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Report from the UMTS Forum

**ENABLING UMTS /
THIRD GENERATION
SERVICES AND
APPLICATIONS**

UMTS Forum, October 2000

This report has been produced by the UMTS Forum, an association of telecommunications operators, manufacturers and regulators. The UMTS Forum comprises of IT and media industries interested in broadband mobile multimedia that are active both in Europe and other parts of the world and who share the vision of UMTS (Universal Mobile Telecommunications System). These are key industry members of the Forum and have contributed significantly to this report. In terms of a technology platform UMTS will move mobile communications forward from today's environment to the Information Society incorporating third generation mobile services that will deliver speech, data, pictures, graphics, video communication and other wide-band information direct to people on the move. UMTS UTRA (Universal Terrestrial Radio Access) is a member of the IMT-2000 family of standards.

This report has been generated by one of the UMTS Forum Working Groups, the Information and Communication Technologies Group (ICTG), which addresses the main services and applications enables for the introduction of UMTS / Third Generation.

Report 11 is one of the family members of UMTS Forum reports that deal with the regulatory framework and the vision for UMTS. Other outputs from the Forum cover technical aspects, economic conditions, and licensing issues.

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0 EXECUTIVE SUMMARY

0.1 General

This report is aimed at an audience that needs to understand the new opportunities that arise from third generation mobile systems and the associated dynamic but complex third generation market that will be created. It addresses the most important enablers and drivers that will ensure that the vision of third generation becomes a reality; this vision is to provide global access and delivery of information services of all possible kinds to the mobile community at large. This report leverages in-depth knowledge of current market developments and forecasts, and highlights key issues that must be addressed for the realisation of the UMTS vision and that are not normally discussed within the world's Standards Development Organisations; such issues arise especially in a cross-sector "converged" environment.

0.2 Expectations

There are two clear trends that can be recognised in the telecommunications market:

- Users have an increasing need to gain access to information in an efficient manner as possible
- Users have an increasing need to be mobile.

To date, these two requirements have been met by two very different solutions, namely the Internet and mobile networks, respectively. The convergence of both solutions is the ultimate goal of third generation systems, and will enable both user requirements to be met through the same platform and through new generations of access devices.

Within this converged world, an important goal of system design for third generation wireless systems is to support applications and services at performance and Quality of Service (QoS) levels equivalent to or better than wire line networks and to enable inter-working with other networks (e.g. 2nd generation GSM). This creates the momentum behind the development of a new breed of wireless systems where the underlying technology will and must be all but irrelevant to the user.

Driven by the Internet, the amount of information accessible through networks is growing exponentially. Digitisation of information from paper, film and tape archives and creation of new multimedia information "content" based on image, video, voice and text all exist today and such information is being delivered electronically on a large scale over the fixed Internet.

The electronic delivery to end-users of services such as entertainment, marketing, advertising and distance learning is nowadays also common practice. Additionally, data collected from networks of specialised embedded systems for applications such as traffic monitoring, earth resource monitoring, energy management, healthcare monitoring and even usage analysis of the networks themselves are other forms of information being sent across networks. All these forms of information will increasingly be transferred over wireless links.

Even though 3G will drive the convergence of services and drive content to be offered over a common platform, it would be a mistake to apply the business models and strategies that have been developed for the fixed Internet on a one-to-one basis to the "mobile Internet". Clearly, the end users' experience of the Internet over mobile networks will be different from their experience over the traditional "wired" Internet. This different experience will be driven by

new capabilities such as mobility support and restricting factors such as limited battery power and terminal display sizes.

Enhanced features of second generation mobile networks such as SMS, GPRS and WAP enable operators to offer new services aimed at the mass market and assist them to gain experience prior to the launch of third generation systems. However, the rollout of WAP and GPRS services has only just begun. The challenge will be to master a very short learning curve for the successful deployment of third generation networks and to ensure the availability of attractive services, applications and solutions for the user both in public and private networks. In addition, the Internet continues to grow rapidly and networks based on the Internet Protocol will become predominant in the future. The Internet is clearly positioning itself as the single most important channel for delivery of information to the mass-market user.

There is little doubt that the wireless communications industry will drive the Internet into new markets with the introduction of third generation mobile systems. These developments will also influence and change the Internet itself.

The two user requirements identified at the start of this section are indications that end users will be willing to pay for secure, convenient wireless data services. The question is how operators might reconsider the value of their wireless data assets to gain incremental revenues and, more significantly, incremental profit and cash flows, so that each end user will generate higher revenues, beyond wireless voice services and low speed data.

Since most future third generation services will be implemented over packet-based networks and will show very different traffic patterns to voice, these services could be priced according to network usage or volume of data rather than by the number of minutes that a subscriber is logged onto the network. As such, pricing has the potential to be a function of demand, time of day, bandwidth and delay tolerance. It is obvious that the future potential success of third generation services will very much depend on the implementation of the right pricing of these services in both level and structure.

All these aspects, namely user requirements, applications and services (both public and private), network platforms for the support of these applications and billing aspects are addressed in this report.

0.3 Creating the Environment

The mobile market is changing from an environment dominated by voice to one where mobile Internet and enhanced data services will be equally important. This transition requires new service concepts and an in-depth understanding of the “new” user. New cross-industry partnerships as well as new business models are required in order to address these challenges, accompanied by a re-organisation of the supply chain. The potent mix of the Internet, e-commerce and mobile communications promises huge potential market revenues; however, a number of steps must be implemented before this can be accomplished.

Accurate customer segmentation, focusing on customer value and availability of services at the right price will be key factors to success. Additionally, “content” needs to scale to the various display sizes of different terminals and also requires interoperability in order to ensure wide end-user acceptance.

As the wireless market moves towards multimedia, operators will need to ensure that subscribers using such services are effectively supported wherever they happen to be located. Mobile data applications are commercially viable today but future mobile network

enhancements will enable operators to offer a broader, more profitable range of (multimedia) services.

Since the wireless Internet is an unprecedented phenomenon and the required business models and strategies are yet untested, market estimates vary widely and entry into this market is often associated with high risks. However, there are also indicators that provide evidence of its potential:

- Current offerings from cellular network operators include information on stock prices, weather forecasts, sports, traffic, and other Internet content for mass markets, all largely delivered by the Wireless Application Protocol (WAP). However, the current offerings have made some major shortcomings apparent, caused mainly by lack of terminals and the circuit-switched nature of the underlying 'bearer' services¹.
- The success of i-mode in Japan has been driven by its early entry into the market as well as by the development of content by more than 3,400 information providers. The rapid growth and current penetration of the service (some 11 million subscribers²) has demonstrated the acceptance of data services in future networks.

Mobile commerce has many facets such as B2B (business-to-business) and B2C (business-to-consumer) where consumer behaviour plays a critical part in its acceptance. However, the network operator will initially have to be content with a small transaction margin on new m-commerce business. Clearly, profitability in this case will be strongly dependent on volume, i.e. on the rapid creation of a mass market. Otherwise, network operators would have to decide as to how much a broader and more global scale they want, based on their abilities and organisational structure.

The key enabler for the consumer mass market is the packaging of applications and presentation of content within an easy-to-use terminal device. This captures the imagination of the consumer, in the same way in which the latest generation of mobile handsets and tariffs combined with voice messaging services have driven the wireless voice markets. These enable previously unconscious and undefined, or wholly new, user needs to be identified and satisfied, and this process results in the creation of completely new, previously unknown classes of services.

The next generation of mobile terminals is expected to be multimedia (voice, data, text, image and slow-scan video) and based on a combination of functions seen in the laptop, the palm-sized handheld and mobile phone. This means that for third generation services and applications, a large variety of mobile terminals targeted at various market segments will emerge, with voice as one of the features.

¹ GPRS, which would be much better suited for WAP services, is currently either not available or just being rolled out

² 3rd quarter 2000.

0.4 Recommendations

0.4.1 User Expectations

- **Attractive and Intuitive Services**

All players in the market need to consider the complexities of the service delivery channel while balancing the customers' requirements for ease-of-use.

- **Transparency of Charging**

Since the forms of charging will be manifold in UMTS/Third Generation, transparency and visibility of service charges should be a key element of any service offering. The ability to better control cost via easy-to-use interfaces is likely to be another driver for customers to use 3G services.

- **Maintaining High Levels of Security**

Third Generation service offerings for business users must provide at least the same level of security as known from today's leased line-based corporate networks, including encryption, authentication, user identity (digital signatures) and non-repudiation.

- **Ubiquitous Access to Location-Based Services**

For the user relying on the network to provide location information a heterogeneous environment involving different positioning methods will constitute a deterrent. It is necessary for the industry to address this situation so that location-based services may be provided irrespective of the technology. This is considered to be critical since users have come to expect seamless service roaming.

0.4.2 Service Provisioning

- **Leveraging Interactivity, Mobility, Broadband and Positioning Capabilities**

Service providers will achieve most value from third generation networks by combining third generation's inherent capabilities (Interactivity, Mobility, Broadband and Positioning) in the creation of new and innovative services.

- **Positioning in the Value Chain**

Revenue margins on the transport of data and information will continue to decrease. Operators need to address this situation by basing business cases on either the predicted exponential growth of traffic, or build into their models methodologies for billing for content, based on the value of the content itself.

- **Preparing for M-Commerce**

Mobile operators will need to re-evaluate their position in the value chain as it is likely that a major part of m-commerce revenues will go to the portal provider or supplier of goods. Additionally, a number of unprecedented issues will need to be

tackled, including legal issues such as taxation of goods purchased online.

- **Enabling Global Roaming and Interoperability in Packet Networks**

Operators must agree on the deployment of common IP protocols that impact roaming (i.e. the interfaces between core networks) and the communications between terminals and networks in order to achieve maximum interoperability.

- **Need to meet the Challenge of Roaming for Content Services**

The impact of roaming will need to be explored fully when dealing with a content world. The demands for localisation and personalisation will need to be balanced and existing standards for data transfer will need to be enhanced.

- **Impact of QoS on Charging**

Quality of Service will be a major element of charging in UMTS/Third Generation. This implies that interfaces between network elements and mediation/rating are as seamless as possible. There must be a strong link between the users' perceived QoS and the charging.

0.4.3 Technology Issues

- **Handling QoS in and between Packet-Based Networks**

Service providers will need to take into consideration the current limitations of IP in terms of QoS while planning for third generation services. In the longer term, QoS support across multiple networks will require new forms of commercial agreements between operators that will be radically different from the traditional peer-to-peer agreements from the Internet world or the roaming agreements known from the 2G mobile World.

- **Evolving towards IPv6**

The rapid wide-scale introduction of IPv6 should be the basis for overcoming the problems relating to numbering, addressing, naming and QoS for real-time applications and services.

- **Role of Broadcasting**

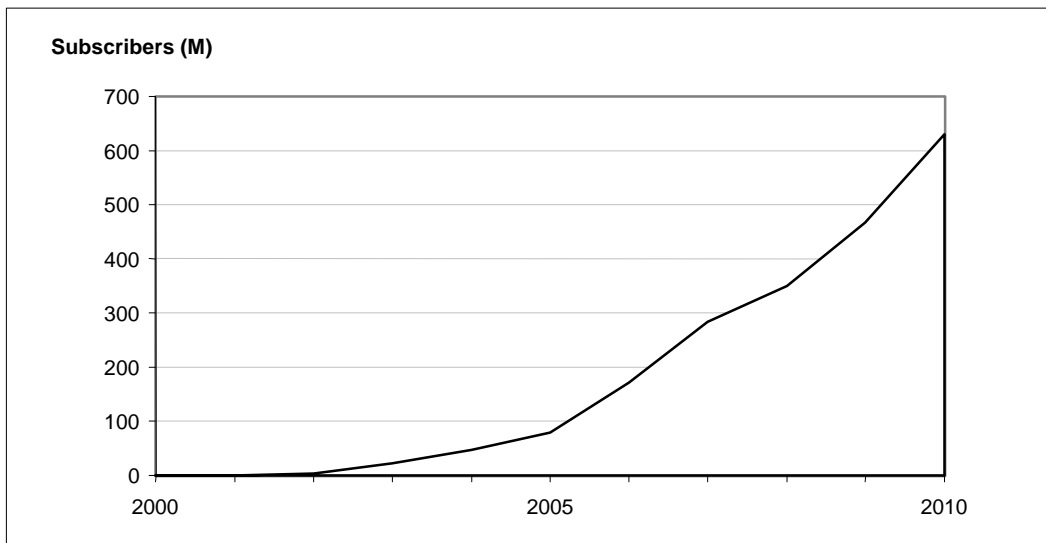
Operators will need to evaluate the role of broadcasting as an additional source of revenues and content.

1 INTRODUCTION

1.1 General

This document is one of a series of UMTS Forum reports that address different aspects of an overall complex system. Applications and services are essential components in future cellular networks. They will be the main competitive differentiators and sources of increased revenue for operators and service providers. This report focuses mainly on applications as enablers and addresses important service categories. Applications can be expected to evolve from current market developments and consumer requirements and are considered to be the building blocks that will enable services in the 3G environment.

The initial *UMTS Market Forecast Study* concluded by Analysys/Intercai in February 1997 analysed future services and presented four adoption scenarios. A new market study has extended this work taking account of current mobile subscriber forecasts for the next five to ten years (Figure 1). This UMTS Forum market study (*UMTS Forum Report No. 9: "The UMTS Third Generation Market – Structuring the Service Revenue Opportunities"*) explores service revenues on a regional and country basis. It has formed the foundation for the work in the UMTS Forum ICT working group.



Source: Telecompetition, August 2000

Figure 1: 3G Subscribers Worldwide

UMTS/Third Generation applications and services will stimulate new business opportunities for large numbers of new market players. The key question is: What will these services and applications be? This is the question addressed by this study. The title of the report, "Enabling UMTS/Third Generation Services and Applications", reflects what is needed to achieve the expectations of UMTS.

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1.2 The Report

This report covers the evolution and development of important services and applications in a UMTS/Third Generation environment. It goes on to address user expectations of the future services to be delivered by mobile. Applications have been grouped into specific building blocks that are enablers for the service categories considered in this report. The report addresses the following enabling applications:

- Multimedia
- Mobile commerce
- Unified messaging
- Voice over IP
- Interactive broadcasting
- Positioning

The main service categories addressed are:

- Location-based services
- Edutainment and Infotainment
- B2C Services
- Office Extension
- Telemedicine
- Telematics/Telemetry/Monitoring

The report considers Quality of Service (QoS) levels and the essential elements required in delivering these services. Since the billing of services relates directly to accrual of revenues, the report tackles billing issues within the UMTS/Third Generation environment. Services and applications in the non-public environment should not be forgotten and these are covered in Chapter 9.

In all the areas above, key issues have been identified and recommendations made where appropriate. Both have been highlighted in the relevant chapters and listed separately within the report.

The industry is now moving towards a mobile network architecture that will be entirely based on IP technologies. "IPv6" has been chosen by 3GPP in a first step to be introduced into 3G core networks, but later to be deployed as a protocol. However, it is too early to identify specific IP applications in mobile networks that will spin-off from the deployment of IPv6.

1.3 What makes Third Generation Different?

The combination of the inherent capabilities of UMTS/Third Generation will lead to a sharp increase in the number and variety of services available compared with current wireless and even most wire line communication systems. Data communications is expected to achieve a larger market share than voice communications in the future. The Internet will be one of the major drivers in this development, leading to increased traffic from:

- Mobile users fulfilling their demands for goods, entertainment and information
- Teleworkers having remote access to services in the corporate network, irrespective of their location, to provide, *inter alia*, immediate on-site customer care.

Critical success factors for creating a mobile data mass market include access to all types of information in a format appropriate to each type of terminal and the right diversity of products (including terminals) to accommodate all types of users and usage.

More and more companies are using the Internet platform to organise and optimise mobile access to the corporate network. The introduction of VoIP in a corporate network environment leads to a genuine integration of voice and data services. This single system platform for all services/applications in one network provides significant savings in capital costs and maintenance. It improves scalability and flexibility, reduces overall communications costs and allows enterprises to be more competitive.

Problems of latency are to a large extent controllable in corporate networks since the network owner can control most of the parameters affecting Quality of Service in his Intranet.

QoS in the public environment is an open issue, especially where multiple networks owned by different operators are involved.

3GPP is currently evaluating the impact of IP (including IPv6) on QoS requirements of UMTS/Third Generation systems.

2 USER EXPECTATIONS

2.1 User Perceptions

From a user perspective there are three key attributes that describe a successful service:

- **Value** means that a service satisfies a concrete need or requirement. Value can have different interpretations depending on different user perspectives. It can relate to saving money, saving time or how much “fun” a service is to use.
- **Ease-of-use** for both terminals and services demands a user-friendly, intuitive Man Machine Interface (MMI). Ease-of-use also refers to effective navigation tools that encourage service usage and the full exploitation of enhanced features by avoiding steep learning curves.
- **Cost benefits** are closely related to perceived value. Cost-effectiveness is based upon what the user concludes when evaluating benefits against costs.

The following aspects will drive users in evaluating the benefits of 3G compared with current fixed line and 2G/2G+ services:

- Access to a wide variety of multimedia content (e.g. information, entertainment).
- Control of personalised services (“profiling”).
- The same “look and feel” irrespective of the user’s location, e.g. Virtual Home Environment (VHE).

To fulfil user expectations in the long term, applications and services must be able to take advantage of all UMTS/Third Generation capabilities such as QoS, bandwidth-on-demand, security and privacy.

Combinations of the following characteristics, depending on the specific market, will attract users to 3G services:

- One number/one address
- One bill
- Pre-pay option
- One-stop shopping
- Single point of customer care
- Single access point to content and services, enabled through the concept of wireless portals
- Seamless access to services, irrespective of the serving network
- Transparency/visibility of service charges.

Transparency/visibility of service charges allows users to control costs; this will have an impact on billing and signalling within the network.

Easy personalisation and customisation of applications and services via one or more user profiles will be a requirement. Service portability will also be important, since users will want to set-up their profile once only and transfer it should they change operators.

2.2 Migration towards UMTS/Third Generation from a User Perspective

Within the next decade, fundamental changes in the use of personal communications, data networks, broadcasting and entertainment services will occur, many of which constitute a revolutionary shift from current business models and the underlying value chain.

Early adopters will gain their first experience of the advantages of advanced data services and new tariff models using GPRS/EDGE devices that may incorporate short-range radio and/or WAP capabilities. From a user perspective, multi-mode and multi-band devices will be the first step in the transition from 2G to 3G. Over time, network operators and service providers will promote some of their new service offerings only on their UMTS/Third Generation networks, differentiating themselves from other operators and defining a natural migration path to 3G. Consistent tariffs in 2G/3G networks, and 3G coverage areas will be key factors to consider in the rollout of third generation services. From a user perspective, this migration phase means that initial service quality may not be globally consistent.

Third generation capabilities such as high bandwidth will also provide new opportunities for traditional or Internet-based broadcasting organisations to start delivering content and providing interactivity to a new breed of mobile customers. At the same time, there will be an increased focus on local content and its creation and provision. IP will be one of the most significant enablers for the creation of these new opportunities because both IP and third generation are global platforms ensuring ubiquitous availability. All this means that:

- Wireless communications will converge with the IP world
- Broadcasting will grow closer to the Internet.

Delivery of personalised information, through both content and services, to the global citizen utilising a variety of devices is one aspect of UMTS/Third Generation.

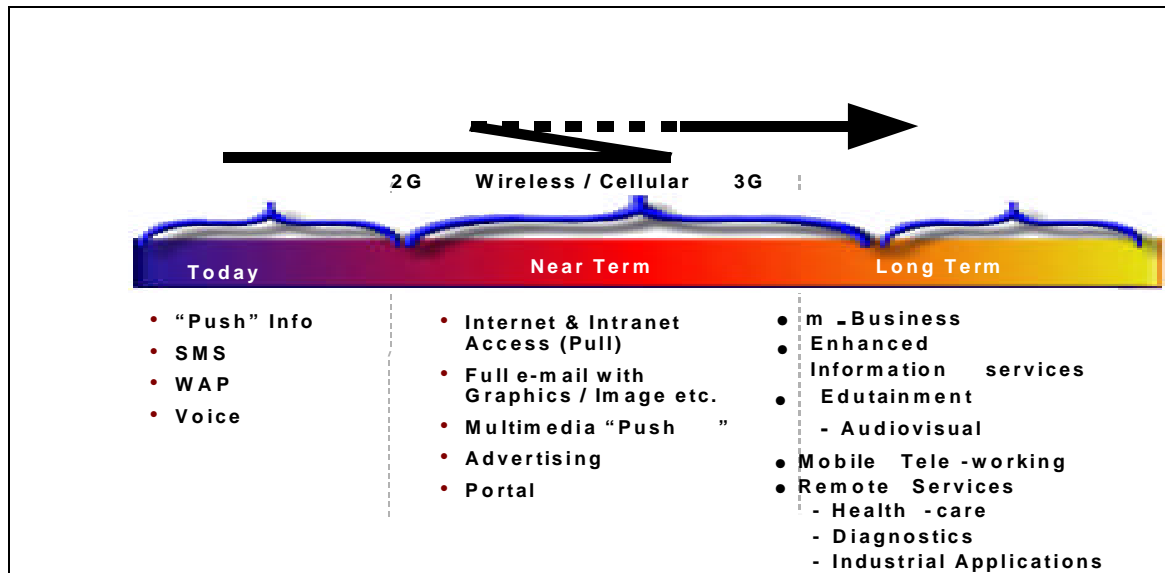


Figure 2: More Advanced Services as the Market Evolves

Figure 2 illustrates how services will evolve with the market and what users may expect in the near-term and long-term future. Near-term services are enablers for long-term services. The

creation of long-term services will require a thorough understanding of the matured market, which will have been gained through experiences from near-term services.

As an example, “Mobile Business” encompasses the sum of all services (e.g. mobile commerce and Intranet access) that facilitate the combination of business and mobility. A number of issues will need to be resolved for the implementation of long-term services, including the creation of rich content and application software as well as legal aspects.

The development of 3G services and applications must take into account users’ communications habits and handle situations where ubiquitous access may not be available initially. However, 2G+ services could also be made available on 3G networks (with better performance) to ensure consistent and seamless availability of such services.

3 ICT VISION OF SERVICES AND APPLICATIONS

The future of the wireless information society will not be driven by technology. Users will decide what are the most appropriate services for their needs. The technology only defines the boundaries of what can be achieved. Users will need a device of their choice that will adapt to the programmed profile and make access to the service possible. The device type will be determined by the application and present the content, made available by the service. A future-oriented platform requires certain essential capabilities for the implementation of applications. These are illustrated in Figure 3.

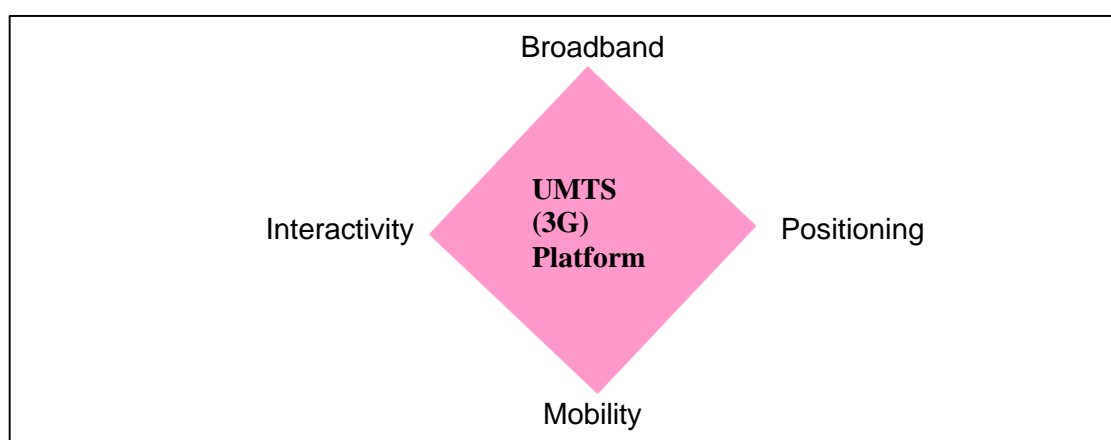


Figure 3: **The Magic Square**

UMTS/Third Generation delivers **inherent** capabilities for the effective use of advanced services and applications (**Interactivity, Mobility, Broadband** and **Positioning**) and therefore a unique and future-proof platform.

A multitude of cross-industry actors will participate in the value chain to develop a wide variety of services and applications for customers, operators and manufacturers.

Most importantly it is necessary to create a global platform for interconnection of all network elements, which would allow for seamless access to services regardless of the user's location.

The concepts of services and applications need to be clearly defined (Figure 4):

- **Services are the portfolio of choices offered by a service provider to a user.**

Services are elements that service providers may choose to charge for separately or as a package. They will be a prime differentiator between service providers in the third generation environment. Users are likely to select their preferred third generation service provider based on the options available in its portfolio.

- **Applications are the building blocks that enable the creation of services.**

Applications are invisible to the user; they do not appear on a user's bill.

- **Content is the information the user wants and is willing to pay for, provided the quality of the delivery is that which has been agreed.**
- **Devices allow a user to interact with the application in order to access and use the content.**

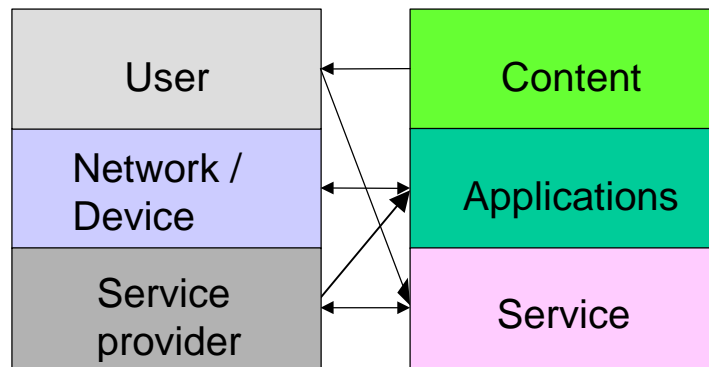


Figure 4: **Functional Diagram of Definition of Services and Applications**

The number of services available to users of both wire line and wireless communications is growing rapidly. The expectations of service or network providers to offer higher bit rate services have been met with several different technologies but in many ways the required variety of applications is not yet available.

Wireless offers mobility as an added value and wireless carriers and operators compete with segmented service offerings. The societal driver of this renewed thrust into wireless communications will still be competition. It will not be sufficient to offer the same services at a cheaper tariff on a different network; a panoply of services from which a user can pick and mix to meet teenagers' and executives' needs alike will be important. An understanding of society – the characteristics of people in different regions of the world with their cultural variety and particular needs – will be key to success.

As we consider the current and future requirements of wireless customers globally, it becomes very apparent that the Internet, location-based services, interactive broadcasting, etc., influence the lifestyles of people and are creating a new understanding of telecommunications, enabling new technologies and spurring future demand.

Content, a wide variety of mobile devices to access content, and ubiquitous seamless mobile access are key elements of the ICT vision, each of which forms an essential part of the overall picture.

It is important to distinguish between content generation and content provision. Content may be accessed free-of-charge, or be subsidised (e.g. in combination with advertisements) or in some cases paid on-demand. The paradigm for use is market driven.

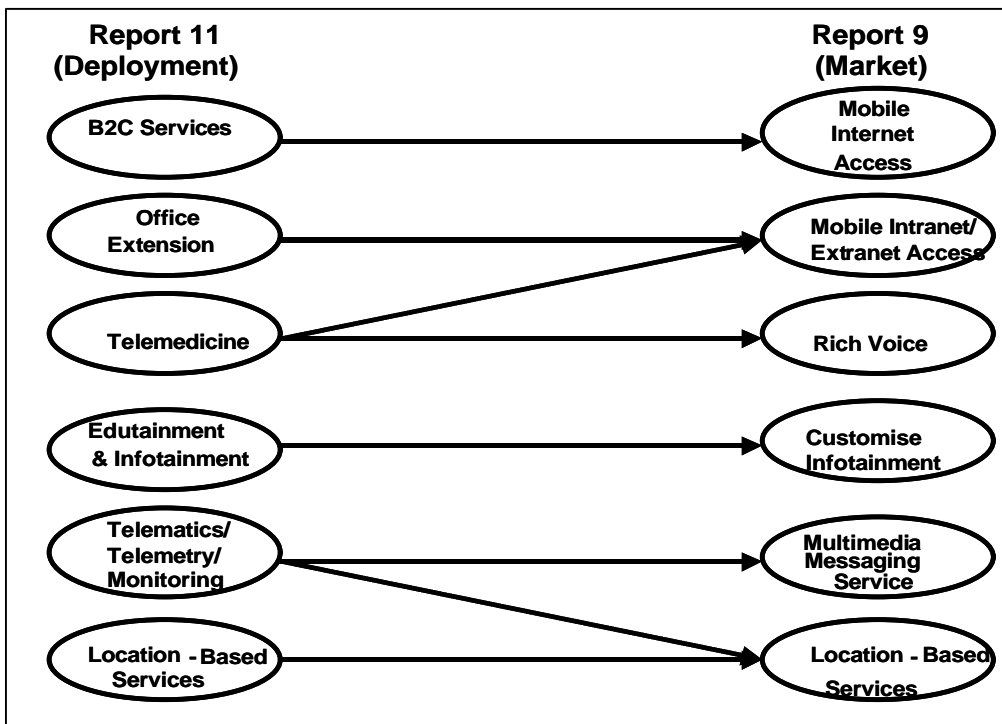
The vision of mobile multimedia has been one that will enable operators to offer a broader, more personalised, more profitable (more added value) range of services. However, content providers and the broadcast industry that create and own multimedia content will be looking at opportunities to convert from a passive to an interactive content activity.

Very little needs to be said about the influence of the Internet in all fields and industries. As consumers become increasingly mobile, it is logical that they demand mobile access to the multimedia services available from the Internet. Mobile networks are therefore becoming a platform for introducing leading edge Internet services. While the Internet is still very much wire line orientated, we are slowly progressing towards a mobile Internet concept. Within a couple of years, we will be able to access the same content from any chosen device. The UMTS Forum expects that by 2010 nearly 50% of Internet users will access the Internet from two or more devices, which may be identical or significantly different in functionality and capabilities.

Within the IP environment we expect video and images to enrich individual services beyond what is known today, allowing users to transmit video clips or receive streamed news updates. Content providers will find a strong demand for their news and information services if they can tailor delivery to the new medium. Currently, news and information can be delivered on demand in short byte-sized bursts at the request and convenience of the user. In the future, this will be enriched by full multimedia including graphics, audio and video.

The recent UMTS Forum market study³ (UMTS Forum Report No. 9) has identified a framework of six service categories using a market focused approach that explores 3G services from a user perspective. The market study presents revenue forecasts for three of these service categories.

The work presented here (UMTS Forum Report No. 11) analyses services and applications more from the perspective of what is required for a successful deployment to meet the revenue growth potential identified in the market study. The services discussed in the present report can be mapped onto the broad service framework of the market study as indicated in Figure 5.



³ UMTS Forum Report No. 9: "The UMTS Third Generation Market – Structuring the Service Revenue Opportunities", October 2000.

Figure 5: **Mapping of Service Categories (Report 11) onto Service Framework (Report 9)**

Applications are the building blocks which enable service creation. Figure 6 illustrates how the applications described in this report can be used to build specific service categories, and to what degree each building block will impact such service creation.

Service Categories Applications (Enablers)	Location based (5.1)	Edutainment and Infotainment (5.2)	B2C Services (5.3)	Office Extension (5.4)	Tele- medicine (5.5)	Telematics/ Telemetry/ Monitoring (5.6)
Multimedia ⁴ (4.1)	H	H	H	H	M	L
m-commerce (4.2)	H	H	H	L	L	M
Unified messaging (4.3)	L	L	L	H	M	L
VoIP (4.4)	M	M	M	H	H	L
Interactive Broadcasting (4.5)	H	H	M	L	L	L
IP Access ⁵	M	H	H	H	M	H
Positioning (4.6)	H	H	L	M	L	H

L: Low importance; M: Medium importance; H: High importance

Figure 6: **Applications Enabling Third Generation Service Categories**

In chapter 4 the applications that will be offered in a third generation environment are identified and described. These are the most important "**enablers**" for the huge variety of third generation services. Chapter 5 deals with the most important classes of service categories.

⁴ Including video-based services such as video-telephony.

⁵ IP Access refers to access to any IP-based infrastructure, be it the Internet or private IP-based networks.

4 UMTS/THIRD GENERATION APPLICATIONS

In this section, applications are described in terms of their enabling functionality. They represent the building blocks from which third generation value chain actors can create a nearly unlimited number of services.

4.1 Multimedia Applications

Multimedia applications are enablers for broadband services with either real-time (e.g. video telephony) and/or non real-time (e.g. Internet access, file transfer) requirements. Third generation systems take care of the resulting basic bandwidth demand in combination with global mobility and interactivity. This unique combination of capabilities enables new applications and opens new areas of business.

4.1.1 Video Telephony and Videoconferencing

Video telephony and videoconferencing are typical communication services, which can be economically supported by third generation networks for mobile users. To date, video telephony and videoconferencing have not become as successful as anticipated. Lack of bandwidth, high cost, lack of equipment and services and the need for dedicated equipment rooms have been some of the major restricting factors. Videoconference services have generally been offered to corporate customers and have been unable to reach the volume expectations of manufacturers and operators.

Availability of high bandwidth is now emerging in both fixed and mobile telecommunications networks. Video telephony and videoconferencing are now possible on a broad scale and have acceptable quality. UMTS/Third Generation systems support both the required bandwidth and provide mobility, which enables videoconferencing to take place independent of a fixed location.

Within the context of interactive real-time applications, QoS support in 3GPP Release 99 specifications is focused only on traditional voice. It is expected that Release 2000 (or version 5) will be most likely based on IETF specifications and definitions of QoS to support real-time packet-switched domain-based services.

4.1.2 Audio-Visual Non-Broadcasting Data Transport over 3G

The high bandwidth of 3G enables real-time and fast downloading of multimedia content from various service platforms and the Internet. Such services will compete with offline stored media such as CDs and Music Cassettes. A high user value can be obtained through:

- Competitive pricing of services
- Providing ubiquitous, on demand access to services
- A reduction in the need to use offline archiving platforms.

Figure 7 shows the download times for typical applications and gives an indication of which system platform meets customers' requirements concerning acceptable download times.

<u>Services</u>	<u>2G</u>	<u>PSTN</u>	<u>ISDN</u>	<u>2G+</u>	<u>UMTS/3G</u>
E-mail file 10 kbyte	8 sec	3 sec	1 sec	0.7 sec	0.04 sec
Web page 9 kbyte	9 sec	3 sec	1 sec	0.8 sec	0.04 sec
Text file 40 kbyte	33 sec	11 sec	5 sec	3 sec	0.2 sec
Large report 2 Mbyte	28 min	9 min	4 min	2 min	7 sec
Video clip 4 Mbyte	48 min	18 min	8 min	4 min	14 sec
Film with TV Quality	1100 hr	350 hr	104 hr	52 hr	>5 hr

Figure 7: **Platforms for Multimedia Applications**

This chart shows the strength of the 3G platform for multimedia applications. However, the transport of TV quality video content (large screen, high resolution, hi-fi sound quality) generally requires today a constant bit rate of about 4 Mbit/s and so is beyond the scope of technologies currently included in the IMT-2000 family (as indicated by the demarcation line). The shaded area indicates the download times typical in fixed networks.

Digital video/still picture cameras and scanners are today almost commodity items. The digital content can be easily transported over communications networks such as 3G and the Internet. Streamed low bit rate coded video can be transported over UMTS/Third Generation systems in real time, whereas higher bit rate coded video would need to be downloaded into a local storage device for later playback. Video/multimedia transport will most likely use the MPEG-4 family of compression and presentation coding.

Digital cameras are today available with up to 6 Mpixel resolution. Such a high definition is generally only needed for professional use. Cameras therefore offer various compression schemes, mainly in JPEG format, which reduce the file size by an order of magnitude. This provides, for private use, a fully acceptable quality for printouts up to A5 size.

HiFi audio could be transported live (real time) over UMTS/Third Generation systems with CD quality. New compression methods providing improved coding efficiency and retaining acceptable quality are becoming increasingly popular. One such technology is MPEG-2 audio layer 3, often known as MP3. At the same time it is expected that large numbers of audio files will be downloaded into local storage to enable later multiple playbacks.

UMTS/Third Generation will open up new opportunities for the delivery of audio-visual content regardless of the user's location. These new opportunities may complement or compete with existing "offline" offerings. For some users and services they may be the only means to access or transmit audio-visual content (e.g. "walkman-in-the-mobile-terminal").

4.2 Mobile Commerce

4.2.1 General

E(lectronic)-commerce and its subset m(obile)-commerce will have an important impact on the revenue of operators in the short to medium term. Fully-fledged m-commerce involving purchasing goods, services or content, or making financial transactions directly from a handset, will require operators to reconsider their position in the value chain.

4.2.2 Market Forecasts

The key to the m-commerce revolution – unsurprisingly just like industrial e-commerce – is the Internet. Not because the Internet does everything other networks do not provide, nor because it is better. It is simply because the Internet provides ubiquitous connectivity for virtually all non-voice communications. The flat-rate tariff structures and low entry cost characteristics of the Internet environment encourage global use.

Figure 8 illustrates the significant potential of the mobile Internet for m-commerce in 3G. The UMTS Forum expects that nearly 50% of mobile subscribers worldwide will become mobile Internet subscribers by 2010.

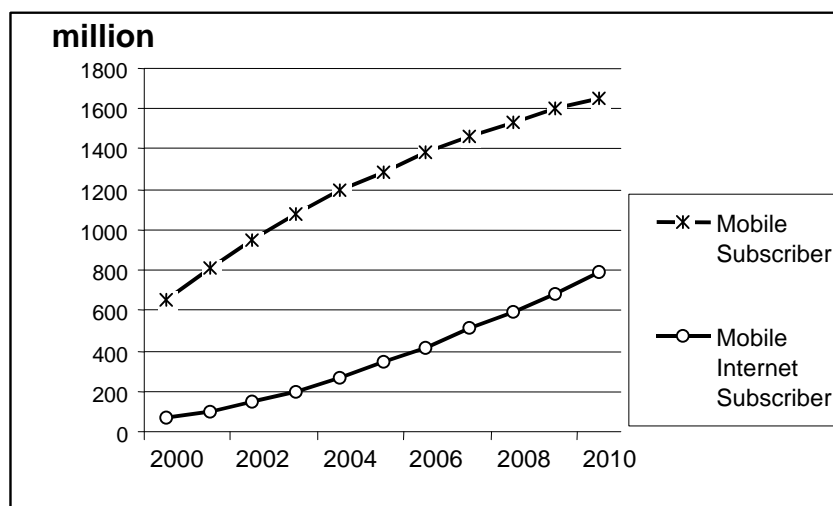


Figure 8: **Mobile Subscribers Worldwide**

Wireless Internet access improves the ability of e-businesses to learn about their customers, leading to the development of better content and more business.

M-commerce, as well as e-commerce, involves a number of different capabilities and services. With the fast growing market for 2G+/3G mobile terminals, analysts expect an exploding demand for different m-commerce applications, as shown in Figure 9.

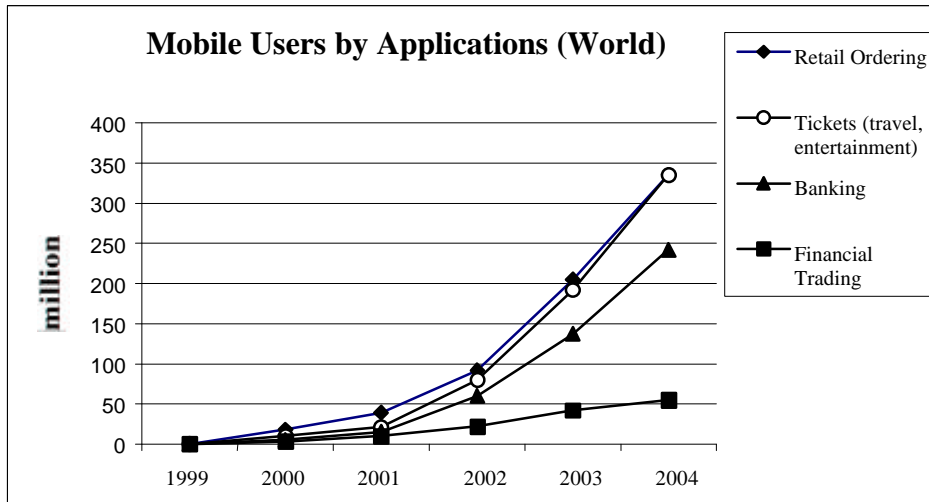


Figure 9: Mobile Users by Applications Worldwide

M-commerce will become a leading driver for the successful rollout of UMTS/Third Generation systems and will influence the relations between existing and emerging players.

It is expected to become one of the most important applications for nearly all social classes. However, the major proportion of the revenues from m-commerce will go to the portal or supplier of a variety of goods.

E-/m-commerce falls outside the well-understood legal and regulatory frameworks for telecommunication providers within which trading has traditionally taken place. One example is taxation, which is currently an open issue.

4.2.3 Security Aspects

There are some concerns relating to e-/m-commerce such as security, trust and methods of payment. Concerns relating to the security of the Internet must be addressed by appropriate action from standardisation groups such as the IETF. Other approaches involving end-to-end encryption could result in solutions which are not dependent on Internet security.

With the use of smart cards or USIMs where multiple processors and very large memory capabilities will emerge, multiple applications (within and outside the 3G context) will be supported. Mobile encryption and authentication protocols will offer the necessary checks and secret keys.

4.2.4 Example

The role of m-commerce as an important enabler of services and applications is underlined by the experience of i-mode in Japan. Figure 10 illustrates that the most popular applications and services are m-commerce related.

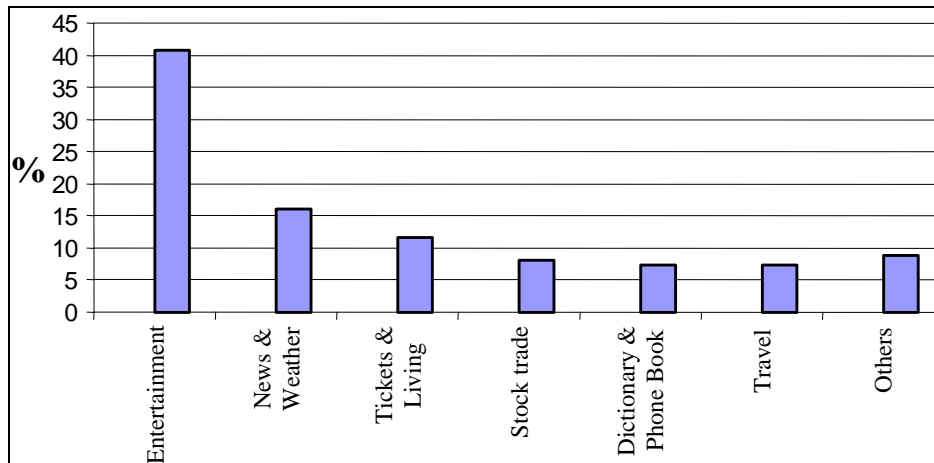


Figure 10: Use of i-mode Applications

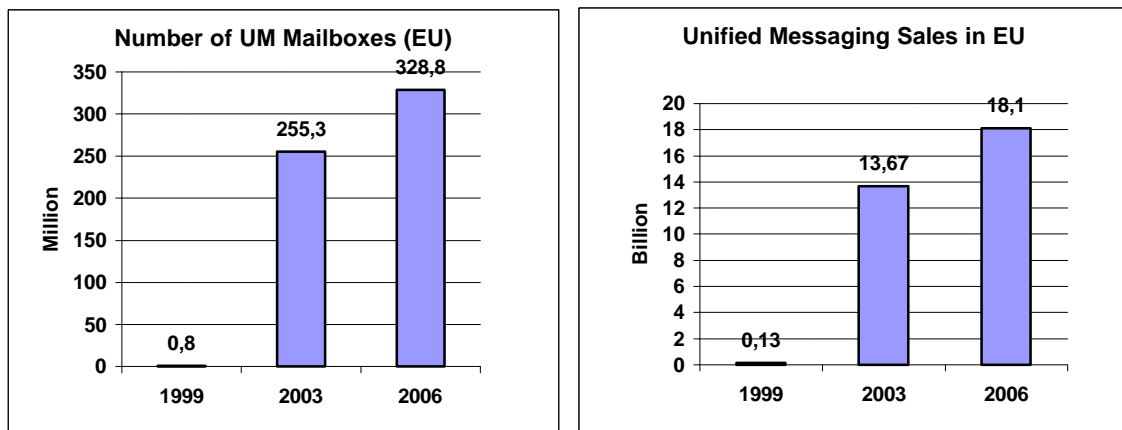
4.3 Unified Multimedia Messaging

The increasing volume of communications is resulting in information overload. Messaging appears to offer a solution but it needs to be intelligent and intuitive. Speech recognition, neural networks and even mood monitors are all going to come into play in the future of messaging technology.

Unified Multimedia Messaging uses MIME and transmits word processing, faxes, voice, video, e-commerce, software applications and multimedia data files as registered by the Internet IANA Registry. MIME allows the transmission of compound documents (e.g. images and drawings) and will handle future requirements such as simultaneous voice and fax transmissions.

It can therefore be considered as a converged application, which is ideally suited to the mobile network and can deliver significant end-user value. Having a single mailbox and one number for voice, fax and e-mail (all messages, types and formats) improves time efficiency for the end user. The UMTS Forum believes that non-UMTS unified messaging could become mainstream technology by 2001.

The desire to increase productivity is driving unified messaging. Users can save time by only having to check one box with mobile and fixed access for all their messages. Unified messaging saves everyone else's time by removing the need to chase people around leaving messages in random locations. It allows individuals to receive and act quickly upon urgent or important information they could not receive directly for some reason, allowing them to choose not to be interrupted. Adding "indexing" of messages (i.e. providing a summary including type, originator and priority) allows users to access mailbox information selectively, avoiding charges for accessing unimportant messages. Users can also respond to messages in the most appropriate manner, through voice, fax or e-mail.



Source: Frost & Sullivan, Report 3655, April 2000

Figure 11: **Development of Unified Messaging**

In the European Union, more than 250 million mailboxes will be installed by 2003, creating revenues of nearly \$14 billion (Figure 11). The availability of messaging services will drive awareness and development of the unified messaging market where interest is prevalent in mobile workers, work-at-home households and road warriors.

An essential development in this area is G5 Messaging. G5 is a set of protocols. It is a superset of the existing standards for Internet e-mail and Group 3 fax and will run over either medium. Formats permissible include text, image, EDIFACT and the new EDI/XML standards. G5 Messaging addresses the thorny issue of legal validity, as currently Internet e-mail and fax does not provide legal proof of the sending or receipt of messages.

G5 provides an extremely secure messaging environment and allows for the archiving of messages in a local and/or remote archive. The archived message store may be operated in compliance with codes of practice, which provide a legally admissible record of the message and its delivery to the intended recipient.

4.3.1 Benefits of Multimedia Messaging Services

The economic advantages of Multimedia Messaging Services are apparent at the service level:

- Carrier speed of transmission if required (e.g. for e-mail)
- Internet transfer costs if required (e.g. for fax)
- Optimum transmissions based on class of service/costs.

Multimedia Messaging Services will offer new technical features beyond e-mail and fax. Important features include:

- Matches sender/recipient capabilities
- Automatic Integrated Directory services
- Security
- In-built facilities for personal/organisational ID and digital signature provision
- G5 Messaging can inter-operate with standard Internet e-mail and MIME
- Interoperability with Group 3 fax, Internet and internal e-mail.

G5 Messaging is used to communicate with both Group 3 fax and the Internet, providing integration and additional benefits to both. It also provides new messaging opportunities for voice and video markets and offers new "Electronic Original" benefits such as legal admissibility.

- **Usable, Searchable Documents**
G5 Messages carry control information delivering usable/searchable documents. Retained documents can be searched against header file information if required. Received documents can be run on applications software – they are usable and can be modified.
- **Legally Acceptable Transmission**
Messages are uniquely stamped at the point of transmission (electronic postmark) and are uniquely confirmed providing legal status for the transmission. Outgoing and incoming transmissions can be automatically archived to optical storage systems under user control where legal status is required. Legal weight is provided by compliance to five international codes of best practice.

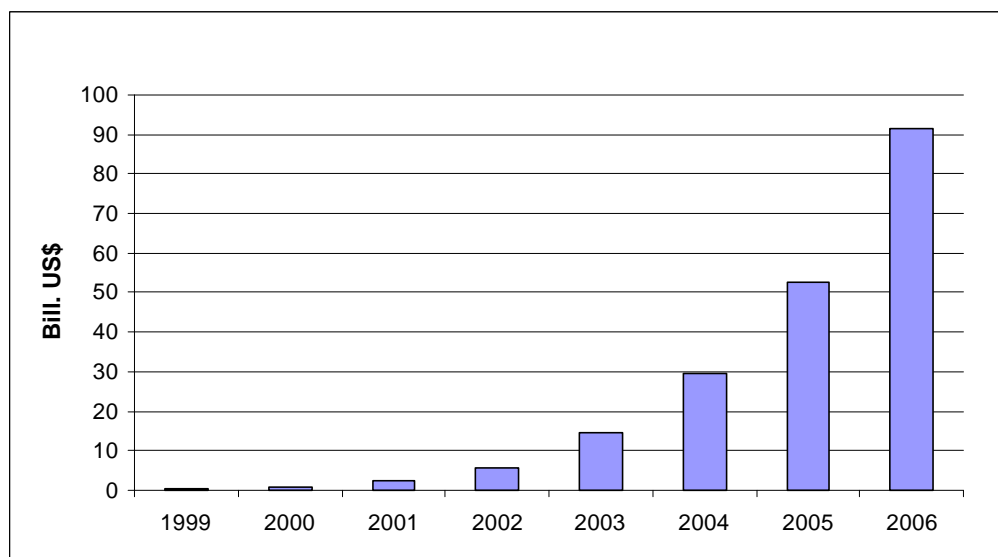
UMTS/Third Generation will eventually provide the capacity (bandwidth) necessary for fast delivery of messages, while terminals will allow for the display of picture-style content (e.g. fax as a TIFF file).

4.4 Voice over IP (VoIP)

This report has already outlined the transition of 'data over voice', as seen in today's services, to the 'voice over data' model that will be a characteristic of tomorrow's services. The following statements are valid for all real-time services.

3G network operators have an interest in reducing costs in their networks. It is unlikely that a network operator will want to operate both circuit-switched and packet-switched networks to cater for different data types for very long. The most likely scenario is that the network operator will want to migrate quickly to a single multi-service packet-switched network.

This does not necessarily mean that voice will be not be offered in UMTS/Third Generation networks. The expectation is that at least the same quality as today's circuit-switched transmission of voice service will be offered. IP telephony is expected to generate significant revenues over the next five years (Figure 12).



Source: Frost and Sullivan, Report 7159, January 2000

Figure 12: IP Telephony Sales Forecasts Worldwide

This has clear implications for the treatment of voice in third generation networks. The very fact that many of the new applications proposed for third generation systems will be IP-based leads to the question ‘should voice be dealt with as just another data application?’

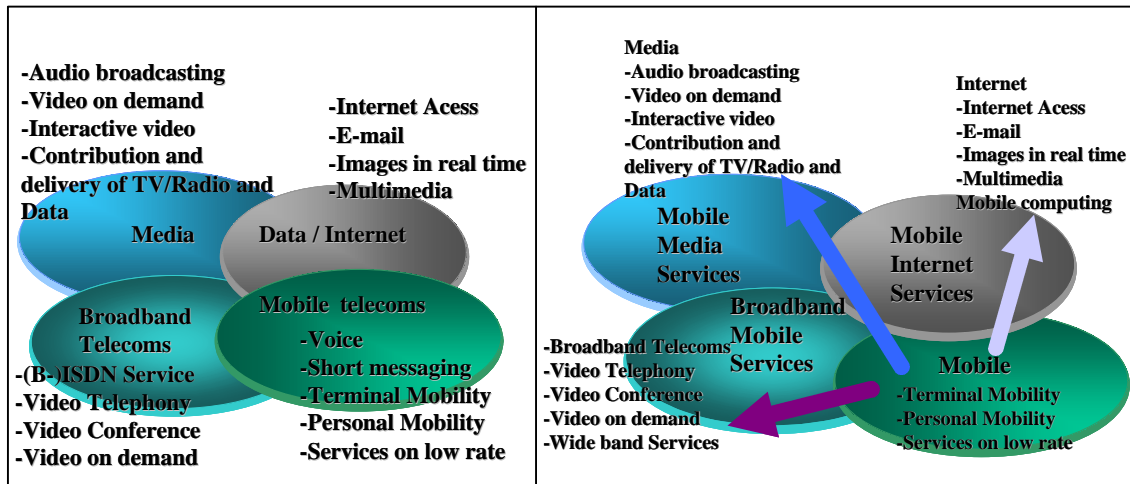
The regulatory implications of VoIP are still not entirely clear. The Internet community believes that regulation within the Internet environment is not required. The European Commission has already announced that there is no need to regulate VoIP. Opinions on this issue differ in a number of the European Union member states but it may not be a widespread issue worldwide.

VoIP will become an important enabler of convergence for services in fixed and mobile networks (2G+/3G).

4.5 Interactive Broadcasting

Broadcasting and telecommunications are inherently different: broadcasting is mainly “one-to-many” whereas telecommunications is mainly “one-to-one”. No single model is the best for every service; both models have advantages and disadvantages, and so both will continue to be needed for different types of services.

However, these two formerly separate markets are converging as broadcasting embraces digital techniques and mobile gains access to broadband capacity, allowing for the interactive provision of multimedia services to a broad audience of mobile users (Figure 13). The need to provide Internet access has effectively driven this process.



Source: European Broadcasting Union, March 2000

Figure 13: Convergence of Mobile Communications and Broadcasting

The concept of broadcasting has evolved to include elements of interactivity. Working Parties 10A and 10B of ITU-R have proposed a new definition: “Broadcast services are those vision, sound, multimedia and data services intended for use by the public, inclusive of those using access control or interactivity. They typically use an asymmetrical distribution infrastructure that allows high capacity information downloading to the public with a low capacity backward link to the service provider”.

Interactivity enhances the canonical unidirectional point-to-multi-point distribution mechanism, allowing for service on demand, i.e. bi-directional quasi point-to-point communications. The resulting system will provide an asymmetrical bi-directional link combining a broadband downlink based on DAB/DVB-T and a narrowband return channel provided by GSM/GPRS (where there is no UMTS coverage).

This would open a wide variety of business opportunities in many areas including:

- Education: High School, University, Continuous Education/Life-long Learning
- Trade and Commerce: Enterprises, Finance, Stock Exchange transactions and sales, Employment Agencies
- Interactive games
- Location-based information services
- Healthcare services.

This digital convergence impacts the value chains, creating opportunities for additional competition as well as for co-operation.

Broadcasters are contemplating the use of mobile communications systems such as UMTS to enhance their multimedia content (e.g. feedback from audiences, including real-time polling). Mobile operators are seeking to provide user access to such content and in so doing provide a whole new range of rich services (e.g. complementing broadcast services with other UMTS entertainment and information services).

Confronted with traffic streams that are inherently asymmetric, mobile operators envisage broadcasting as a **complementary** delivery mechanism, which could also distribute update/upgrade information to all mobiles in a given region.

As well as convergence, complementarity is a key driver – different services from different service providers could be combined to offer enhanced services. A wide variety of distribution systems will partly compete with and partly complement each other. Figure 14 presents the attributes of such systems with respect to the electronic distribution of information:

Attribute Distribution System	Interactivity	Point-to-Point	Point-to-Multipoint	Maximum expected data rates
DVB	no	yes*	yes	16 Mbit/s
DAB	no	yes*	yes	1.5 Mbit/s
Analogue Broadcasting	no	no	yes	-
2G/2G+	yes	yes	yes	9.6 – 384 kbit/s
3G	yes	yes	yes	up to 2 Mbit/s

* Service on demand

Figure 14: **Capabilities of Complementary Mobile Information Distribution Systems**

Figure 14 illustrates that UMTS/Third Generation offers significant business opportunities (either new or through substitution) due to its unique platform which bundles broadband and interactivity with global mobility.

Distribution methods involving bi-directional communications between content or service providers and customers are able to improve customer relationships in an effective manner. The offering of and the demand for services and information can be adjusted quickly and efficiently to the benefit of both users and providers.

To optimise their business model, service providers are focused mainly on achievable coverage and usage rates of their services. The range of distribution is limited by the access system, contracts and distribution rights as well as by economic and legal considerations.

Third Generation systems reduce the technically related restrictions of 2G mobile networks; this may induce changes to all elements of the business model for distributing news and information.

4.6 Positioning

There are two basic mechanisms for determining a user's location: satellite-based (e.g. GPS) or terrestrial infrastructure-based (e.g. UMTS/Third Generation systems). Both can enable a large number of services, albeit with different properties in terms of positioning parameters such as availability, accuracy and reliability. GPS reception in particular may be (partially) interrupted for many reasons (Figure 15).

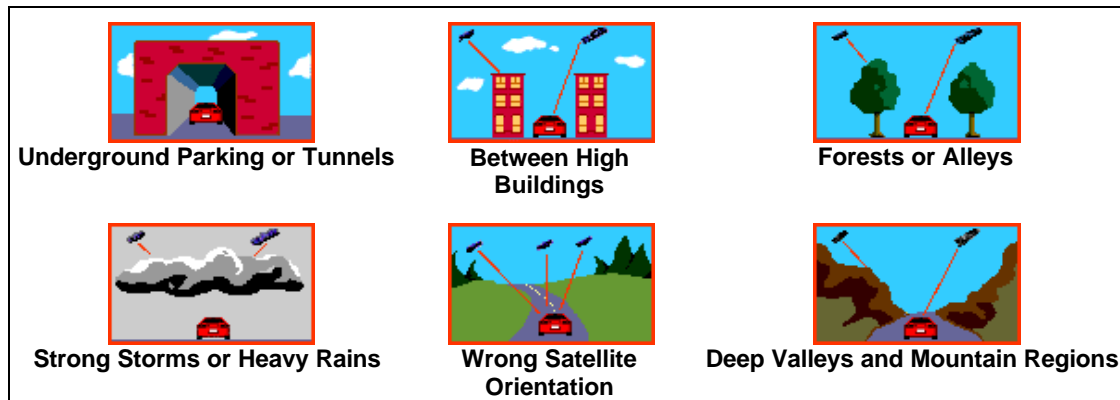


Figure 15: **Interruption of GPS Reception**

Network-based solutions may deliver less precise accuracy compared with GPS, however, GPS can be less reliable as shown in Figure 15. The ability of network-based solutions to support existing handsets is an advantage in the rollout of location-based services.

Terrestrial and satellite-based location systems have their own place, and complement each other in certain cases: satellite-based location does not work well in deep canyons and indoors where cellular coverage may be denser. Terrestrial-based location may be more imprecise with sparse deployment of base stations in rural environments, where satellite visibility is at its best.

Positioning can be described in terms of different attributes, such as accuracy, reliability and time-to-fix. Each positioning method has different values associated with these attributes (e.g. different levels of accuracy). Applications using location information are likely to have differing requirements concerning these attribute values. Some methods will be better suited for certain classes of service than others.

4.6.1 Satellite-Based: Global Positioning System (GPS)

A constellation of 24 satellites launched by the US transmits information enabling a GPS receiver to determine its position (the European Galileo system will eventually provide a similar capability). The Selective Availability (SA) feature has been switched off since May 2000 making the precise positioning mode available for commercial applications.

In GPS location determination uses the timed difference of arrival of satellite signals and is performed either entirely within the mobile unit or within the network. In the latter scenario the necessary satellite signal attributes are detected by the terminal and reported to the network for location computation, map matching, etc. This results in scaled down user unit hardware, but requires a wireless data link between the mobile and the network centre.

- The terminal-based method provides 10-40 metre accuracy. It renders the user totally independent and, in principle, allows access to any location-based services from third-party service providers.
- The second method, known as Differential GPS, can potentially provide location accuracy at the metre and sub-metre level by using infrastructure-based assistance. It would enable more accurate services from a UMTS/Third Generation network operator, enhancing the value of the network. With Differential GPS, a “correction” signal from a terrestrial network containing known bias errors computed at a known reference receiver can be used to improve accuracy to ~10 cm.

Any satellite-based location system requires a GPS receiver to be implemented at the mobile terminal, increasing the cost and complexity of the device.

4.6.2 Terrestrial Infrastructure-Based

Location determination through terrestrial infrastructure comes with two main options, each with its advantages and disadvantages. The first is where the position is determined by the terminal itself, called the “terminal-centric” approach. The second is where the position of the mobile phone is established by the infrastructure, the “infrastructure-centric” approach. Sub-options such as the “network-centric” approach might require additional information from the handset, the “terminal-assisted” case, while in the “terminal-centric” approach there might be some interest in getting some corrections from the network, the “network-assisted” case.

The simplest example of a “network-centric” approach is the cell-ID-based method. Cellular networks such as existing 2G and future 3G systems have a built-in capability to identify the cell where a specific mobile terminal is located with an appropriate level of accuracy. This capability is an inherent part of mobility management. Clearly, the positional accuracy increases with decreasing cell size.

Third generation systems, with their hierarchical cell layered structure (pico/micro/macro cells – see Figure 16) will offer a coarse location capability which will be sufficient to support many classes of location-based services such as zone-based billing.

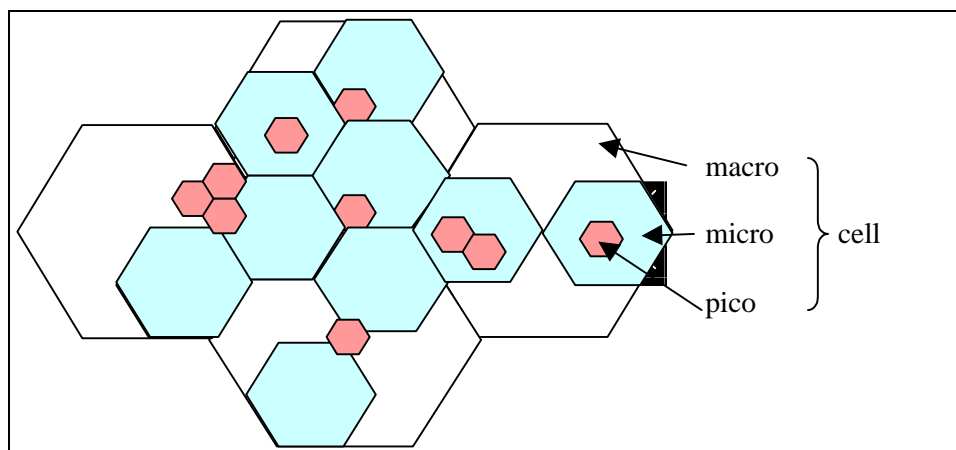


Figure 16: **Hierarchical Cell Architecture in UMTS/Third Generation Systems**

In addition to this cell-based coarse approach for determining a terminal’s location, a number of radio-based techniques have been developed such as Time of Arrival (TOA) and Enhanced-Observed Time Difference (E-OTD) (Figure 17).

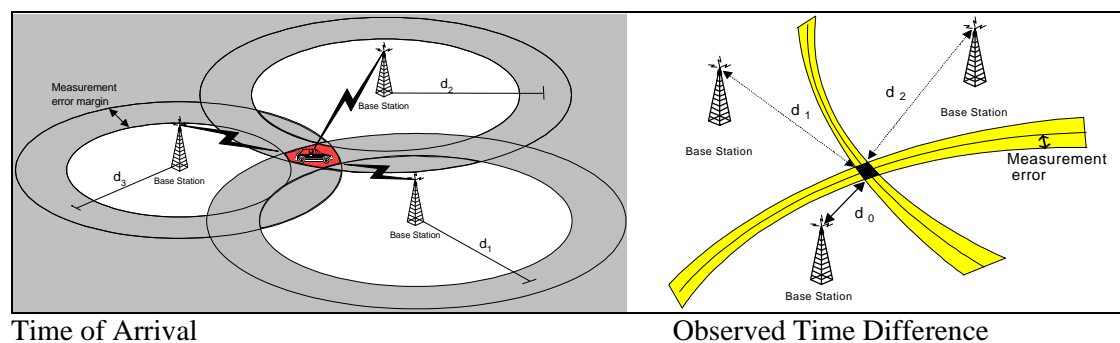


Figure 17: **Methods of Location Measurement**

In the network-centric approach (Up-Link TOA) time of arrival measurements are performed at the BTSs and forwarded to the Mobile Location Centre for generating a position fix.

In the terminal-centric approach (E-OTD or Down-Link TOA) time of arrival measurements are performed at the terminal and used to generate the position fix, or they are forwarded to the Mobile Location Centre for position fix generation.

Currently, a wide variety of different proposals for location determination are serving the same end.

In order to ensure maximum levels of interoperability and global roaming, the industry should agree on a common standard for position determination, which should be focused on combining application requirements and minimising system complexity.

5 UMTS/THIRD GENERATION SERVICES

This section identifies the most important service categories built from multiple “enabling” applications (see Figure 6).

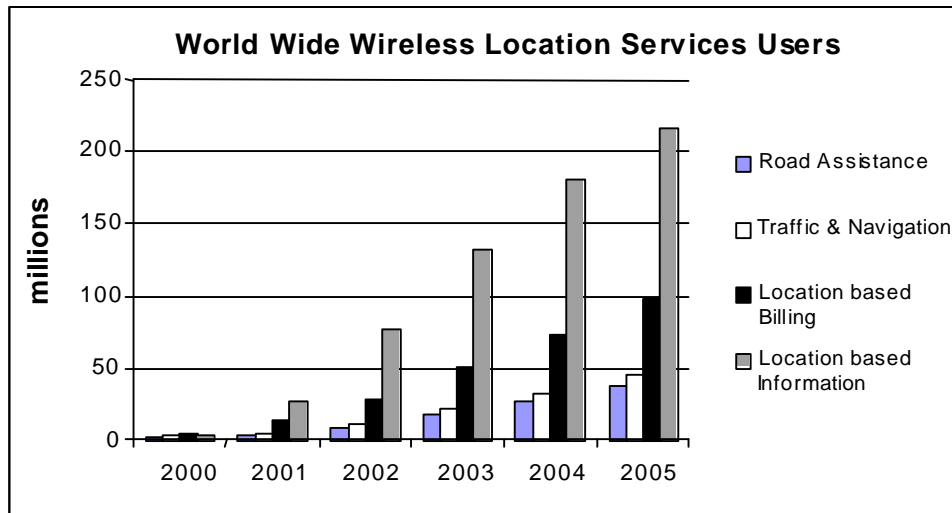
5.1 Location-Based Services

The possibility of obtaining substantial revenues from Location-Based Services has taken the industry by storm. ETSI and 3GPP are currently standardising a number of technologies, both (cellular) network and terminal centric, while a number of proprietary solutions are already the subject of trials together with more conventional GPS-based solutions. Location-based services provide another tier of customer knowledge that allows Internet businesses to deliver “context” specific services that also deliver added value to the customer:

- Navigation/reservation/ordering depending on user’s actual location
- Home/local/travel information depending on user’s actual location
- Translation services depending on cellular/roaming information
- Up-link for satellite-based interactive services (e.g. via DAB-S, DVB-S)
- End user assistance services: low usage services designed to provide end users with safety networks for difficult situations such as roadside assistance and emergency services.
- Monitored person location: includes data for health care, emergency calls and prisoner tagging
- Third party tracking services for both corporate and consumer markets. Information regarding the location of a third party is provided for use in fleet management, asset tracking and people finding
- Trigger services are automatically initiated when end users enter a pre-determined area. Examples include location-based billing and advertising services
- Billing models dependent on the location of the source and destination of actual communications (e.g. family & friends, mobile workers, corporate mobile users).

Wireless location technologies will become a crucial tool for providing the right service, at the right time, in the right location for mobile customers. In the fast approaching age of the mobile Internet, end users will not want to pay mobile Internet charges for irrelevant information. Cellular operators must be able to deliver pertinent and accessible information to their customers. Information services will make use of information banks where information is filtered according to the relative position of a user and the service he or she has selected.

Location-based services offer a global opportunity for new revenue although complex location-based services are still a few years away from introduction. However network operators can use the technology available today to differentiate, gain market leadership and hone critical technical skills. These opportunities help differentiate service portfolios, improve network efficiency and create greater pricing flexibility to address discrete market segments (Figure 18).



Source: The Strategis Group Inc.

Figure 18: Wireless Location Service Users Worldwide

According to Ovum this market will generate US\$5 billion for European operators by 2005.

Companies in each sector of the value chain (involving network infrastructure and device suppliers, network operators and service/content providers) have a symbiotic relationship with each other. While content providers have the information and services that wireless customers desire, they cannot deliver service without the network operator. Although content companies could concentrate on edge solutions that use the network operator only for data transmission, they would be limited to specific wireless devices. With the network operator involved, content companies can offer a service (albeit with varying capabilities) to the substantial mobile subscriber base.

Content companies and network operators can co-operate in getting products to market and selling services by establishing the necessary sales channels. Network operators need the products and knowledge of numerous technology vendors.

Infrastructure manufacturers provide a combination of switch triggers and intelligent network platforms. Location-finding equipment vendors (both handset and network-based solutions) provide the actual location technology. Handset manufacturers provide the user interface to the customer. Finally, geographic information systems (GIS) tie the system together.

At the time of the initial third generation deployments, there will already be a vibrant, yet very heterogeneous market in place. For example a current GSM operator awarded a 3G licence would have to deal with at least two different location determination systems (not considering the interaction with a variety of terminal-based solutions, as users request location-based services over its network). Operators will have some delicate inter-working issues to resolve.

For the user relying on the network to provide location information (location-based services are to be provided by independent location-based ISPs), such a heterogeneous environment will constitute a deterrent, unless a **common standard for position determination** is agreed upon. This would allow services to be provided by any location-based ISP, irrespective of the technology providing the position fix. This is considered to be critical since users have come to expect seamless service roaming.

Users will require control over the reporting of their location, although it will be centrally logged to comply with legal and emergency service requirements.

5.2 Infotainment and Edutainment

5.2.1 General

Information and entertainment are major driving factors in the information society. In the past radio and TV were the sole wireless distribution channels for entertainment distribution. In recent time interest in web-casting over the Internet has grown rapidly. The Internet gives ubiquity to any station (as well as to any web site). Bandwidth limitations, however, restrict the transmission of normal broadcast quality TV transmissions. TV over web-casting is limited to small picture sizes and unreliable reception. Broadband technologies such as 3G systems, cable modems and xDSL will offer great improvements although still not sufficient to reach normal TV transmission quality.

Broadcasting offers a limited number of programme channels whilst 3G systems will offer access to an almost unlimited number of services. Unlike other services, pricing of entertainment is often not subject to cost-effective considerations as in many cases “benefits” cannot be measured and cannot be compared with alternative solutions; prices should therefore be pitched at an affordable level for the target segment.

Performance and pricing as well as broadband mobility (enabling location-independent access to services) are key factors that will affect competition in the video/audio entertainment sectors.

5.2.2 Games and Remote Gambling

Games are a proven way to draw users into new applications and devices. Although games are often focused towards young people, mobility could present an opportunity for both game developers and games services. 3G systems offer the possibility to play games independently of location and time. Remote gaming enables a user to play games in a person-to-machine mode or between multiple persons in different locations.

Providers also target particular segments such as commuters, thereby embracing adults but within a general group having different education levels and cultures. Games delivered through mobile phones or other mobile terminals not only allow users to play a wealth of games but can also allow persons to play interactive games with any user around the world.

In the gambling arena, virtual casinos, online gambling, blackjack, poker, horse racing, sports betting, lotteries and slot machines can all be offered to users. Web sites permit users to play either for fun or for money by opening an account and leaving a deposit in a banking centre.

Restrictions are imposed in some jurisdictions through national regulations and laws. There may be age restrictions in some areas. Many countries will have different regulations from the user’s home country that may lead to conflicts. 3G systems provide an “anywhere, anytime” possibility for the user to participate in the described gaming activities.

5.2.3 Travel

3G systems will become one of the most valuable tools for the travel and tourism industries. Travel information services are often location dependent and location information will be a feature of 3G mobile networks that will then become the key to reach the offered services. Travel services encompass numerous aspects of travelling. Relevant application building

blocks include positioning, information and news, multimedia and m-commerce that together will enable an unlimited number of services.

5.2.4 Educational Services

Major changes have occurred in how and when education is effected. More and more people are now working and studying at the same time. Many students are not located where the universities are located. The Internet has enabled remote learning. Although legacy networks have not been able to offer the bandwidth needed for efficient distribution of learning material, the usage of remote learning facilities has already become very popular in a growing number of regions.

Remote learning services can also be cost-effectively provided via UMTS/Third Generation systems to areas where the cost of the installation of fixed lines would be prohibitively high such as rural areas with low user density. Remote learning could also be enabled in a cost-efficient manner in developing countries where the penetration of fixed telecommunications lines is comparatively low. In these scenarios, mobility support may not be a major factor. The ability of UMTS/Third Generation to provide high bandwidth and interactivity support combined with the lower cost of infrastructure installation could be important advantages. UMTS/Third Generation systems will also enable students and teachers to access additional educational and support material.

Third generation systems offering both high bandwidth and location-independent usage will become one of the most important enablers for remote learning.

The UMTS/Third Generation approach will be a key enabler for new forms of education on a global basis and should help improve the success rate of educational systems.

5.3 B2C Services

The Internet offers businesses unprecedented opportunities through e-commerce. Internet consumer commerce will generate billions of dollars in sales for merchants by enabling worldwide market reach. It enables extensive cost savings in the sales cycle and the ability to build stronger, interactive customer relationships. The Internet commerce market provides many smaller businesses with new chances to compete globally, enabling new brands to compete with industry giants on an entirely new playing field.

The ability to make purchases with just one click of a mouse enormously simplifies the buying process for the consumer. Merchants are better able to understand and serve their customers through a two-way communications medium. The Internet commerce market will shift the power of transactions in favour of the consumer by speeding and simplifying the product comparison stage of the buying cycle.

Important examples of B2C services are New Customer and Field Sales as well as Customer Care and Field Service.

5.3.1 New Customer and Field Sales

In the highly competitive world market, both existing and start up enterprises must stabilise their existing market position and attempt to gain new market share. This implies increasing their customer base, offering new innovative products, services and solutions, and acting globally at all times.

The shift from an industrial to an information society is leading to a change in the nature of work from product manufacturing to the delivery of information and services. Today most

activities involving entertainment, travelling and leisure are essentially independent of time and place and are having a strong impact on the lifestyle of all generations. Such activities include communications, obtaining information (news, stock rates, schedules, last minute trips, etc.), shopping, listening to music or looking at video clips, and playing games.

Both UMTS/Third Generation Systems and the Internet are global concepts and the combination of the technologies will enable enterprises and organisations to address, advertise and sell their products and services worldwide to new targeted customer groups to satisfy their spontaneous demands. This leads to a broader customer base and more business.

5.3.2 Customer Care and Field Service

Using the unique mix of features provided on the UMTS/Third Generation platform enterprises can optimise their customer care services. In many cases communication between the customer and the enterprise is a “person to person” communication. The customer has a strong requirement to get immediate competent answers to his questions, however the expert needed to respond is often not available at his desk.

The global mobility approach including the “One Number Service” gives the company the chance to connect the customer directly to the mobile expert. In order to solve the customer’s problem the expert will have remote access to all relevant information he needs from the corporate database. With the VHE concept he can work with all the services in a familiar manner, at any location in the world. The net result is that the direct, fast and competent resolution of customers’ problems improves the satisfaction of both customers and employees.

Customer satisfaction will become more and more important. This is due to the fact that the influence of a product brand is extremely significant; the quality of customer care activities therefore becomes more and more important and is a strong success factor for reducing customer churn and improving customer loyalty.

UMTS/Third Generation systems will help improve the management of the relationship between the customer and the enterprise.

Field sales and service units will benefit from UMTS/Third Generation capability to support mobility and broadband access to corporate (information) databases, and will also enable enterprises and organisations to access new groups of customers.

5.4 Office Extension

5.4.1 General Survey

Enormous changes in the areas of work and private lifestyles will have strong impacts on nearly every person, enterprise and organisation in the future and will become an important enabler for mobile communications in areas such as:

- The globalisation of competition
- The change from an industrial to an information society
- Immediate realisation of customers’ spontaneous demands (any place/any time).

This development requires that enterprises and organisations bring business and staff nearer to the customer. This leads to a strong push for increased flexibility and mobility combined with the need to have interactive access to corporate data at any time and any place, resulting in:

- Increased market awareness and business even for mobile customers
- Improved business process efficiency and customer care management
- Attractive working conditions to obtain and retain the right staff, who will be willing to work flexibly.

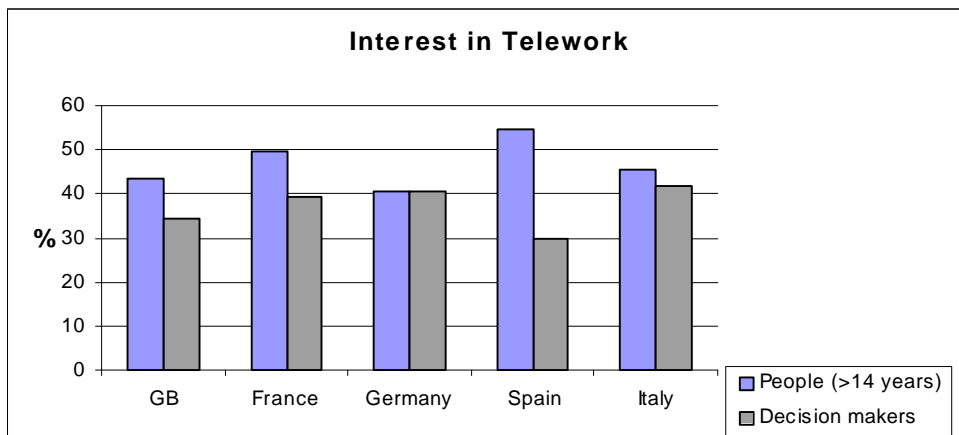
The capabilities of UMTS/Third Generation systems will offer strong support to every person, enterprise and organisation to become successful in this rapidly changing world.

5.4.2 Teleworking

In Europe and North America there is a rapidly growing demand for teleworking. The reasons for this development are:

- To better satisfy the demands of family and work
- To avoid daily trips between home and office thus improving efficiency and reducing pollution
- To attract and keep highly skilled employees.

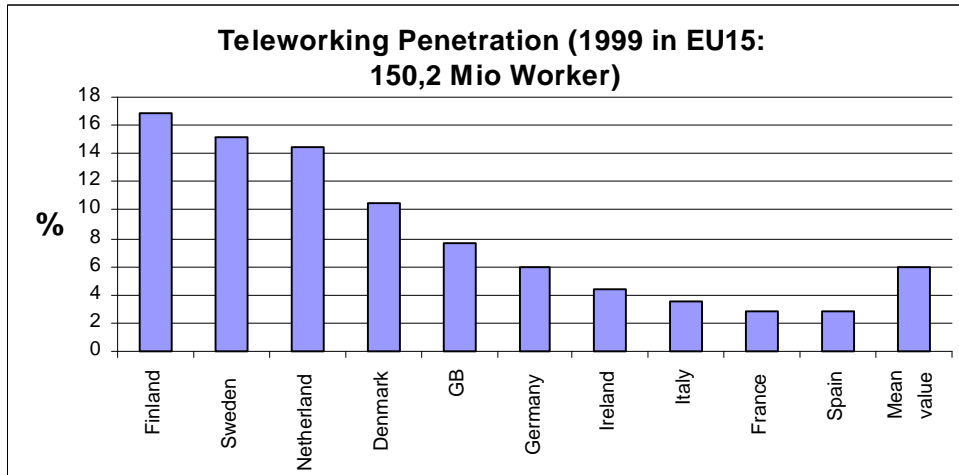
Figure 19 shows the significant interest in teleworking expressed by both employers and employees in the European Union. Nearly 50% of the people and 40% of the decision makers support this manner of working.



Source: empirica GmbH, March 2000

Figure 19: Interest in Teleworking in the European Union

The huge potential of teleworking for the future development of work is illustrated by Figure 20 which shows the difference between different countries in the European Union.



Source: empirica GmbH, 1998

Figure 20: Teleworking Penetration in the European Union

The “1999 Telework America National Telework Survey” provides information on teleworking in the USA. Some 19.6 million people work in a teleworking environment, equivalent to 10% of the population over 18 years of age. Since 1992 the annual growth in teleworking has been around 15%. These figures exhibit the same tendency as in Europe.

Teleworking encompasses both home working in a private dwelling as well as mobile working whilst travelling or changing locations.

The first scenario will be realised typically through fixed network access (e.g. ISDN, xDSL, cable modem) or indoor wireless systems. In the second scenario the mobile worker requires mobile broadband access anytime, anywhere and this will contribute significantly to the development of the overall UMTS/Third Generation market. The Non-Public Environment option (Chapter 9) enables mobile workers to use the same terminals and services indoors and outdoors.

The implementation of third generation systems together with the Internet platform offers global mobility combined with high bandwidth and will enable employees and companies to separate work and the location where the work has to be performed with increasing efficiency.

Mobile access to the corporate network (Intranet) will be a major driver for the introduction of enhanced business services within a UMTS/Third Generation system environment.

The motivation of employees and companies to introduce mobile working to achieve higher efficiencies generates an increase of traffic, hence revenue.

5.4.3 Virtual Home Environment (VHE)

It is of utmost importance that mobile workers get their personal service profile at any place in the world independent of the actual network operator. The proposed concept of VHE (Virtual Home Environment) in 3G systems leads to the portability of services over “borders” (networks, countries, operator domains). This enables mobile workers to achieve the same productivity anywhere, at home or when travelling, thus not losing productive time as a

consequence of training periods at every new location. VHE will therefore become a means of increasing staff efficiency.

The right “service bundle” from narrowband (voice only) to broadband services (multimedia) combined with the integration of global mobility in existing processes such as workflow, e/m-commerce will give new benefits in well known processes or make new processes possible for the first time.

Considerable time and money will be saved with the introduction of the VHE concept once employees are able to use services at any place in the world in the manner that they are accustomed to at home. All these opportunities lead to advantages in the competitive environment providing additional business opportunities for both operators and enterprises.

In the future a multitude of partly **virtual companies** will emerge manned with flexible contract staff rather than the ‘job for life’ quasi-permanent situations of the recent past. This will reduce permanent costs, enabling entrepreneurs to make extensive use of future mobile infrastructure and utilise competent and highly motivated staff to best effect, increasing overall customer satisfaction.

5.4.4 Whiteboarding/Collaborative Work

In the global economy, groups of people must work together despite being separated by time and distance; they build a temporary “virtual company”. These work groups must find ways to collaborate, and computer-based technologies such as groupware are being used to support them.

Teams who share a common mission and performance objectives depend on each other to complete a myriad of small tasks in a timely and co-ordinated manner in order to achieve significant milestones. Often collaborative work though long recognised as better quality is foregone because it takes too much time and effort to keep all the pieces moving together. In today’s world the arduous task of scheduling meeting times, of actually reaching a live person on the telephone or walking down the hall to get a quick piece of information has become an ongoing frustration challenging relationships, commitments and deadlines.

Team members can edit, iterate and enhance each other’s work by highlighting their inputs in different colours, adding comments and linking related work together independent of their actual locations. Meetings (in-person, phone or electronic) end with clear action items assigned to individuals, who share status and reveal their work in progress on an ongoing basis with all members of the team.

5.4.5 Security Aspects within the Office Extension

The issue of security is paramount whenever a requirement for communications with new customers or project team members occurs. These different types of customers will require different levels of security. Such levels of security go beyond those currently being addressed in standardisation bodies addressing security issues at the air interface.

In all cases there will be a difficult trade-off between security and ease-of-use. It is necessary to balance high security at both the air interface and the IP level against ease-of-use. It will be particularly important to be able to respond promptly to rapidly varying security requirements. Thus, the deployment of a dynamic network management configuration handling capability in the corporate network is mandatory, without decreasing the network's security. Corporate networks, today based on leased lines, provide a high security against external attacks.

3G systems must offer a similar level of security to that available on existing fixed networks, including encryption, authentication, user identity (digital signatures) and non-repudiation.

5.5 Telemedicine

The healthcare system is discovering telecommunication and Internet services, which improve contacts between physicians for the transfer of patient data. Contacts with patients can also be improved through telecommunications capabilities.

Physicians within the European Union, though still considered slow adopters of computer technology, are increasingly using on-line services. One-third of them already communicate with their patients by e-mail; a growing trend which is probably dictated by the patients themselves. A similar pattern is apparent in many other regions of the world. Despite these promising figures an important issue has been highlighted in recent surveys: the security and the privacy of the data exchanged between physician and patient. The lack of meaningful and extensive content and services are other factors holding back potential users from subscribing to existing services. Within UMTS/Third Generation systems, user security features, user authentication, encryption and the user's traffic integrity aim to guarantee the performance of data transfer on the radio path and on the fixed network.

A large number of telemedicine services can be identified:

- Monitoring patients at their home and on the move. Monitoring equipment can work on a stand-alone basis but be connected to doctors or hospital computers on demand for further action. Mobility gives the patient freedom to move without inhibiting necessary medical data exchanges.
- Doctors on the move can access their patients' records, order prescriptions and medical services such as laboratory tests, access databases listing drug interactions, allergies, etc.
- Ambulances at an accident location or on the move to the hospital can receive data concerning the patient to facilitate pre-treatment and can have interactive communications with a doctor at the hospital at a critical time in the care of the patient.
- Consultation services allowing patients to pay and receive prescriptions from their doctors.
- In developing countries or areas with a low density of population or with a poor telecommunications infrastructure physicians can be supported through mobile access to necessary information.

UMTS/Third Generation implementations will support an improvement in the relationship between physicians and patients. Doctors on the move will become significantly more efficient through access to database information and the ability to consult experts or colleagues via videoconferencing. The response times and effectiveness of ambulance personnel will be improved.

UMTS/Third Generation services can be lifesaving.

5.6 Telematics/Telemetry/Monitoring

Specific examples of telematics services made possible by UMTS/Third Generation systems include: self-diagnosis checks for vehicles before breakdowns occur; the provision of breakdown service when the vehicle has an immediate fault; handling emergency calls when the vehicle breaks down; and positioning information giving the exact location of the vehicle.

In Europe, field trials have been conducted with the automobile industry to install GSM chipsets in cars to monitor performance. These provide an early warning system that sends a message to the manufacturer indicating the problem. Some car manufacturers are also incorporating telematics into their top-of-the-range vehicles where the additional expense can be easily absorbed. In-car navigation systems, which include real time mapping, street-by-street guidance services, will also be popular. In France, one ISP provides WAP-based navigation and proximity services that locate the nearest service station from any address entered on the telephone keypad. During the next 18 months, many other new products and services will arrive.

The rate of market development is dependent on when carriers will begin to offer location-based services and the extent to which they create awareness and demand through the promotion of these services.

Rental cars are likely to be the first to arrive on the market with telematics. A key driver will be product standardisation. Many major manufacturers within the automobile industry are working together to develop revenue-generating content services for "Intelligent Cars". The aim is to launch in-car services in the telematics market and drive universal standards for telematics equipment. Other critical technologies are speech recognition and technologies to remove background noise and echo encountered in hands-free cellular phone conversations.

Figure 21 illustrates a wide range of specific services for telematics and telemetry that could be made available by UMTS/Third Generation systems. All actors in the value chain have nearly unlimited opportunities to create services and applications, increase their business and generate revenues, as this short and incomplete table shows.

Segmentation	Service	Benefits	Example
Alarm and security	Commercial/ residential security alarms Smoke/fire detectors	Alarm and status messages sent to alarm service centre Security against compromise of wireline connections	Burglar breaks into a house and cuts the phone and power wires Alarm company is notified of break-in and dispatches police
Agricultural, irrigation and environmental	Pipeline corrosion monitoring systems Water pump failures, levels of contamination Air quality systems	Monitor environmental condition Alarm systems for hazardous environmental conditions	A city registers unusually high air pollution readings Public service announcement is sent out warning those with medical conditions to stay indoors
Asset management and tracking	Office equipment Industrial machinery and manufacturing processes Vending Machines	Monitor meter information Service diagnosis and maintenance Inventory management Fleet/route management	A delivery truck follows a specific route to fill vending machines Truck can be re-routed if the vending machine is still full from the last delivery
Atmosphere controls	Heating, ventilation, and air conditioning Refrigeration, temperature and humidity controls	Air quality standards Temperature controls for food and other perishable items Climate control for greenhouses and agricultural products	A commercial refrigerator door in a restaurant is left open after a food delivery An alarm is triggered, alerting people to close the door to save the food from spoiling
Public And Municipal Services	Parking meters Highway tolls	Parking meter servicing Service route management	A city is losing money everyday because parking meters are full or robbed

Services	Railroad crossing Switches		or robbed
Transportation systems and facilities	Vehicle location Vehicle engine computers Container asset tracking	Inventory management Emergency communications Vehicle maintenance Navigation services	A truck is making an urgent delivery but there is a major accident that delays arrival; information about alternative routes
Utilities	Utility meter reading Oil and gas pipeline facilities	Reduced cost of servicing meters and remote meter control Customer account management and additional enhanced cost saving services	A customer is moving out of town Utility company can provide up- to-the-minute billing to settle the account

Figure 21: **Telematics and Telemetry Applications**

6 INTERNET PROTOCOL TRENDS

6.1 Introduction

In less than five years, the Internet has grown from 16 million to over 190 million users, according to the Nua Internet Surveys. It has spurred billions of dollars of economic growth and enabled the meteoric growth of thousands of companies, from small start-ups to multinational corporations. It has started to transform businesses, governments, and other organisations around the world into e-businesses. Yet the Internet revolution is less than three per cent complete. In about five years, we expect to see over a billion people using the Internet, whether with a PC, a mobile phone, a PDA or some other type of wireless terminal.

Mobility, in all its many forms, is becoming the watchword of our society. An inherent characteristic of wireless systems is their potential for accommodating device roaming and mobility. Everything moves faster and faster. IP is becoming the end-to-end protocol of the future delivery of most services since it will exist in the wire line and wireless world, in Office Extension environments and Home networks.

In order to advance the Internet to a new level of efficiency for networked communications and applications development, a new Internet Protocol version 6 (IPv6) has been specified by the IETF and is being promoted by the IPv6 Forum. It fixes a number of limitations of IPv4 and, in addition to a number of specialised protocols, offers the following features for cellular networks and users in its “native” form.

Operators

- Auto configuration
- Embedded encryption support and authentication
- Embedded mobility
- Embedded multicasting
- Internet provider selection
- Efficient packet processing in routers
- Real-time support
- Protocol extensions for proprietary solutions.

End Users

- Easy management (auto-configurations)
- Efficient address allocation
- Improved multicast management
- Renumbering possible
- Efficient network route aggregation
- Efficient packet processing in routers
- Real-time support.

There are several Internet protocols defined, such as ‘anycast’ service and Service Location Protocol (SLP), that may aid in developing location-based services for example. But a better understanding of many of these protocols and their deployment implications is desirable.

Operators must agree on the deployment of common IP protocols that impact roaming (i.e. the interfaces between core networks) and the communications between terminals and networks in order to achieve maximum interoperability.

6.2 Mobile IP in UMTS/Third Generation Networks

Mobile IP is a specific protocol that has been specified by the IETF (e.g. RFC 2002 for IPv4) and essentially provides a mechanism for re-routing packets from one part of the IP network to another, and which allows the mobile node⁶ to keep its fixed-assigned IP address.

Mobile IPv6 (MIPv6⁷) is well suited for cellular networks for a number of reasons, two of which are:

- The increased addressing space does not require the mobile node to use dynamic address allocation; there is enough addressing space in the foreseeable future for every mobile terminal in the world to use at least two IP addresses, and this could significantly speed up the registration process. One address would be used as a globally unique identifier of the terminal, and the other would be used to identify its, temporary, location in the global Internet. However, it is feasible to assign many more IPv6 addresses to terminals, depending on the specific applications.
- MIPv6 does not use the concept of foreign agents, which means that a mobile node must use a co-located care-of address. This address can be acquired by IPv6's stateless address auto-configuration; this method allows a mobile node to add its own link-layer (MAC) address (which is assumed to be globally unique) to the prefix of the local network to which the mobile node is attached to form the co-located care-of address. In this way, it is not necessary for the mobile node to query a DHCP server for example, which also saves time.

Since the mobile node is always using a co-located care-of address, there are no problems with firewalls that implement ingress filtering either. When communicating with a correspondent node, the mobile node's original packet will always be encapsulated into a second IP packet that specifies the mobile node's care-of address as source address. There are no problems with ingress filtering since this is a topologically correct address.

6.2.1 User Mobility within Mobile IP

Support of user mobility will be an integral part of UMTS/Third Generation networks, and will be facilitated for example by smart cards. User mobility allows a user to change terminal without changing subscription. The separation between smart card and terminal is necessary especially for security and billing purposes.

Mobile IP's "location tracking" scheme currently relates only to the location of a terminal (its fixed IP address), and not to the location of the user. Extensions will be required to support user mobility.

The Network Access Identifier (NAI) could be used as a means to identify the location of a user. An NAI extension to Mobile IP registration messages is currently in the process of being

⁶ The 'mobile node' (IETF terminology) refers to a terminal or a 'mobile router'.

⁷ Reference: IETF RFC 2026

specified. However, assuming only the user is being registered and not the terminal, additional protocols will be required to facilitate the dynamic allocation of a home IP address to the mobile node. Furthermore, the role of the IMSI (International Mobile Subscriber Identity), which fulfilled a similar role to the NAI in GSM networks, would need to be re-evaluated, especially with regards to backward compatibility.

Clearly, the convergence of the cellular worlds with the mobile IP world must ensure that addressing schemes are mutually compatible.

6.2.2 Support of Terminals that have not Implemented Mobile IP

By the time all-IP based networks have been introduced, there will be a large number of mobile terminals that will not have implemented the Mobile IP protocol (e.g. the first generation GPRS and UMTS terminals).

The Mobile IP specification currently prescribes that the protocol must be implemented in mobile terminals. In other words, Mobile IP networks do not support terminals that have not implemented Mobile IP. This could represent a significant problem for mobile network operators.

Special consideration must be given to backward compatibility for terminals that have not implemented Mobile IP.

A scheme will have to be developed that would allow network support of terminals that have not implemented the Mobile IP protocol.

For terminals that operate in both IPv4 and IPv6 environments (e.g. wireless via IPv6 and fixed access via IPv4), both IPv4 and IPv6 stacks will have to be supported in the user device and network nodes.

6.2.3 Building Robustness into Mobile IP Networks

Reliability is a critical issue for public network operators. Considering failure scenarios in Mobile IP, mobile nodes become unreachable for any correspondent node if the mobile node's home agent fails. Likewise, the mobile node becomes unreachable when a foreign agent serving that mobile node fails. Redundancy is an intrinsic feature of SS7, which is currently widely used in cellular networks.

Mobile networks that are based on IP will have the same requirements for high reliability that exist in today's public cellular networks.

Some form of a "mobility agent redundancy protocol" will be required to enable a redundant agent to be automatically updated whenever a home agent's mapping table is updated. Such a protocol could also be used to duplicate table entries in foreign agents. This protocol would also enable the redundant mobility agent to become active after the "master" agent had failed.

6.2.4 Authentication, Authorisation and Accounting in Mobile IP Networks

Billing and the ability to authenticate and authorise users to access the public IP-based mobile network are crucial features that must be available as part of an all-IP solution for a public

third generation system. Mobile IP does not specify functionality for billing and authorisation, and does not provide a complete solution for security.

The IETF is working on the specification of a generic AAA protocol (Authentication, Authorisation and Accounting) that would provide this type of functionality.

Mobile IP issues revolve around solutions to the automatic establishment of security associations between the mobile node and a foreign agent, as well as the home and a foreign agent. Interim solutions for AAA that have been implemented involve use of RADIUS, however there are concerns with the necessity for repeated dynamic key generation during handoff.

6.3 Other Issues

Evaluating requirements and addressing all of these open issues appears to be an excellent opportunity for mutual co-operation on open standardisation and review. For example, the IETF's SIP (Session Initiation Protocol) protocol has been selected by 3GPP as the basis for call control in IP-based third generation systems. SIP supports mobility for VoIP, with graceful handling of mobile handoff, updating location information with remote peer, and even simultaneous handoff of both endpoints. The problem with SIP adoption seems to be its slow standardisation brought about by focusing on the harder multicast model rather than expediting the definition of a unicast "profile".

There is a need for IETF to expedite finalisation of SIP, however it is likely that many products will need to develop support for both SIP and H.323, and for their inter-operation. This requires that extensive work be started in both standards areas with co-operation to achieve common goals.

At the moment IP applications are not being considered but as time goes by and the deployment of IP in cellular networks becomes more stable, it is expected that most applications will be IP-based, bringing the Internet closer to the mobile network. IP can be viewed as the current best-of-breed solution for the foreseeable future.

The question of how a server application might find out the capabilities of a receiver is yet to be answered. This could allow for application adaptation to client device and path characteristics. An alternative is the use of the RSVP payload in IPv6 that is able to transport QoS information. A second possibility is to push capability exchange and negotiation to the application layer.

The rapid wide-scale introduction of IPv6 should be the basis for overcoming problems relating to numbering, addressing, naming and QoS for real-time applications and services.

7 QUALITY OF SERVICE LEVELS

QoS will be a key component of UMTS/Third Generation data transport due to the packet-based nature of the network and the limited resources of the air interface. Roaming between networks will have an impact on the solutions that need to be deployed to provide the QoS expected by the end user across domains. QoS may also be a subject for differential tariffing, whereby the same service could be offered at different levels of quality and be priced accordingly.

Specific QoS requirements for radio access networks and core networks within UMTS/Third Generation are under development in 3GPP. Inter-working QoS parameters are also required for connectivity to other networks to ensure content-related service portability and interoperability.

3GPP has preliminarily defined four QoS classes for data transport over UMTS/Third Generation systems:

- Conversational class
- Streaming class
- Interactive class
- Background class.

In general the conversational class sets the highest requirements for QoS, whereas the background class has the lowest requirements and can be seen as a best-effort solution.

As a general requirement it can be seen that QoS parameters should not be restricted to one or only a few mechanisms, but should provide the capability for different levels of QoS by using UMTS/Third Generation specific control mechanisms. This is especially true for the conversational class and also with respect to inter-working to other type of networks. QoS for UMTS/Third Generation must also consider the efficient use of the radio spectrum. It has to allow for an independent evolution of the core networks and the radio access networks. The evolution of UMTS/Third Generation QoS should be as far as possible independent from wire line QoS development, but has to consider the requirements of inter-working to those wire line services allowed by UMTS/Third Generation.

Figure 22 shows a preliminary QoS scheme for UMTS/Third Generation services, which includes interoperability to 2nd generation high bit rate packet-based solutions. The full utilisation of the UMTS/Third Generation bandwidth, especially for conversational (real time) types of service will require further development.

Type	Service	Data Rate	Delay	Delay Variation	Reliability
Conversational/ real time	Conversational voice	4-25 kbit/s	<150 ms	<1 ms	<3% FER
	Videophone	32-384 kbit/s	<150 ms		<1% FER
	Telemetry (control)	<28.8 kbit/s	<250 ms		~0% FER
	Games	<1 kbit/s	<250 ms		<3% FER
Interactive	Voice messaging	4-13 kbit/s	<1 sec	<1 ms	<3% FER
	Web browsing		4 sec/page		
	e-commerce		4 sec		<0% FER
Streaming	Streaming audio	32-384 kbit/s	<10 sec	<1 ms	<1% FER
	Video	32-384 kbit/s	<10 sec		<1% FER
	Telemetry (monitoring)	<28.8 kbit/s	<10 sec		~0% FER

Source: ITU et al.

Figure 22: **Quality of Service (QoS)**

Enabling support for voice and other real-time services along with data capabilities requires Quality of Service (QoS) features to arbitrate access to the limited resources of the wireless environment. The wireless and mobile environments require QoS support at the air interface, i.e. between the mobile device and network access point.

When selling differentiated services to the user, the actual “product” (e.g. content) takes the form of a service level agreement (SLA). SLAs will be required between content/service providers and network operators, where the SLA parameters and their values will be defined by the content provider.

For the operator, the first step is to define the class of service – the standard set of features available within it. Quality of Service, on the other hand, is defined as a set of performance attributes associated with the service, such as availability, delay variation and the throughput of packets and packet loss.

8 CHARGING: THE CHALLENGES AND OPPORTUNITIES

8.1 Overview

The traditional world of telecommunications is disappearing. The traditional challenges for the billing manager are also disappearing. The move away from telecommunications towards information delivered over packet-based IP infrastructure presents an entirely new set of challenges for the billing manager, the pricing manager and business as a whole. This section examines some of the challenges presented by UMTS/Third Generation and presents some solutions and frameworks for solutions.

8.2 Change of Business

The first and the most fundamental question that arises from the advent of IP services is:

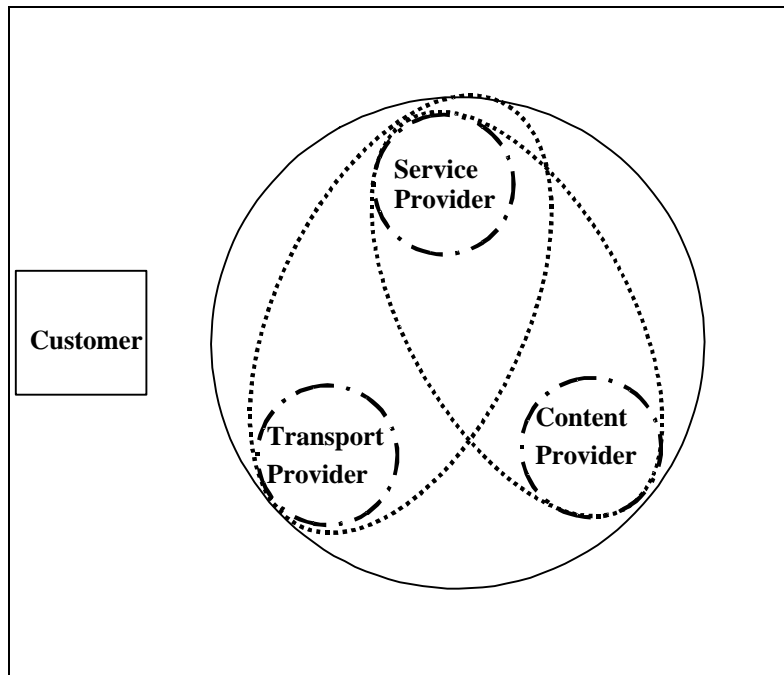
“What shall we bill?”

The traditional elements that were billed in the past will become irrelevant: “time” on the network is already fading and will disappear quickly as customers get used to the idea that connections are ‘always on’. Distance will disappear quickly, too – IP addresses are always ‘local’.

The answer then becomes “data” or “volume” although the meaning of these terms requires further clarification. The cost of transporting information must be covered and should at least cover the cost of maintaining the network.

The real opportunity for service providers will be to take their place in the value chain of m-commerce and in return for billing and supporting the customer receive a percentage of revenues of the products and services bought. In addition, there is the opportunity to act as a wholesale ‘agent’ for content providers, selling competitive products and services.

Figure 23 shows the functional relationships between the different actors. Different combinations are and will be realised. For example there could be one company for each function or the service provider and the transport provider could be the same corporate entity. It makes sense for this entity to own content as well, in order to maximise revenues from these new services. In addition, third party content can always be delivered to customers.



Source: Global Billing Association, August 2000

Figure 23: **New Business Relationships in the Value Chain**

Competitive market forces will continue to decrease margins for the transport of data and information. Operators will need to address this situation by basing business cases on either the predicted exponential growth of traffic, or build into their models methodologies for billing for 'content' based on the value of the content itself.

8.3 What Will Be Billed?

There will not be a single business model on which to base billing processes. Every agreement between service provider, transport provider and content provider could be different. The key to an efficient billing process will be flexibility. The key to an effective billing system will be scalability, as the volumes of data being filtered by mediation devices increases from today's levels by factors of five or 10.

8.3.1 Billing for Transport

It is generally agreed that 'transport' costs have to be covered although margins will continue to decrease. However, for certain services, the Quality of Service at which services are delivered will be of recognisable value to the customer. For example, a customer will require a certain QoS if watching a video, listening to music or taking part in a videoconference. Different levels and parameters of QoS will be required for each service.

At a charging level, QoS parameters are well understood. However, a dialogue needs to be formalised between the billing vendors, mediation suppliers and network equipment manufacturers in order to ensure that the relevant information can be passed from network device to billing engine in a timely fashion.

8.3.2 Billing for Content

Content can vary from basic information services, such as Stock Exchange information, to downloadable or streamed video, to transactions taking place over UMTS/Third Generation networks.

In order for service providers to gain the potential to bill for these transactions and services the first step is to identify the content that is being delivered. At present it is difficult to achieve this and service providers, such as ISPs, are not able to take advantage of the full potential of e-commerce.

The US-based Internet Protocol Detail Record Organisation (IPDR) is currently working on a standard for identifying usage and content on IP networks. The format has to be open and flexible. The current (iterative) approach is to define essential parameters for any IP transaction and to provide a mechanism for extension that enables efficient communication between service elements, mediation layer and business support systems. IPDR release 1.1 is now available, and activities involving 'proof of concept' are in progress.

8.4 Who Pays?

8.4.1 Corporates

It is likely that the complexities involved at the consumer level will be simplified to some extent when offering service to corporates. Companies are familiar with the concept of 'data' and 'bandwidth' and are used to negotiating with their service providers for access and use of high bandwidth services. A wide range of information services will be catered for in this way. However, complications will arise when executives are using UMTS/Third Generation services when travelling, particularly internationally.

8.4.2 Consumers

Inevitably there will be a need to educate the market. Terms such as 'always-on' and 'data' are not yet widely understood. If the services and products that can be accessed and bought via UMTS are as near to the real world as possible, then the take up by users is likely to be that much faster. How much more understandable to buy a video or piece of music than to buy 'megabytes' or QoS?

There will certainly be many different types of services to collect money for and these may be a mixture of access fee (perhaps subsidised by advertising), subscriptions, network usage and transactions. It will be further complicated by the fact that a customer will do several things during a UMTS session. Itemised billing may become complex and cumbersome, as illustrated in Figure 24.

Session	Duration: 3:10:15	Volume: 15Mb
<input type="checkbox"/> Watch CNN broadcast <input type="checkbox"/> Buy a book from booksRus <input type="checkbox"/> Download a video		
<ul style="list-style-type: none"> • Value \$8 • Volume • Duration 	-0:45:00	7Mb
<input type="checkbox"/> Use Search Engine <input type="checkbox"/> Fetch Weather Report <input type="checkbox"/> Total transport charge is based on:		
Total	2:25:15	8Mb

Source: Global Billing Association, August 2000

Figure 24: Example of a Billing Record

As can be seen, the session contains various activities including downloading of a video. Since the video has a value, which includes the transport (\$8), this will need to be accounted for, perhaps by subtracting the relevant amount once the session has finished. Alternatively, sophisticated methods of identifying what a customer is doing during a session will need to be devised.

8.4.3 Complexity

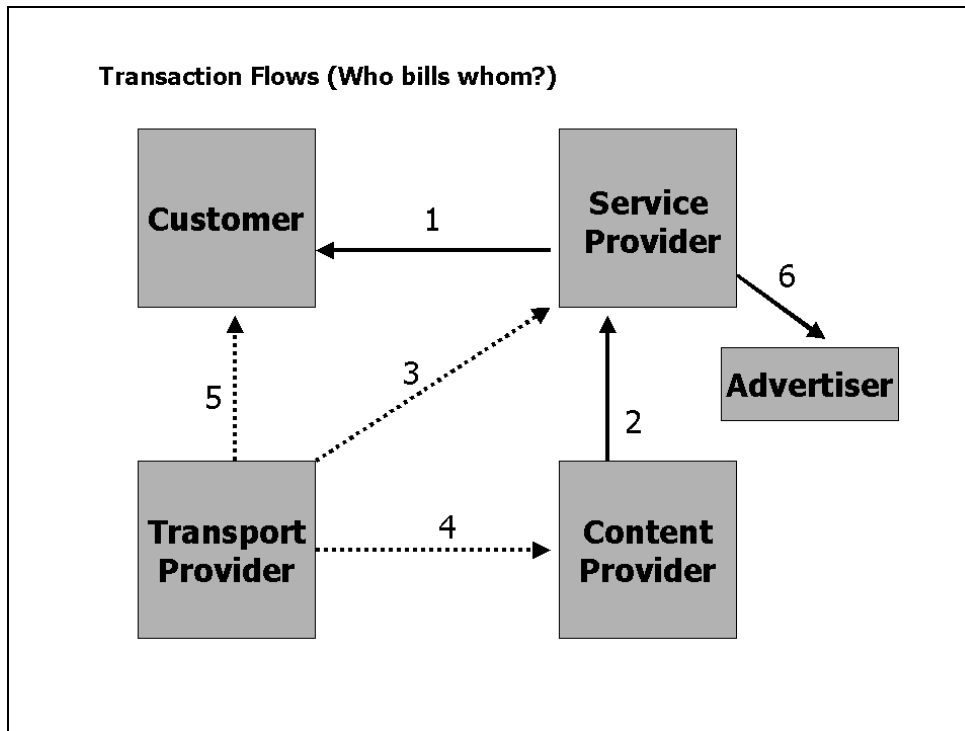
The customer, both now and in the future, will require clarity and simplicity from the bill. Service providers will need to think carefully about how much detail to put on the bill of the future, particularly as bills will begin to resemble credit card bills. It may be that a certain amount of ‘transport’ will be bundled as part of the service, and only charged for as line items once certain thresholds of usage have been reached. QoS discounts will need to be thought through in terms of presentation.

The increasing acceptance of Electronic Bill Presentation and Payment (EBPP) will play a major role, not only in the context of the Virtual Home Environment (VHE), and will be a key factor in attracting and retaining customers. Customers will be less likely to churn if using multiple services and/or EBPP. Presenting bill summaries via UMTS will be an attractive feature; indeed presenting bill summaries for a wide range of services will inevitably attract customers. It incorporates the need for simplicity with a mechanism for presenting the customer with as much detail as required, without ‘pushing’ all the detail to the customer in the first place.

Operators/players need to think carefully about the complexities of the service delivery channel while balancing the requirements for charging simplicity and clarity from the customer.

8.4.4 Reconciliation

In addition to customer or retail billing, areas of complexity will arise when reconciling or billing content providers and other partners for services delivered or bought as wholesale items. Figure 25 illustrates that potentially there are many different ‘transactions’ between entities that will need to be accounted for.



Source: Global Billing Association, August 2000

Figure 25: Transaction Flows

1. The customer bill
 - Access/subscription information (inc. customer preferences/set up)
 - Usage
2. Wholesale content/commission etc.
3. Wholesale transport; QoS and usage
4. Wholesale transport QoS and usage⁸
5. Transport⁹
6. Advertising

Quality of Service will be a major feature of billing in UMTS/Third Generation. It is imperative that the interfaces between network elements and mediation/rating are as seamless as possible. Information will be collected from a wide range of network elements, increasing the need for this accuracy.

8.5 Key Issues

The concept of 'billing' needs to be further developed and will be replaced by 'rating', 'charging', 'paying' and 'revenue distribution':

- 'Rating' will be by volume, content, etc.
- 'Charging' will include advice of future charge, real-time charging and possible cut-off, immediate advice of charge of a service just completed as well as conventional 'billing'. 'Billing' by a post-paid invoice is only one element of billing.

⁸ If (4) exists, then (2) will include transport and (3) will not exist.

⁹ May be addressed by (1) if the company is the same entity.

- 'Paying' can be by credit card, pre-paid balance, e-purse/wallet, bank transfer, cyber-currency, etc. (i.e. not just post-payment of a bill).
- 'Revenue distribution' is about sharing out the monies received, e.g. because of billing on behalf of others (bobo) or taxes.

The major issues are listed below.

- Linking of the IPDRs from the transport and content layers in order to ensure the correct accounting can take place.
- Pre-paid will demand real time metering, or real time mediation, and is complicated by the uncertainty of estimating the length of a session. It may not be acceptable to 'cut off' a session during a piece of music or during a video.
- Roaming will require the delivery of personalised services whilst on a visited network as well as location-based services, such as directory type services. Pre-paid for roaming users will need to be addressed. The GSM standards of TAP3 and CAMEL provide the accepted building blocks to address this issue. In the longer term, it is expected that IP-based solutions for roaming will be adopted.
- Quality of Service issues are being addressed, and a dialogue between billers, mediation companies and network equipment manufacturers has started within the Global Billing Association.
- Interconnect agreements will become more complex when content delivery and accounting is considered.
- Access to and usage of customer data needs careful attention in light of national regulation.
- The impact of IP addresses is an issue that is being addressed within organisations such as the UMTS Forum.

The impact of roaming will need to be explored fully when dealing with a content world. The demands for localisation and personalisation will need to be balanced and existing standards for data transfer will need to be enhanced.

9 NON-PUBLIC ENVIRONMENT

9.1 Introduction

This section describes the demand for Non-Public Environment¹⁰ 3G spectrum. Within the spectrum identified for UMTS, non-public spectrum refers to the unpaired bands that have been identified for domestic or corporate users. In addition, there are also other regions of licence-exempt spectrum that are available for use by these market segments, using technologies such as Bluetooth, DECT¹¹ and WLAN technologies.

This section focuses on the most important technologies both inside and outside the spectrum identified for UMTS.

9.2 Benefits of Non-Public Environment Spectrum

The most important benefits of the use of non-public environment spectrum include (see also Figure 26):

- No specific licence is necessary so the environment is well suited for deployment by business users and consumers.
- Straightforward installation of cellular corporate networks using the same technology platform as in public networks with only a few adaptations (e.g. radiation power, cell radius, user density).
- People can use the same set of terminal-based technologies at home, on the road and in the office. This allows for roaming between these different environments, a priority for highly mobile workers. This is a major advantage for the user, as a single service platform is presented via a consistent user interface on the same terminal.
- Higher economies of scale can be achieved, resulting in more attractive prices of terminal devices for end-users.
- Optimal support of VHE (Virtual Home Environment).
- Optimal solution to connect the corporate network with the WAN.
- Increased capacity through smaller cells (related to use in the non-public environment but not necessarily to UMTS/Third Generation as such).
- Private indoor 3G coverage in areas that are not covered by public 3G networks. It is expected that 3G will start off as "islands" of coverage, where end-users may access 3G services in specific geographic areas (e.g. areas with high user density in cities). Elsewhere, users must resort to available evolved 2G alternatives (e.g. EDGE/GPRS). By using this type of spectrum, end users can benefit from the advantages of 3G, such as higher bandwidth, when they are located outside these 3G islands (in many large cities, end users tend to work in city centres and live in close-by rural areas where 3G coverage may be patchy).
- Capacity offloading in cellular networks. If UMTS/Third Generation systems evolve as expected (strong demand) and end users make use of high-bandwidth applications, capacity constraints in some areas of the public network could occur. Enabling end users to use their applications in this type of spectrum could help reduce such

¹⁰ It is understood that the "Non-Public Environment" refers to the licence-exempt spectrum.

¹¹ There are five terrestrial members of IMT-2000, these being IMT-DS, IMT-MC, IMT-TC, IMT-SC and IMT-FT; IMT-FT is DECT and IMT-TC encompasses both UTRA-TDD / TD-SCDMA, all of which operate in unpaired spectrum.

potential capacity constraints and risks. This will be particularly advantageous for operators that are in a position to offer both fixed and wireless access services.

Some of these aspects can also be achieved using licensed spectrum, depending on national spectrum allocation policies.

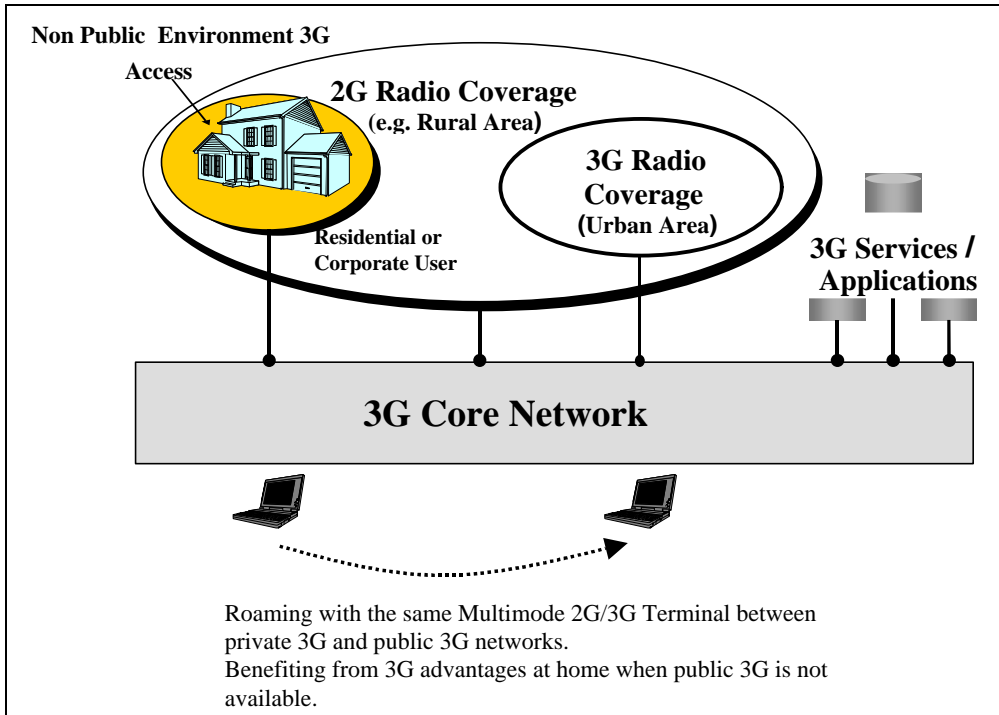


Figure 26: Spectrum Usage in the Non-Public Environment

The current access standards do not support wireless broadband extensions such as HIPERLAN/2. Specification of such extensions is under consideration.

The non-public environment spectrum is primarily focused on residential and corporate users and deployed especially in an indoor environment. Such deployment scenarios are usually characterised by rapidly changing traffic conditions (e.g. different user densities at different times of the day) and by specific propagation conditions (e.g. strong multi-path fading), which can only be adequately addressed by deploying pico-cells. Under such conditions, cell planning is generally difficult to perform, which is the reason why systems operating in this spectrum require additional functions such as dynamic frequency allocation, whereby the operating frequency is changed automatically depending on the level of interference. This self-co-ordination is another reason why deployment by corporate/residential users is straightforward. DECT is an example of a technology where such principles have been successfully deployed; this success demonstrates that this principle could also be implemented in UMTS/Third Generation technologies.

9.3 Technology Competitors to UTRA TDD in the Non-Public Environment

There are a number of technologies that may be deployed for non-public environment use. In most cases, multi-mode terminals will be required if they need to operate in both public and non-public environments. There is clearly an advantage for the end-user to be able to use the **same** terminal both indoors and outdoors and it is expected that there will be services and applications that end users can use both inside and outside buildings. The support of the same services and applications on the same terminal ensures a consistent interface for the end user. The UTRA TDD is the only technology platform which has the prospect to be deployed in both the public and non-public environments, facilitating the use of lower-cost terminals which can be used in both environments.

The following competing technologies should be noted:

- Infrared for very short range applications within a room (e.g. remote control, PC to mobile, one voice channel)
- Bluetooth for short range applications (e.g. wireless PC, headset, communications between PC and electronic organiser, home automation)
- Home RF/SWAP for short/middle range applications (voice and data applications, WLAN)
- 802.1x¹² for short/middle range applications (WLAN)
- HIPERLAN/2 for short/middle range applications (multimedia, WLAN)
- DECT for short/middle range applications (voice and data applications, VoIP, WLAN).

Figure 27 compares the advantages and limitations of these technologies.

³802.1x family of IEEE wireless standards, which includes IEEE 802.11 (operating in 2.4 GHz at 2 Mbit/s), 802.11b (2.4 GHz at 11 Mbit/s), IEEE 802.11a (up to 54 Mbit/s in the 5 GHz band) and 802.15 (IEEE label for Bluetooth).

Technology	ISM-Band	Effective cell radius	Expected level of penetration		Advantages	Limitations (today)
			Resid.	Corp.		
Infrared	N/A		High	Low	Price, no regulation worldwide	One room, line of sight
Bluetooth	Yes	10 m	Low	High	Nearly all applications in a sphere of 10 m	<1 Mbit/s, 8 active devices
Home RF/SWAP	Yes	< 50 m	High	Low	Combines benefits of 802.11+DECT	Smaller cells due to EMI
802.1x	Yes	< 50 m	Low	High	Best wireless data for SME High rate – up to 54 Mbit/s	EMI/Lack of interoperability
HIPERLAN/2	No	< 50 m	Low	High	Max. 25 Mbit/s QoS support	Price range (high)
DECT	No	20-300 m*	High	High	Proven technique IMT-2000 member	Protected band only in some countries
Licence-exempt UMTS / Third Generation	No	20-300 m*	High	High	One technology at any place Protected band	Not allocated worldwide

*not indoor

Figure 27: Comparison between Wireless Technologies in the Non-Public Environment

The weakest point of all technologies operating in the ISM (Industrial, Scientific & Medical) band is the electronic “pollution” causing a high level of interference. This can dramatically reduce the effectively transmitted bit rate and the cell radius. Some advantages of these different competing technologies are therefore significantly reduced. Today only the low-end 2.45 GHz band seems to be approaching congestion; in the 5 GHz band used by HIPERLAN/2 (Europe), MMAC (Japan) and IEEE 802.11a (USA) such problems are not expected in the medium term due to an initially higher price level of terminal devices.

While there are a large number of competing wireless technologies that could be deployed in the non-public environment, they are likely to be cost-effective primarily as stand-alone devices. Using the same terminal both for indoor and outdoor use has definite advantages from the end users’ perspective, as it presents the same consistent interface to the user. However, such a terminal would require more expensive multi-mode technology if based on a combination of 2G/3G for public access and one of the non-3G technologies for private access.

3G technologies for the Non-Public Environment have the potential to reduce the cost of the terminal for services and applications that operate both in public and non-public environments.

10 TERMINALS FOR THE MULTIMEDIA AGE

The merging of the mobile phone and the personal organiser has been promoted as the ubiquitous executive toy. However, no single type of device will win out in the collision of technologies. There will be a divergence in philosophies for the management of personal mobile data and a wide range of devices will compete with one another and may also complement one another. For example, mobile phones incorporating MP3 players for downloading music from the Internet will appeal to the young, while many executives will still want to see a screen full of data on a notebook. Technologies such as Bluetooth mean that consumers will have the option to have separate devices that can transparently communicate with one another. Furthermore, different market segments might prefer to deploy different combinations of services, which will justify the use of a variety of terminal types.

So mobile terminals will allow access to the Internet, rapidly download e-mails, music and high quality pictures, and even hold videoconferences on the move. Already today the latest generation of web-enabled mobile phones have most functions business people need: e-mail, calendars, alarms, games, calculators, phone directories and electronic wallet.

The multimedia drive is also likely to intensify once broadband Internet access arrives. Terminals will need increasing amounts of processing power so they can handle full-screen, high-quality video content. Technologies which insert video clips into web pages are just the beginning and icons will become dynamic pictures.

Format and compression standards are key to the delivery of multimedia content. For pre-generated images, JPEG (Joint Picture Experts Group), GIF (graphics interchange format), and DIB (device-independent bitmap) are among the best known. For pre-generated audio, WAV and MIDI (Music Instrument Digital Interface) are widely used. MPEG-1 (Motion Picture Experts Group) Layer 3, popularly known as MP3, stores in almost CD-quality sound at compression ratios of up to 10:1. A popular format for pre-generated video is Video for Windows (kept in files with AVI, or Audio Video Interleave extension). For very high quality video, whether pre-generated or streaming, MPEG-2 and MPEG-4 can be used¹³.

A decade from now, the Internet will look and behave completely differently. Accordingly, content availability and the Internet will have a strong influence on devices as well.

The semiconductor industry is already building entire systems on a chip. These multimedia-enabled systems will be made small enough to be used in web pads, mobile phones, thin clients, set-top boxes, and a host of other, yet-to-be-conceived devices. They will offer full flexibility to be used in any way required.

Figure 28 illustrates the convergence of different types of well-known equipment functionality towards the future fully-integrated multimedia terminals.

¹³ MPEG-4 can be used from 15 kbit/s up to around 50 Mbit/s depending on the application.



Figure 28: Mobile Multimedia Devices

11 KEY FINDINGS

Delivering the 3G Future	UMTS/Third Generation delivers inherent capabilities for the effective use of advanced services and applications (Interactivity, Mobility, Broadband and Positioning) and therefore a unique and future-proof platform.
	Content, a wide variety of mobile devices to access content, and ubiquitous seamless mobile access are key elements of the ICT vision, each of which forms an essential part of the overall picture.
	Critical success factors for creating a mobile data mass market include access to all types of information in a format appropriate to each type of terminal and the right diversity of products (including terminals) to accommodate all types of users and usage.
	A multitude of cross-industry actors will participate in the value chain to implement a wide variety of services and applications for customers, operators and manufacturers.
User Expectations	To fulfil user expectations in the long term, applications and services must be able to take advantage of all UMTS/Third Generation capabilities such as QoS, bandwidth-on-demand, security and privacy.
	Transparency/visibility of service charges allows users to control costs; this will have an impact on billing and signalling within the network.
	The development of 3G services and applications must take into account users' communications habits and handle situations where ubiquitous access may not be available initially. However, 2G+ services could also be made available on 3G networks (with better performance) to ensure consistent and seamless availability of such services.
Application Development	M-commerce will become a leading driver for the successful roll-out of UMTS/Third Generation systems and will influence the relations between existing and emerging players.
	E-/m-commerce falls outside the well-understood legal and regulatory frameworks for telecommunication providers within which trading has traditionally taken place. One example is taxation, which is currently an open issue.
	UMTS/Third Generation will eventually provide the capacity (bandwidth) necessary for fast delivery of messages, while terminals will allow for the display of picture-style content (e.g. fax as a TIFF file).
	VoIP will become an important enabler of convergence for services in fixed and mobile networks (2G+/3G).
	Any satellite-based location system requires a GPS receiver to be implemented at the mobile terminal, increasing the cost and complexity of the device.
	In order to ensure maximum levels of interoperability and global roaming, the industry should agree on a common standard for position determination, which should be focused on combining application requirements and minimising system complexity.
	The UMTS/Third Generation approach will be a key enabler for new forms of education on a global basis and thus should help improve the success rate of educational systems.

Service Implications	UMTS/Third Generation systems will help improve the management of the relationship between the customer and the enterprise.
	Mobile access to the corporate network (Intranet) will be a major driver for the introduction of enhanced business services within a UMTS/Third Generation system environment.
	3G systems must offer a similar level of security to that available on existing fixed networks, including encryption, authentication, user identity (digital signatures) and non-repudiation.
	UMTS/Third Generation services can be lifesaving.
	The impact of roaming will need to be explored fully when dealing with a content world. The demands for localisation and personalisation will need to be balanced and existing standards for data transfer will need to be enhanced.
	Operators must agree on the deployment of common IP protocols that impact roaming (i.e. the interfaces between core networks) and the communications between terminals and networks in order to achieve maximum interoperability.
Internet Protocol Trends	The convergence of the cellular worlds with the mobile IP world must ensure that addressing schemes are mutually compatible.
	Special consideration must be given to backward compatibility for terminals that have not implemented Mobile IP.
	Mobile networks that are based on IP will have the same requirements for high reliability that exist in today's public cellular networks.
	The rapid wide-scale introduction of IPv6 should be the basis for overcoming problems relating to numbering, addressing, naming and QoS for real-time applications and services.
	When selling differentiated services to the user, the actual "product" (e.g. content) takes the form of a service level agreement (SLA). SLAs will be required between content/service providers and network operators, where the SLA parameters and their values will be defined by the content provider.
Quality of Service	QoS in the public environment is an open issue, especially where multiple networks owned by different operators are involved.
	Within the context of interactive real-time applications, QoS support in 3GPP Release 99 specifications is focused only on traditional voice. It is expected that Release 2000 (or version 5) will be most likely based on IETF specifications and definitions of QoS to support real-time packet-switched domain-based services.
	Quality of Service will be a major feature of billing in UMTS/Third Generation. It is imperative that the interfaces between network elements and mediation/rating are as seamless as possible. Information will be collected from a wide range of network elements, increasing the need for this accuracy.

Billing issues	At a charging level, QoS parameters are well understood. However, a dialogue needs to be formalised between the billing vendors, mediation suppliers and network equipment manufacturers in order to ensure that the relevant information can be passed from network device to billing engine in a timely fashion.
	Operators/players need to think carefully about the complexities of the service delivery channel while balancing the requirements for charging simplicity and clarity from the customer.
	The current access standards do not support wireless broadband extensions such as HIPERLAN/2. Specification of such extensions is under consideration.
Non-Public Environment	3G technologies for the Non-Public Environment have the potential to reduce the cost of the terminal for services and applications that operate both in public and non-public environments.
	The current access standards do not support wireless broadband extensions such as HIPERLAN/2. Specification of such extensions is under consideration.

12 ABBREVIATIONS AND GLOSSARY

2G	Second Generation	Generic name for second generation networks, for example GSM.
2G+	Second Generation enhanced	Name given to 2G networks enhanced with GPRS or EDGE.
3G	Third Generation	Generic name for third generation mobile networks.
3GPP	Third Generation Partnership Project	A co-operation between regional standards bodies to ensure global inter-working.
AAA	Authentication Authorisation Accounting	
B2B	Business to Business	Term used to identify a business to business transaction.
B2C	Business to Consumer	Term used to identify a business to consumer transaction.
Bluetooth™	Wireless industry standard	Short-range radio link standard. Uses licence-exempt spectrum @ 2.45 GHz to provide 1 Mbit/s.
BTS	Base Transceiver System	
CAMEL	Customised Applications for Mobil networks Enhanced Logic	CAMEL specifies how features normally associated with Intelligent Networks can be integrated into a GSM network. The greatest benefit CAMEL provides is to allow information on the caller's location to be passed from the network to an Internet web site.
CD	Compact Disc	Initially used to store music, now used for data and increasingly films/movies.
CN	Core Network	Physical infrastructure linking wireless base stations. Predominantly circuit-switched, core networks will increasingly become packet-switched.
DAB	Digital Audio Broadcasting	A digital radio technology used for radio broadcasting in a number of countries.
DECT	Digital Enhanced Cordless Telecommunications	A wireless technology used for short range communications, for example cordless telephones.
DHCP	Dynamic Host Configuration Protocol	An IP-based protocol that allows the automatic configuration of an IP address to a host.
DVB	Digital Video Broadcasting	A digital radio technology used for television broadcasting in a number of countries.
EBPP	Electronic Bill Presentation and Payment	With EBPP, the process of creating and delivering the bill and the process of paying the bill are connected through integrated systems and common databases.
EC	European Commission	
e-commerce	Electronic Commerce	Term used to describe transactions that take place on-line where the buyer and seller are remote from each other.
EDGE	Enhanced Data rates for Global Evolution	A further enhancement to TDMA systems which allows for data speeds up to 384 kbit/s.
EDI	Electronic Data Interchange	The exchange of standardised document forms between computer systems for business use. EDI is part of electronic commerce.

EDIFACT	Electronic Data Interchange For Administration, Commerce and Transport	EDIFACT or UN/EDIFACT (full acronym) comprises a set of internationally agreed syntax standards, directories and guidelines for the structuring and exchange between independent computer systems of data that can be generated in character format. The UN/EDIFACT rules are published in the United Nations Trade Data Interchange Directory (UNTDID).
EMI	Electro Magnetic Interference	
E-OTD	Enhanced-Observed Time Difference	
ETSI	European Telecommunications Standards Institute	One of the standards body for Europe.
EU	European Union	A community of 15 European nations comprising the European Economic Community.
FDD	Frequency Division Duplex	One technique used for wireless communications where the up link and down link are at different frequencies.
FER	Frame Error Rate	
G5 Messaging		G5 Messaging is designed with a fallback to Group 3 fax and Internet e-mail as core capabilities. With a single keystroke, a message may be sent to multiple recipients using any mix of Group 3 fax, Internet e-mail and full G5 Messaging.
GIF	Graphics Interchange Format	
GIS	Geographic Information Systems	GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations.
GPRS	General Packet Radio Service	Technique used to upgrade current TDMA mobile networks. Allows a subscriber to gain up to eight 14.4 kbit/s channels. Also introduces packet switching.
GPS	Global Positioning System	A US satellite-based positioning system.
Group 3 fax		The most recent standard for fax devices which accounts for about 99% of all fax machines built since 1980. Group 3 actually refers to two recommendations defined by the ITU known as T.4 and T.30.
GSM	Global System for Mobile communications	The most popular standard for 2G mobile networks.
H.323		An umbrella recommendation from the ITU that sets standards for multimedia communications over Local Area Networks that does not provide a guaranteed QoS. These networks dominate today's corporate desktops and include packet-switched TCP/IP and IPX over Ethernet, Fast Ethernet and Token Ring network technologies.
HiFi	High Fidelity	
HIPERLAN/2	High Performance Radio LAN Type 2	Wireless LAN (specify by ETSI/BRAN) in the 5 GHz IMS Band with a bandwidth up to 50 Mbit/s.
IANA	Internet Assigned Numbers Authority	
ICT Group	Information and Communication Technology Group	A working group in the UMTS Forum.
ID	Identification	

IETF	Internet Engineering Task Force	An engineering and protocol standards body that develops and specifies protocols and Internet standards, generally in the network layer and above.
i-mode		Proprietary HTML-based mobile information service offered by NTT DoCoMo in Japan. The i-mode service is similar to WAP.
IMSI	International Mobile Subscriber Identity	
IMT-2000	International Mobile Telecommunications	ITU initiative for a global standardised 3G wireless network.
IP	Internet Protocol	The dominant network layer protocol used with the TCP/IP protocol suite.
IPDR	Internet Protocol Detail Record Organisation	
IPv4	Internet Protocol version 4	The version of IP in common use today.
IPv6	Internet Protocol version 6	The emerging standard, which aims to rectify some of the problems seen with IPv4, not least the address space.
ISDN	Integrated Services Digital Network	A telephone service that offers high speed digital services for devices connected to a telecommunications network.
ISM	Industrial Scientific and Medical	
ISP	Internet Service Provider	A company or organisation that provides access to the Internet to users.
ITU	International Telecommunication Union	
JPEG	Joint Picture Expert Group	Standard for the compression of still pictures.
MAC	Media Access Control	Part of the physical layer of a network that identifies the actual physical links between nodes.
m-commerce	Mobile Commerce	Similar to e-commerce but the term is usually applied to the emerging transaction activity in mobile networks.
MIME	Multipurpose Internet Mail Extensions	A specification for the transfer of non-text files with regular Internet e-mail.
MMAC	Multimedia Mobile Access Communication systems	MMAC systems will provide high-speed, high-quality mobile communications via seamless connections to fibre optic networks, enabling the use of multimedia services anywhere and at anytime. MMAC services are targeted for launch around 2002 in Japan.
MMI	Man Machine Interface	A term used to describe the environment that encompasses the activities surrounding a user and their interaction with a device.
MP3	Music Player	The term has become synonymous with the MP3 player which delivers CD quality music, It is the MPEG-1/2 audio layer 3.
MPEG	Moving Picture Expert Group	Standard for compression of moving pictures and sound. MPEG-1, 2, 4 are used.
NAI	Network Access Identifier	
PC	Personal Computer	Common term to describe the personal computer, usually based on a common architecture.
PDA	Personal Digital Assistant	
PSTN	Public Switched Telephone Network	The network, or groups of networks, consisting of switches and transmission that provide the bulk of switched services to the general public.

QoS	Quality of Service	Subjective and objective metric sets that quantify the performance of a network and its suitability for use with some applications and services.
RADIUS protocol	Remote Access Dial-In User Service protocol	An access server authentication and accounting protocol. The RADIUS authentication protocol is documented separately from the accounting protocol, but the two can be used together for a comprehensive solution.
Release 2000	Release from 3GPP	Term applied to the group of specifications due to be released in early 2001 which will concentrate on the core network. Also known as Version 5.
Release 99	Release from 3GPP	Term applied to the group of specifications forming the first phase of release specifications by 3GPP mainly concentrating on the radio access network.
RF	Radio Frequency	
RSVP	Resource ReSerVation Protocol	The RSVP protocol is part of a larger effort to enhance the current Internet architecture with support for QoS flows. The RSVP protocol is also used by a host to request specific QoS from the network for particular application data streams or flows. RSVP is also used by routers to deliver QoS requests to all nodes along the path(s) of the flows and to establish and maintain state to provide the requested service.
SA	Selective Availability	An artificial error introduced into satellite data by the US DoD (Department of Defense) to reduce the possible accuracy of a position to 100 metres for commercial users.
SIP	Session Initiation Protocol	A signalling protocol for Internet conferencing and telephony. SIP was developed within the IETF MMUSIC (Multiparty Multimedia Session Control) working group, with work proceeding in the IETF SIP working group.
SLA	Service Level Agreement	
SLP	Service Location Protocol	An emerging Internet standard for automatic resource discovery on IP networks.
SME	Small to Medium Enterprise	Term used to describe a company that has less than 500 employees.
SMS	Short Message Service	The service that enables the sending and receiving of short text messages of up to 160 characters.
SS7	Signalling System No. 7	
SWAP	Shared Wireless Access Protocol	SWAP is the name given by the Home RF Working Group to its specification for data and voice wireless communication. SWAP is a combined protocol from the TDMA-based DECT protocol for voice communication and CSMA/CA (Carrier Sense Multiple Access / Collision Avoidance) based IEEE 802.11 protocol for data communication.
TAP3	Transferred Account Procedure version 3	TAP is the process that allows a visited network operator (VPLMN) to send billing records of roaming subscribers to their respective home network operator (HPLMN). TAP3 is the latest version of the standard and will enable billing for a host of new services that networks intend to offer their customers.
TCP	Transmission Control Protocol	A transport layer protocol that offers connection-oriented, reliable stream services between two hosts. This is the primary transport protocol used by TCP/IP applications.

TDD	Time Division Duplex	One technique used for wireless communication where the up link and down link use the same frequencies.
TIFF	Tag Image File Format	A widely used format for storing image data.
TOA	Time of Arrival	
TV	Television	General term used to describe the broadcasting and reception of video and audio.
UDP	User Datagram Protocol	
UMTS	Universal Mobile Telecommunications System	UMTS is a modular system that incorporates several technologies that realise the convergence of existing and future mobile and fixed networks, including the Internet. The UMTS concept embraces also all applications and services that can be offered to the end-user. UMTS is a member of the IMT-2000 family of systems.
UMTS Forum	Cross industry body	<p>Non-profit, independent forum that gives guidance to standards and other bodies in terms of market requirements and issues to be solved to allow for a smooth deployment of UMTS.</p> <p>UMTS Forum's "Extended Vision" embraces all elements of the value chain beyond the standards (specified by 3GPP/ETSI) for 3G mobile networks.</p>
USIM	Universal Subscriber Identity Module	The module that identifies, and is unique to, the mobile subscriber.
UTRA	Universal Terrestrial Radio Access	
VHE	Virtual Home Environment	The term used to describe the concept of offering a subscriber the same services and facilities that he experiences on his home mobile network.
VoIP	Voice over IP	The generic term used to describe the techniques used to carry voice traffic over IP.
W3C	Worldwide Web Consortium	
WAN	Wide Area Network	
WAP	Wireless Application Protocol	Used to allow the transmission of simple web pages in 2G networks. Consists of a protocol stack that covers layers 4 to 7 of the OSI model. Uses IP but replaces TCP and HTTP with UDP. Web pages are written in WML.
WLAN	Wireless Local Area Network	
WML	Wireless Mark-up Language	
xDSL	Digital Subscriber Line	A group of technologies that allow higher speed access over standard wired lines to a telecommunications network, for example ADSL, which offers up to 512 kbit/s in one direction and up to 8 Mbits/s in the other (A= Asymmetric).
XML	eXtensible Mark-up Language	An open standard for describing data from the W3C. It is used for defining data elements on a web page and business-to-business documents. By providing a common method for identifying data, XML supports business-to-business transactions is expected to become the dominant format for electronic data interchange.

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