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Report from the UMTS Forum

The Future Mobile Market

Global trends and developments with a focus on Western Europe

UMTS Forum, March 1999

This report has been produced by the UMTS Forum, an association of telecommunications operators, manufacturers and regulators who are active both in Europe and other parts of the world and who share the vision of UMTS. UMTS will be a member of the IMT-2000 family of standards. UMTS will move mobile communications forward from where we are today into the Information Society of third generation services, and will deliver speech, data, pictures, graphics, video communication and other wideband information direct to people on the move.

A key objective of this report is to assess the expected future market for mobile multimedia services, as well as mobile voice and data services. Much of the content of this report is taken from an original study commissioned in 1997 by DGXIII of the European Commission, which has been openly available from the Commission. That study was carried out by the consulting companies Analysys and Intercai under the guidance of and with contributions from the Market Aspects Group (MAG) of the UMTS Forum. Although the original study was focussed on Western Europe, many trends and developments have a global applicability.

Certain data have been updated since the original study was conducted in order to reflect more recent market estimates, with particular regard to:

- projected global growth in mobile users;
- satellite traffic [data taken from Forum Report #6]

Unless otherwise credited, the source of all diagrams and exhibits is Analysys/Intercai.

This report - the eighth published by the Forum to date - follows on from other outputs which have dealt with a regulatory framework and spectrum aspects for UMTS (Report #1), technical aspects (#2), impact of licence cost levels (#3), licensing conditions (#4), minimum spectrum requirements (#5), UMTS/IMT-2000 spectrum (#6) and extensions to core band spectrum (#7).

Many statements in this report represent the views of the original authors, Analysys and Intercai, and have not been subject to formal approval in the UMTS Forum. However, the main conclusions and key findings in the report are supported by all operators and manufacturers of the UMTS Forum. The National Administrations that are members of the Forum have actively supported the development of the report. However, the Administrations cannot be bound by the detailed recommendations contained in the report.

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0.1 Executive Summary

0.1 SCOPE OF THIS REPORT

Convergence of communications, information, entertainment, commerce and computing, as a result of advances in technology in areas such as multimedia computing, interactive TV and the Internet will lay a foundation for the development of an "Information Society".

This report describes the Forum's view based on a study carried out by Analysys/Intercai [8], under the guidance of and with contributions from the Market Aspects Group (MAG) of the UMTS Forum. Findings of the study were first published in 1997 as part of the UMTS Forum's first report, "A Regulatory Framework for UMTS" [1]. Certain figures, particularly with reference to mobile user and Internet user predictions have been updated.

The objectives of the study were to forecast the evolution of the world-wide market for mobile communication services, in particular mobile multimedia services, over the next ten to twenty years, and to identify the key requirements for the successful development and implementation of third-generation UMTS/IMT-2000 mobile systems.

Spectrum demand to support UMTS/IMT-2000 services is significantly dependent on the number of users, the quantity of traffic flow and its distribution. In order to identify this critical impact, the original study that forms the basis of this report considered the total public market for mobility. Assessment was made of developments and growth of the global market, spanning North America and Asia Pacific regions but with a primary focus on the EU15 member states. Subsequent study work by the Forum has assessed spectrum requirement for satellite services.

The study was underpinned by a central hypothesis that the evolution of the market for mobile multimedia services will be strongly influenced by the site and nature of the market for networked multimedia services, e. g. Internet and Intranet. Societal and technological trends were evaluated, leading to the evaluation of "scenarios" and hence market forecasts. Key findings may be summarised:

0.2 TERRESTRIAL MOBILE SERVICES MARKET - KEY FINDINGS

1. The world market for physical users of terrestrial mobile services (including multimedia) will be 426 million users by the year 2000, rising to 940 million by 2005 and more than 1.7 billion users by 2010.
2. There will be 190 million physical mobile users in North America by 2005, rising to 220 million by 2010.
3. There will be 400 million physical mobile users in Asia Pacific by 2005, rising to 850 million by 2010.
4. There will be 200 million physical mobile users in Western Europe by 2005, rising to 260 million by 2010. 32 million of these will be mobile multimedia users in 2005, rising to 90 million mobile multimedia users by 2010.
5. In the rest of the world, there will be 150 million physical mobile users by 2005, rising to 400 million by 2010.
6. The total Western European mobile market will be worth 104 billion ECU¹ per year in 2005, representing total traffic levels of 6,300 million Mbytes/month.
7. The mobile multimedia segment of this Western European market will be worth 24 billion ECU¹ per year in 2005, representing total traffic levels of 3,800 million Mbytes/month. Terminal revenues in 2005 will add a further 10 billion ECU¹ per year to this European market value.

UMTS/IMT-2000 services are also likely to be used by other sectors, including systems with limited mobility (e.g. in areas with low population density), and in private/corporate markets, ranging from home use to wireless PBXs, emergency and cordless systems. Note that the market for non-public (or "license exempt") applications of this type is the subject of separate study by the UMTS Forum, and is not addressed in this report.

0.3 MOBILE SATELLITE SERVICES MARKET - KEY FINDINGS

Additional material contained in this report, particularly with reference to the market for satellite based systems, is based on the findings of separate work carried out by the UMTS Forum's Spectrum Aspects Group (SAG) and published in UMTS Forum Report #6 *UMTS/IMT-2000 Spectrum*.

While more than 80% of the European population can be expected to be covered by terrestrial UMTS/IMT-2000 in 2010, less than 20% of the world's total land area will be covered by terrestrial cellular networks within the envisaged timescales of UMTS/IMT-2000. Satellite systems are therefore important to UMTS/IMT-2000 to provide complete coverage. The forecasts summarised in this report deal only with mobile satellite services, i.e. those services supplied from either moving terminals or portable/transportable terminals capable being moved easily:

¹ The currency denomination „ECU“ has later been replaced by the name „Euro“.

8. The world market for physical users of mobile satellite services (MSS) (including multimedia MSS) will be 11.5 million users by the year 2005, rising to 18.5 million by 2010.

9. There will be 1 million MSS users in Europe by 2005, rising to 1.6 million by 2010. 0.4 million of these will be multimedia MSS users in 2005, rising to 0.7 million multimedia MSS users in Europe by 2010.

10. Total traffic levels (multimedia + non-multimedia) for the European MSS market will reach 22 million Mbytes/month in 2005, rising to 40 million Mbytes/month in 2010.

0.4 STUDY APPROACH

A multi-stage process was adopted for the (non-satellite) study conducted by Analysys/Intercai. Societal and technological trends likely to have an impact on the future market for mobile multimedia services were first researched and identified, followed by a process of service scenario development, validation and finally drawing of conclusions relevant to the successful development of a market for UMTS/IMT-2000.

0.4.1 Market Definitions

UMTS and other IMT-2000 third generation mobile systems will deliver voice, graphics, video and other broadband information direct to the user, regardless of location, network or terminal. These fully personal communication services will provide terminal and service mobility on fixed and mobile networks, taking advantage of the convergence of existing and future fixed and mobile networks and the potential synergies that can be derived from such convergence. The key benefits that UMTS/IMT-2000 promises include improvements in quality and security, incorporating broadband and networked multimedia services, flexibility in service creation and ubiquitous service portability.

Networked multimedia may be defined here to include services such as pay-TV; video- and audio-on-demand; interactive entertainment; educational and information services; and communication services such as video-telephony and fast, large file transfer.

0.4.2 Key Assumptions and Dynamics Model

While global market growth was considered, the major focus of the study was on the 15 EU member states. The study forecast the evolution of personal communication services delivered via a wireless interface to personal or portable devices. The market for the delivery of services to fixed terminals was not explicitly considered. Furthermore, the analysis assumed that the first mobile multimedia services will be delivered via enhancements to the second generation network technologies such as GPRS or via DECT before the commercial launch of third generation systems such as UMTS.

0.5 KEY SOCIETAL AND TECHNOLOGY TRENDS INFLUENCING THE EVOLUTION OF THE MOBILE MULTIMEDIA MARKET

Research was undertaken to identify societal trends that are likely to have an important effect on how the marketplace reacts to third generation mobile services. Equally, the continuing evolution of existing technologies will have an important impact on the capability of third generation mobile systems and services.

0.5.1 Societal and Market Trends

Three market trends were identified that will have the most significant impact on the size and nature of demand for mobile multimedia services.

- The market for fixed networked multimedia services – e. g. home entertainment – is growing rapidly, at over 60% per year.
- Computer-based communications is being widely accepted and embraced by society. The Internet market, for example, is predicted to grow to over 500 million world-wide by 2005.
- There is growing demand for accessing both information and entertainment services while mobile.

0.5.2 Technology Trends

Developments were identified which will exert a direct influence on the attractiveness and cost of mobile multimedia terminals and services over the next ten years and beyond:

- Mobile multimedia terminals will create a step-change in the way in which individuals communicate and access information. Functionality and cost of these devices will be determined by semiconductor, display and interface technologies.
- The attractiveness and costs of mobile multimedia services will be determined by delivery and management technologies including the Internet, Java, database and spectrum-enhancing as well as service creation technologies.

0.6 SCENARIO ANALYSIS

Four scenarios for the evolution of the mobile multimedia services market up to 2005 were developed. These scenarios examined permutations of two key factors, namely take-up of fixed multimedia services in the mass market, and the primary location of intelligence, be it in the network or the device. Of the scenarios considered, that of an "Evolved mass market" may be regarded as most plausible, characterised by a high market take-up of multimedia services and a "device-centric" environment.

0.6.1 Key Drivers, Enablers, Barriers and Uncertainties

Other key factors likely to affect development of the mobile multimedia market were also considered in the study:

<i>Drivers:</i>	<ul style="list-style-type: none"> • Growth in communications, commerce and entertainment services on the fixed network, influenced by increased Internet usage and falling costs. • Demand for rapid, remote access to information, driven by increasing need for business productivity, greater personalisation and increased mobility.
<i>Enablers:</i>	<ul style="list-style-type: none"> • Regulation to encourage competition and allow cheap, easy access. • World-wide adoption few mobile radio and open service standards. • UMTS/IMT-2000 specifications to support IP-based services. • Early exploitation of GPRS as an interim means of delivering MM services. • Improvements in user interface design and display technologies. • Technologies that enhance spectrum efficiency & utilisation. • Improvements in semiconductor performance/costs.
<i>Barriers:</i>	<ul style="list-style-type: none"> • High cost and limited availability of spectrum. • Failure to resolve security issues and reassure consumers re security. • Slow development of IT literacy in the mass market.
<i>Uncertainties:</i>	<ul style="list-style-type: none"> • Rate of growth of the mobile multimedia market. • The network paradigm – network or device centric? • Increase in demand for capacity/spectrum in a network centric scenario.

0.7 MARKET FORECASTING RESULTS

0.7.1 World Mobile Market

World markets for mobile and mobile multimedia were projected on the basis of the current status of market development, GDP per head and expected sophistication of the telecoms market in each country or region. Results show clearly that markets outside the EU will dominate the world mobile market by 2005.

Exhibit 0.7 shows the world-wide market forecast for the physical users of terrestrial mobile services including multimedia.

Physical users in millions	2000	2005	2010
Europe, EU15	113	200	260
North America	127	190	220
Asia Pacific ²	149	400	850
Rest of the world	37	150	400
Total	426	940	1730

Exhibit 0.7: World-wide Mobile Market Forecast

Europe, Japan and North America are most likely to face market saturation in terms of physical users by the year 2010. However, there is likely to be further market potential

² thereof Japan Segment acc. To ARIB 1/98 year 2000: 60-70m; year 2010: 90-100m

for machine-to-machine communications. Many countries in Asia Pacific, Africa and South America are expected to be far from saturation in terms of users in 2010.

0.7.2 The European Mobile Terminal Market

Assuming that users will upgrade their mobile device every three years, by 2005 the annual mobile terminal market is forecast to be between ECU11 billion and ECU23 billion with mobile multimedia devices accounting for between 45% and 60% of this total. (The currency denomination „ECU“ has later been changed to „Euro“)

0.7.3 The European Market for Mobile Multimedia Content

A significant proportion of the total revenue collected by the service provider will be passed on to the third party content providers. By 2005, the value of this market is projected to reach between ECU1.5 billion and ECU7 billion per year.

0.7.4 European Mobile Traffic Forecasts

Projections were made for levels of voice and multimedia traffic in a variety of radio environments. A significant assumption was made that asymmetric multimedia services will require an average of 33% higher information flow due to the need to download software for processing locally. A significant result is that in the mass market/network centric scenario, data traffic will reach in some environments around 70% of total mobile traffic by 2005.

0.8 SUMMARY

A great opportunity exists for the mobile communications industry to develop services that will meet the developing needs of both businesses and consumers as the Information Society emerges world-wide over the next decade. Those needs are rapidly being shaped by developments in the convergence of computing, broadcasting and communications. Consequently, the mobile industry must respond in a manner that recognises those influences and exploit their characteristics to the greatest effect.

1. Introduction

This report outlines a vision and forecast for the evolution of the market for public mobile communication services, in particular mobile multimedia services, over the next ten to twenty years. It also identifies the key requirements for the successful development and implementation of the third generation mobile system, UMTS (Universal Mobile Telecommunications System), part of the IMT-2000 "family" of third-generation mobile systems envisioned by the ITU.

Many statements in this report represent the views of the original authors, Analysys and Intercai, and have not been subject to formal approval in the UMTS Forum. However, the main conclusions and key findings in the report are supported by all operators and manufacturers of the UMTS Forum.

1.1 BACKGROUND

As telecommunications moves into an era where the distinction between voice, video and data will be blurred, convergence of communications, information, entertainment, commerce and computing will lay the foundation for the development of an Information Society in Europe. Over the last five years there have been a number of significant developments in multimedia computing power, CD-ROM technology, digital television, the Internet/Intranet, and IP-based services and terrestrial and satellite mobile communications, which could have a profound impact on our society. These technologies and systems may enable dramatic changes to take place in working practices, entertainment, education and healthcare.

Many organisations within the computing, entertainment, and communications industries are now looking to identify and capitalise on the promise of new market opportunities in multimedia created by these developments. To date, these organisations have worked largely within the fixed network sector. However, demand for multimedia services, should they be successful, is unlikely to be constrained to the fixed network. Greater pressure on time, and the need for flexibility and responsiveness in business, will lead to a growing demand for access to these services anytime, anywhere.

It follows that a great opportunity exists for the mobile industry to contribute to, and even further, the development of the Information Society by its ability to provide easy access to public databases and government services, and to increase the availability of and access to skilled, knowledge-based workers, so facilitating the trend towards flexible working practices that could help to increase employment in the EU.

In order to meet the evolving needs of customers, and to capture the opportunity which this evolution represents, the European mobile industry is looking to define and develop

a third generation of mobile technology – Universal Mobile Telecommunications System (UMTS).

UMTS and other IMT-2000 third generation mobile systems³ will take the personal communications user into the Information Society by delivering voice, graphics, video and other broadband information direct to the user, regardless of location, network or terminal. These systems will move mobile communications forward from second generation systems – that are currently creating a mass market for low-cost digital wireless services – to encompass fully personal communication services.

These personal communications services will provide both terminal and service mobility on fixed and mobile networks, taking advantage of the convergence of existing and future fixed and mobile networks and the potential synergies that can be derived from such convergence.

The key benefits that UMTS/IMT-2000 promises include improvements in quality and security, incorporating broadband and networked multimedia services, flexibility of future service creation and introduction, and offering ubiquitous service portability.

The study has sought to identify the key uncertainties and events associated with the development of the market for mobile multimedia services, which may be delivered by systems such as UMTS/IMT-2000, and to quantify the market based on varying outcomes of these uncertain issues and events. It has then drawn conclusions as to the likelihood of particular outcomes, and of the size and characteristics of the market for mobile multimedia services.

1.2 OBJECTIVES AND STUDY APPROACH

1.2.1 Objectives

Four specific objectives were set for this study:

- to determine the level and nature of world-wide demand for third generation mobile services with a specific emphasis on the EU
- to determine the key issues that will influence the evolution and the level of impact they will have on the market
- to produce a robust analysis which forecasts the evolution of the world-wide market for UMTS/IMT-2000 (mobility services) to 2005 and the expected market evolution between 2005 and 2015

³ The International Telecommunications Union (ITU) world-wide recommendations for third generation mobile systems are known as International Mobile Telecommunications 2000 (IMT-2000) – originally called Future Public Land Mobile Telecommunication Systems (FPLMTS).

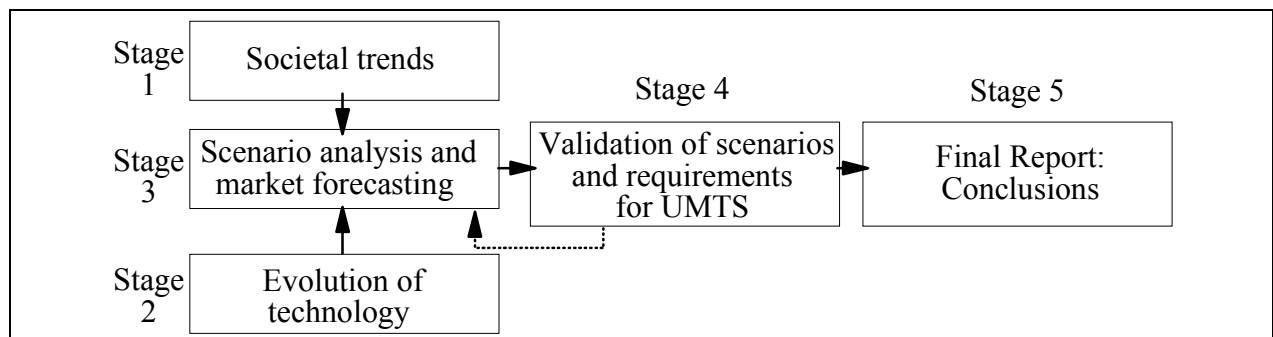
- to forecast the emerging requirements and any intermediate steps for UMTS/IMT-2000.

1.2.2 Study Approach

A five-stage process was adopted for the study:

- Stage 1 and 2 researched and identified the societal and technological trends which are likely to have an impact on the future market for mobile multimedia services.
- Stage 3 involved the construction of scenarios for the evolution of the market, based on the trends identified during Stage 2, as well as the production of market forecasts for each scenario.
- Stage 4 validated the scenarios, and gathered industry opinion regarding future market development and requirements through a series of workshops for industry players.
- Stage 5 involved the process of clarifying the conclusions which had emerged from each stage of the study, and identifying the key drivers, enablers of and barriers to successful development of a market for UMTS/IMT-2000.

EXHIBIT 1.1:



1.3 SCOPE AND STRUCTURE OF REPORT

Following this introduction, Section 2 of the report describes the definitions adopted in the study for multimedia markets, and presents the conceptual model of the multimedia market used to describe the dynamics of the development of the mobile multimedia market. Section 3 summarises the research into societal and technology trends that will shape the evolving market for fixed and mobile multimedia services, which were used in Stage 3 to form the basis of the forecasts of market development in the scenario analysis process. Section 4 presents a brief description and explanation of the four scenarios developed in Stage 3. Section 5 presents the market forecasts. Section 6 discusses key drivers, enablers, barriers and uncertainties framing the mobile market, and Section 7 concludes with a summary of overall findings from the study.

The original study [8] was supported by two annexes, which were:

- *Annex A/ Societal and Technology Trends* provided a report of the research into the societal and technological trends affecting the future market for mobile communications carried out in Stages 1 and 2.
- *Annex B/ Scenario Analysis and Market Forecasting* explained the scenario development process and market forecasting methodology used in Stage 3.

2. Market Definitions and Key Assumptions

The key differentiator of third generation mobile systems such as UMTS/IMT-2000 will be the ability to deliver broadband and multimedia services alongside the traditional mobile services such as voice, messaging and slow rate data.

This section presents the definition of the term 'multimedia' used in this study, and identifies the generic fixed and mobile multimedia services and applications that are expected to be central to the future multimedia marketplace. It also presents some key assumptions of the study, including those in the market dynamics model of the multimedia market, which underpins the analysis and was used to develop the four scenarios discussed in Section 4.

2.1 MARKET DEFINITIONS

Mobile multimedia services will be a sub-set of networked multimedia services delivered via fixed networks, as well as services designed specifically for mobile delivery. It is therefore equally important to define the networked multimedia market, as well as the mobile and mobile multimedia markets. The following sections describe in detail the market definitions used in the study, that is, the generic services which are likely to fall into each category.

2.1.1 Networked Multimedia Market

'Multimedia' can be interpreted in a variety of ways. It is commonly associated with the combined presentation of data, sound, and vision in software applications stored on CD-ROMs. Others define it as the combined use of video and sound within product marketing material, however that material is created and replayed. A more appropriate and commonly accepted definition is 'services arising from the convergence of computing, communications and established media'.⁴ For the purposes of this study,

⁴ Susan Ablett and Simon Norris, *Multimedia in Telecoms* (Analysys Publications, Cambridge, 1994)

multimedia has been defined as the set of audio-visual and information services delivered via communications networks – known as networked multimedia.

A fundamental hypothesis that underpins the analysis in this study is that the evolution of the market for mobile multimedia services will be strongly influenced by the size and nature of the market for networked multimedia services provided via fixed networks. The exposure to multimedia services and applications on fixed networks, combined with increasing demands on mobility, will create expectations for delivery of these services to users wherever they are. Therefore, this study has considered the development of fixed multimedia services as a precursor to mobile multimedia.

Five generic service categories have been identified from the range of services which are either currently on offer, or are envisaged in the future:

Passive audio-visual services:

- Pay-TV (cable and DTH satellite)
- Video-on-demand (as an alternative to video sales/rentals)
- Narrowcast business TV

Passive audio services:

- Audio-on-demand (as an alternative to CDs, tapes, radio)

Information, education, and entertainment services:

- Highly interactive services such as education, training and games
- Public information services such as tourist information and booking services
- Home shopping/banking
- Online media services such as newspapers and magazines
- Business information services such as stock data and business analysis reports online

These services are largely asymmetric in their communication requirements – i.e. the amount of information flowing in one direction greatly exceeds the amount of information flowing in the other direction.

Personal communication services:

- Videotelephony, for example, telemedicine (i.e. remote consultation)
- Videoconferencing, for example, remote training

These are person-to-person services, which tend to be symmetric in nature – i.e. the amount of information flowing to the user

approximately equals the amount of information flowing in the other direction.

Corporate Communication Services:

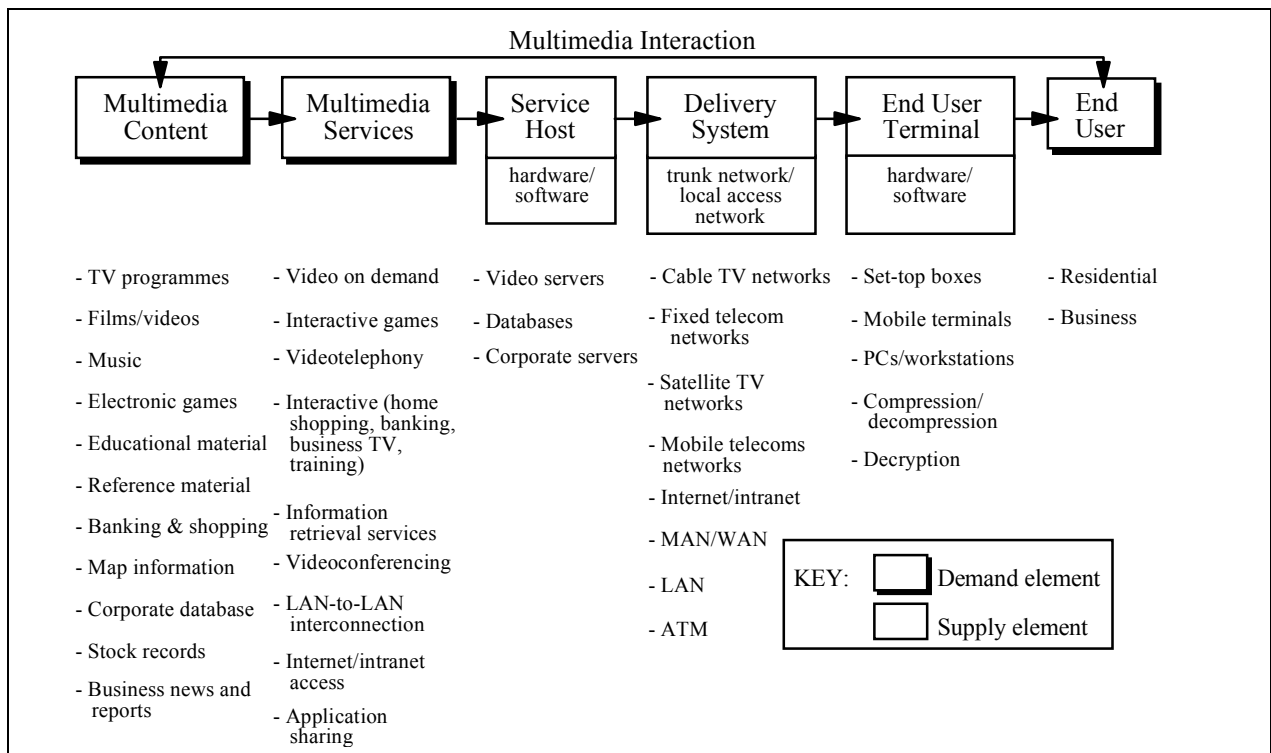
- LAN-LAN interconnect and Intranet access, for example, access to journalism database of video clips of news events
- Remote collaborative working, for example, the simultaneous development of architectural design or fashion design, and remote diagnostics

These are corporate communication services which support key business processes and are, in general, asymmetric.

Networked Multimedia Value Chain

Delivery of multimedia services involves a number of players and activities. As demonstrated in Exhibit 2.1, the multimedia service provider (MSP) is the key player in the multimedia value chain.

EXHIBIT 2.1: The Multimedia Value Chain



MSPs purchase multimedia information (content) from third party suppliers such as TV programme providers, movie studios, publishers, and software developers. They then format the content (i.e. video-on-demand, home shopping catalogue, interactive games, etc.) to what they believe is appropriate for their customer base and store, or 'mount', it on a multimedia server, or 'service host'. The host can either be an MSP's own server, or

part of a server leased from a third party (either another service provider or a network operator). MSPs must then provide easy and low-cost access to the host for its customers via a fixed or mobile telecoms link.

2.1.2 Mobile Market

As fixed and mobile networks converge, integrated mobility services will be provided – offering the benefits of mobility and personalisation and allowing the user:

- to access some services via either a fixed or mobile terminal
- to be contactable anywhere regardless of location
- to modify their service profile to meet their own personal preferences and needs.

Third generation systems such as UMTS/IMT-2000 will be an essential element of the integrated network that delivers these services. However, this study has assessed and forecast the evolution of the market for terminal mobility services only, i.e. personal communication services delivered via a wireless interface to personal or portable devices. **The study has not considered the market for the delivery of services to fixed terminals – whether delivered via wired or wireless technologies.** Unless stated otherwise, any reference to mobile services made in the report implies terminal mobility services.

In order to describe the evolution of the whole mobile market in Europe, three basic mobile service types have been defined as follows:

- Voice:*
- Simple one-to-one and one-to-many voice (teleconferencing) services
 - Voicemail

These services are tariffed on a per minute basis.

- Messaging:*
- SMS (short message service) and paging
 - Email delivery
 - Broadcast and public information messaging
 - Ordering/payment (for simple electronic commerce).

These services are tariffed on a per message basis.

- Switched Data:*
- Low-speed dial-up LAN access
 - Internet/Intranet access
 - Fax

Legacy services – mainly using radio modems such as PCMCIA cards, are not expected to be very significant by 2005. These services are tariffed on a per minute basis.

2.1.3 Mobile Multimedia Market

It is clear that many, if not all, of the services developed and taken up by fixed network multimedia users will be candidate services for mobile multimedia, in addition to those that will be developed specifically for mobile. It is also clear that the nature of the traffic flow and traffic distribution will have a significant impact on the quantity of spectrum required, and hence on the cost of service provision. At present, spectrum is a scarce resource and a key constraint in the development of mobile networks. In order to capture this critical characteristic of the evolving market, three generic mobile multimedia service types have been defined:

Medium multimedia (asymmetric) Asymmetric services which tend to be 'bursty' in nature, require moderate data rates, are characterised by a typical file size of 0.5MBytes, with a tolerance to a range of delays. They are classed as 'connectionless' services and are tariffed on a per Mbyte basis. Applications include:

- LAN, and Intranet/Internet access
- application sharing (collaborative working)
- interactive games
- lottery and betting services
- sophisticated broadcast and public information messaging
- simple online shopping, banking (electronic commerce) services.

High multimedia (asymmetric) Asymmetric services which also tend to be 'bursty' in nature, require high data rates, are characterised by a typical file size of 10MBytes, with a tolerance to a range of delays. They are classed as 'connectionless' services and are tariffed on a per Mbyte basis. Applications include:

- fast LAN, and Intranet/Internet access
- video clips on-demand
- audio clips on-demand

- online shopping.

High interactive multimedia (symmetric)

Symmetric services which require reasonably continuous and high-speed data rates with a minimum of delay, and are tarified on a per minute basis. Applications include:

- videotelephony and videoconferencing
- collaborative working and telepresence.

2.2 KEY ASSUMPTIONS

The study has focused on the future potential demand for mobile multimedia services, without making explicit assumptions regarding the specific radio technology or standards used to deliver them. It has been assumed that the first mobile multimedia services will be delivered via enhancements to the second generation network technologies such as GPRS or via DECT before the commercial launch of third generation systems such as UMTS/IMT-2000 happens, which is not expected to be any earlier than 2002.

In addition to personal communications services, third generation systems such as UMTS/IMT-2000 are expected to deliver a wide range of machine-to-machine communication services, for example, transport telematics. Although these services will generate reasonably significant traffic volumes, it is expected that they will be relatively small in comparison to those delivered to individuals, and have only been implicitly included in this analysis in the context of personal services – for example, electronic commerce, and location and direction finding services.

A key factor for the success of third generation mobile systems such as UMTS/IMT-2000 will be the ability to offer the 'virtual home environment', thus making the customer feel as though he is on his home network, even when roaming. With this service, the customer's profile moves with him wherever he is or whatever network he uses. The increased usage (i.e. traffic and revenues) of mobile multimedia services as a result of the provision of 'service portability' has been assumed in this study.

The major focus of the study, in particular the scenario analysis and market forecasts, has been on the European market, defined as the 15 EU member states: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Spain, Sweden, and the UK. Assessment has been made of developments and market growth in the rest of the world – in particular North America and Japan, but not to the same degree of detail as for Europe. Eastern Europe, with a market size of approximately 10-15% that of Western Europe, is included in figures for "rest of world".

2.2.1 Market Dynamics

The market analysis presented in this report is based on a relatively simple conceptual model of market dynamics. This model, illustrated in Exhibit 2.2, underpins our assumptions for the interaction of market demand and supply, and the influence of external factors such as societal trends, technological developments, and regulatory and industrial policy.



EXHIBIT 2.2:
Market Dynamics
Model

Service take-up in the marketplace will be influenced by the affordability of the service, determined by the price of the service and the terminal, and the attractiveness of the service.

The price of the service will be determined by:

The level of competition in service delivery Determined by the degree to which liberalisation of the sector encourages competition in service provision and the cost to the service provider of access to the network.

The cost of network access Determined by:

- **liberalisation of the provision of infrastructure** and encouraging infrastructure competition.
- **component costs** – for example, technology developments such as advances in optical fibre technology have dramatically reduced costs of access to broadband services.
- **production volumes**, which are influenced by the degree of standardisation – the more widely adopted the standard, the larger the market and overall levels of service demand. Increasing production volumes will lower unit costs as a result of economies of scale.

Price of terminals will be determined by:

Component costs Technology developments, such as high volume semiconductor manufacturing, and new display technologies such as cholesteric liquid crystal (CLC) screens (see Section 3.22 of Annex A), will have a significant effect on manufacturing costs of multimedia terminals.

Production volumes Influenced by the degree of standardisation and overall levels of service demand.

Attractiveness of services will be determined by:

Service variety Competition in service provision will encourage innovation and the development of a wider range of services in order for service providers to differentiate themselves and to meet the growing need for personalised or customised services.

Service usability Technology developments will influence service design and the man machine interface (MMI) enabling users to personalise, and therefore simplify, the user-interface making services easier to use.

Service utility The value placed on a particular service will depend on how closely the service or application meets the needs of the customer, and how important that need is to the customer.

Note: references to service providers include the service provision businesses of fixed **and** mobile network operators.

The issues influencing these factors will be crucial in determining the nature, rate of growth and overall size of the market for mobile multimedia services. Section 3 identifies those key issues on the basis of which the four scenarios are constructed for the evolution of the market to 2005 (described in Section 4).

3. Societal and Technology Trends

The changing behaviour and attitudes of society will have a major impact on how the marketplace reacts to new services. Research was undertaken to identify and understand the societal trends that are likely to have an important effect on third generation mobile services, and to measure their rate of development in order to predict how the market might evolve. Equally, the continuing evolution of existing technologies will have an important impact on the capability of third generation mobile systems and services. For the purposes of this study, however, it was considered more important to identify technologies that, although in their infancy today, may have a disruptive effect on the evolution of existing technologies and systems.

Societal trends addressed within this study included:

- demand for increased personal productivity and its impact on quality of life
- the changing nature and growing demand for home entertainment services
- increasing acceptance of information technology in the workplace and at home
- increases in crime and its impact on the perception of personal and family security
- the growth of electronic commerce and its impact on retailing
- the emergence of flexible working practices and subsequent demands for remote access to information.

Technology trends identified in the study, that may intercept and revolutionise aspects of third generation mobile system design, included:

- cost/performance trends in terminal components such as semiconductors
- development of human-machine interfaces and ergonomic technologies
- Internet and IPng, and associated technologies such as intelligent agents and Java

- advances in database and data compression technologies
- development of spectrum efficient radio technologies
- service creation, delivery and management technologies.

The following sections summarise the key findings of the analysis of these trends, and postulate their impact on the evolution of the mobile multimedia market in Europe. The detailed results of this research are presented in [8, Annex A of the Analysys/Intercai Study].

3.1 KEY SOCIETAL INFLUENCES ON THE MOBILE MULTIMEDIA MARKET

Three market trends were identified that will have the most significant impact on the size and nature of demand for mobile multimedia services:

- The market for fixed networked multimedia services is growing rapidly (Internet/Intranet).
- Computer-based communications is being widely accepted and embraced by society.
- There is growing demand for accessing both information and entertainment services while mobile.

3.1.1 The Market for Fixed Networked Multimedia Services Is Growing Rapidly

The market for home entertainment services, particularly those based on interactive media, is growing rapidly, encouraged by an increasing acceptance of IT at home and a growing demand for personalised products and services. The market for business oriented multimedia services is growing rapidly as many businesses develop and implement multimedia applications to improve productivity and establish competitive advantage.

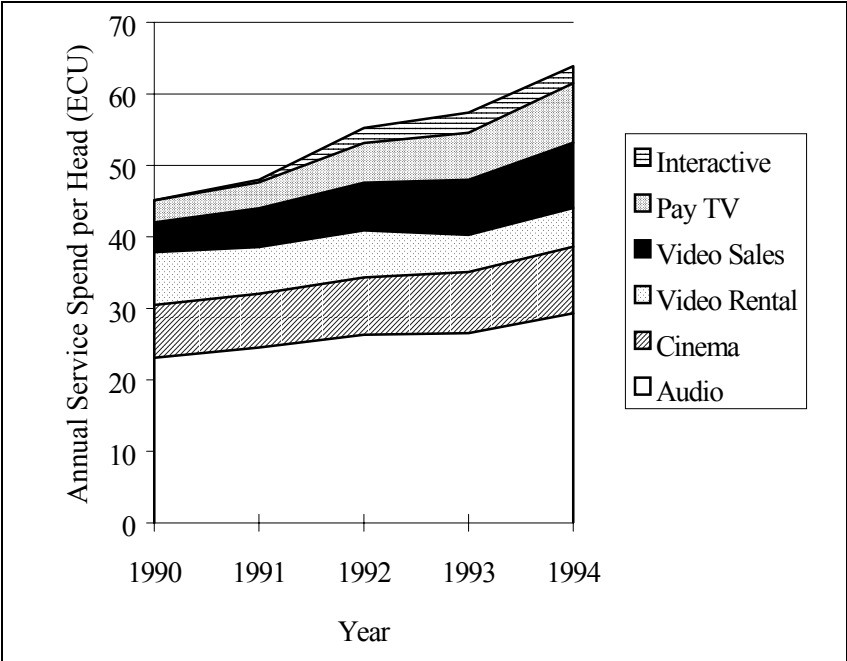
Both trends will be facilitated by the lower cost and increasing performance of PCs and availability of low cost networking technologies, such as the Internet and Intranets.

The market for home entertainment services is growing rapidly, with a significantly growing proportion associated with interactive media

European expenditure on audio-visual entertainment services, including television revenues generated directly from the consumer, grew by one third between 1990 and 1994, to around ECU66 per head. In that time, the market for both interactive and pay TV services has increased both in terms of revenues and market share; revenues have grown from ECU3 to ECU11 per head, whilst market share has increased from 5% to 18% between 1990 and 1994. The overall market is expected to expand by over 50% by

2005. Interactive and pay-TV services will grow more rapidly, to reach a market share of approximately 34% and revenues of approximately ECU44 per head by 2005.

*EXHIBIT 3.1:
European AV
Software Spend
Proportion by
Service (1990-
1994) [Source:
Screen Digest –
reproduced by kind
permission of
Screen Digest]*



The range of services currently under development for delivery via digital TV, and the many multimedia trials that are being undertaken throughout the world, are just a taster for what we might expect in ten years time. Examples include: pay-per-view TV, video-on-demand films and news clips, interactive home shopping and banking via virtual shopping ‘malls’, capability to customise and personalise products such as clothes, interactive entertainment such as games, interactive TV shows, gambling, travel and theatre booking services, and local and national government services.

An increasing acceptance of IT at home will drive demand for, and acceptance of home delivered multimedia services such as pay-TV and interactive services

Attitudes towards advanced technology are changing as people become more used to technology at work and in their everyday lives. For example, the Internet/Intranet and the PC are changing the way in which people view technology, and as these become more and more integrated into everyday activities, they will increase acceptance of technology within society. Although currently only about 18% of European households own a home computer, a PC in most cases, this is forecast to reach at least 40% by the end of the decade. The upper limit may be constrained by the cost of a PC or the attitudes in some sectors of society to the technology. However, the development of cheaper computing tools, such as the network computer (NC), may help to take home computing beyond these currently predicted limitations.

The growing desire for individuality and ability to personalise products and services will have a significant influence on driving demand for interactive services

A key societal driver of the market for interactive services, is the trend towards individuality in society – i.e. the desire to be different and to choose products and services which meet one's own personal needs most effectively, which manifests itself in the demand for personalised services. Throughout the retail and service industries, there is a trend towards giving consumers control of defining the product or service to meet their personal choice or need. This is valued by consumers as it extends choice, saves money (in many cases) and saves time – with the subsequent improvement in quality of life. Therefore, it is expected that the growth in demand for interactive and pay-TV, entertainment and information services will be driven by this trend, provided content and service providers can give the consumer control of customising services, and that this control is made easy by simple design of delivery mechanism and interface.

The market for networked multimedia services in the corporate sector is growing rapidly

A number of industries are experiencing the beginnings of a paradigm shift from work focused on a static, central location with long-term employment contracts, to smaller, more flexible business units where the workforce is more mobile, both in terms of where they work and who they work for. Progressive companies within these industries are already attempting to streamline their organisational structure and to adopt more flexible working arrangements with their staff by experimenting with new concepts such as outsourcing functions, virtual project teams and teleworking, in order to cut costs, increase productivity or create competitive advantage through increased responsiveness to market trends or customers needs.

The development of the PC in the early 1980s has led to an increase in the use of information technology in industry, particularly in office environments. New developments such as the Internet, and particularly the Intranet, are now increasing the intensity of information usage in business again.

The combination of these two trends, together with the demand for flexibility and demand for access to information facilitated by the widespread usage of the PC and advances in communication services, has created an environment in which corporate networked multimedia services, such as videotelephony, collaborative working and Intranet-based applications, is now a significant growth area. Over the next ten years, multimedia information and communications technologies and applications will be increasingly used in 'mission-critical' applications – where IT is fully integrated into business processes, rather than just used as a support tool. For example, one multinational oil company has recently transferred all of its human resources records and systems onto its Intranet for access by its employees world-wide. Future applications will include co-ordinated scheduling, parts ordering, stock checking for service engineers from fixed or mobile terminals, collaborative working systems which enable 'virtual project teams' to perform effectively even when working in different parts of the world, remote telemedicine and consultation, fast access to digital libraries of art, design, news articles, business information, virtual reality walkthrough of architectural designs, etc.

Electronic commerce will be a fundamental component of future multimedia services

Growth in electronic commerce over the next 10 years will be fuelled by continuing counter automation in the retail and finance sector, growing penetration of PCs at home and in the office, the explosive growth of Internet/Intranet hosts and users, and by growing familiarity with credit and debit cards. Financial institutions and retailers are experimenting with virtual malls, testing user acceptance and the capabilities of the system. Although the speed of development and the importance of the Internet/Intranet in promoting this trend is still uncertain, it is clear that a key driver of future multimedia services will be the demand for alternative, cheaper, means of marketing and distributing goods and services. However, the success of multimedia services based on financial transactions is predicated on the ability of the industry to allay current user concerns about the security of Web-based transactions.

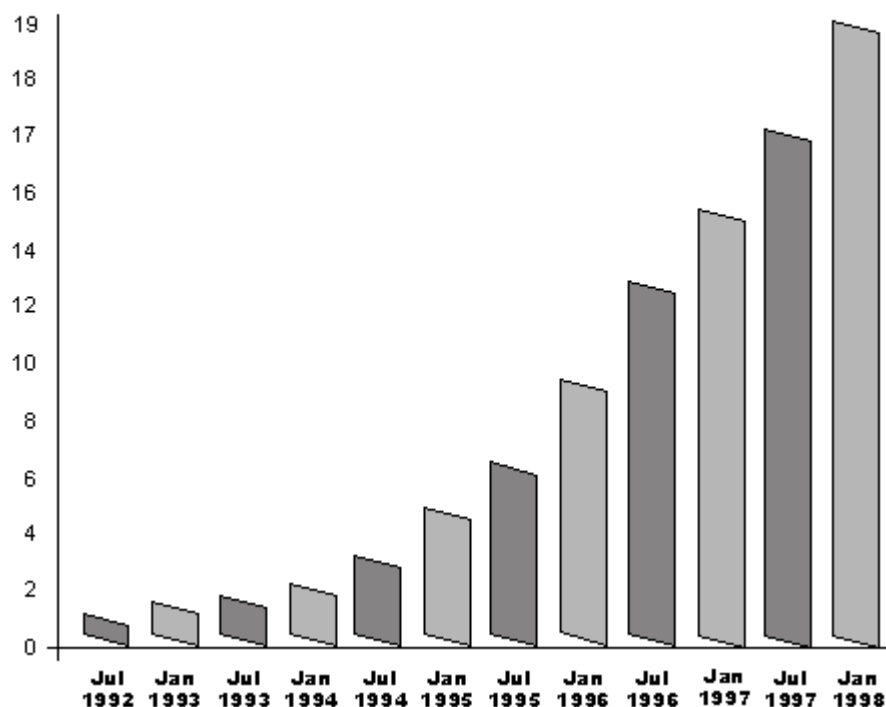
3.1.2 Computer-based Communications is Being Widely Accepted and Embraced by Society

The commercial Internet market is currently at a very early stage of its growth, but its development since 1989 has been so explosive and its growth potential is still so large that it may well be a breakthrough technology with respect to the acceptance of information technology, and especially networked multimedia services, in the home. Exhibit 3.2 shows the market doubling annually in terms of users, and tripling in terms of traffic.

It is conceivable that by 2005 the number of Internet/Intranet users will be at least 500 million world-wide – a number that could easily equal or exceed that of PCs. In part, this will be due to more than one user being linked to a terminal but, more importantly, it is also because a number of different terminals of Internet/Intranet access are currently being developed. By the end of the decade, the PC will be only one amongst several different terminals for home access to the Internet, along with televisions, network computers, mobile terminals and handheld games units.

EXHIBIT 3.2:

GROWTH OF INTERNET HOSTS IN MILLIONS



As a result of these developments, most fixed networked multimedia services, including information and entertainment services, are likely to be packet based (for example, based on IP over ATM) and will probably be asymmetric in nature. This will have significant implications for delivery systems for mobile multimedia services such as UMTS/IMT-2000, as it implies that many mobile multimedia services will be IP based. It is not clear at this stage, however, whether these services will be delivered over a delivery system where intelligence is centred in the device, or whether the so-called network computer (NC) will prove a more economic and attractive service delivery system.

3.1.3 There will be Growing Demand for Access to Networked Multimedia Services While Mobile

This hypothesis, which underpins the expectations for the mobile multimedia marketplace, is supported by evidence of three key trends: the increasing mobility of individuals, whether as employees or as individuals, increasing requirement for responsiveness in business and the growing demand for communications and access to information while on the move.

Increasing mobility of individuals, in their business and personal lives, is creating pressure to turn 'dead time' into productive time

In a quest to improve the quality of their lives, people are increasingly shunning the city in favour of suburban or rural homes to avoid the perceived rise in crime in urban areas, and to benefit from lower cost housing in the country. Consequently, many individuals are spending more time travelling, whether for commuting or for pleasure, creating significant growth in 'dead', or unproductive, time in the working day. Meanwhile, increasing competitive pressures are forcing businesses to increase the productivity of their employees, so placing greater demands on their time and creating a need to make 'dead' time more productive.

The increasing popularity of portable computing devices provides evidence that more workers, particularly those in knowledge-based industries, are becoming more mobile, working remotely from their normal base, and making better use of otherwise 'dead' time. The notebook market is the fastest growing section of the PC market – it is estimated that 25% of all US PC sales in 1995 were laptop computers.⁵

Demand for flexibility in time and location of work, and for responsiveness, is increasing

Increasingly fierce competitive pressures are forcing companies to look for new sources of competitive advantage, as well as to increase productivity. Increased flexibility and responsiveness to market trends or customer needs is becoming vital in practically all sectors, creating a demand for more flexibility from staff in terms of where and when they work. The requirement for responsiveness is spreading as businesses strive to differentiate themselves on customer, or personalised, service. Employees at all levels, especially in service industries, are expected to be more contactable throughout the working day and to respond more quickly to requests from both colleagues and clients – creating growing demand for mobile or personal communications services within the workplace as well as beyond it.

Creating growing demand for 'mobile' office solutions

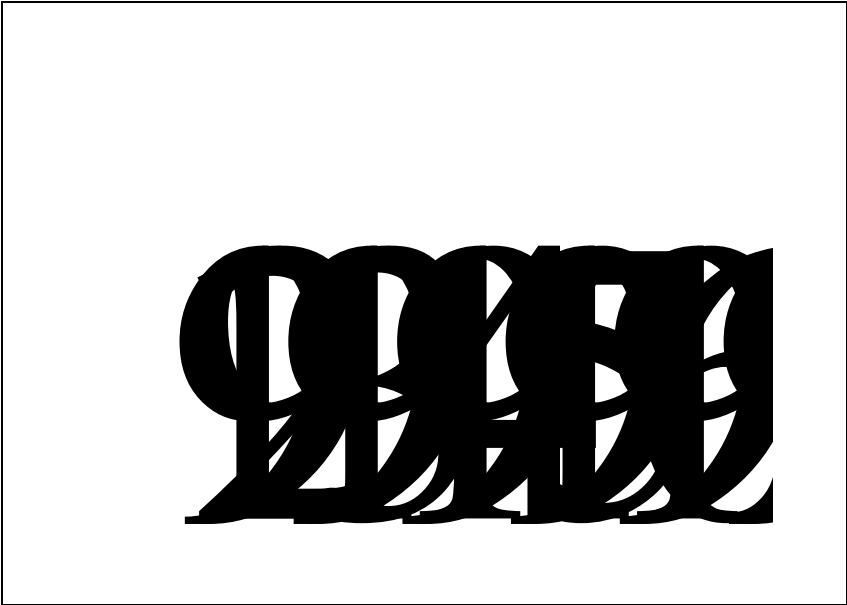
The two trends described above are clearly demonstrated by the 60% per annum growth rate of cellular voice telephony in Europe over the last years. But responsiveness on the basis of voice communications may be insufficient on its own – appropriate action may also need to be taken, in which case rapid, often remote, access to information can be vital, especially for the growing number of mobile and remote workers.

There is, therefore, a growing demand for 'mobile office' solutions, that enable workers to operate 'on the move' as effectively as they do at their desks. These would enable users to increase their effective utilisation of commuting time, and provide immediate access to corporate and publicly available information in order to improve responsiveness and productivity. The availability of PCMCIA (PC) cards as well as integrated PCMCIA solutions into the basic mobile handset is already addressing these needs to some degree, enabling users to operate as if they were at their desk, even when away from base. The rapidly growing demand for PC cards is shown in Exhibit 3.3.

⁵ *Telephony* magazine, July 1996.

There is also clear evidence that an increasing number of PC enabled devices will be portable, demonstrating the trend towards remote and mobile data communications.

*EXHIBIT 3.3:
History and Short-term Forecast of World-wide Shipments of Personal Computers with PC Slots*
[Source: Andrew Prophet Research and Consulting (APR&C) – reproduced by kind permission of APR&C]



As more and more office systems and business processes will be based on multimedia applications, these ‘mobile office’ solutions will inevitably have to deliver mobile multimedia services. In addition, greater travel time will create an opportunity for targeting multimedia information and entertainment services to consumers on the move, enabling them to turn this ‘dead’ time into leisure time.

3.2 KEY TECHNOLOGY INFLUENCES ON THE MOBILE MULTIMEDIA MARKET

The speed and nature of development of today’s mobile market has clearly been closely intertwined with advances in radio design, cellular system technology, microprocessor miniaturisation, battery technology and subsequent reductions in the cost of these technologies. Likewise, foreseen and unforeseen technology developments will continue to exert a direct influence on the nature and costs of mobile multimedia terminals and services over the next ten to twenty years.

Research conducted for this study has shown that, from the wide range of over 30 relevant technologies studied, some possess significant potential to push terminal and service capabilities or costs significantly beyond current expectations. In other areas, it will be seen that further advances either in basic or system technology will be necessary if the mobile multimedia mass market is to become a reality. The conclusions of this research can be summarised by the following hypotheses regarding key technologies and their relevance to the mobile multimedia market:

- the functionality, performance and costs of mobile multimedia terminals, future derivatives of today’s handheld computers, will be primarily determined by advances in semiconductor and user interfaces technologies

- the attractiveness – i.e. variety, usability and utility – and costs of mobile multimedia services will be primarily determined by service delivery and management technologies such as the Internet/Intranet, and associated technologies such as intelligent agents and Java, database and data compression technologies.

3.2.1 Mobile Multimedia Terminal Technologies

The high degrees of processing, memory and communications power predicted for handheld and wearable computers – mobile multimedia terminals – in the next ten years, particularly combined with the Internet explosion, will create a step-change in the way in which individuals communicate with each other and access and use information. The functionality, performance and costs of these devices will be determined by the following key technologies:

Semiconductor development

The phenomenon known as Moore's Law, where the power of computers doubles every 18 months to 2 years, while cost and power consumption fall almost as dramatically, appears to be reaching its limits. The limits are set, not so much by basic physics, as by the ability of the industry to generate the exponential capital investments needed to create the fabrication facilities for each technology step. This will have profound implications for the extent to which the other technologies identified below are able to influence functionality, performance and cost of terminals and services.

Human-machine interface and ergonomic technologies

The reconciliation of friendly visual displays with miniaturised environments, and the replacement of the traditional keyboard as an input device, remain ongoing problems. Significant component technologies that will simplify the use of and reduce the cost of mobile devices include display technologies such as plasma display panels (PDP) and cholesteric liquid-crystal (CLC) screens, voice and man-machine interface technologies such as handwriting and voice recognition. However, it is clear that more research needs to be devoted to the user interface if a mass market for mobile multimedia is to be achieved.

In the longer term, holographic displays and natural language processing will make devices much more user-friendly, though it is difficult to predict when they will become commercially viable. Taking the high-processing power demands with the relatively flat projections for improvements in battery technology, it is possible that these more exotic forms of user interface may be restricted to mains-powered environments.

3.2.2 Service Delivery and Management Technologies

The attractiveness and costs of mobile multimedia services will be primarily determined by the following key service delivery and management technologies:

The Internet, Intranet and IPng

The Internet is perhaps the most significant technology to be driving understanding and familiarity with IT interfaces such as the PC, and so societal acceptance of information technology. If IPng⁶ and future generations of the Internet protocol, which will include mobile IP, are adopted by consumer electronics producers and corporate networks, and fully exploit the broadband multimedia capabilities of fixed fibre networks, the impact of the Internet on multimedia service and interface design will be huge. This impact will be seen in terms of increased functionality, ease of use, wider availability and access to services, as well as improving the general level of IT literacy through greater exposure to the Internet/Intranet.

Agent and Java-like technology

Downloadable applications and software intermediation by agents promise to relieve the complexity barriers which make it difficult for users of today's computing equipment to understand their systems, and keep them up-to-date with new software. Potentially, these technologies may reduce the inherent complexity and cost of the terminal, encouraging the 'network centric' model to predominate in the future. In the longer term, artificial intelligence technologies promise self-learning and self-adaptive systems.

The subsequent reduction in complexity of services and interfaces will break down the barriers that would otherwise prevent less IT-literate users from exploiting the benefits of mobile multimedia services. Software technologies such as AI, fuzzy logic and intelligent agents are likely to be combined to provide powerful yet easy-to-use information and entertainment applications.

Database technology

Digitisation of information has only just begun, but with the projected developments in this area, such as the availability of holographic storage around 2003, almost every piece of information could be turned into binary data by 2005, with significant implications for reductions in costs of service and increase in service variety.

Data compression technology

Data compression technologies such as MPEG-4 and its successors, CMTT and fractal coding which are currently in the early stages of development, are potentially very important both in reducing transmission bandwidth (spectrum) requirements and the storage density for content. High data rate services, especially involving multimedia, may become surprisingly viable in mobile environments, and pressure for further advance in data compression will continue.

Configurable radio

⁶ Next generation of Internet protocol (IP version 6).

Configurable radio is the dynamic configuration of the radio parameters of mobile terminals and base stations (Software Radio). In the appropriate context, it could enable a mobile operator to accommodate two or more air interfaces without re-investing the whole infrastructure, and in that way be a key enabler for third generation mobile systems. It is a way of realising multi-mode terminals, and may be a cost-effective means of developing global markets for terminal and infrastructure equipment enabling manufacturers to gain from significant economies of scale.

Service creation technology

A thriving market for mobile multimedia is identified as one where many service and content providers address their customers through networks that may be seen as a distribution media. This represents a very different paradigm from networks today, both fixed and mobile, and implies open access and intelligent network platforms. Whether this means open access to unitary platforms, or network access for multiple and separately owned platforms, is an implementation distinction. The service creation technology should be geared towards supporting a dynamic market where services come and go on possibly short life cycles, yet are tested and assured to do no harm to network infrastructures.

Billing technology

The billing requirements of the mobile multimedia market will differ significantly from today's fixed and mobile markets in three ways:

- many more players will share the revenue from individual calls and operations
- the transfer price of a unit operation may be small
- the market may be restrained if each supplier is required to set up a billing relationship with each user.

Fixed network broadband and local loop access technology

Technologies such as **Bluetooth** and **IEEE-1394 (FireWire)** afford dramatic increases in the speed, efficiency and convenience of data transfer between a vast range of consumer communications, information and entertainment devices.

Meanwhile, optical fibre liberates almost unlimited user bandwidth in core fixed networks. While the economics of residential fibre local loops remain contentious for many operators, the copper loop technologies of ADSL and, in the future, VDSL promise bandwidths up to tens of Mbit/s that will enable many attractive information, education and entertainment services to be brought into the home. This impacts the market for mobile multimedia in a number of dimensions:

- fixed networks may provide the leading method of access to broadband services

- slimmed down or adapted versions of broadband services may be received over air interfaces at mobile terminals
- UMTS/IMT-2000 may encompass broadband services by providing user mobility management and service mobility
- UMTS/IMT-2000 services should be viewed comprehensively, as a sub-set of fixed broadband and mobility specific services, with the air interface seen as just one method of access.

4. Scenario Analysis

On the basis of the research into societal and technological trends, and using the conceptual market dynamics model shown in Exhibit 2.2, four scenarios for the evolution of the Western European market for mobile multimedia services were developed to illustrate a range of realistic and plausible ways in which the mobile market might evolve.

The scenario adopted by the UMTS Forum for its own calculations as the most plausible is No. 3, that of an "*evolved mass market*." While detailed analysis of other scenarios is omitted in this report, brief reference is made to them for comparison purposes.

Each scenario describes the outcome of interactions between elements of the market dynamics model and different assumptions for the development of societal trends, the evolution of technology and the actions of industry players. Those outcomes were expressed in terms of market size and characteristics, with the main drivers and barriers to market development being identified in each case.

The detailed scenarios and a description of the forecasting and modelling methodology adopted, are presented in [8, Annex B of the Analysys/Intercai Study]. They are written in the style of a magazine article written in 2005 looking back over the last ten years at the market for mobile multimedia services in the context of developments in the fixed multimedia and broader mobile telecoms markets. The objective for developing scenarios was to provide reference and justification for the assumptions used in each market forecast, and to identify and explore the impact of key issues and events that are likely to shape the converging industries of telecoms, computing and entertainment and hence influence the development of mobile communications over the next ten years and beyond. Thus, by bringing these issues into focus, the scenarios are intended to help identify areas in which industry bodies must work to ensure that the value of the opportunity represented by third generation mobile systems is maximised.

This section describes how the scenarios were constructed, and gives a summary of each.

4.1 SCENARIO DEVELOPMENT

4.1.1 Defining the Scenarios

The scenarios in [3, Annex B] are intended to represent a plausible set of events which are consistent with a coherent set of assumptions regarding trends in the following topic areas:

- social and market trends
- technology developments
- the regulatory and political environment
- industry structure and competition.

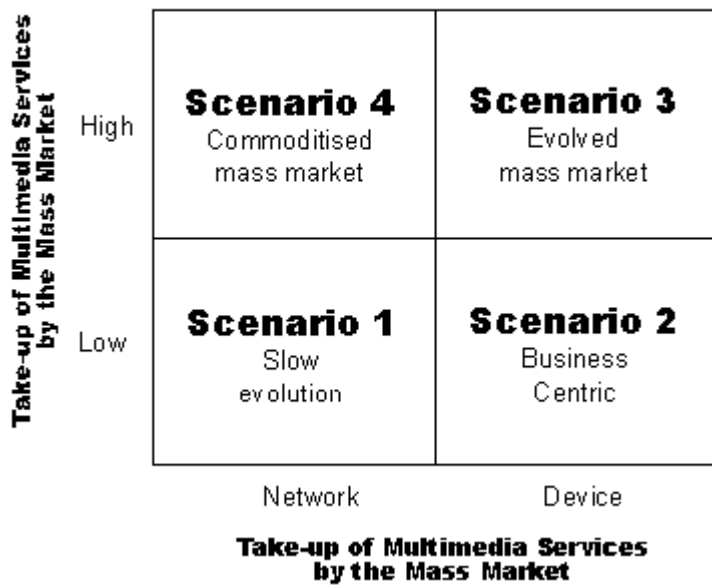
They are designed to help understand uncertainties, test assumptions and develop ideas of how the market may develop, given certain unpredictable events or developments. In preparing them, potential discontinuities in the market evolution which are difficult to predict, and which could lead to a change in industry paradigms, have been emphasised (examples of such discontinuities in the past include the technology breakthroughs enabling ISDN and video to be carried over copper pairs, or the dramatic growth in the Internet). During the study it was agreed that the two 'critical uncertainties' used to distinguish the scenarios, and to determine the assumptions underlying them, should be as follows:

- Will there be widespread take-up of multimedia services in the mass market?
- Will the primary location of intelligence be in the network or the device?

The four scenarios were therefore defined as illustrated in Exhibit 4.1.

EXHIBIT 4.1:

Define scenarios



The two key dimensions were identified using structured brainstorming techniques: major issues that are likely to influence the development of the market for mobile multimedia services over the period to 2005 and beyond were identified, then ranked in order of importance and uncertainty. Out of the issues judged to be both highly important and highly uncertain in the evolution of the market, the two issues chosen to be the key dimensions of the scenarios were selected on the basis that they had the most fundamental impact on the characteristics of the market.

4.1.2 Scenario Market Forecasting

For each scenario, forecasts for the size and value of the market for basic mobile and mobile multimedia services, in terms of subscriber and terminal numbers, and bearer, content and terminal revenues, have been made. In each case, the market forecasts are intended to be consistent with the underlying assumptions, developments and events described. The forecasts were carried out using a model developed specifically for this study based on demographic and market data for Europe and a series of assumptions regarding market segmentation, take-up and usage consistent with the particular developments and conditions of each scenario. These assumptions are described in detail in [3, Annex B].

On the basis of the research into societal and market behaviour it was concluded that the evolution of the market for networked multimedia services on the fixed network will be critical in setting the environment in which the market for mobile multimedia services will develop. Moreover, it was concluded that the development of a mass market for mobile multimedia is entirely dependent on the development of a mass market for fixed networked multimedia.

4.1.3 Validation of the Scenarios

The scenarios were validated at a series of 15 workshops attended by 190 participants ranging from fixed and mobile operators and equipment suppliers, to organisations providing financial, retail and transport services. The workshops were also used to gather industry views of the key success factors, and hence market requirements, for UMTS/IMT-2000.

4.2 SCENARIO SUMMARIES

4.2.1 Scenario 1: Slow Evolution

The networked multimedia market is slow to evolve, with developments in mobile multimedia mirroring those in the fixed networks. Unsuccessful liberalisation discourages market entry by service providers, failure of global standardisation sustains high prices and the attractiveness of service is limited by fears about network security.

By 2005, only 8% of European households subscribe to networked multimedia services. After a slow start, demand in the business sector grows so that by 2005 nearly 22% of the workforce use some form of multimedia services. Therefore, in 2005 the business market accounts for over 86% of the ECU46 billion market.

High tariffs are a consequence of limited competition and high costs. Governments become more cautious about encouraging competition and award third generation licences to incumbent mobile operators only, who are also reluctant to invest heavily and roll out UMTS/IMT-2000 networks rapidly.

Standards developments between trading blocks is hindered by protectionist trade policies. Therefore, the European third generation network standard is developed in relative isolation from equivalent standards developed in the USA and Japan. Consequently, full service roaming is limited and the fragmentation of third generation equipment markets results in high costs. The poor take-up of multimedia at home reduces the incentive for MSPs to target mobile services for consumers.

Although the network centric model developed in the fixed network is followed by the mobile industry, leading to simpler and therefore relatively cheap mobile multimedia terminals, it necessitates greater interaction with the network to download software and data. Therefore, as capacity continues to be constrained, and bandwidth is expensive, usage costs of high data rate applications remain very high.

4.2.2 Scenario 2: Business Centric

Multimedia takes off in the business sector quite quickly, but the consumer market grows slowly. Limited liberalisation discourages market entry by service providers, and limited

success in development of global standards sustains high service and terminal prices, and the attractiveness of service is limited by low IT literacy.

The business market develops relatively, facilitated by the continued implementation of the device centric network model, i.e. the distributed storage and processing of data based on intelligent devices such as the PC and Intranets. Over 27% of the workforce use multimedia services by 2005. But, as a result of high service tariffs and limited innovation in consumer targeted services and applications, multimedia services only reaches 10% of European households by 2005. Therefore, by 2005 business sector accounts for over 85% of the ECU66 billion networked multimedia market.

A breakdown in collaboration on telecoms and software standards world-wide leads to the small number of global alliances developing their own de facto standards for multimedia delivery – limiting opportunities for economies of scale. Service interfaces are too complex for consumers and little account is taken of their personal tastes and preferences.

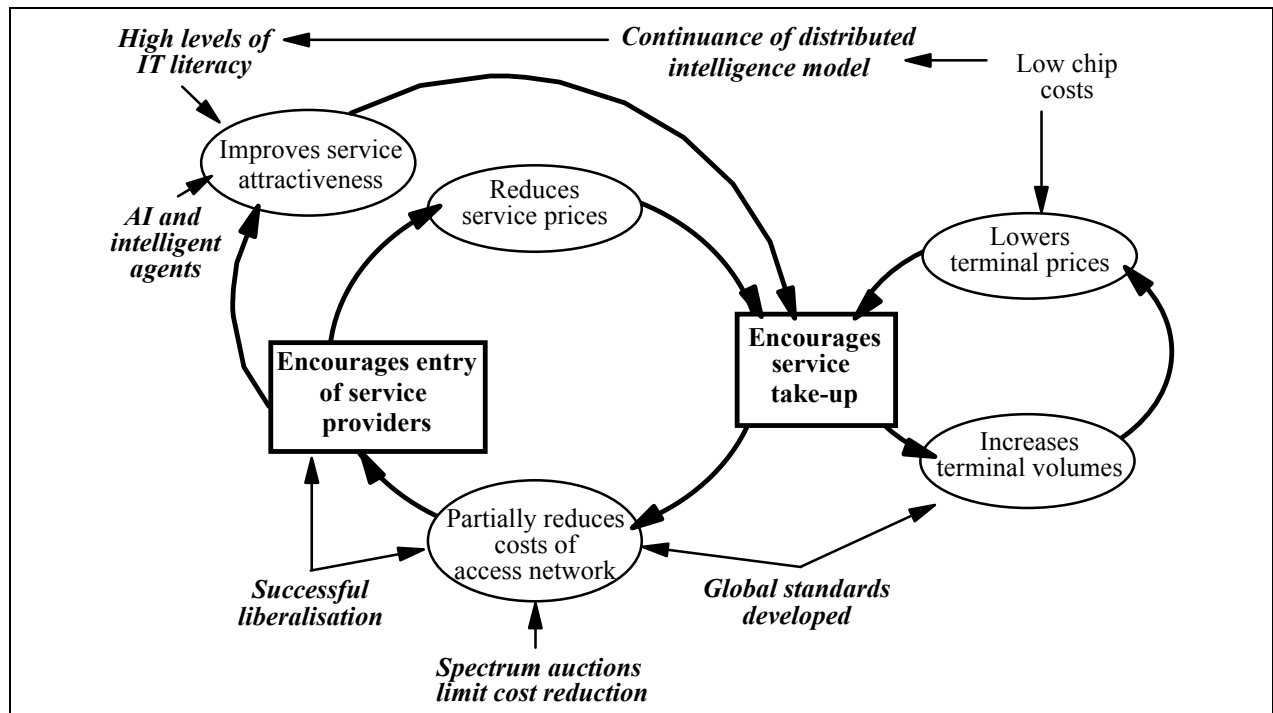
A number of governments auction third generation licences, increasing the cost of access and limiting competition. Breakdown of collaboration on third generation standardisation between the EU and rest of the world prevents the creation of the global equipment and terminal market envisioned for third generation systems that would have forced prices down.

Manufacturers locate high levels of intelligence and storage capabilities in mobile devices, increasing the attractiveness of devices and applications to IT-literate users.

4.2.3 Scenario 3: Evolved Mass Market

The Information Society has reached the masses, and mobile multimedia services and applications have played a key role in making it accessible anytime, anywhere. Exhibit 4.7 shows that successful liberalisation encourages market entry by service providers, and the development of global standards helps to reduce service and terminal prices. Service attractiveness is improved through a combination of high levels of IT literacy, artificial intelligent interfaces and agent technology and the continuation of the distributed intelligence network model.

EXHIBIT 4.7: Major Forces Acting in Scenario 3: Evolved Mass Market



Consumers readily adopt feature rich multimedia services

Information and entertainment services delivered to the home account for revenues of ECU30 billion by 2005. Their popularity is driven by users' exposure to multimedia at work and intense competition in service provision. By 2005, 22% of all European homes are connected to the Information Superhighway, and the business market for networked multimedia has reached ECU73 billion as over 30% of the workforce access multimedia services for use in their jobs.

The development and widespread deployment of IPng ensures almost world-wide compatibility of applications, and the development and adoption of highly secure encryption algorithms avoids fears of fraud and invasion of privacy resulting in a very strong electronic commerce market. Successful liberalisation of telecoms in Europe opens up the access network, widening the choice of infrastructure providers, and in some cases completely unbundling the local loop. Consequently the low cost and ease of access to the local loop encourages market entry by a large number of service providers and an extremely competitive market develops, creating a wide choice of innovative, and low-priced, well designed services and applications.

Applications based on IPng, and distributed processing and storage of data via PCs and Intranets are first developed for business, encouraged by the falling costs of sophisticated PCs and the high level of control and adaptability of services and applications this facilitates. The continuation of the distributed intelligence model is facilitated by the growing IT literacy of the population, as people become more exposed to PCs and software applications at school, at work and increasingly at home.

The mobile multimedia market is, however, slow to develop initially, since tariffs for the first services are high as a result of high investment costs and costs of spectrum. Higher spectrum fees are charged for exclusive spectrum license per operator as governments recognise the value of the scarce resource. However, the combination of competition in infrastructure and service provision and the creation of global markets for third generation infrastructure and terminals, thanks to successful co-operation in developing a single world-wide standard for third generation mobile systems, has pushed prices steadily down.

Although falling prices, as a result of fierce competition, are partly responsible for growing demand for mobile multimedia in the consumer sector, the increasing pace of life and demands on individuals' time encourage consumers to use their new devices to make better use of their time – both at work and in leisure. The exposure of consumers to sophisticated multimedia services and terminals at home and at work has helped to break down some of the barriers to acceptance and understanding, but the implementation of new artificial intelligence interfaces and widespread use of intelligent agents have been instrumental in reducing complexity, and thus increasing attractiveness of 'multimedia on the move'.

4.2.4 Scenario 4: Commoditised Mass Market

The multimedia market grows quickly, with the developments in mobile multimedia mirroring those in the fixed networks. Liberalisation encourages service providers, while global standards help reduce service and terminal prices. A centralised intelligence network model increases the attractiveness of services through simple interfaces.

Unbundling of the local loop in some areas occurs as governments embrace the spirit of liberalisation. High-capacity storage media allows fast cheap access to vast volumes of information, and lowers the cost of providing information services. A stable regulatory environment encourages highly competitive service provision market.

Global telecoms operators dominate infrastructure provision, and are the only players to retain reasonable margins in the fiercely competitive area of multimedia service provision. Innovative and diverse Internet services appear. Traditional broadcast services are superseded by on-demand TV, video and interactive entertainment. The network computer (NC) is widely adopted in business, enabling easy and rapid access to corporate and public information for all staff. This shift in network paradigm results in the development of services that are simple to use and understand. Terminals are relatively cheap, attractive, easy to use and highly portable, to the extent that a number of manufacturers launch 'wearables' – a computer and third generation communicator that is worn on the sleeve and marketed as a fashion accessory. Japanese, Korean and Chinese suppliers start to dominate by leveraging their experience of consumer commodity goods.

5. Market Forecasts and Analysis

The market forecasts for each scenario have been carried out using a model developed specifically for this study. The key extraneous inputs to the model included:

- demographic data for the EU and the rest of the world, including age, occupation and income (GDP) per head of population
- current and historical mobile market data, including subscriber numbers, number of operators, traffic, revenues and tariffs where available, and prices and ex-factory costs of terminals
- indicators of user sophistication and propensity to use multimedia services, including household penetration of PCs and spend per head on audio-visual services.

In order to forecast the size and value of the basic mobile and mobile multimedia markets for each scenario, a number of important assumptions were made:

- the potential size of three business and three consumer market segments in each country – each market segment was defined by usage requirements of customers typical of that segment, and its size determined on the basis of demographics
- future tariffs – tariff trend assumptions were based on current tariff levels and the expected intensity of competition in network and service provision
- terminal costs – assumptions regarding manufacturing costs were made on the basis of technological complexity, component cost trends and production volumes
- service take-up and usage of each of these potential markets – based on current and future expected sophistication of customers, GDP per head, historic market development and assumed costs of services and terminals.

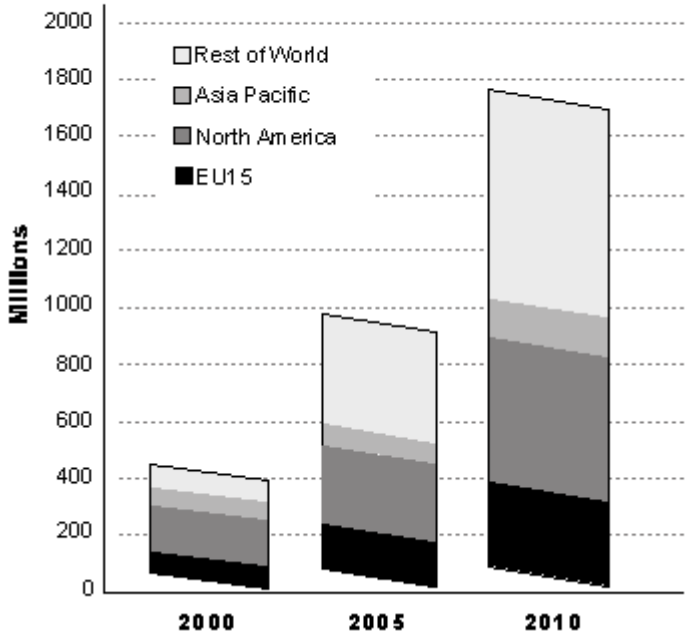
The results of the market forecasts are based on a view of the development of the mobile communications market that is consistent with assumptions described for Scenario 3, that of an evolved mass market. The research conducted for this study and

the scenarios themselves demonstrate that market development is determined by many different issues, therefore these forecasts are intended to illustrate the range of possible outcomes for the global and Western European mobile market, not to prescribe one single view of its future.

5.1 WORLD MARKET FORECASTS FOR MOBILE SERVICES

There will be huge potential for growth in basic mobile voice and data services in areas in and outside the EU, North America, Asia Pacific and the rest of world.

EXHIBIT 5.15:
WORLD MOBILE SUBSCRIBERS



Revenue forecasts for the rest of the world have been made assuming similar levels of revenue per subscriber as the EU. This may appear unrealistic for countries with much lower GDP per head than the EU, but evidence suggests that such countries will have large numbers of potential business subscribers and some early adopter consumers with sufficient income to support these services at tariff levels similar to those experienced in more developed markets. It was beyond the scope of this study to validate these assumptions in any significant detail, given that the agreed focus was on the EU.

Analysis of the world market for mobile multimedia shows that, even in developing countries where the mobile markets and networks will probably be less well developed than in the EU, North America and Asia Pacific, a significant opportunity will exist for mobile multimedia services and terminals. This is because it is expected that many business users and a few of the early adopter consumers in these countries will have

equally demanding requirements for communications and access to multimedia information services to those of their counterparts in the developed world.

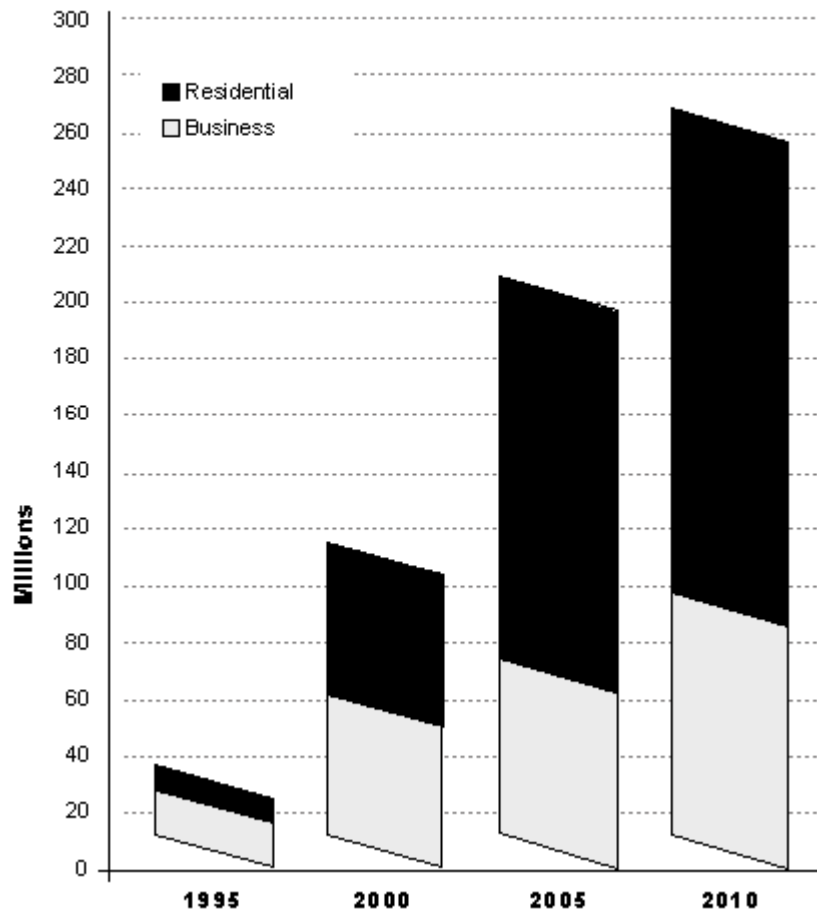
5.2 EU MARKET FOR MOBILE SERVICES

Given the dramatic growth in the world mobile market over the last two to three years, current levels of penetration in Scandinavian markets and the expected increase in competition and availability of service across Europe, it is expected that by 2005 penetration levels of 50% to 90% will be achieved in some of the more developed markets such as Scandinavia, Italy, the UK, France and Germany, with an average of 52% for the whole of the EU. The impact of lower tariffs and retail prices of terminals, and greater awareness and demand generated by high levels of marketing and advertising as a result of more competitive markets and greater availability of spectrum after 2000, will be responsible for the far higher take-up of mobile services. By 2010, average EU penetration levels are anticipated to reach as high as 67%.

Exhibit 5.3 shows that the majority of future growth will be in the residential sector, where people are generally much lower volume users than business customers and therefore generate lower revenues.

EXHIBIT 5.3:

EU MOBILE SUBSCRIBERS

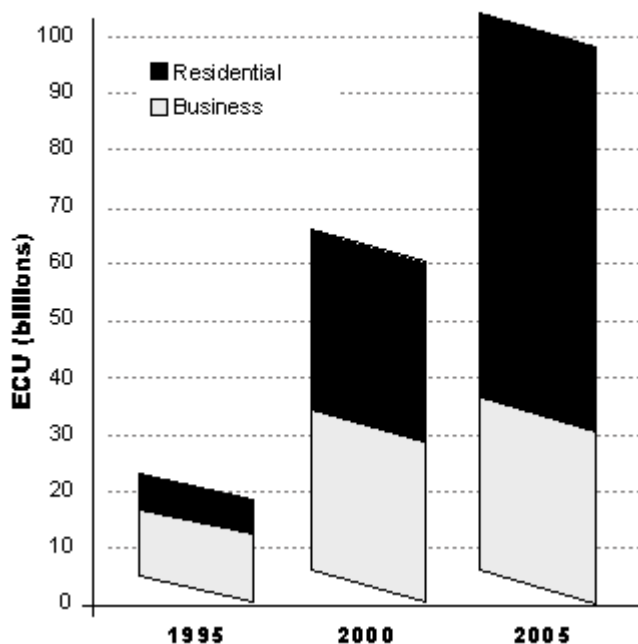


It is not expected that **expenditure on mobile communications for residential subscribers** will change dramatically from current levels, which are approximately **ECU30 per month in Europe**. In the **evolved mass market scenario** it will **change to approximately ECU25** and **for the business subscriber** it is expected to fall from the current figure of around **ECU80 to approximately ECU78 per month**. Revenues per subscriber for some business segments, such as mobile managers, will rise as a result of substitution of fixed voice traffic and use of value added services such as mobile multimedia. However, a high proportion of business subscribers will be generating lower than average revenues each month – either because they are only using mobile services on-site in their workplace at much lower tariffs than mobile tariffs for wide area mobility, or because they are using wireless VPN and closed user group services at lower tariffs than public services.

Despite the rapid growth in the residential market, the business market is still expected to be the most valuable by 2005. Growth in the business market will be fuelled by growth in the large developing mobile markets such as France and Spain, and by the penetration of mobile services further down the hierarchy of the workforce.

EXHIBIT 5.4:

ANNUAL EU REVENUES FROM MOBILE SERVICES



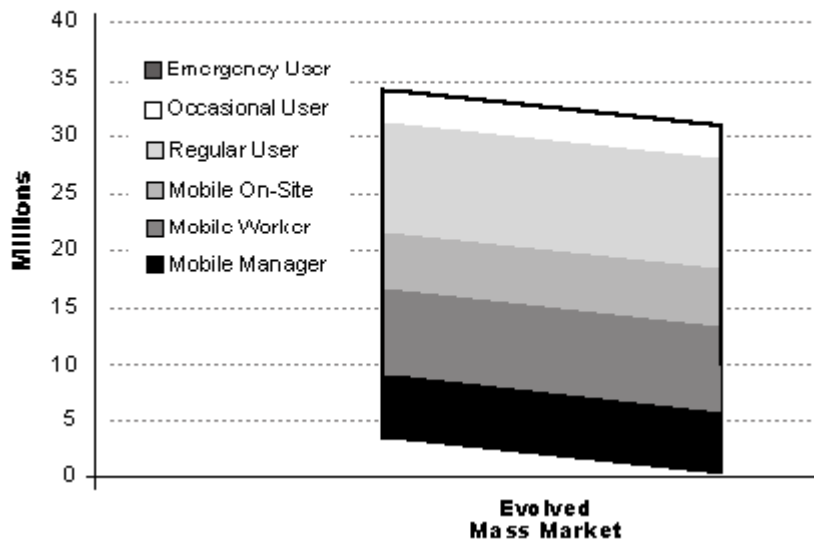
5.3 EU MARKET FOR MOBILE MULTIMEDIA SERVICES

As in the fixed market, demand in the business sector is determined by pent-up demand for access to critical corporate and public information and increasing use of video in communications by the growing number of workers who operate remotely from their base, or who are mobile on-site at their place of work.

Exhibit 5.5 shows that the high cost does not deter those who can justify the added productivity or flexibility that the service offers, such as busy executives and travelling sales representatives (mobile manager segment) and service engineers and tradesmen (mobile worker segment). **A typical business subscriber to a 'high-multimedia' service package will spend between ECU200 and ECU300 per month in all scenarios.** The lower cost of services, as a result of greater competition and availability of spectrum and terminals, encourages businesses to provide these mobile multimedia services to more staff, encourages business users to make greater use of these services, and lowers the barrier to consumers, especially those that are characterised by the 'regular user' market segment, which is also more familiar with multimedia at home (see [8, Annex B, Section 2.1] for the definition of market segmentation used in the study).

EXHIBIT 5.5:

EU MOBILE MULTIMEDIA SUBSCRIBERS (YEAR 2005)

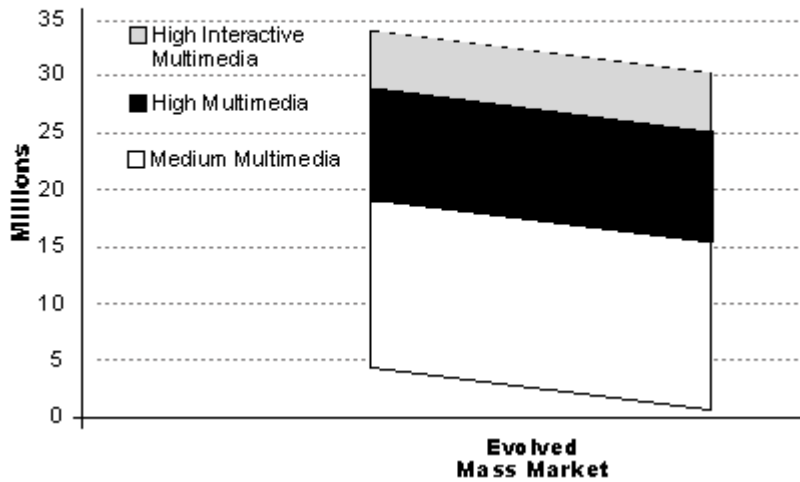


It is expected that the take-up of mobile multimedia services will occur first in the more highly developed and growing mobile markets. Evidence shows that some countries already use high levels of computer communications, for example, high levels of PC penetration and use of email and LAN.

The changing nature of business processes and the development of electronic information and entertainment services will lead to a far greater use of electronic data transfer by 2005. For example, a salesman will download pricing and stock availability information from a corporate database, or a service engineer will send a video image of a damaged machine tool to his company's design office for advice on repair procedures. Exhibit 5.6 shows that, as a result of this trend, it is expected that asymmetric multimedia services, such as 'medium-' and 'high- multimedia' services, will be most popular as data files – from a simple email message to a large, compressed video clip – are transmitted via the wireless interface. Even in the **mass market scenarios, symmetric multimedia services such as mobile videotelephony are likely to be relatively expensive, costing as much as ECU0.9 per minute**, and will have limited appeal and utility given the size of terminals required to deliver these services.

EXHIBIT 5.6:

EU MOBILE MULTIMEDIA SUBSCRIBERS BY SERVICE TYPE (YEAR 2005)

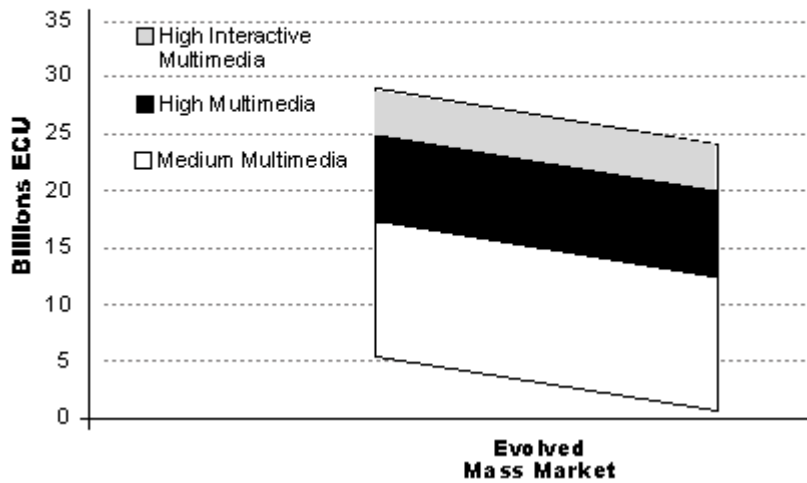


Note on Exhibit 5.6: Mobile voice, simple messaging and switched data services are not shown here as these are not included in the definition of mobile multimedia services. It is assumed that subscribers to a given level of service e.g. high-multimedia services also use all of the lower levels of service, for example, medium-multimedia, simple messaging and voice services.

However, Exhibit 5.7 shows that 'high multimedia' services will generate significantly more revenues than 'medium multimedia' services, as they will be tariffed at slightly higher rates per Mbyte of data transferred. The higher data rates and thus higher quality will be especially valued by business users, and they will generate considerably more traffic as a result of the higher data rate and average size of files transferred.

EXHIBIT 5.7:

ANNUAL EU REVENUES FROM MOBILE MULTIMEDIA SUBSCRIBERS (YEAR 2005)



The exhibit also shows that the value of the mobile multimedia market in the mass market scenarios will be approximately twice the size of the other two. **Revenues from mobile multimedia will account for approximately 25% of total mobile revenues (104 bio. ECU), indicating that services based on third generation mobile systems will provide a considerable opportunity for the mobile industry to increase the overall value of the market.**

5.4 EU MARKET FOR MOBILE TERMINALS

The market for mobile terminals was forecast assuming that each of the six mobile service types defined required a mobile terminal with the attributes and capabilities shown in Exhibit 5.8. The number of terminals shipped in each year was calculated on the basis of assumed service take-up and the assumption that, on average, users will upgrade their mobile device approximately every two years.

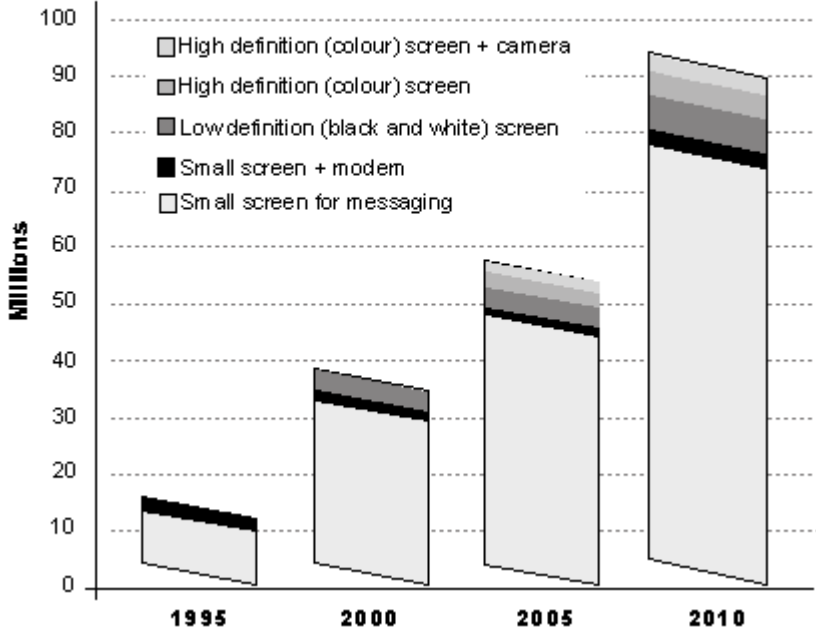
EXHIBIT 5.8: *Mobile Terminal Requirement for Each Mobile Service Type*

<i>Terminal Type</i>	<i>Maximum Level of Service Capability</i>
Small screen for messaging	Voice and simple messaging
Small screen + modem	Switched data
Low definition (black and white) screen	Medium-multimedia
High definition (colour) screen	High-multimedia
High definition (colour) screen + camera	High-interactive multimedia

Clearly, the greatest demand in all scenarios will be for simple voice and messaging devices – voice communications will still be the preferred means of communication, whether via a fixed or mobile device. However, Exhibit 5.9 shows that the market for

sophisticated mobile multimedia devices in 2005 will be as large as the market for simple voice and messaging devices is today.

EXHIBIT 5.9:
EU MOBILE TERMINAL SALES



The assumptions for **ex-factory cost per unit for each scenario** are presented in [3, Annex B] for the evolved mass market **ranging from 80 - 1200 ECU depending on terminal type**. This estimate is based on price points of new mobile devices in today's market. For the **mobile multimedia terminal market sales in the year 2005 are therefore calculated to be approx. 10 bio. ECU**.

5.5 EU MARKET FOR MOBILE MULTIMEDIA APPLICATIONS (CONTENT REVENUES)

When a mobile multimedia service is delivered, if it includes content provided by a third party, such as video of a sporting event, a news bulletin, weather information or stock market data, the content provider will expect payment for the value of that content. This payment may be collected from the customer direct, or more typically from the service provider who has aggregated the content within his service offering. Alternatively, content may be provided free of charge but revenues are generated by including advertising in the content – this is expected to be significant as it is expected that many mobile multimedia devices will be capable of receiving broadcast TV. In either case, content revenues will constitute a significant proportion of the total revenue collected for the service, in addition to the revenue retained by the network operator or service provider for delivery of the service.

Content revenues will form a much smaller proportion of total revenues for services delivered to business users than to residential users. This is because the majority of multimedia services used by businesses are for communications (e.g. videotelephony) or for services where the user's organisation provides the data or application itself – for example, access to corporate data via Intranets. Services targeted at residential customers will contain a great deal of third party content, for example, video and audio, online newspapers and special interest magazines, online restaurant or movie reviews, and so on.

This demonstrates that third-party information and programme providers will benefit from a mass market for mobile multimedia, and thus it will be to their advantage to minimise the costs of their services to the end user in order to encourage the market to develop.

These projections have been made on the basis of existing expenditure patterns on audio-visual content and the degree to which revenues will be substituted from traditional services, such as video rental, broadcast TV and printed media by mobile multimedia services (see Annex B for further explanation of the methodology used).

5.6 MOBILE SATELLITE SERVICES MARKET

Current expectations are that less than 20% of the world's land area will be covered by terrestrial cellular networks within the envisaged timescales of UMTS/IMT-2000. Satellite systems, which provide world wide service on day one of operation, are therefore

important to UMTS/IMT-2000 to provide complete coverage. In turn, this is expected to spur further demand for terrestrially based UMTS/IMT-2000 services. On the other hand, in EU15 more than 80% of the population can be expected to be covered by terrestrial UMTS/IMT-2000 in 2010. Price differences between terrestrial and satellite services will play an important role in the usage of these services. This difference in price is not likely to significantly change in the future.

The forecasts included in this Report deal only with mobile satellite services, i.e., those services supplied from either moving terminals or portable/transportable terminals capable being moved easily. Fixed Satellite Service (FSS) systems (those systems providing services $> \sim 1$ Mbit/s to fixed installations) are specifically excluded, as these systems are assumed to be outside the bounds of UMTS/IMT-2000.

5.6.1 Traffic Forecasts

Forecasts for World-wide and European satellite UMTS/IMT-2000 users have been segmented into non-multimedia users (those requiring non-multimedia services only) and multimedia users. These forecasts have been derived from forecasting the total MSS demand with UMTS/IMT-2000 forming a part of this. It is expected that all the forecast MSS multimedia users will be UMTS/IMT-2000 compliant, while only a portion of the MSS non-multimedia users will be UMTS/IMT-2000 compliant.

For non-multimedia users, services extend only to basic speech services (but at high quality - 8/16 kbit/s) and low speed data (9.6/16 kbit/s). For multimedia users the requirements are for a variety of different services and applications. Based on forecast usage patterns, the MSS and UMTS/IMT-2000 traffic figures (in Million MB's) were derived.

The forecasts are summarised in Table 5.10. The demand for UMTS/IMT-2000 satellite services differs from region to region and depends, inter alia, on population density and developed terrestrial infrastructure. In the EU15, the demand may decrease in the long term, as countries complete their terrestrial UMTS/IMT-2000 coverage and combine with 2nd generation cellular systems. This effect is not taken into account in traffic figures for 2010 for EU15, where it can be expected that UMTS coverage will be high. Therefore, the demand for 2010 in EU15 may be considered as overestimated.

Year	Worldwide		EU	
	2005	2010	2005	2010
MSS Subscribers (000s)				
Non-Multimedia	4,875	7,500	609	938
Multimedia	6,585	10,975	395	659
	11,460	18,475	1,004	1,596
Average Usage per subscriber (kB's per month)				
Non-Multimedia				
Voice	8,709	8,491	8,709	8,491
Low Speed Data	6,208	5,587	6,208	5,587
Multimedia				
Voice	1,194	1,561	1,194	1,561
Low Speed Data	2,584	3,380	2,584	3,380
Asymmetric	26,154	34,247	26,154	34,247
Interactive	1,781	2,334	1,781	2,334
Total Annual Traffic (Million MB's)				
Non-Multimedia				
Voice	509	764	64	96
Low Speed Data	491	736	45	63
Multimedia				
Voice	94	206	6	12
Low Speed Data	204	445	12	27
Asymmetric	2,067	4,510	124	271
Interactive	141	307	8	18
Total	3,506	6,968	259	486
Annual Traffic (Mill. MB's) - excluding non UMTS/IMT-2000 compliant traffic				
Non-Multimedia				
Voice	34	123	4	15
Low Speed Data	33	119	3	10
Multimedia				
Voice	94	206	6	12
Low Speed Data	204	445	12	27
Asymmetric	2,067	4,510	124	271
Interactive	141	307	8	18
Total	2,573	5,710	158	354

Table 5.10: World-wide satellite market*

5.7 LOOKING TO THE FUTURE

The structure of the telecoms industry will be significantly simplified at the network provision level, with a small number of global network operators formed from alliances of

* For Non-Multimedia, the UMTS/IMT-2000 segment forms a small element of the overall MSS market due to the assumption taken that most handheld speech based systems will not be compliant with UMTS/IMT-2000 (previously it was assumed to be a much higher element). Some indications (from handheld speech based satellite systems) are that the portion compliant will be higher than shown here, due to systems achieving compliance when it was assumed they would not. If this were the case then the forecast for EU would be higher as well.

the biggest national operators during the first decade of the new millennium. Telecoms network provision will have become a primary industry, with low margins for the provision of commodity products and services over integrated wired and wireless networks. It will be at the service provision level that we will see fierce competition and rapid innovation. Many companies, small and large, will be adding value to the basic set of communications, information and entertainment services provided by the network providers.

5.7.1 Mobile Communications in 2015

By 2015, we can expect to see the majority of Europe's adult population and many teenagers and children equipped with a personal communicator. Some will be simple voice and messaging devices, others sophisticated multimedia devices far more powerful and versatile than those described in the four scenarios.

As far as the customer is concerned, there will be no distinction between fixed and mobile services. They will expect the service to be delivered to them, when and where they want it, and will have come to trust their service provider – or perhaps their own personal communicator – to carry out the appropriate negotiations with the network to use lowest cost routing, to find the service that fits their needs most closely and to manage their contactability, i.e. when and where they can be contacted and by whom.

Almost everyone will have a unique address via which they are contactable for any form of communication – voice, video, graphics or text. However, it is possible that many people will have more than one unique addresses. In order to protect their privacy, which will become increasingly more important as technology enables tracking of individuals, some people will adopt separate addresses for different parts of their lives, even to enable them to take on different personalities. The device or system in the network will become an extension of the individual, controlling as well as enabling communication.

Communicators will be 'wearable' – small enough to fix unobtrusively to any item of clothing, or in some cases even surgically implanted. Visual displays will be varied, some providing direct retinal projection of images, others using 'head-up' display technologies on simple spectacles, and quite probably some with the capability to project three dimensional, holographic images. Thus, virtual meetings will be possible where the user can 'feel' as if they are in the same room as their colleagues, moving between them and exchanging information. Interaction with the services or applications will be primarily via voice recognition systems, enhanced by natural language processing and artificial intelligence systems, so enabling the machine (network or computer) to interpret not only the words but the true meaning of a command. The keyboard as we know it today will be a museum piece. Manual interfaces will still be necessary, but handwriting recognition and some form of stylus will be the main tools for input devices.

5.7.2 Trends Influencing Demand for Flexible Communications

In twenty years, electronic commerce could be the norm. It is possible that electronic cash and electronic bill payments will have replaced notes and coins, with many transactions taking place without the purchaser having to open their wallet or purse, as transactions will be carried out over radio. Their communicator will have replaced the wallet or purse for many.

The need to travel may diminish due to advances in communications to such an extent that the demands for mobile communications may fall. The increasing availability of videotelephony, videoconferencing and virtual reality conferencing will reduce the need for face-to-face meetings, and the availability of a plethora of passive and interactive video-based entertainment services, direct to the home or direct to the individual's communicator, will reduce the need to travel for our leisure activities.

However, the increasing ease of travel –it may take less than two hours to cross the Atlantic – and the globalisation of trade will facilitate high levels of travel for many people. In addition, it is expected that tourism will be a significant growth area as more people have more leisure time to travel. This will bring greater demands on service portability and global roaming capabilities from telecoms networks.

Furthermore, the trend away from voice to data communication will continue. Much of today's information gathering and messaging that is carried out via voice communications will be replaced by information and electronic messaging services such as the future evolution of the Internet and email.

5.7.3 Societal Impacts

In a world where information is power, the creation of an 'information have nots' class becomes more of a problem. Those who can neither afford or understand the technology that delivers information and knowledge will be further marginalised and disenfranchised, with possible consequences for instability in the social fabric of Europe. Therefore, it is a possibility that some form of universal service obligation will be applied to ensure that even those who cannot afford a personal communicator or multimedia terminal at home can access them in public places such as travel termini, libraries, community centres etc.

6. Key Drivers, Enablers, Barriers & Uncertainties

6.1 KEY DRIVERS, ENABLERS, BARRIERS & UNCERTAINTIES

The following sections discuss the drivers, enablers and barriers listed below in Exhibit 6.1, together with others considered significant in the development of the market for mobile multimedia services. These factors have emerged as a result of the desk research, scenario analysis, market forecasting and industry consultation undertaken in this study.

6.1.1 Key Drivers to the Development of the Mobile Multimedia Market

Growth in the use of computer-based communications, commerce and entertainment services on the fixed network will act as the most important driver to continued growth of fixed and ultimately mobile networked multimedia services. As has already been identified, use of computer-based communication and commerce services, and multimedia-based entertainment services, is advancing strongly both at home and in business. This trend is in turn increasing acceptance of IT in society, and, together with increasing use of computers within the education sector, is raising levels of IT literacy amongst the European population. The first network multimedia services are now being deployed on the fixed network across the Internet, Intranets, and TV distribution mediums. Initial evidence suggests that these services will be extremely popular and that future growth in service take-up will be strong.

The degree to which networked multimedia services enters into common usage will have a significant influence on users' attitudes to mobile multimedia services. A high level of take-up will make mobile services highly attractive as users come to feel comfortable with the concept of relying on electronic services. Furthermore, the high levels of IT literacy that a strong market for fixed networked multimedia will create will simplify the service creation process for mobile multimedia service providers, make it easier to have new services accepted, and increase the level of service and terminal functionality that the market place will find attractive.

Increasing competitive pressures in business is increasing demand for greater productivity, flexibility, and responsiveness. It is increasingly necessary for businesses to provide employees with rapid, remote access to public and corporate information wherever they may be. This will underpin demand for services available over the fixed network to be made available while on the move. As a greater proportion of the workforce spends more time travelling – whether to visit customers and suppliers or commuting – users will want to make better use of 'dead', or unproductive, time and will require access to information when on the move.

Exhibit 6.1 shows the key factors likely to affect development of the mobile multimedia market.

EXHIBIT 6.1: Key Drivers, Enablers, Barriers and Uncertainties in the Mobile Multimedia Market

<i>Drivers:</i>	<ul style="list-style-type: none"> • Growth in the use of computer-based communications, commerce and entertainment services on the fixed network, influenced by: <ul style="list-style-type: none"> – falling costs of home computing increasing acceptance of IT in the home – growth in the use of the Internet and Intranets • Increasing demand for rapid and remote access to information, driven by: <ul style="list-style-type: none"> – increasing demand in business for greater productivity, flexibility and responsiveness – increasing demand for personalisation and individuality – increasing mobility of individuals and subsequent demand for reducing 'dead' time
<i>Enablers:</i>	<ul style="list-style-type: none"> • Appropriate regulatory framework to encourage competition in service provision and development of infrastructure • Development of a small number of mobile radio standards and open standards for service development that are adopted world-wide • Development of UMTS/IMT-2000 specifications to support and bill for IP-based services • Early exploitation of GPRS as an interim means of delivering mobile multimedia services • Improvements in user interface design and display technologies • Development of technologies that enhance spectrum efficiency or utilisation to increase capacity and data capabilities of the air interface • Improvements in performance/costs of semiconductors to reduce size, cost and power consumption of mobile devices
<i>Barriers:</i>	<ul style="list-style-type: none"> • High cost and limited availability of spectrum • Failure to resolve security issues and convince consumers electronic commerce is secure • Slow development of IT literacy in the mass market
<i>Uncertainties:</i>	<ul style="list-style-type: none"> • Rate of growth of the mobile multimedia market • The network paradigm – network or device centric? • The increase in demand for capacity/spectrum in a network centric scenario over a device centric scenario

As pressure to meet the needs of 'mobile' individuals increases, so too the demands for personalisation and individuality in the creation of personal communication services will increase. Research has shown that many retail and service industries are already responding to the growing desire for consumers to be able to control and define services on the basis of their own specific needs – and for them to be seen as individuals – rather than select from a range of homogeneous commodity products and services. This trend is already driving mobile service providers to provide services for the delivery of information and entertainment to the individual rather than to fixed points on a network.

At present, there are no obstacles to the on-going development of these drivers, and society is becoming increasingly enthusiastic towards the electronic medium across which mobile multimedia services will be delivered.

6.1.2 Key Enablers of the Development of Mobile Multimedia Services

Industry players, that is operators, equipment suppliers and regulators, will play a significant role in contributing to the development of the market. Positive actions on their part will encourage market take-up through the development and delivery of services that users find affordable, easy to use, and well matched to their needs.

The most significant issue that will enable strong market development will be the nature of the regulatory environment governing access to the underlying network infrastructure and the delivery of services over that infrastructure. This framework will be fundamental in determining whether new service providers (and their backers) find this market easy to enter. Hence it will determine the intensity of competition within the market. It will be crucial for the success of mobile multimedia that service providers obtain cost effective access to mobile networks on fair and reasonable terms.

A second fundamental issue enabling market development will be agreement world-wide on a small number of near-global third generation mobile radio standards. Success in achieving this, rather than many regional standards, will enable rapid development of the market through creation of large terminal and infrastructure equipment markets, which will lead to a reduction in the cost of terminals and network infrastructure. Additionally, agreements on a small number of global standards will give confidence to the consumer that the purchasing decision is a sound one, and that the terminal purchased will not be superseded by another incompatible system in a short period of time. The development of open standards for service and application development, perhaps using a de facto approach along the lines of the Internet standards model, which will also facilitate market development by enabling rapid innovation, simplifying service creation and ensuring service portability.

Other key market enablers are:

Development of UMTS specifications to support asymmetric services

On the basis of research, comments from workshop participants and consideration of the types of services and applications that both business and residential customers will be using in 2005, it was concluded that a significant proportion of services will be carried over packet or cell-based delivery systems and will be asymmetric in nature, i.e. the volume of information flowing between the user and network will be far greater in one direction than the other at a given time. It was also found that the rate of growth of such services will mean that data traffic will account in some environments for over 70% of total mobile traffic by 2005 in a network centric scenario. This has significant implications for spectrum requirements, and service and network design.

Development of UMTS specifications to support IP based services, and volume based charging.

The rate and nature of development of Internet and Intranet services implies that packet-based service delivery mechanisms, particularly IP-based mechanisms, will dominate communications beyond 2000. The design of any third generation system will therefore be required to integrate seamlessly with IP-based communications systems. Current trends also suggest that charging mechanisms for many services will need to be based on the volume (or value) of information transferred, together with quality of service parameters such as error rate and delay. Call duration and destination will become proportionally less important.

Early deployment of GPRS

Industry opinion obtained in the fourth stage of the study supports the view developed in the study that a clear strategy for the migration from current network technology to third generation network technology is essential in order to create a stable and predictable environment for operators to invest. Furthermore, the early development and implementation of services based on the GPRS standard is seen as an ideal opportunity to create a testbed for future mobile multimedia services, enabling operators and service providers to test market new applications and hopefully kick-start the market even before UMTS/IMT-2000 systems are rolled out.

Improvements in user interface design and display technologies

The functionality and ease of use of the next generation of mobile services and terminals will be significant in determining the extent to which mobile multimedia services become accepted by the mass market, especially if the current device centric paradigm continues. Demands from users and the capability of services and devices will increase, and as a result the design of the user interface will become critical in providing the user with simple and efficient access to that service. One defining element of that design will be the terminal display. Improved resolution, and reduced power consumption are, for

example, two goals that can be set for display technologists today. Voice and handwriting recognition are also likely to be essential to the successful development of the market.

Development of technologies that enhance spectrum efficiency or utilisation

Technologies such as configurable radio and data compression offer the possibility of either increasing capacity and data capabilities of the air interface or facilitating higher utilisation of spectrum. The importance of these technologies will be most significant in a network centric environment, where demands on spectrum would be greatest.

Improvements in performance and cost of semiconductors

Technologies that will reduce the size, cost and power consumption of mobile devices will become increasingly important as service functionality and user usage patterns place increasing demands on the capability and processing power of mobile terminals. The evolved mass market Scenario [3] illustrated that continued development of chip technologies will be crucial if mobile devices are to continue to meet market expectations for usability and price.

6.1.3 Potential Barriers to Market Development

In considering what barriers stand in the way of the development of the market, we have identified one significant issue that may inhibit market development given the current situation.

The cost and lack of availability of spectrum could be a major barrier to the development of the mobile multimedia market. Insufficient spectrum to meet the needs of the market place will result in the access network becoming a service bottleneck. Under these circumstances, prices for market access will rise and service development will be suppressed.

Issues which currently appear as drivers or enablers may instead turn out to be barriers to market development. Principal amongst these include:

- *Failure to resolve security issues and convince consumers electronic commerce is secure.* The undermining of consumer confidence will result in market resistance to the delivery of mobile multimedia services whatever actions are taken by industry to improve competition, and enhance service design.
- *Slow development of IT literacy in the mass market.* It may well be that hoped for improvements in IT literacy, and enhanced levels of comfort by the majority of consumers with interactive services will not materialise.

7. Conclusions

7.1 CONCLUSIONS

The world's mobile market had already reached 300m users by the end of 1998. Meanwhile, the European market alone had exceeded 104m users (analogue and digital subscribers) by this time (EU 15 approx. 90 mio.), indicating dramatic expansions in the market for mobile communications that are set to continue over the timescale as envisioned in this report.

It is impossible to be certain of the future. Nevertheless, it is clear that a great opportunity exists for the mobile communications industry to develop services which will meet the developing needs of both businesses and consumers as the Information Society emerges over the next decade. Those needs are rapidly being shaped by developments in the convergence of computing, broadcasting and communications. Consequently, the mobile industry must respond in a manner that recognises those influences and exploit their characteristics to the greatest effect.

The foundation for success in developing and delivering mobile multimedia services is already in place, and the elements needed to build upon it are clear.

7.2 SUMMARY OF MAIN FINDINGS

Key findings of the terrestrial market forecast are:

1. The world market for physical users of terrestrial mobile services (including multimedia) will be 426 million users by the year 2000, rising to 940 million by 2005 and more than 1.7 billion users by 2010.

2. There will be 190 million physical mobile users in North America by 2005, rising to 220 million by 2010.

3. There will be 400 million physical mobile users in Asia Pacific by 2005, rising to 850 million by 2010.

4. There will be 200 million physical mobile users in Western Europe by 2005, rising to 260 million by 2010. 32 million of these will be mobile multimedia users in 2005, rising to 90 million mobile multimedia users by 2010.

5. In the rest of the world, there will be 150 million physical mobile users by 2005, rising to 400 million by 2010.

6. The total Western European mobile market will be worth 104 billion ECU⁷ per year in 2005, representing total traffic levels of 6,300 million Mbytes/month.

7. The mobile multimedia segment of this Western European market will be worth 24 billion ECU⁷ per year in 2005, representing total traffic levels of 3,800 million Mbytes/month. Terminal revenues in 2005 will add a further 10 billion ECU⁷ per year to this European market value.

Key findings of the mobile satellite services market are:

8. The world market for physical users of mobile satellite services (MSS) (including multimedia MSS) will be 11.5 million users by the year 2005, rising to 18.5 million by 2010.

9. There will be 1 million MSS users in Europe by 2005, rising to 1.6 million by 2010. 0.4 million of these will be multimedia MSS users in 2005, rising to 0.7 million multimedia MSS users in Europe by 2010.

10. Total traffic levels (multimedia + non-multimedia) for the European MSS market will reach 22 million Mbytes/month in 2005, rising to 40 million Mbytes/month in 2010.

8. References

- [1] UMTS Forum Report No. 1 'A Regulatory Framework for UMTS', June 1997.
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- [7] UMTS Forum Report No. 7: 'Candidate Extension Bands for UMTS/IMT-2000 Terrestrial Component, March 1999.
- [8] UMTS Market Forecast Study', Final Report for EC DG XIII, Analysys/Intercai. Including Annex A-B. Febr. 1997.

⁷ The currency denomination „ECU“ has later been replaced by the name „Euro“.