shift from GSM to a new system offering more capacity and data rates from the start? Could intermediate solutions develop, which would combine elements of the two approaches, such as the use of different air interfaces within a common integration platform? Will UMTS be designed as a comprehensive system, with users picking the service elements that they require, or as</i> |
|---|

a number of technical solutions which whilst interoperable could each require specialised terminals?

- What should be the respective roles of the private sector and of public authorities in the transition towards UMTS?

It is clear that the private sector must take the lead in creating a new mobile environment. Nevertheless, consideration must be given to the role that public authorities at a national and Community level can play in creating an environment which can foster the market-led development of new systems and the offer of greater choice at lower prices for users. What degree of consensus on the definition of UMTS is necessary in order to allow appropriate political decisions to be taken ?

- How can UMTS impact on the competitiveness of Europe's industry?

Should spectrum management policy give priority to the development of UMTS over other mobile and wireless technologies ? In the affirmative, how would this impact on Europe's ability to retain a competitive telecommunications industry at the global level?

The market is developing at an extremely rapid pace around the world. This includes developments in both mobile and wireless systems as well as developments linked to "Mobile Internet". In this respect, what would be the right date of introduction of UMTS ? Are the dates proposed by ETSI (pilot introduction by 2002 and a full scale deployment by 2005 of UMTS) appropriate ?

- How should we ensure that the broader social and societal interests are secured in the development of the "wireless information society"?

Mobile and wireless communications are considered to be an important means of bringing the information society to the mass market. Are any further measures required to guide the sustainable development of the "wireless information society" and, if so, what issues should be addressed? For example, are further measures required to ensure that all European citizens can access these new services and technologies? How should pan-European roaming, which is one of the great accomplishments of GSM, be extended into the future mobile multi-media age?

The take up of the "wireless information society" will also depend on the perception by the general public that radio communications equipment is safe to use. Further research to collect additional data in this field is planned.²⁷

3.4. Creating conditions for development: key questions relating to the role of public authorities

²⁷ The Commission is currently creating a research programme into the possible health effects related to the use of mobile phones. This follows the recommendations by an independent multi-disciplinary group of experts that reported last year that currently available studies and existing literature give no evidence of any increased health risk, but also that data is sparse and insufficient to draw firm conclusions at this stage and that further research is necessary in particular into the a-thermal effects.

The Regulatory Framework:

The European Community has put in place a comprehensive framework securing the full liberalisation of the telecommunications sector from 1 January 1998. This framework covers both fixed and mobile communications services. The framework is designed to be technology neutral and flexible enough to accommodate new technological and market developments. In the light of UMTS, that framework should nevertheless be examined to decide whether the introduction of UMTS necessitates modifications in the regulatory approaches in the medium term:

- Does UMTS require further changes to the overall regulatory framework for telecommunications?

The comprehensive and predictable framework for competition within the internal market addresses key aspects of licensing, interconnection, universal service as well as the allocation of numbers and frequencies. It attempts to create a framework which may apply to undertakings providing services via fixed, mobile and wireless connections. A first priority must be the effective transposition of current EU legislation and effective and timely implementation of decisions reached on frequency issues with the European Radiocommunications Committee.

A key principle within this framework is the creation of conditions for the delivery of innovative services. The framework also opens up the process of awarding frequency and/or licences by preventing Member States from automatically granting licences to current operators, but at the same time it prevents the automatic exclusion of such operators from getting licenses for new or additional mobile systems, except where excluding them can be justified to prevent the creation or extension of a dominant position in an existing market. In the light of the developments in the market, aspects related to the provision of universal service may need to be reconsidered in the future.

- Does UMTS present particular competition issues which should be addressed at a European level?

One of the major issues concerning fair market competition relates to the issue of roaming. At least in the initial stages of deployment, UMTS systems may have to seek roaming arrangements with GSM networks in order to provide a sufficient degree of national and international coverage. Being based on commercial agreements between operators, the refusal to enter into roaming agreements with UMTS operators would be a major deterrent to use of UMTS systems. It might also constitute an anti-competitive practice under the EC Treaty competition rules. At a later stage, roaming will take on a new dimension as different mobile and/or fixed service segments converge. This will require a careful monitoring of roaming arrangements.

Frequency issues related to UMTS:

- What are the spectrum requirements for UMTS? What decision should be taken in respect of spectrum reservation in view of UMTS ?

Within the spectrum designated at WARC 92 for mobile communications, early action to allocate precise frequency bands for UMTS is likely to be of critical importance to its development within Europe and World-wide. In this context the Commission is watching carefully the comments and reactions to the proposed ERC decision mentioned above.

Approaches to frequency allocation for second generation systems were different in the EC and the USA. The timely decision concerning GSM frequency allocations and the clearing out of these frequencies by Member States by a pre-determined date was central to GSM's success. In the USA, on the other hand, a number of digital standards remain in competition and the licensing of PCS spectrum has not been linked to the use of a specific technology. What balance needs to be achieved in view of UMTS between an early allocation of spectrum for UMTS and the need to keep open the possibility of competition between future mobile systems in view of the benefits this might develop in terms of innovation, service quality and choice? By when are decisions on frequency allocation required? Should frequency allocation be service related (e.g. for multimedia mobile services) or technology oriented (i.e. to allow for one or several interoperable technologies) ?

- What priorities can be identified for Europe in relation to UMTS at forthcoming WRC meetings?

Whilst important decisions were taken at WARC 92 in relation to spectrum for FPLMTS, consideration should be given in the light of the evolving concept of UMTS to ensuring that a clear European perspective is developed in advance of forthcoming WRC meetings. Clear decisions on frequency bands will be essential to the development of future systems and to show a clear political commitment to third generation systems, even if the choice of technology(ies) for such systems is determined at a later stage.

Standardisation related questions:

- Does UMTS create new priorities or a need for new approaches in the area of standardisation?

As the basic shape of UMTS or other third generation systems emerges, ETSI is likely to continue to play a central role, in close co-operation with the UMTS Forum and other interested parties in determining the precise requirements for standardisation. How can it be ensured that this process remains sufficiently open to develop a broad consensus amongst interest parties both within and outside the Community?

How can it be ensured that the development of UMTS strikes the right balance between formal, open standardisation, where this is appropriate (and which implies certain minimum time periods for adoption), and industry-developed de facto standards of a more proprietary nature which may often develop more at a pace commensurate with the rapid life cycle of the information technologies and services which UMTS is likely to offer?

GSM is a comprehensive and open standard allowing for the evolution towards different service forms while maintaining the integrity of the GSM platform. To what extent can or should such an approach be applied to the UMTS concept ?

- Does UMTS require a redirection of standardisation from telecommunication per se towards information technology ?

How can the standardisation activity be sufficiently redirected from a telecommunications and network-centric approach to take into account the very rapid developments on the services side, e.g. to take into account the demand for mobile access of internet / intranet services (in the TCP/IP world) and multimedia services in general ?

Research and Development:

- Which are the strategic technological R&D goals which should be pursued in the framework of mobile and personal communications ?

In the context of the 3rd and 4th Framework Programmes for Research and Development, a significant contribution has been made at European level towards the development and validation of the essential technologies, components, systems, networks, services and applications for mobile and wireless communications. Such efforts have contributed to maintaining European technological leadership in this area. However the fast pace of development and the increasingly significant role to be played by terrestrial and space based wireless communications points to the need to strengthen the research and development efforts in this sector within the 5th Framework Programme. The primary objective of the work should be to ensure global connectivity in future integrated telecommunications networks, enabling access to broadband multimedia communications by anyone from anywhere, at any time, using mobile and wireless services with a capability and quality comparable to that of the fixed network services.

- What level of R&D efforts are to be foreseen in the context of preparing UMTS ?

R&D is an important issue in that it creates scientific and technological excellence while contributing to the definition of an early consensus on the most significant technological options. That consensus feeds the downstream standardisation process and enhances the competitiveness of Europe. To what extent have technologies needed for UMTS been sufficiently examined in the context of R&D efforts and / or what further R&D is needed ?

International aspects:

- What should be the European Community's priorities for co-operation in relation to UMTS ?

Third generation systems development must necessarily take account of proposals for regional and global service concepts, as well as the WTO Telecoms deal. Commitments have been made by more than 60 WTO members in relation to issues

such as market access for mobile services and frequencies. In this context, the European Community and the Member States, operators, manufacturers and services providers must actively co-operate with bodies and companies at a global level in order to ensure that future systems meet user demands for a high degree of global interoperability and are compatible with the WTO commitments taken. Given the development of a concept for UMTS in Europe, where should initiatives for global or regional co-operation be envisaged and on which objectives should it be focused ?

- How can a UMTS concept developed within Europe be best promoted in international organisations ?

The Commission supports continuing co-operation in the area of frequency allocations for third generation digital systems and wireless local loop systems and in the area of standardisation. How can Member States best ensure in accordance with the EC Treaty the co-ordination of their positions in international organisations and fora where decisions concerning frequencies are taken ? How can global co-operation in the field of standardisation be reinforced ?

- How can existing exchanges by the Member States and the Commission in the framework of regular contacts with third countries be best used to promote European positions concerning the future mobile systems ?

4. CONCLUSIONS

After the successful creation of an environment for second generation digital mobile cellular communications systems, demand for further evolution in mobile and wireless systems is now emerging. Users place emphasis on the integration of mobile communication applications, higher performance (in particular accommodating multimedia applications), global and seamless coverage of wired and wireless services as well as greater customisation of services.

At this stage, many uncertainties remain as for the concrete specification of the next generation wireless system, but the process of discussion among market actors and within the standardisation bodies has been launched. Results, in particular from the UMTS Forum and ETSI, will be particularly important for the definition of a UMTS concept(s). In this context, the legitimate interests of the European manufacturers and operators must be balanced with the interests of the users.

The Commission has identified several areas in which an approach at a European level could be important, namely, regulation, standardisation, frequency allocation, R&D efforts and international co-operation. The objective is to create a framework which leads to greater choice, improved quality and lower prices for all users of mobile services, while ensuring full competition within an environment which foster the competitiveness that the sector achieved so far.

The recent evolution of the regulatory environment in view of the full liberalisation of telecommunications has provided a comprehensive framework for both fixed and mobile telecommunications systems. It will be important to assess the flexibility of that framework against the new demands which the emergence of a UMTS concept may place upon it. The same applies for the decision on priorities for standardisation and choices concerning the most suitable allocation of frequency bands in the spectrum so far reserved for UMTS. The current ERC consultation process will form an important contribution in this respect.

At international level, the Commission supports the co-operation in the area of frequency allocation and of standardisation for third generation digital systems through the appropriate organisations on the basis of the UMTS concept currently under discussion.

This communication is intended to extend to all interested parties the discussion on the future of UMTS which has already been initiated within the industry. Comments and opinion are invited on all questions raised in the Communication. On the basis of the response to this communication and other relevant factors, the Commission will propose, if and where appropriate, the adoption of measures by the European Parliament and Council.

Comments²⁸ should be sent at the latest by 15 July 1997 to the European Commission, DG XIII/A/1, rue de la Loi 200, B-1049 Brussels, to the attention of Mr. de Cockborne (fax + 32 2 296 8391) or by e-mail to: umts@bxl.dg13.cec.be.

²⁸ Comments will be made available to the public, unless a specific request to the contrary is received.



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COMMUNICATION

TO THE EUROPEAN PARLIAMENT, THE COUNCIL,

THE ECONOMIC AND SOCIAL COMMITTEE AND

THE COMMITTEE OF THE REGIONS

ON THE FURTHER DEVELOPMENT OF MOBILE

AND WIRELESS COMMUNICATIONS

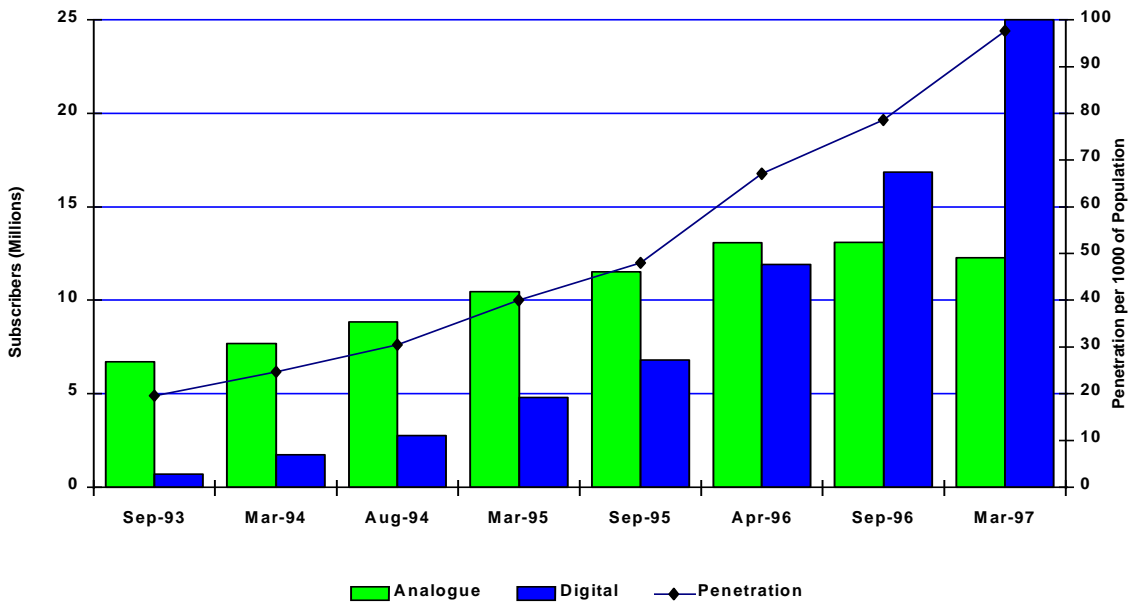
Challenges and choices for the European Union

Annexes

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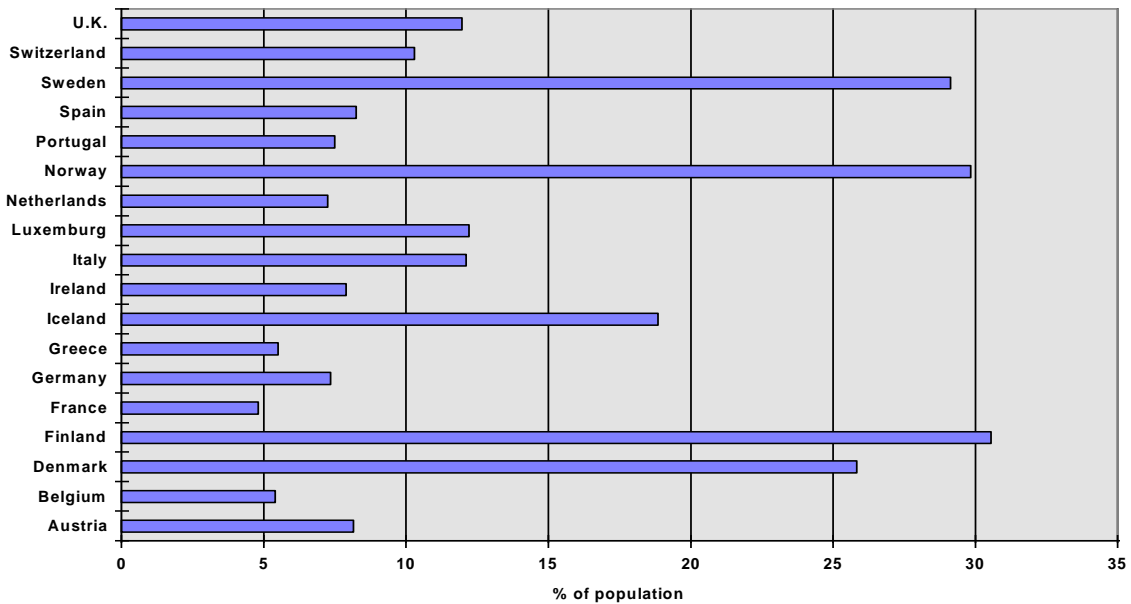
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ANNEX I: MOBILE COMMUNICATION IN EUROPE IN FIGURES



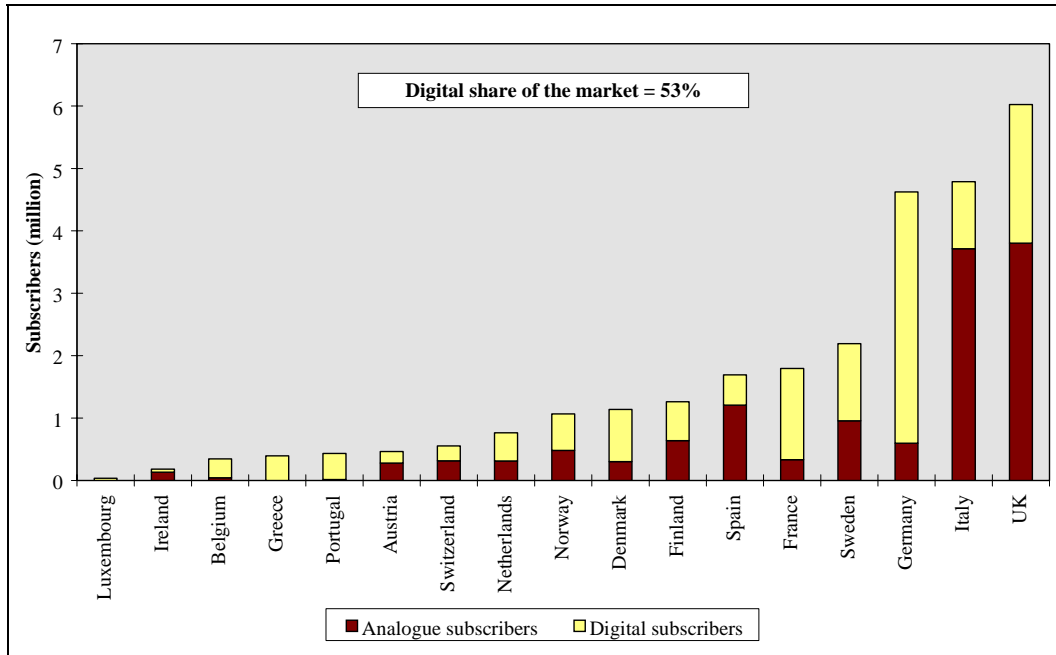
source: Mobile Communications

Figure I.1: Growth of European Mobile Communication Subscribers



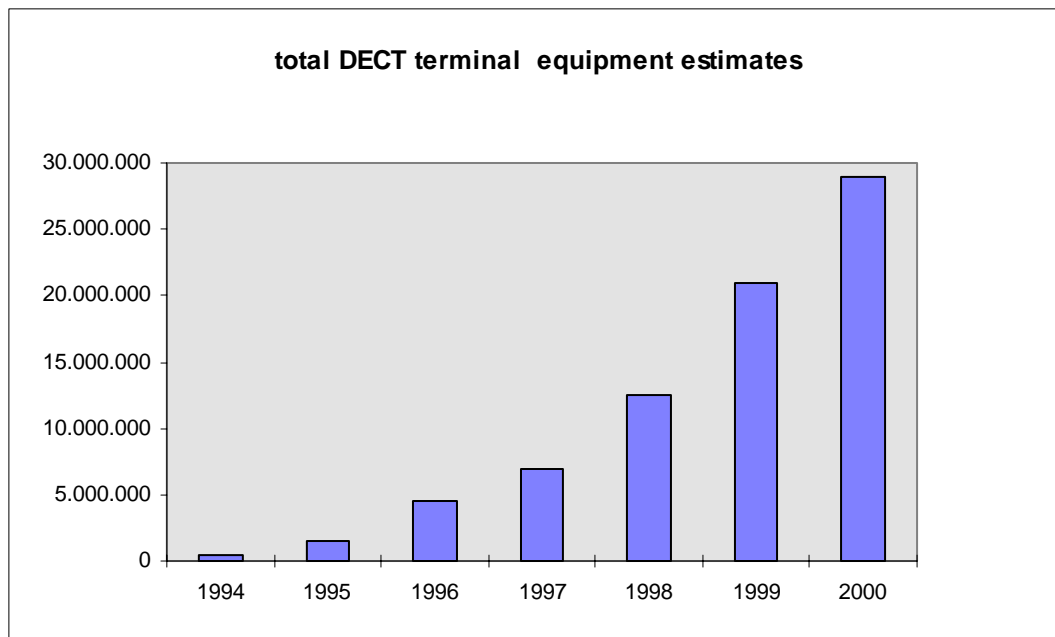
source: Mobile Communications

Figure I.2: Penetration rates for mobile communications per Member States (as of March 97)



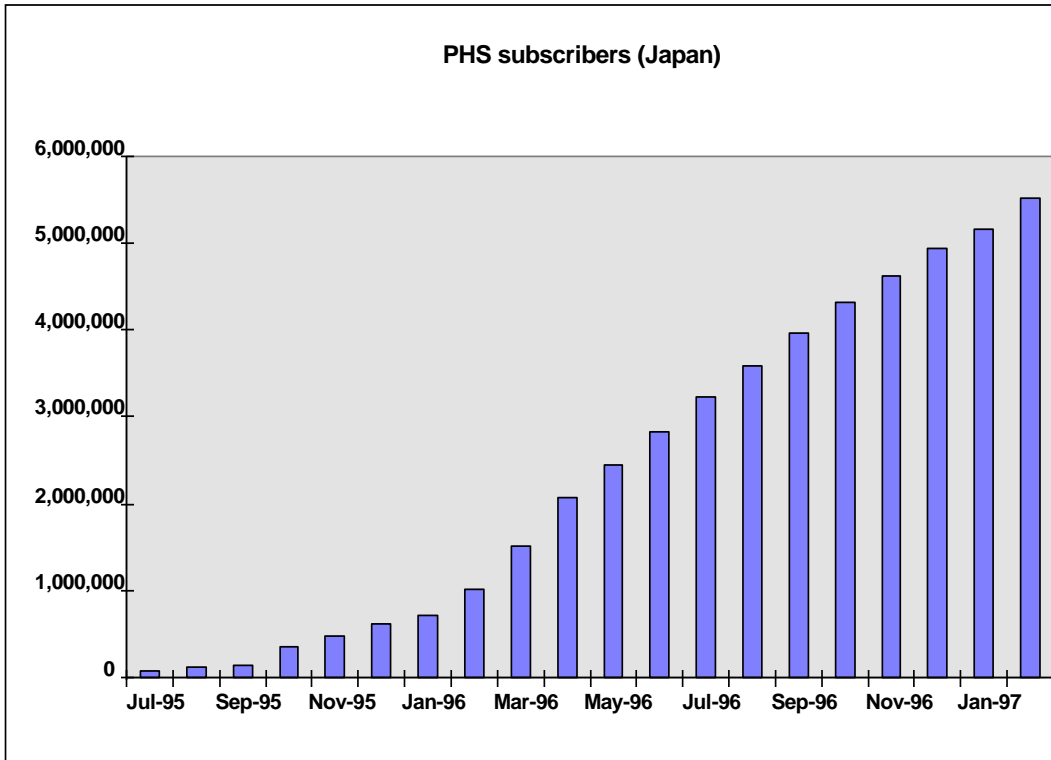
Source: KPMG

Figure I.3: European Mobile Communication Subscribers: Analog vs Digital



source: ETSI

Figure I.4: Deployment of DECT in Europe



source: MPT, Japan

Figure I.5 Deployment of PHS in Japan

ANNEX II: THE REGULATORY FRAMEWORK FOR MOBILE COMMUNICATIONS

Following the 1994 Green Paper on Mobile and Personal Communications, the European Community has progressed a vision of a personal communications environment, reflecting the increasing convergence of wired and wireless, fixed and mobile solutions to meet user needs. In particular, the legal framework²⁹ has established key dates for the further opening of mobile Communications throughout the EC.

KEY DATES FOR THE DEVELOPMENT OF MOBILE SERVICES IN THE EC

November 1996

- Notification of the measures taken to suppress of special and exclusive rights for mobile telephony ;
- Notification of the measures taken to lift the restrictions on mobile operators to construct their own networks / microwave links and/or use third party-owned infrastructure within their mobile networks ;
- Notification of the measures taken to enable mobile operators to directly interconnect their networks with the fixed or mobile network in other EC Member States³⁰ ;

Before January 1998

- Applications must be considered by Member States for licences to operate DCS 1800 services, subject to frequency availability.
- Current fixed or mobile operators must not be automatically granted new frequencies/licences for new mobile services, particularly DCS 1800 services, nor may they be automatically excluded from applying for such frequencies/licenses unless it can be shown that a grant to the operator concerned would affect effective competition, by strengthening the (joint) dominant position of the current operators. Restrictions should be removed, where they exist, which prevent the offering and use of multi-mode equipment which allows the same handset to be used across a number of different mobile systems, for example, a dual GSM-DECT telephone.

Furthermore, the development of mobile communications is being fostered by key elements of the general liberalisation framework which apply to both fixed and mobile network operators and service providers. That framework is designed to be technology

²⁹ See, in particular, Commission Directive 96/2/EC of 16 January 1996 amending Directive 90/388/EEC with regard to mobile and personal communications, OJ L 20/59, 26.1.96. (the Mobile Directive); Commission Directive 96/19/EEC with regard to the implementation of full competition in telecommunications markets, OJ L74, 22.3.96; Directive 97/.../EC of the European Parliament and of the Council on a common framework for general authorisations and individual licences in the field of telecommunications services, OJ L..., Directive 97/ /EC of the European Parliament and of the Council on interconnection in telecommunications with regard to ensuring universal service and interoperability through the application of the principles of open network provision (ONP), OJ ..

³⁰ Additional transitional periods delaying direct interconnection until 1 January 1999 have been accepted for Ireland and Portugal. Decisions are still pending as for Greece and Luxembourg.

neutral. At the same time it limits regulatory intervention to the minimum necessary to safeguard effective competition and secure the general public interest.

This means, for example, that mobile operators enjoy the right to :

- interconnect with the public fixed telecommunications networks in their Member State ;
- benefit from cost-oriented prices for interconnection with the networks of operators with significant market power, as well as the right to select unbundled interconnect offerings from a standard list. and
- receive licences on the basis of open, transparent and non-discriminatory procedures within set time limits. The ability of Member States to restrict the number of licences granted is limited to the scarcity of radio-spectrum or, on a temporary basis, the lack of available numbers.

A key aim of the regulatory framework is to ensure a balance between regulation and the degree of competition in particular markets. In placing obligations on market players, national regulatory authorities must take account of the position of those players on the relevant market and of the degree of competition in the market concerned. So, for example, mobile operators are not subject at this stage to as much detailed regulation as to service quality or pricing supervision as that imposed on fixed network operators with significant market power. Furthermore, in assessing whether mobile networks enjoy significant market power the relevant market will often be the whole of the telecommunications market rather than just the mobile sector.

Nevertheless, in other areas mobile operators may already be asked to assume responsibilities associated with being a provider (often on a national basis) of public telecommunications networks and/or services.

ANNEX III: OVERVIEW OF FREQUENCIES FOR MOBILE COMMUNICATIONS

Table III.1 provides an overview of frequency spectrum used for different mobile technologies across Europe.

Table III.1: Overview of spectrum use by different mobile services in Europe

Frequency range	Systems
47-88 MHz	CT1, paging, PMR, MOBITEX
138-174 MHz	first PLMNs ³¹ , RC2000, PMR, PAMR (MPT 1327), ERMES, paging ³² , MOBITEX
380-430 MHz	TETRA
420-470 MHz	RC2000, NMT 450, System C, RTMS, PMR, paging
862-960 MHz	TACS, ETACS, NMT 900, GSM, DSRR, CT2, PMR
1670-1900 MHz	TFTS ³³ , DCS 1800, DECT
1885-2200 MHz	FLMTS/UMTS

Source: KPMG

Table III.2 shows the harmonised frequency bands allocated to selected mobile systems in Europe. The basis for harmonised designation of frequency bands across Europe has to date been achieved using two mechanisms: European Community Directives (i.e. for GSM, DECT and ERMES) and ERC Decisions.

Table III.2: Frequency bands designated to selected mobile systems in Europe

System	Frequency allocated	Basis of allocation
GSM	890-915 MHz and 935-960 MHz	87/372/EEC
DCS 1800	1710-1785 MHz and 1805-1880 MHz	ERC/DEC/(95)3
DECT	1880-1900 MHz	91/281/EEC
ERMES	169.4-169.8 MHz	90/544/EEC
TFTS	1670-1675 MHz	ERC/DEC/(92)1
DSRR	888-890 MHz and 933-935 MHz	ERC/DEC/(96)6
TETRA	380-400 MHz for emergency services and 410-430 MHz for public services	ERC/DEC/(96)4

Source: European Commission, ERC

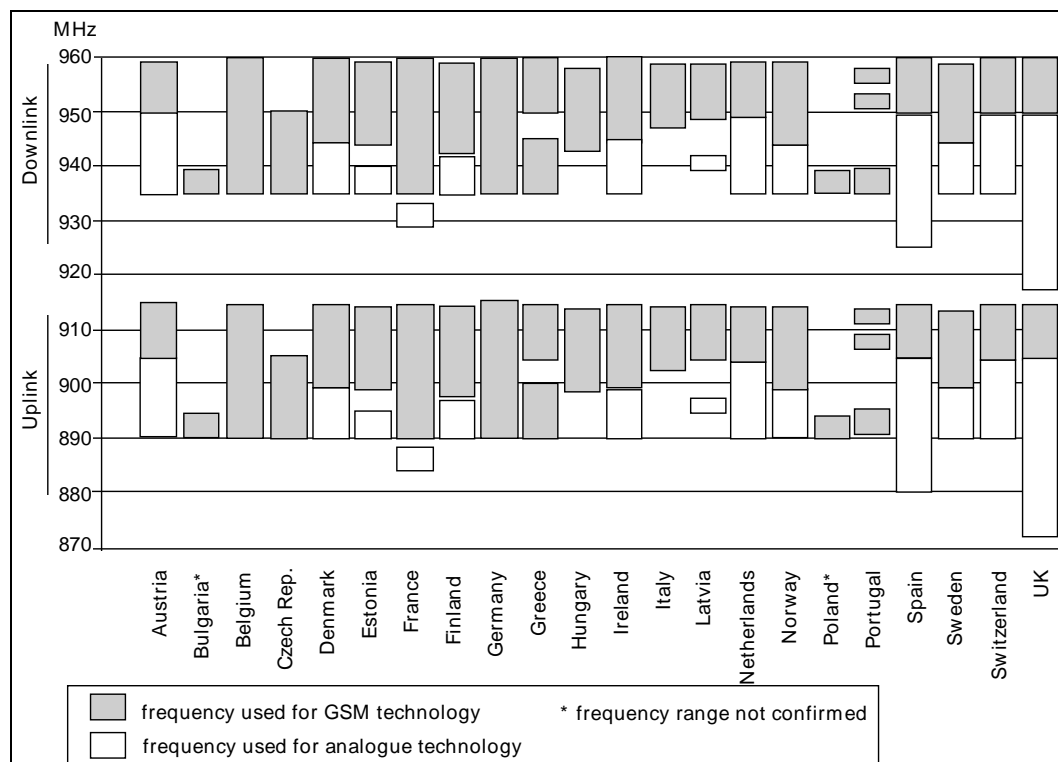
³¹ Most of them have already been de-activated or are to be de-activated in the short term.

³² Mainly POCSAG.

³³ Allocation by ITU/WARC92.

Figure III.1 provides an overview of frequency allocated to GSM and analogue services in the 900 MHz band.

Figure III.1: Frequency allocated to GSM and analogue cellular systems in the 870-960 MHz band



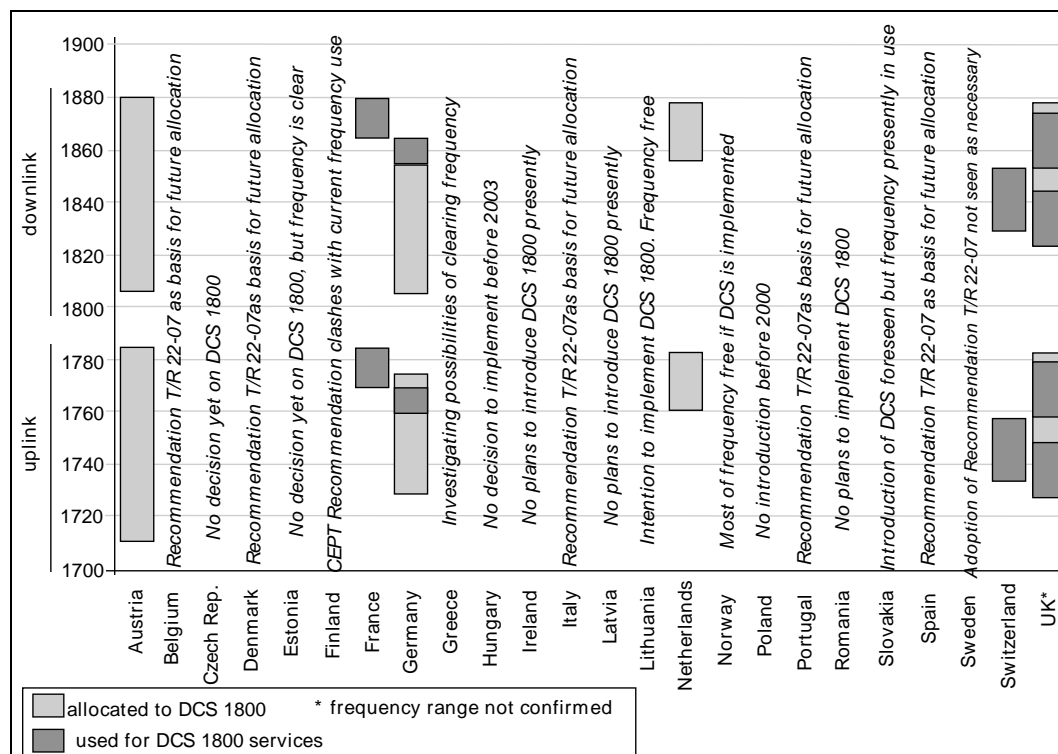
Source: KPMG

The use of spectrum in this band is relatively uniform between the various countries. Some countries have taken frequency harmonisation to its limit and fully co-ordinated their GSM frequencies. In this manner, interference problems are minimised and both users and operators experience fewer problems.

Although there is co-ordination in the use of spectrum, there are large differences in the amount of spectrum allocated to operators in different countries and even to different operators within the same country. In some cases, differences can be justified between countries due to different market conditions, in particular as regards the use of analogue systems around 1990 when GSM was introduced.

But it is harder to justify differences within countries. Very often, an incumbent operator with a mobile subsidiary will capitalise on access to both analogue and digital frequency bands. In this way, a private operator in the same country is at a significant disadvantage.

Figure III.2 shows the frequencies in use for mobile communications in the 1800 MHz band.



Source: ERO 1995

Figure III.2: Frequency allocation and use for mobile cellular systems in the 1800 MHz band

The implementation of DCS-1800 is still in its infancy compared to GSM, though the regulatory framework now requires consideration by EC Member States of requests for licensing of such systems before 1 January 1998. Outside the EC, many countries, particularly the eastern European and Baltic States, do not have any plans to implement this technology at all. One of the main reasons for this is that frequencies which have been designated for DCS-1800 clash with current frequency allocations for other systems in many countries.

The 1992 World Administrative Radio Conference (WARC) of the ITU targeted 230 MHz in the 2 GHz band, on a world-wide basis, for FPLMTS/IMT-2000, including both terrestrial and satellite components. The objective was identified as that of establishing, through the appropriate global standards and the coordinated assignment of frequencies by National and Regional Authorities, truly ubiquitous personal communications created be a seamless infrastructure.

The whole 230 MHz of spectrum identified by WARC-92 was reserved in Europe to Third Generation, UMTS, technology. Elsewhere, and especially in the US, the situation is far more complicated, and little hope exists of ever arriving at a common global standard with different regional solutions already subsumed.

Figure III.3 shows the allocation of spectrum for future mobile communications and the current situation in the various regions of the world.

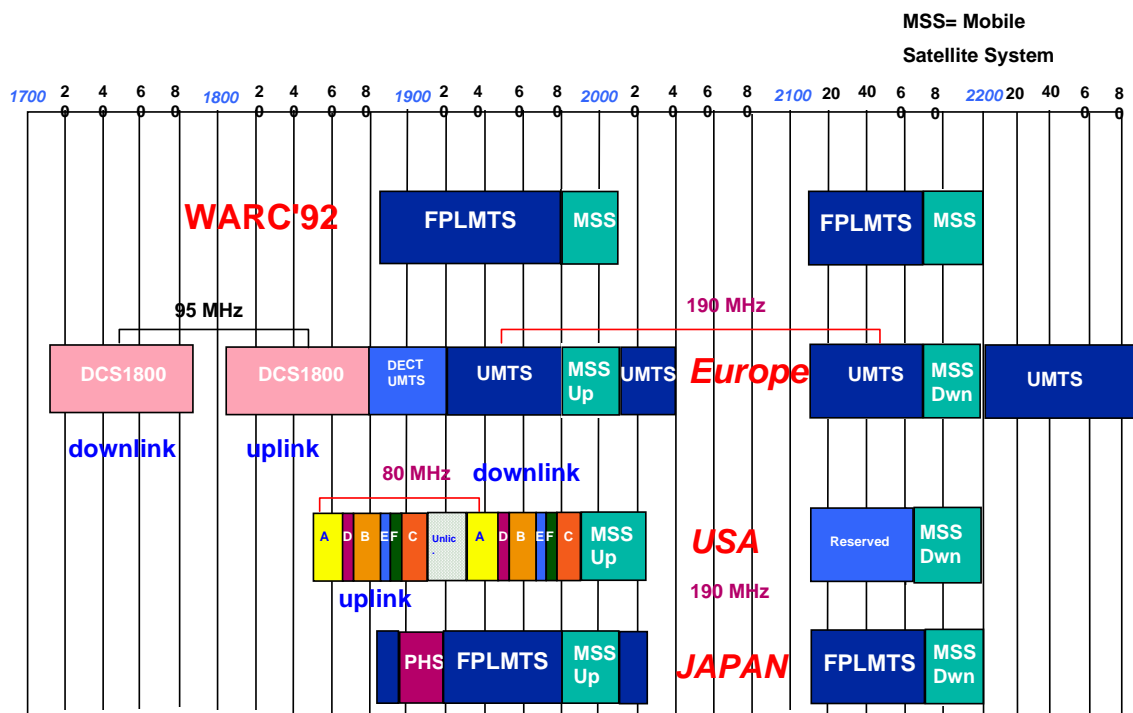


Figure III.3: Frequency allocation for future mobile communications (FPLMTS) around 2 GHz

ANNEX IV: LIST OF ACRONYMS

ACTS	Advanced Communications Technologies and Services
CDMA	Code Division Multiple Access
CEPT Administrations	European Conference of Postal and Telecommunications Administrations
D-AMPS	Digital cellular communications from North America
DCS-1800	Digital Cellular communication System, is like GSM but at 1800 MHz
DECT	Digital Enhanced Cordless Telecommunications
ERC	European Radiocommunications Committee
ETSI	European Telecommunications Standardisation Institute
FAMOUS	Future Advanced Mobile Universal System
FPLMTS	Future Public Land Mobile Telecommunications System
GMM	Global Mobile Multimedia, concept developed by ETSI
GPRS	General Packet Radio Service
GSM	Global System for Mobile
HSCSD	High-Speed Circuit Switched Data
IMT2000	International Mobile Telecommunications 2000
IP	Internet Protocol
ITU	International Telecommunications Union
OECD	Organisation for European Cooperation and Development
PACS	Public Access Cordless System
PBX	Private Branch Exchange
PHS	Personal Handyphone System
PCS-1900	Personal Communication System, essentially GSM at 1900 MHz
RACE	Research and technology development in Advanced Communications in Europe
R&D	Research and Development
PCS	Personal Communication System
S-PCS	Satellite-based Personal Communications System
TCP/IP	Transmission Control Protocol/Internet Protocol
UMTS	Universal Mobile Telecommunications System
WARC/WRC	World (Administrative) Radio Conference
WLL	Wireless Local Loop
WTO	World Trade Organisation