Report No. 16
Report from the UMTS Forum

3G Portal Study

A Reference Handbook for Portal Operators, Developers and the Mobile Industry

UMTS Forum, November 2001

This report has been produced by the UMTS Forum, the only organisation worldwide that brings together leading players in the telecommunications industry with IT companies, media and content providers and developers of mobile services and applications to promote the global success of 3G mobile services and networks. The UMTS forum today comprises almost 270 companies from 43 countries worldwide.

UMTS takes full regard of the trend of convergence of existing and future information networks, devices and services, and the potential synergies that can be derived from such convergence. UMTS will move mobile communications forward from where we are today into the Information Society of third generation (3G) services, and will deliver speech, data, pictures, graphics, video portal services and other high bandwidth information direct to people on the move. The key benefits which UMTS/3G offers of speed and capacity will be appreciated by potentially billions of mobile users globally enjoying affordable voice and innovative 3G services.

The UMTS Forum is at the forefront of 3G developments and has published a series of studies including market forecasts for 3G service revenues for 3G network operators. Many of the services, which are identified and analysed in these studies, will be experienced by end users via 3G portals. Therefore the importance of portals cannot be understated.

The need for this 3G portal study was identified at the April 2001 UMTS Forum/3GPP workshop in Sophia Antipolis- “Assessing the Requirements for Deploying 3G Services”. The need was identified for feedback and guidance to industry in order to smooth the implementation and customer up-take of 3G services. The existing plethora of technology, standards, browser types, and options would otherwise hinder market developments.

The following project team participated in this study:

1. Josef Huber
2. Bosco Fernandes
3. Alan Hadden
4. Eileen Healy
5. Jagdish Kohli
6. Thomas Sidenbladh
7. Paola Tonelli
8. Andy Watson

This report follows on from other UMTS forum deliverables that have dealt with regulatory framework and spectrum aspects for UMTS (Report #1), technical aspects (#2), impact of license cost levels (#3), licensing conditions (#4), minimum spectrum requirements (#5), UMTS/IMT-2000 spectrum (#6), extensions to core band spectrum (#7), and the future market for mobile multimedia services, as well as mobile voice and data services (#8) revenues and service enablers in UMTS Forum Reports No. 9, 10, 11 and 13. All of these reports can be downloaded from the UMTS Forum Web site, www.umts-forum.org/reports.html.

Many statements in this report represent the views of the original author, Telecompetition, Inc., and have been subject to formal approval in the UMTS Forum GA # 24 in Yokohama, Japan. Thus, most operators and manufacturers within the UMTS Forum support the main conclusions and key findings in the report. The National Administrations that are members of the Forum have actively supported the development of the report. However, the views and conclusions expressed in this report do not necessarily represent the views of the National Administrations. Therefore the Administrations cannot be bound by the detailed recommendations contained in the report.

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Comments on this report will be appreciated for future enhancement of this work to include new technology and industry developments. Please direct your comments to:

Josef Huber: josef-franz.huber@icn.siemens.de

Jagdish Kohli: jagdish.kohli@telecompetition.com

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0. Executive Summary

The mobile industry is currently undergoing a rapid stage of evolution and development, and 3G portal services are at the heart of this evolution. With a 3G portal services revenue potential of over $200 billion by 2010[1], a number of industry participants are actively engaged in developing the 3G portal services market.

The UMTS Forum is at the forefront of 3G developments and has published a series of studies including market forecasts for 3G service revenues for 3G network operators. Many of the services, which are identified and analysed in these studies, will be experienced by end users via 3G portals. Therefore the importance of portals cannot be understated.

The need for this 3G portal study was identified at the April 2001 UMTS Forum/3GPP workshop in Sophia Antipolis, “Assessing the Requirements for Deploying 3G Services”. The need was identified for feedback and guidance to industry in order to smooth the implementation and customer up-take of 3G services. The existing plethora of technology, standards, browser types, and options would otherwise hinder market developments.

The UMTS Forum decided during the above-mentioned workshop to undertake this 3G portal study in order to support the industry with information and guidance, and to help to identify standardisation requirements and implementation issues in this crucial area.

This “3G Portal Study” takes a snapshot of current trends in mobile portal technologies, standards and services, and provides a quick reference to mobile operators, portal operators, manufacturers and content developers. The report identifies and discusses the most significant issues. The purpose is to provide guidance to the industry that will facilitate the development and adoption of 3G portal services. A concerted industry effort to address these issues will create a more harmonious industry environment for the success of evolving mobile services.

This report has identified three major approaches to resolve issues related to the development and deployment of 3G portal services:

- Convergence
- Market Decision
- Technological Research and Development

Interviews with major industry players from the Internet and the mobile sectors of this industry have revealed a common interest in resolving technical and market issues that will enable all players to achieve the needed scale for economic viability. However, the current focus is quite different. Those from the traditional Internet space are more concerned with the consistent packaging; delivery and presentation of content across mobile and fixed devices; while those from the mobile industry are more focused on resolving the technical issues to enable data transmission on historically voice-centric networks and devices. Both parties are now beginning to appreciate the need to work together to resolve the market and technical issues involved.

This handbook has identified three topic areas that the industry is working on to create a mass market for 3G portal services. These topics include:

- Portal application development
- Mobile terminals
- Critical portal service enabling capabilities

[1] UMTS Forum, Report 13

Furthermore, each of these three areas includes details on:

- Important issues and trends
- Technology and standards discussion
- Mobile industry implications

A number of critical capabilities have been identified in this 3G portal study for successful development and delivery of 3G portal services. These capabilities include:

- Security
- Privacy
- Billing and Payment
- QoS
- Interoperability
- Content Format/Compression

In order to analyse 3G portal service development and delivery issues identified in this report, three functional sets have been defined to cover the following perspectives:

- Timeframe required for issue resolution and commercialisation into 3G portals

(Functional Set I)

- Role of industry players in capability selection **(Functional Set II)**
  - Mobile operator
  - Content developer
  - Portal Operator
  - Manufacturer
- Status of issues relative to a number of capability considerations **(Functional Set III)**
  - Current Standards
  - Market Decision
  - Terminal Types
  - Technology

The 3G portal study recommendation section includes:

- 3G service enablers
- Key issues
- Recommendations
- Action needed

The most important recommendations are:

- The markup languages XHTML and HTML are preferred.
- The open content format and compression standards are preferred: JPEG 2000 for images, MP3 and MP3 PRO for audio and music and MPEG-4 for video.

The 3G portal services industry is a very young industry with a tremendous momentum to advance forward. This report has identified key trends in technologies that will pave the way for the growth of the market. Critical service delivery issues of billing, security, privacy, QoS, interoperability and content format will need a concerted industry effort and resolution to realise the full potential of 3G services.

A number of progressive trends have been identified in the processor, memory, battery, display, operating system, and browser technologies. Collectively these advances will create a new

family of harmonised and user-friendly 3G mobile devices. A richer end-user usability experience on these new devices will promote the growth of 3G portal services.

While the mobile industry has to address all the technological issues to create a 3G network and marketing infrastructure, it must maintain its focus on the needs of the end-users. It's the end-user who decides the success of a particular service. The end-user needs a simple mobile device and all the complexities of operating system, browser, and media player should be hidden within the layers of technology. Insulating the customer from these technological complexities will provide the ease-of-use and increase the usage and growth of 3G portal services. In the long term an end-user should simply be able to talk to the mobile device and ask for a movie, a song, selected weather report, customised sports news and/or directions to a restaurant from a 3G portal.

1. Introduction

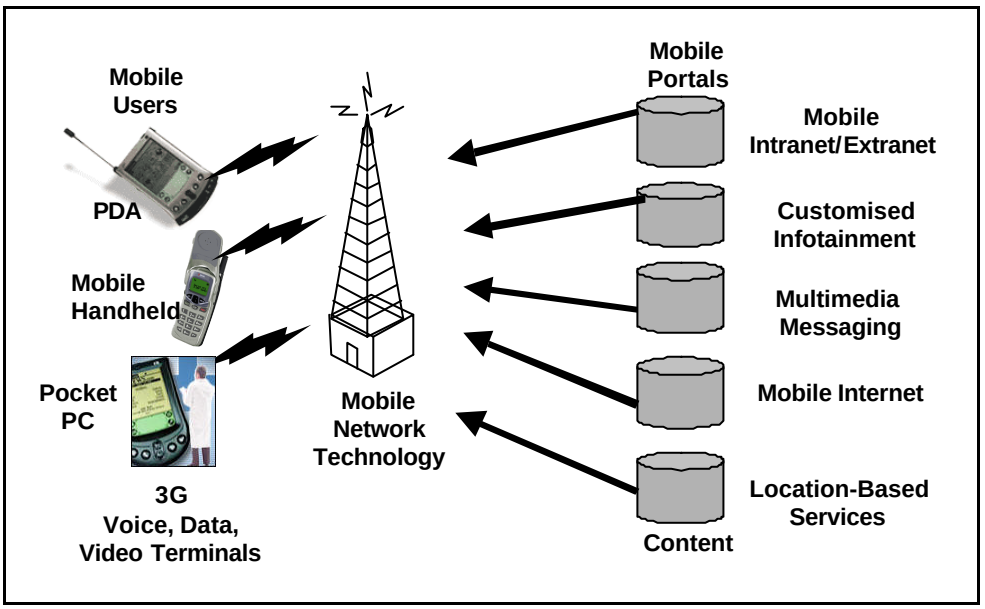
By 2010, worldwide revenues for 3G services are expected to exceed $300B annually.[2] Because of large economic opportunities for mobile operators, manufacturers of portal platforms and mobile terminals, content developers and aggregators, many research and development activities have been intensified in the portal space. Much confusion in the mobile portal marketplace exists due to a number of mobile terminal types with a wide variation in form factors, many operating systems and browsers, multiple content development languages and tools, and many open and proprietary incompatible standards.

The UMTS Forum has defined a framework for 3G portal services. The portal types in this framework include:

- Mobile Intranet/Extranet portals
- Customised Infotainment portals
- Multimedia Messaging Services portals
- Mobile Internet portals
- Location-Based Services Portals

Figure 1 illustrates a unified view of delivering a number of emerging 3G portal services to mobile users with a variety of devices.

Figure 1. End-to-end harmonised 3G portal services for mobile users.



Source: UMTS Forum, June 2001.

This "3G Portal Study" takes a snapshot of current trends in mobile portal technologies, standards and services, and provides a quick reference to:

- Portal Operators
- Mobile Operators

[2] UMTS Forum, Report 13, Table 10.

- Manufacturers
- Content Developers

The “3G Portal Study” identifies and discusses the most significant issues. The purpose is to provide guidance to the industry that will facilitate the development and adoption of mobile portal services. A concerted industry effort to address these issues will create a more harmonious industry environment for the success of evolving 3G portal services.

This handbook has identified three areas that the industry is working to resolve. These topics include:

- Portal Application Development
- Mobile Terminals
- Portal Service Delivery Capabilities

This report has identified three major approaches to resolve issues related to the these topics:

- **Convergence** approach works toward a globally accepted open standard combining mobile, Internet, media, and communication concerns.
- **Market Decision** approach where the most dominant player or a small number of strong players create de facto standards, driven by the sheer volume of originally proprietary implementations.
- **Technical Research and Development** approach in which new technology will be developed. This is technology that is not yet available, but necessary to deliver the needed requirements.

Interviews with major industry players from the Internet and the mobile sectors of this industry have revealed a common interest in resolving technical and market issues that will enable all players to achieve the needed scale for economic viability. However, the focus is quite different. Those from the traditional Internet space are more concerned with the consistent packaging, delivery and presentation of content across mobile and fixed devices; while those from the mobile industry are more focused on resolving the technical issues to enable data transmission on historically voice-centric networks and devices. Both parties are now beginning to appreciate the need to work together to resolve the market and technical issues involved.

Portal services have caught the attention of many users, especially in Europe and Japan where a number of major industry players have been deploying mobile portal services during the past two years. A large number of portals have been deployed in the mobile industry. Examples of portal providers include:

- BT
- Carphone Warehouse
- Telefonica Moviles
- Sonera
- Vodafone
- NTT DoCoMo
- Yahoo Mobile
- Excite
- Lycos
- AOL

In order to gauge the growing customer interest in WAP based portal services an industry wide survey[3] of portal providers is periodically conducted in Europe and beyond. This survey has been sponsored by GSA – the Global mobile Suppliers Association, the representative body for GSM/3G suppliers worldwide. The 2Q 2001 survey, conducted by Satama Interactive, covers 74 mobile portals in 22 countries with a focus on European portal service providers. The services and content provided by the mobile portals are divided into six main categories:

- **Communications and community** – e.g. e-mail, calendar and chat.
- **Information** – e.g. news, weather, directories.
- **Lifestyle** – e.g. listings of events, restaurants, movies and games.
- **Travel** – e.g. hotel listings, direction assistance and timetables.
- **Transaction** – e.g. banking, stock trading, purchasing and auctions.
- **Other** – includes information about personalisation, location-based services, device type, and advertising, and also about the openness of the mobile portal, billing and target group.

A mixture of methods have been used when surveying the mobile portals:

1. Direct access with mobile terminals when possible,
2. Access with WAP[4] emulators (over http) when possible,
3. Information from the Web site of the mobile portal, or from the corporate Web site, when neither of the first two options was possible.

The 2Q 2001 survey reveals that more and more portal providers are offering new portal services and there is a growing acceptance of portal services. The key points of survey findings are summarised in "must have" and "nice to have" categories:

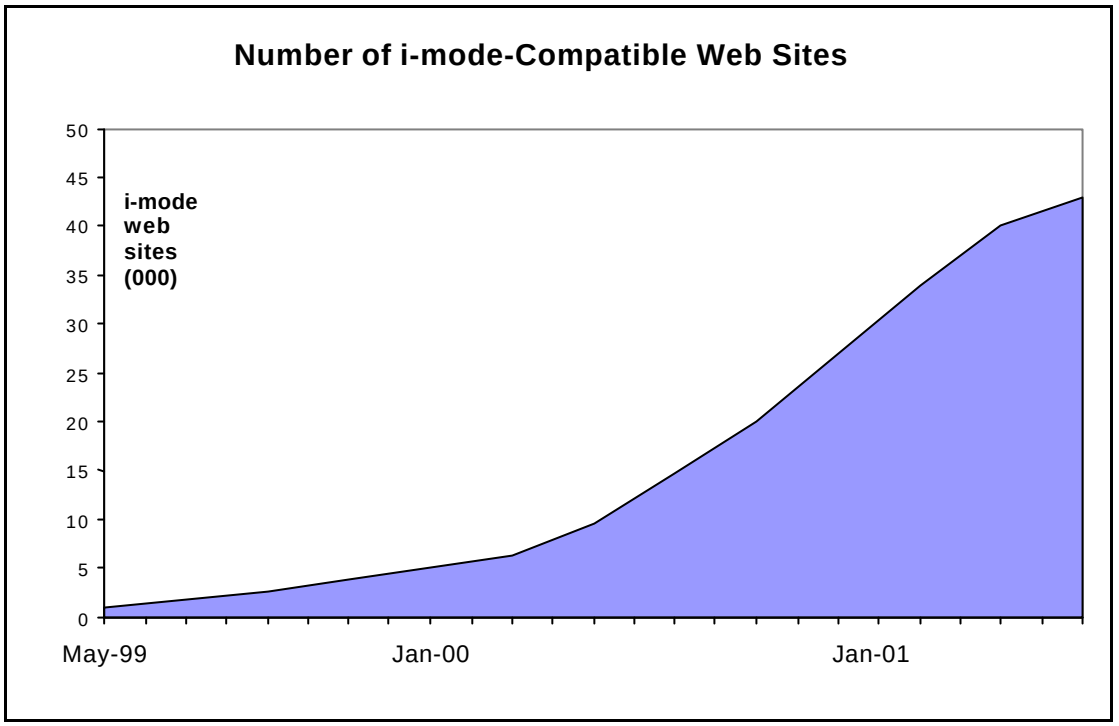
- **Must Haves** – Services in the "must have" category, i.e. services that are offered by almost all (approximately or more than 80%) mobile portals are divided into two main groups: the information and communications group of news – including financial news and weather – e-mail and directories, including search engines and phone directories. The "lighter" group of must haves includes general entertainment services – horoscopes, jokes etc. – event information, sports results, TV and movie listings, and games. Personalisation also seems to be a must have service.
- **Nice to have** – The "nice to have" category includes services that well over half (approximately or more than 60%) of the portals offer. The most frequent services in this category are travel-related services, such as direction assistance and city guides. Restaurant listings are also often provided. Travel-related nice to haves also include traffic information and commuting timetables, hotel listings and flight information. Transaction services, such as purchasing and bank account information, were provided by around half of the mobile portals.

NTT DoCoMo introduced their i-mode portal service over two years ago and has seen a rapid growth of its customer base. The number of subscribers has grown to over 28.7 million based on 4 November 2001 numbers. i-mode deployed a stringent portal-to-handset end-to-end approach for a single homogeneous Japanese market. The user browser was based on cHTML (compact Hypertext Markup Language) that provided the content developers with a uniform standard to develop and display portal content. The growth of i-mode portal sites is shown in Figure 2.

[3] Source: www.gsacom.com

[4] WAP is a trademark of WAP Forum

Figure 2. Growing number of i-mode portal sites.



Source: I-Search, May 2001

NTT DoCoMo has introduced a 3G service under the trade name of FOMA (Freedom of Multimedia Access). The name FOMA expresses the concept of content access anytime and anywhere in a Wideband Code Division Multiple Access (W-CDMA) mobile environment. i-mode will eventually be incorporated into FOMA. A number of multimedia applications will be introduced under the umbrella of FOMA service. The ability to send and receive video is expected to be a key feature of the service.

The full potential of 3G portal services will be realised in the coming years when a robust technology and marketing infrastructure are fully developed. A number of critical service delivery issues of security, privacy, billing, QoS and content format need to be addressed by the mobile industry for successful development of 3G portal services mass market.

While the mobile industry has to address all the technological issues to create a 3G network and marketing infrastructure, it must maintain its focus on the needs of the end-users. It's the end-user who decides the success of a particular service. The end-user needs a simple mobile device and all the complexities of operating system, browser, and media player should be hidden within the technology. Insulating the customer from these technological complexities will provide the ease-of-use and increase the usage of 3G portal services. In the long term an end-user should be able to talk to the mobile device and ask for a movie, a song, selected weather report, customised sports news and/or directions to a restaurant from a 3G portal.

2. 3G Portal Overview

There are a number of aspects of portals that are important when developing and delivering 3G portal services. These include:

- Portal type
- 3G Data Rate
- Service Type
- Service Revenue Potential
- 3G Portal Traffic

2.1 Portal Definition and Types

There are many ways to classify and characterise mobile portals. UMTS Forum Report No. 9 developed a structured approach and defined a framework for characterising 3G services that could be offered on mobile portal. Using this same classification, the following five types of content-based portals can be considered:

- Mobile Intranet/Extranet portals – A 3G portal that provides secure mobile access to corporate Local Area Networks (LANs), Virtual Private Networks (VPNs), and the Internet. Examples of Intranet/Extranet portal services include:
  - Corporate e-mail
  - Calendar
  - Training
  - Customer relationship management including selling to existing customers, servicing existing customers and marketing to new prospective customers
  - Corporate vertical applications
- Customised Infotainment portals – A 3G portal that provides device-independent access to personalised content anywhere, anytime. Examples of infotainment portal services include:
  - Streaming music
  - Short films
  - m-wallet
  - m-shopping
  - Horoscopes
- Multimedia Messaging services portals – A 3G portal that offers non-real-time, multimedia messaging with always-on capabilities allowing the provision of instant messaging. Examples of these services include:
  - Multimedia postcard
  - Video clips
  - Movie trailers

- Mobile Internet portals – A 3G portal that offers mobile access to full fixed ISP services with near-wireline transmission quality and functionality. Examples of mobile Internet portal services include:
  - Browsing
  - Mobile chat
  - M-commerce
  - Mobile games
- Location-Based Services (LBS) portals – A business and consumer 3G portal that enables users to find other people, vehicles, resources, services, or machines. It also enables others to find users, as well as enabling users to identify their own location via terminal or vehicle identification. Examples of LBS portal services include:
  - Emergency services
  - Asset tracking
  - Navigation
  - Shopping information

While mobile portals are often viewed as an extension of fixed Internet portals, mobile portals are faced with additional challenges of content optimisation due to small form factor[5] devices, and the necessity of delivering that content to the mobile user–independent of user location and time. UMTS Forum Report No. 10 developed the following portal definition:

> "A portal is an entry point to a wealth of information and value added services. Portals can be personalised and are Internet/Intranet based with browser user interfaces. Portals will deliver content according to device's characteristics and user's needs."

Mobile portals are often classified as horizontal or vertical. This classification is based on the type and the depth of services provided by the portal.

2.1.1 Horizontal Portal

Horizontal portals have a broad, mass-market focus and feature a wide range of mostly common applications such as mobile commerce. Sites like Yahoo, Netcenter and Excite appeal to a much broader audience base and are examples of horizontal portals. E-mail, stock quotes, news, chat sessions and community building are some of the features of these portals.

Corporate or enterprise portals can also be characterised as horizontal portals when these offer the following services to most of its employees:

- Consolidate information and provide a single point of entry to all kinds of corporate systems.
- Provide users with search, personalisation and other usability features.
- Provide integration of e-mail and calendar capabilities.

[5] The term "small form factor" is used in the industry to describe any device that can be carried on a person, typically palm or pocket sized or handheld. Laptops, for example, are considered "luggable" and are not small form factor devices.

- Centralise intranet/Internet security and distribute information via a centralised administrative console.
- Supply standardised reporting and publishing capabilities.

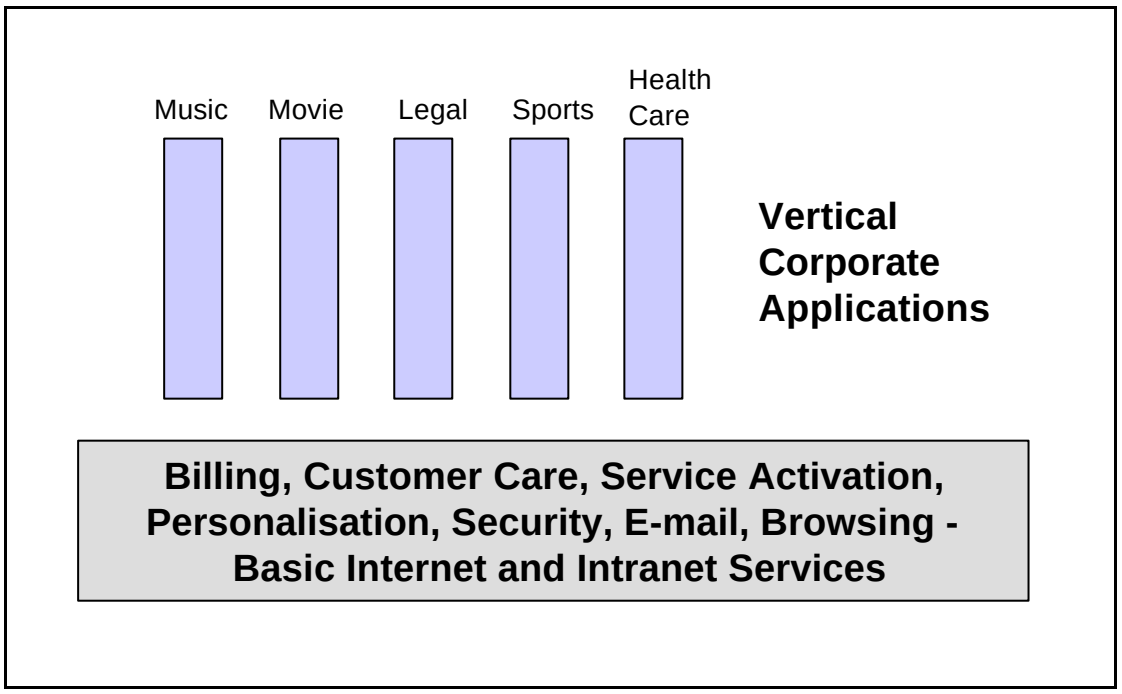
2.1.2 Vertical Portal

Vertical portals are focused on a particular market segment, and feature varying degrees of specialisation and niche applications.

Sports portal, finance portal or travel portal are some of the examples of evolving vertical portals.

A number of examples of horizontal and vertical portal capabilities are shown in Figure 3.

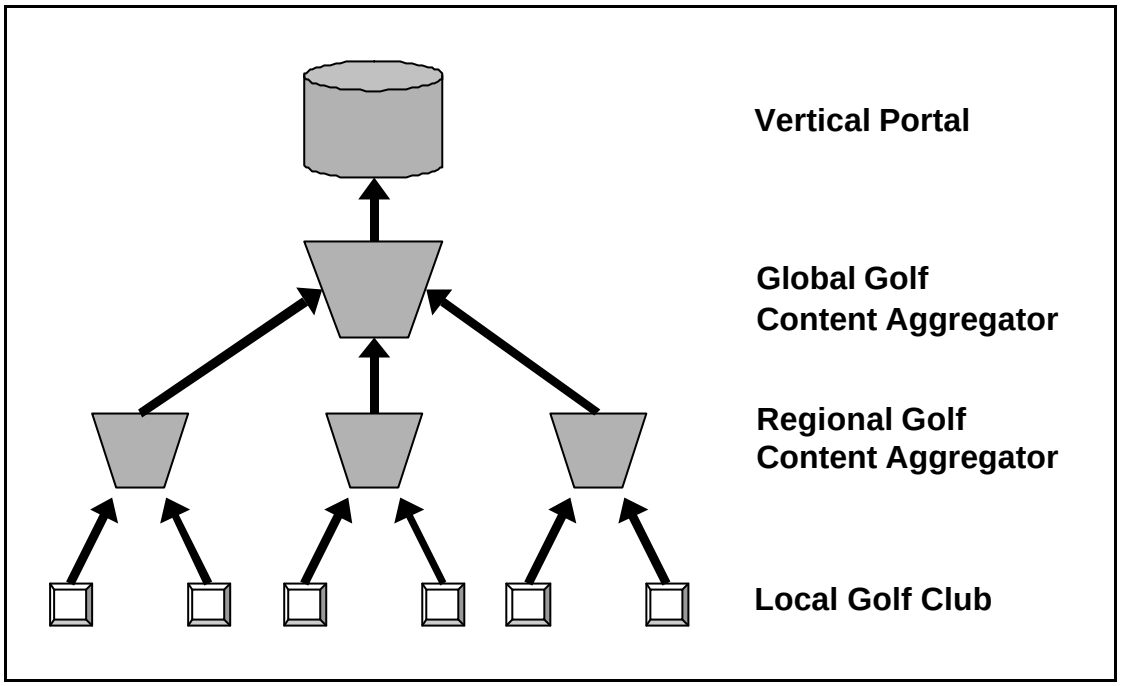
Figure 3. Horizontal and vertical portal capabilities.



Source: UMTS Forum

As a natural evolution of vertical portals, a number of specialised content portals can also be developed. A view of a special golf sport portal is shown in Figure 4. In the information rich society, mobile consumer appetite for specialised content will continue to grow, and the industry focus will create other sport portals such as tennis, baseball, cricket, etc. By the same token, other industries may create specialised content portals. For example, education industry will likely focus on physics portal, chemistry portal, biology portal, astronomy portal and other sub-fields of education. As these initial efforts succeed, specialists in various countries of the world will create multilingual portals for people travelling across national and regional territories and wishing to access local content.

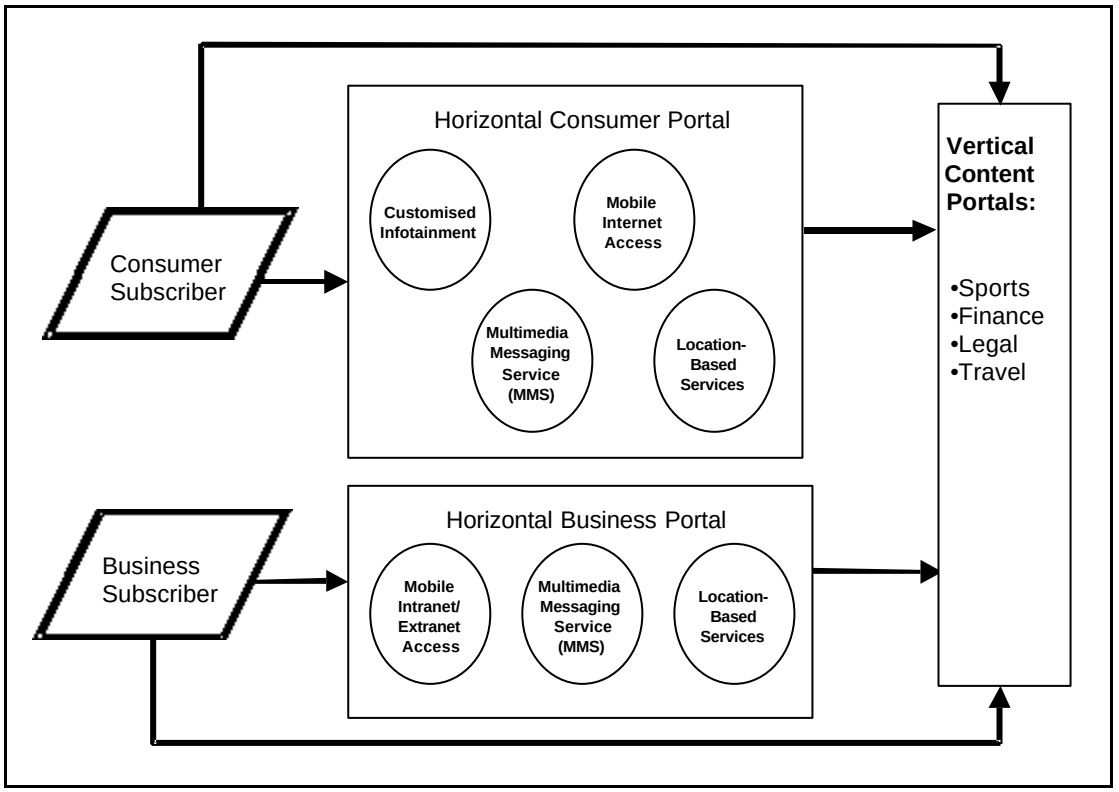
Figure 4. Specialised vertical portal content aggregation.



Source: UMTS Forum

A unified view of mobile portals based on horizontal and vertical portal capabilities and UMTS forum services framework with the end-user points of entry is shown in Figure 5.

Figure 5. End-user points of entry – mobile portals and UMTS service categories.



Source: UMTS Forum

2.2 Portal Service Characteristics

Today's wireless digital networks are primarily characterised as second-generation (2G) networks, predominantly designed for voice communication with a low speed (9.6 Kbit/s) data carrying capability. 2.5 G and 3G will offer higher data rates and increased capacity. These data rates plus compression techniques will allow access to HTML pages, video and audio streaming for laptops and smaller devices.

Examples of portal services and their average file size and data transfer times at 64Kbit/s, 128Kbit/s and 384kbit/s are shown in Table 1.

Table 1. Portal service transfer times at selected 3G speeds.

Portal Services	File Size in Kilobytes	Transfer Time in Seconds @ 64Kbit/s	Transfer Time in Seconds @ 128Kbit/s	Transfer Time in Seconds @ 384Kbit/s
Mobile Music	• 6000	750	375	125
Mobile Intranet/Extranet	• 1500	188	94	31
Mobile Games	• 600	75	38	13
Mobile Shopping	• 2500	312	156	52
Mobile Online Bill Payment	• 800	100	50	17

Source: Telecompetition Inc., June 2001.

Table 2 shows UMTS Forum portal types, service examples, market segment and preferred end-user mobile devices (as described in Section 4.1). The devices shown are preferred in order to enhance the usability experiences of the user. Mobile terminals are further described in Section 4.

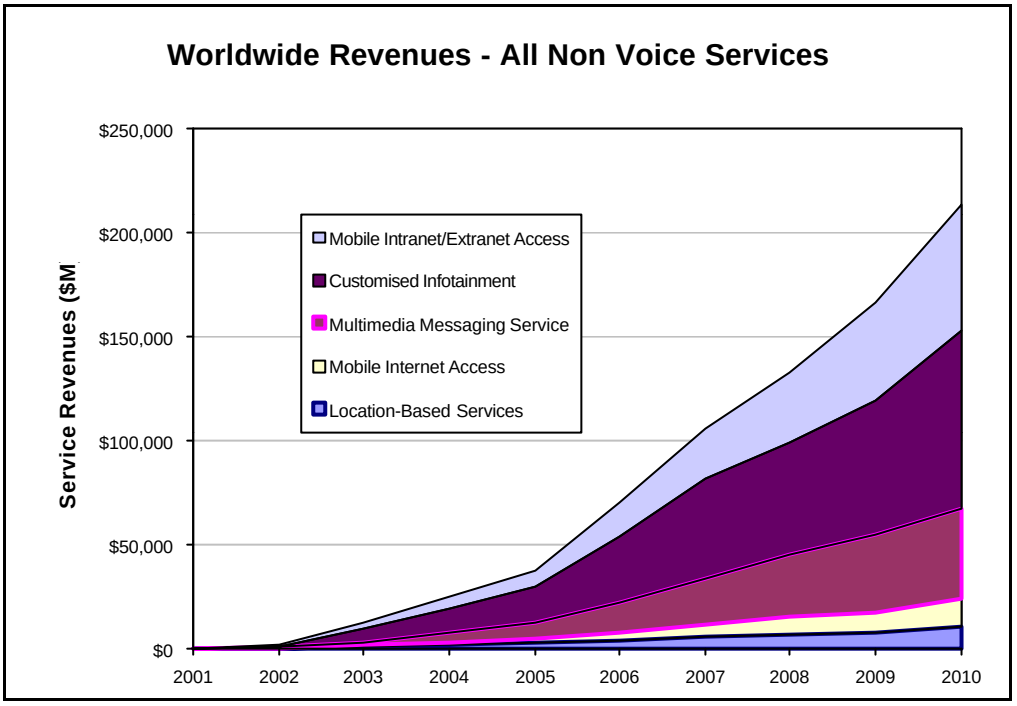
Table 2. UMTS Forum portal types and services.

Portal Type	Service Examples	Market Segment	Preferred Mobile Devices
Mobile Intranet	• Corporate e-mail • Calendar • Training • Corporate vertical applications	Business	Mid-range and High-end Mobile Devices Laptop
Customised Infotainment	• Streaming music • Short films • m-wallet • m- shopping • Horoscopes	Consumer	High-end and Mid-range Mobile Devices Personal Digital Assistants (PDAs)
Multimedia Messaging Service	• Multimedia postcard • Video clips • Movie trailers	Business and Consumer	Mid-range Mobile Phones Personal Digital Assistants (PDAs)
Mobile Internet	• Browsing • Mobile chat • m-commerce • Mobile games	Consumer and Business	Mid-range and High-end Mobile Devices Laptop
Location-Based	• Emergency services • Asset tracking • Navigation • Shopping information	Business and Consumer	Mid-range Mobile Phones or PDAs

Source: UMTS Forum.

The size of the mobile content-based market opportunity is of great interest to the mobile industry. This topic has been extensively studied and documented in UMTS Forum Report No. 9 and 13. Worldwide revenue from 2001 to 2010 for the five service categories available through portals is shown in Figure 6[6]. The over $200 billion revenue forecast in 2010 for 3G portal services is based on a conservative set of assumptions–the real number may be higher. The total number of worldwide subscriptions for all mobile services during 2010 is expected to reach 2.2 billion.[7] A large segment of this mobile population will use some form of mobile data service.

Figure 6. 3G services worldwide revenues.



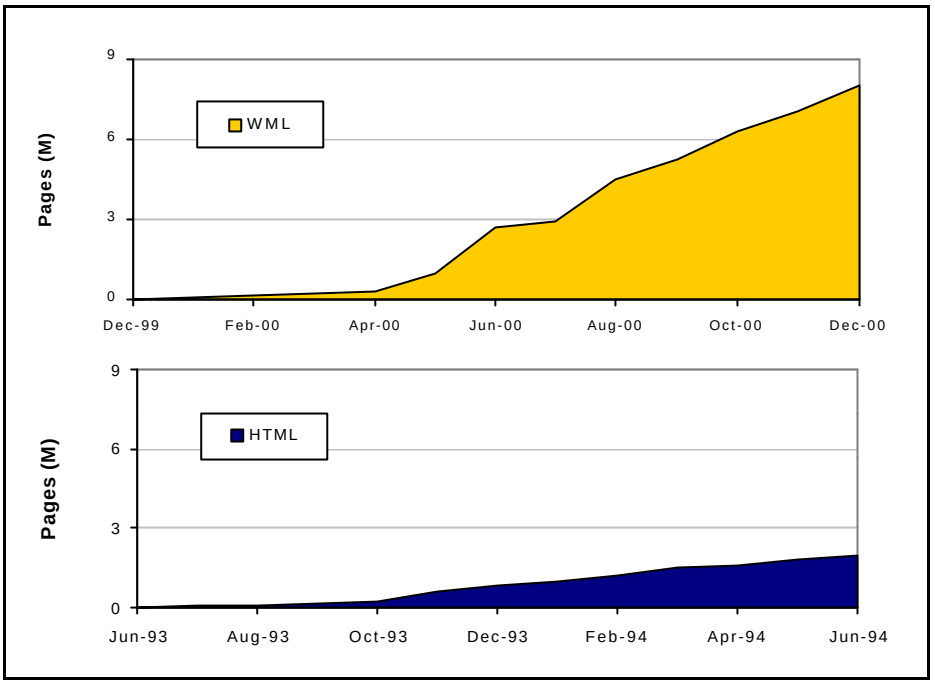
Source: UMTS Forum Report No.13, March 2001.

Europe has predominantly deployed WAP-based portal services using WML. In spite of problems with WAP browser incompatibility standards, the customer interest in portal services has been very high. A comparison of HTML page downloads to WML page downloads over their start-up periods is shown in Figure 7. The uses of portal services are expected to improve with the introduction of the WAP 2.0 family of standards for 2.5 and 3G services.

[6]Based on revenues released on March 2001. These revenues are currently under review.

[7] Source: Telecompetition, Inc., *Worldwide Mobility Report: 2001*.

Figure 7. Page download growth comparison – WML (WAP) and HTML content.



Source: Pinpoint Networks.

3. Portal Application Development

This section introduces key issues regarding portal application development. The areas of open services architecture, application programming interfaces, markup languages and personalisation are explored.

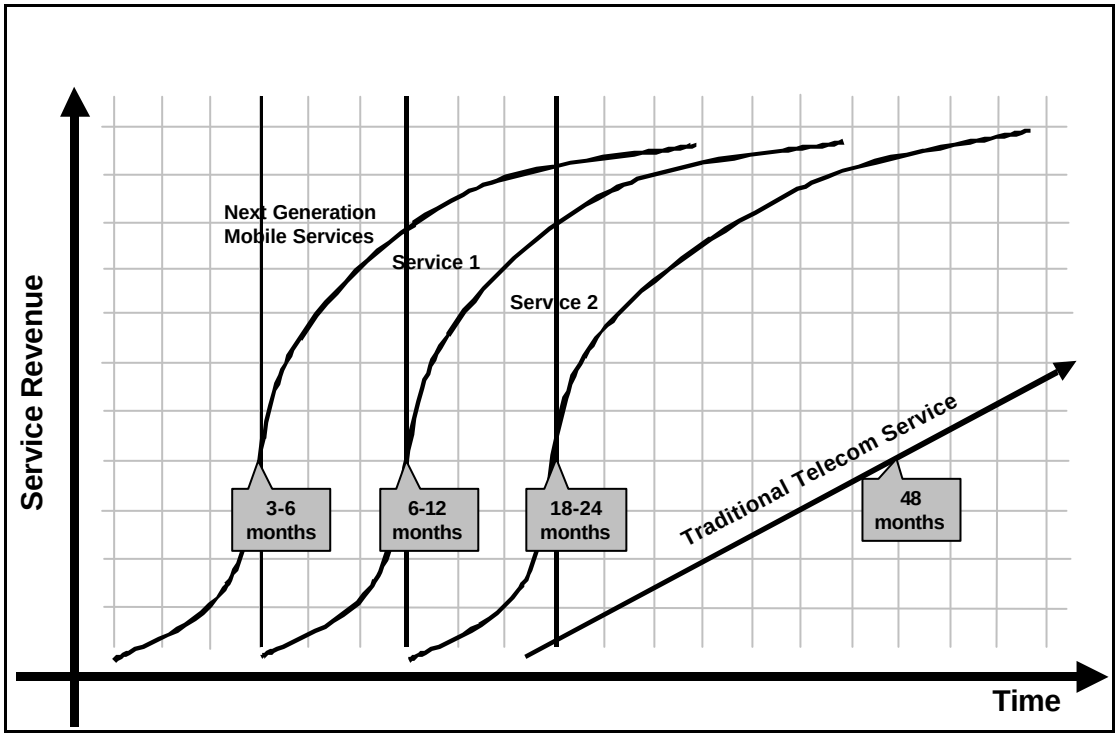
The application development requirements for mobile services are different from the conventional telecommunication services. The key differences are:

- Shorter launch times – Service deployment lifecycles are measured in months and not in years.
- Number of service offerings – The number of potential mobile service offerings is much larger than voice-centric services.
- Faster return on investment – Each service development project must become profitable quickly.
- Support for successive product launches – Services need to be building upon each other's successes using adaptive processes.

To provide services and applications that meet the breadth of user needs, services and devices envisioned for the future require a dynamic and more timely approach to application development. The continued development of mobile extensions to Open System Architecture, Application Programming Interfaces (APIs), and Internet markup languages will provide an efficient content-development environment.

Open standards-based development tools allow rapid application development and shorter project break-even time as shown in Figure 8. This picture captures qualitatively the need for rapid service development in a multi-service market.

Figure 8. Improvements in application development with open standards.



Source: Telecompetition Inc. and www.iec.org/tutorials.

3.1 Important Issues and Trends

Table 3 summarises the significant trends and issues for the technical areas identified in this section.

Table 3. Summary of issues and trends related to portal application development.

Technical Area	Trends or Issues
APIs	APIs together with the Open Services Architecture accepted by 3GPP will help ensure multi-vendor product interoperability between 3G portal platforms and services. Trials are underway to test various APIs. The interoperability software for mobile portals such as CORBA, SOAP, Java RMI and Jini are important.
Markup Languages	Specialised markup languages have evolved to meet specific applications. Within the mobile industry, WML and cHTML have been the two dominant languages. A recent development within the mobile industry intended to resolve the issue of competing markup languages is to combine HTML and XML into Basic XHTML. The industry remains concerned about the backward compatibility and interoperability of Basic XHTML, WML, and cHTML. CXML and ebXML markup languages have been developed for electronic commerce. VXML based voice interface will be important for a number of services i.e. for safety reasons for people in vehicles. No industry effort is underway to limit the number of markup languages. Some of the existing Intranet, Internet and infotainment content will be converted to XHTML format.
Personalisation	The concept of personalisation is evolving from providing the capability for personal choice in the presentation of content provided by the terminal, to the capability to provide personal choice in the selection and management of the content by the user. Current personalisation capabilities provide limited differentiation value for operators. Trials are recently underway to develop personalisation capabilities for the corporate intranets. There is currently no significant effort to develop standards in this area.

Source: UMTS Forum.

3.2 Open Services Architecture (OSA) Framework

OSA provides a general framework for building new mobile applications and the Third Generation Partnership Project (3GPP) has adopted this framework.

A number of industry groups have been working for the past few years to define a standards-based framework for building new telecommunication applications. Mobile service development is an important part of this industry effort. The key attributes of this OSA are:

- Uniform support for voice and data/Internet services
- Layered architecture with open APIs and network interfaces enable true multi-vendor procurement
- Application developments, independent of network-assisted service execution and management
- Easy and cost-effective deployment of niche services
- Rapid introduction of services by leveraging a global content developer talent pool

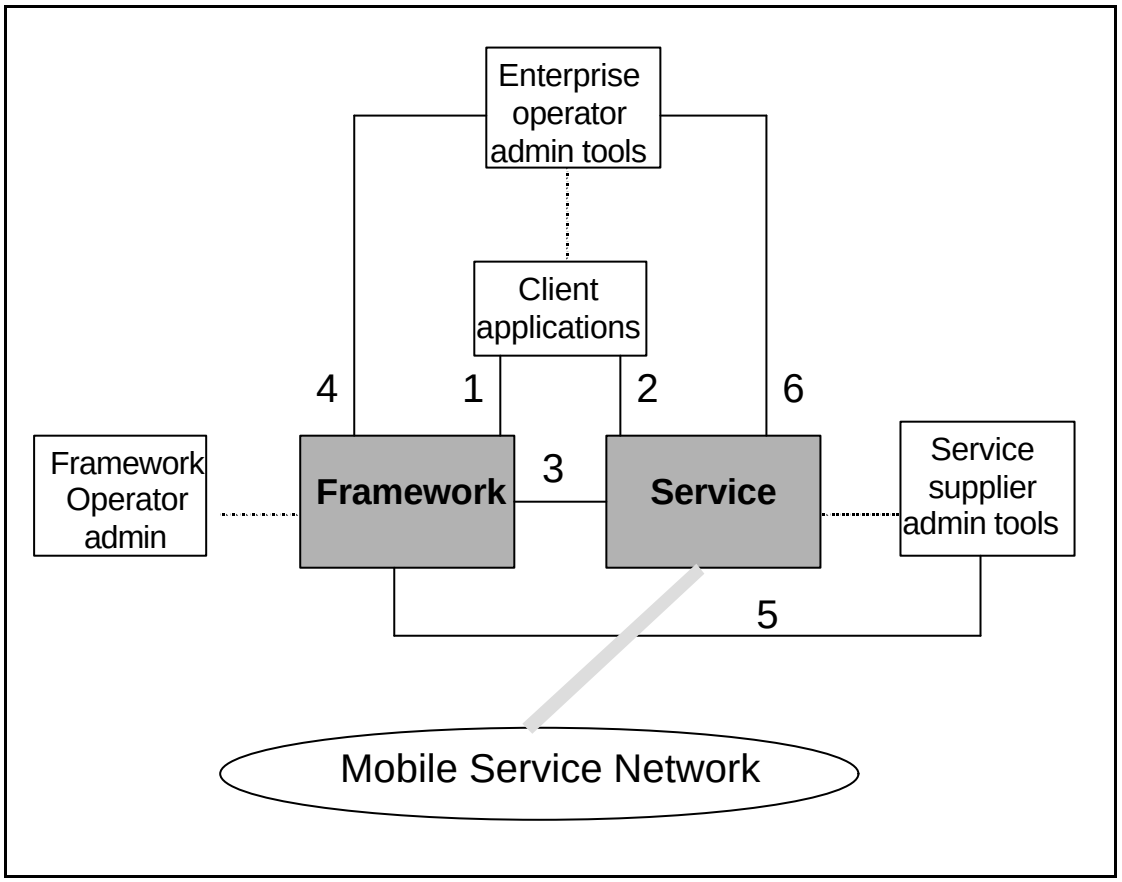
The OSA architecture framework elements are shown in Figure 9. This framework was originally

created by the Parlay group and later adopted by 3GPP. OSA is comprised of the following two interface sets:

- Framework Interface Set: These Application Programming Interfaces (APIs) provide the supporting management capabilities necessary for service interface access (e.g., security, integrity, service registration and discovery).
- Service Interface Set: These APIs offer application access to a variety of network capabilities and information. Functions provided by service interfaces allow access to mobile network capabilities such as call control, location, user interaction, messaging and charging.

A number of interface reference points are defined in the OSA framework. These reference points are shown in Figure 9. The reference points provide a comprehensive coverage of all aspects of mobile service development.

Figure 9. Open Services Architecture (OSA) framework.



Source: 3GPP and Parlay APIs.

The OSA interface reference points and their functional capabilities are summarised in Table 4.

Table 4. OSA reference interfaces and functional capabilities.

Interface Reference Point	Functional Capabilities
1	Defines interface classes between the applications and the framework, which provide applications with basic mechanisms (e.g., authentication) that enable them to make use of service capabilities in the network.
2	Defines interface classes between applications and service capability features (SCFs), which are individual services that may be required by the client to enable the running of third-party applications over the interface (e.g., messaging-type service).
3	Defines interface classes between the framework and the SCFs, which provide the mechanisms necessary for multi-vendorship.
4	Defines interfaces between the framework and enterprise operator administration tools.
5	Defines interfaces between the service capability features and enterprise operator administration tools.
6	Defines interfaces between the framework and service supplier administration tools.

Source: Parlay APIs and ETSI.

3.3 Application Programming Interfaces (APIs)

Parlay Group, ETSI, JAVA for Intelligent Networks (JAIN) and 3GPP have collaborated on the development of standard APIs for a rapid and cost-effective telecommunication service creation. 3GPP has standardised a number of APIs for mobile applications. Table 5 shows a summary of APIs accepted by 3GPP and the next phase of APIs targeted for standardisation.

Table 5. Summary of APIs-3GPP evolution of framework and service capability interfaces.

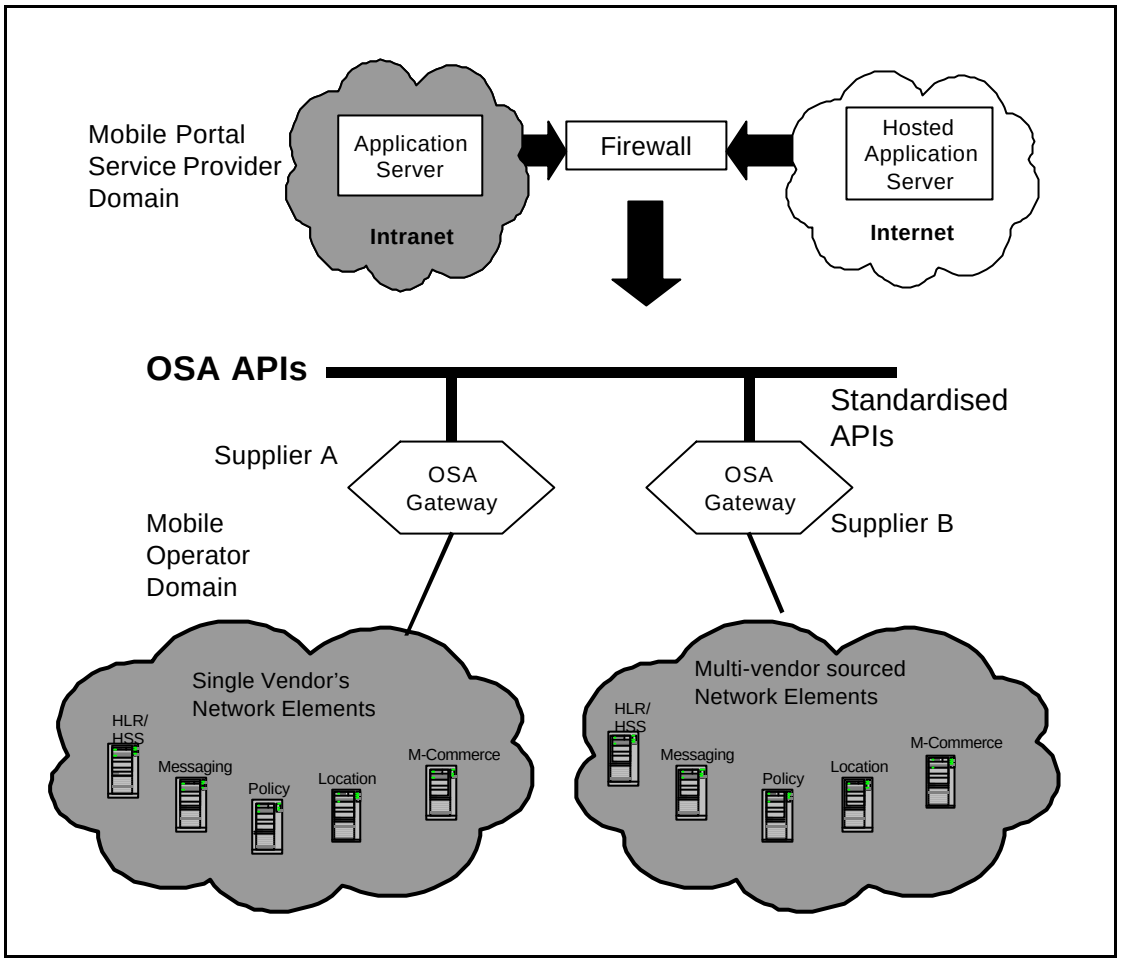
Interface Type	Release 1999 (R99)	Release 4 (R4)	Release 5 (R5)	Remarks
Framework	• Trust and Security Management Integrity Management • Service Registration and Discovery	In addition to R99: • Event Notification • Accounting Management	Candidates in addition to R4: • User Profile Management • Policy Management	R99 was completed in Dec. 2000 R4 was targeted for completion in July 2001 R5 is scheduled for completion in Dec. 2001 (under development)
Service Capabilities	• Generic Call Control • Data Session Control • User Location • User Interaction • User Status • Terminal Capabilities	In addition to R99: • Multi-party Call Control • Content-based Charging	Candidates in addition to R4: • Messaging • Multimedia Call Control • Presence and Availability • QoS •	R99 was completed in Dec. 2000 R4 was targeted for completion in July 2001 R5 is scheduled for completion in Dec. 2001 (under development)

Source: 3GPP, April 2001.

An application-level network configuration with OSA gateway and standards-based APIs is shown in Figure 10. OSA and standards-based APIs create a network configuration whereby

different elements of mobile service delivery can be procured from various vendors. Open APIs ensure multi-vendor product interoperability.

Figure 10. Open API-based multi-vendor configuration.



Source: 3GPP and Parley APIs.

A number of trials are being conducted to establish the feasibility of an open API gateway approach across multiple vendors. Appium, Wirenix, and Ericsson recently conducted a trial to demonstrate a multi-vendor approach to next generation mobile service platforms. More comprehensive trials are being planned for testing of various APIs.

While many traditional telephone companies support the standards based approach to APIs, this may not enjoy the same level of support from Internet content developers. This may lead to two competing approaches to new application development.

3.4 Markup Languages

SGML (Standard Generalised Markup Language) is a language for describing markup languages, particularly those used in electronic document exchange, document management and document publishing. This language was developed in 1986.

HTML (Hypertext Markup Language) is an SGML application conforming to International Standard ISO 8879, and is widely regarded as the standard publishing language on the World Wide Web. In a remarkably short span of time, HTML became wildly popular and rapidly outgrew its original purpose. Since HTML's inception, there has been a rapid invention of new elements for use within HTML and for adapting HTML to vertical, highly specialised portals. The

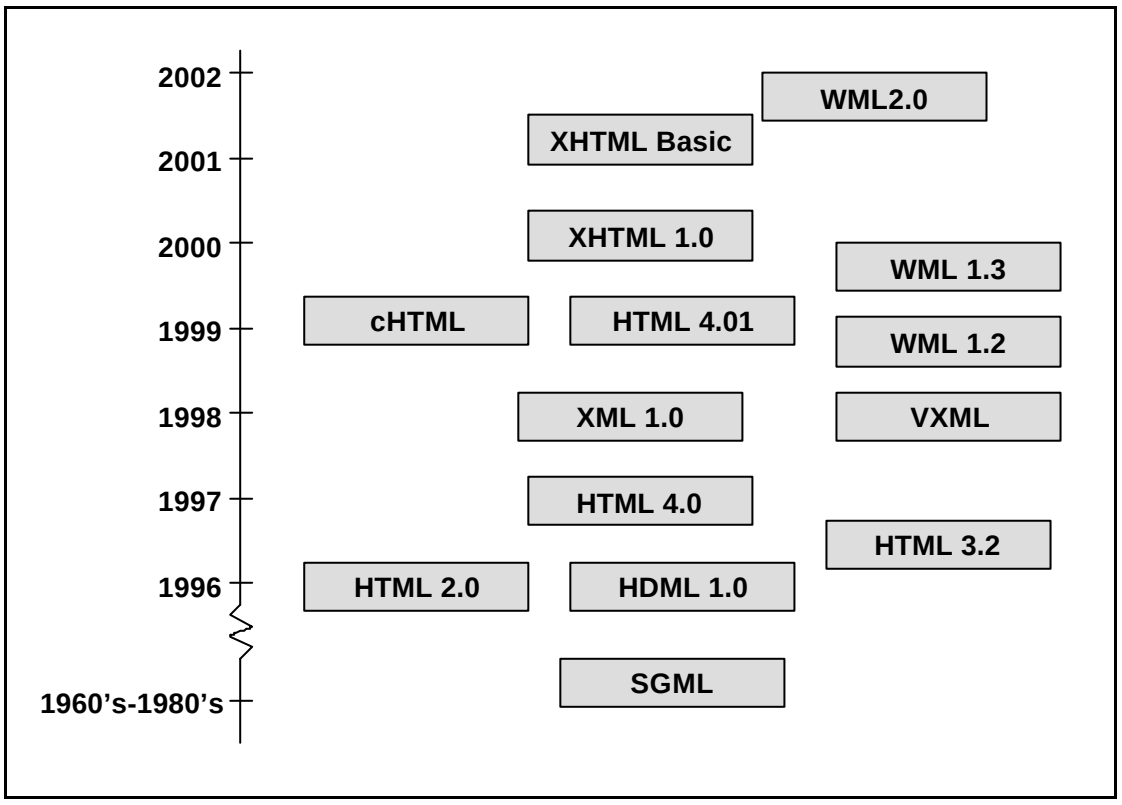
limitations of HTML have led to the development of a new markup language called XML (Extensible Markup Language).

A number of markup languages have been specified for various application environments during the past five years. Figure 11 gives a pictorial representation of the rapid evolution of a number of markup languages. A summary of these languages with their attributes is given in Table 6. From the standpoint of mobile services the following languages are currently important:

- WML
- cHTML
- XHTML
- VXML

The markup language is an evolving area and new languages may appear for very specialised applications. CXML (Commercial XML) and ebXML (e-business XML) markup languages will find applications in the area of mobile commerce.

Figure 11. Evolution of markup languages.



Source: UMTS Forum.

These markup languages are summarised in the following table. Shading indicates the most important languages.

Table 6. Markup languages, applications and characteristics.

Format	Description	Application Examples	Characteristics
HTML	Hypertext Markup Language	Web browsers	Development started in 1990 Defines a simple, fixed type of document with markup designed for a common class of office or technical reports Nearing the limit of its usefulness
HDML	Handheld Device Markup Language	Cell phones with Openwave UP.browser	Invented by Unwired Planet Year introduced: 1997 On its way to obsolescence
XML	Extensible Markup Language	Web browsers	W3C standard since 1998 Not a fixed format like HTML Enables the translation of HTML on the World Wide Web
WML	Wireless Markup Language	WAP-enabled cell phones	Supported by the WAP Forum Based on XML WML 1.2 – December 1999 WML 1.3 – June 2000 and WML2.0 – August 2001
cHTML	Compact HTML	i-mode cell phones	Proposed to W3C in 1998 Pushed by i-mode Based on HTML
XHTML 1.0	Extensible HTML	Web browsers	Supported by W3C A combination of HTML and XML All elements of HTML 4.01 combined with the syntax of XML
XHTML Basic	Basic XHTML	Mobile devices	Supported by W3C Year of approval: 2000 Is a subset of WAP V2 and WML V2 W3C hopes to reconcile competing markup languages using XHTML Basic as a common reference
CXML	Commerce XML	Exchange of catalogue content for secure transactions over the Internet	Supported by 40 e-commerce companies First available in mid-1999 A lightweight XML
PML	Procedural Markup Language	Flexible content representation	Introduced by Georgia Institute of Technology Year of introduction: 1998 Allows content representation in a flexible manner by specifying the knowledge structure
ebXML	e-business XML	Intercompany business-to-business (B2B) and supply chain management (SCM)	ebXML is global in scope, support and implementation A joint initiative of United Nations and OASIS Year of approval: 2001
VXML	Voice XML	Voice interface to information systems	Proposed by AT&T, IBM, Lucent and Motorola VXML Forum has over 400 supporting members Allows interaction with Web sites by voice and voice-recognition technology

Source: UMTS Forum.

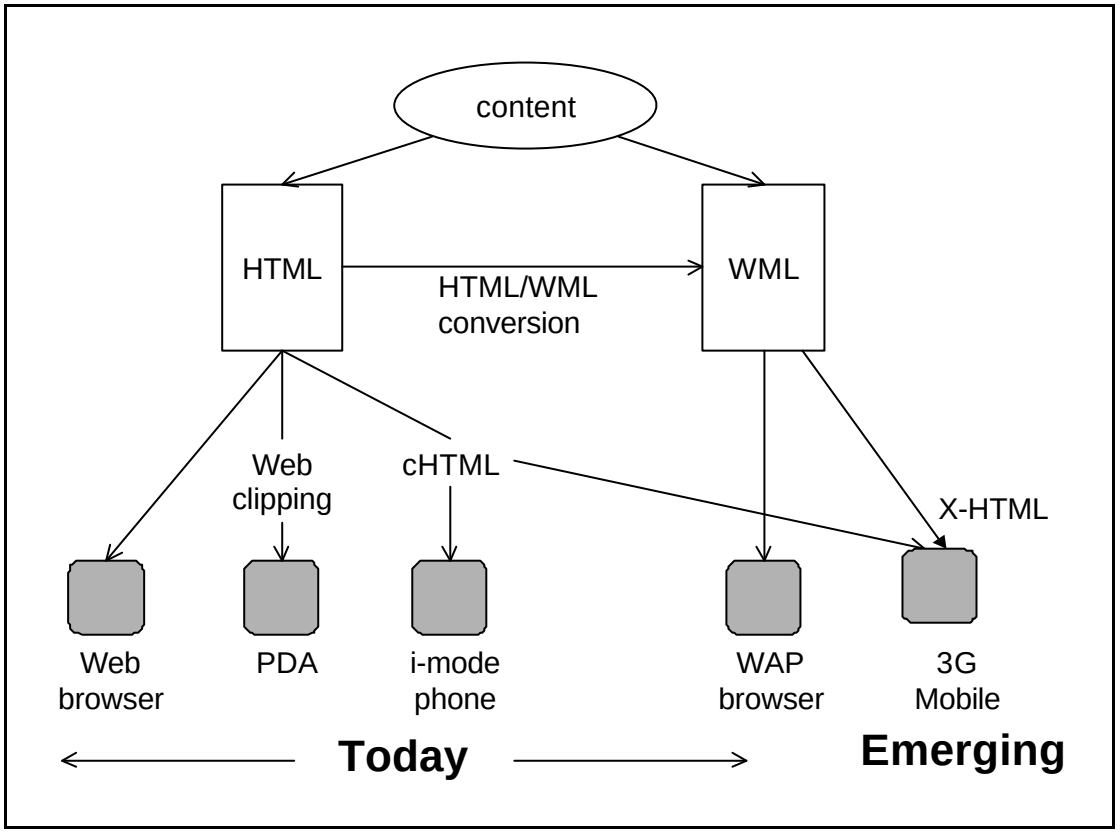
Today there are two dominant markup languages used in providing content to mobile phones. These languages are:

- WML (Wireless Markup Language) developed by the WAP Forum
- cHTML (Compact HTML) developed by Access Co. Ltd. for NTT DoCoMo's i-mode mobile service

There are many incompatibility problems between different WML browsers, which have limited the full acceptance of mobile services by the users. cHTML has seen continuous success in Japan for a range of i-mode services but has limitations for providing the next level of multimedia services.

The industry has come to grips with current WML and cHTML problems and helped create a convergent solution with the acceptance of new XHTML Basic markup language which is part of the WAP 2.0 release. This convergence is shown in Figure 12.

Figure 12. Main approaches to providing Web-style content to mobile devices.



Source: UMTS Forum and Practical WAP, 2001.

XHTML Basic is a smaller version of XHTML 1.0, suitable for mobile devices with little memory. It addresses the need to view Web pages on devices ranging from soda machines to 3G mobile devices. This markup language inherits most of its syntax from HTML and thus will make it easy for content developers to learn and use. XHTML Basic and WAP 2.0 developments are a step forward for the mobile industry; and for users, the dream of on-the-go Internet moves closer to reality.

While adoption of XHTML Basic by the WAP Forum and NTT DoCoMo means a more consistent interface for users, terminal makers have thought about backward compatibility . If terminal manufacturers are required to support both XHTML Basic and the earlier WML, memory demands for new generation devices could double. The GSM Association recommends deploying duel browsers with WML and XHTML capability.

IBM is working with 3GPP/ETSI to develop multi-channel and multi-modal applications by

enhancing codec functions. Multi-channel allows a single application to be used in different user contexts via WML and VXML interfaces. Multi-modal is more complex and extends this with event models to allow users to change from one channel or modality to another at certain points. Examples of these points include page or section boundaries within a document or moving from one type of transaction to another type. These approaches would allow simpler devices with complex functions offloaded to the network and complex devices to enjoy similar experiences.

In another industry development, QUALCOMM has announced a new language and platform called BREW (Binary Runtime Environment for Wireless). The future impact of BREW on the mobile market is not yet known.

3.5 Personalisation

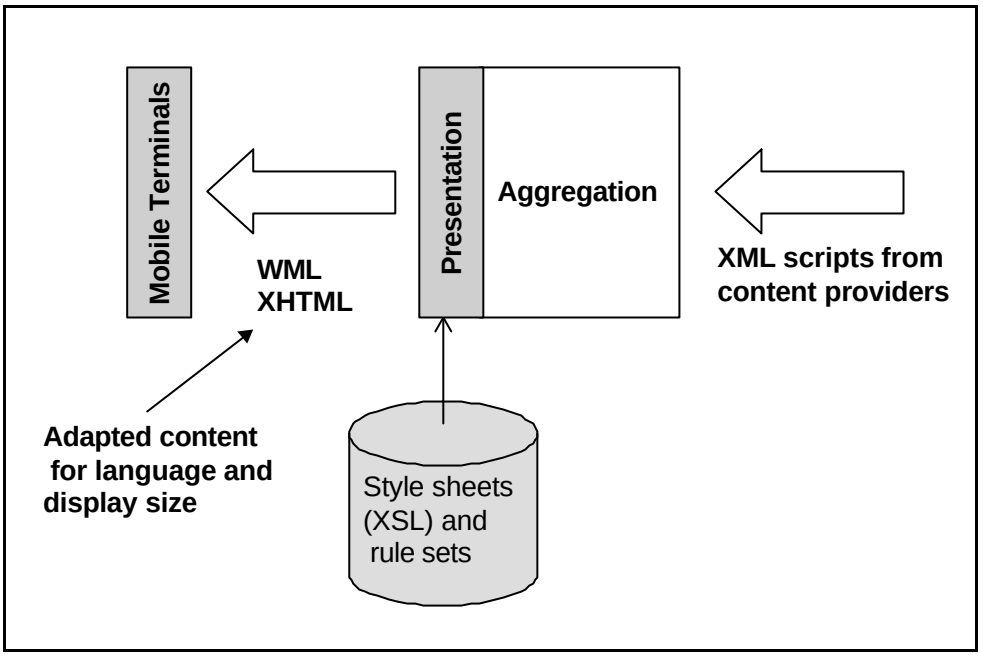
Human beings are individuals. The communication, information and entertainment needs vary from one person to another. Personalising a mobile access device for an individual will enrich his/her usability experience and promote a higher degree of access to mobile services. The following features are examples of how individual devices can be personalised:

- My personal home page
- My personal style sheet
- My personal profile update
- News, stock quotes, weather report only at certain times of day
- Alerts on changes in my credit report
- Alerts on changes in my medical/health condition
- Birthday reminders for my family and friends
- e-mail notification
- My personal handwriting recognition input
- My personal voice recognition input
- My personal thumb impression security
- My personal ring tones for selected callers
- My personal colour and physical shape of the device

Adding these or other personalised features on the access device will harmonise the information access environment for the mobile user. The access device will become an extension of a user's personality.

XSL (Extensible Stylesheets Language) and rule sets are used in WAP-based mobile services to provide personalisation on current devices. The rule sets need updates with the introduction of a new service and with the deployment of a new mobile device. A configuration to provide personalisation with XSL is shown in Figure 13.

Figure 13. Transcoding of content through XSL.



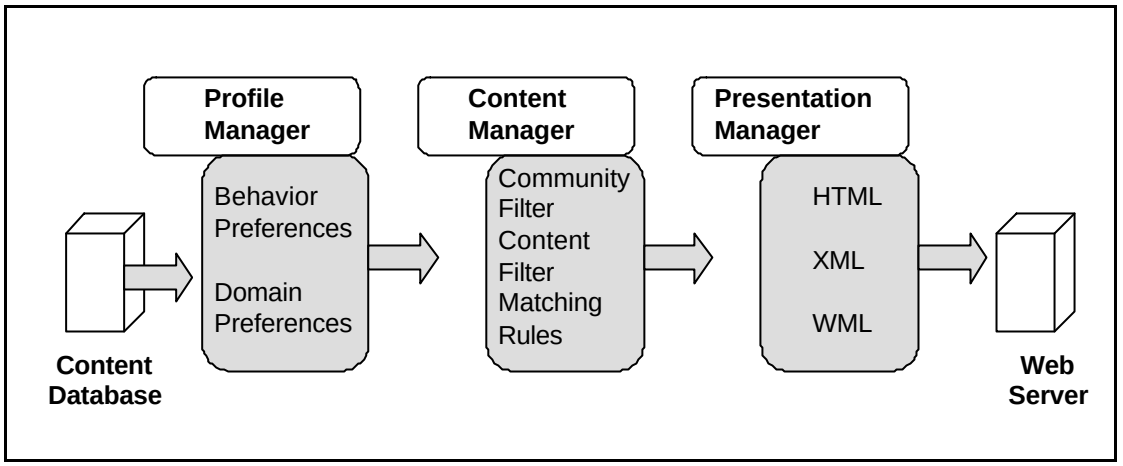
Source: WAP Forum.

Content developers and mobile operators are paying an increasing amount of attention to the personalisation aspect of mobile services. Different vendors are proposing new solutions to provide a family of rich personalisation features. An example of a personalisation engine by ClixSmart is shown in Figure 14. The software platform in this engine is structured as:

- Profile manager
- Content manager
- Presentation manager

The profile manager is an extremely important element in providing on-going and changing personalisation services to individual users. A number of intelligent multi-agent technologies will be deployed to monitor the usage behaviour of individuals and update their profiles periodically. An adaptive user profile data will interact with network databases in creating new rule-based personalisation services. Such an approach to personalisation will provide a very rich usability experience to the mobile user. The level and quality of personalisation provided will vary from one vendor to another and will become a key distinguishing feature of one business to another.

Figure 14. Components of a personalisation engine.



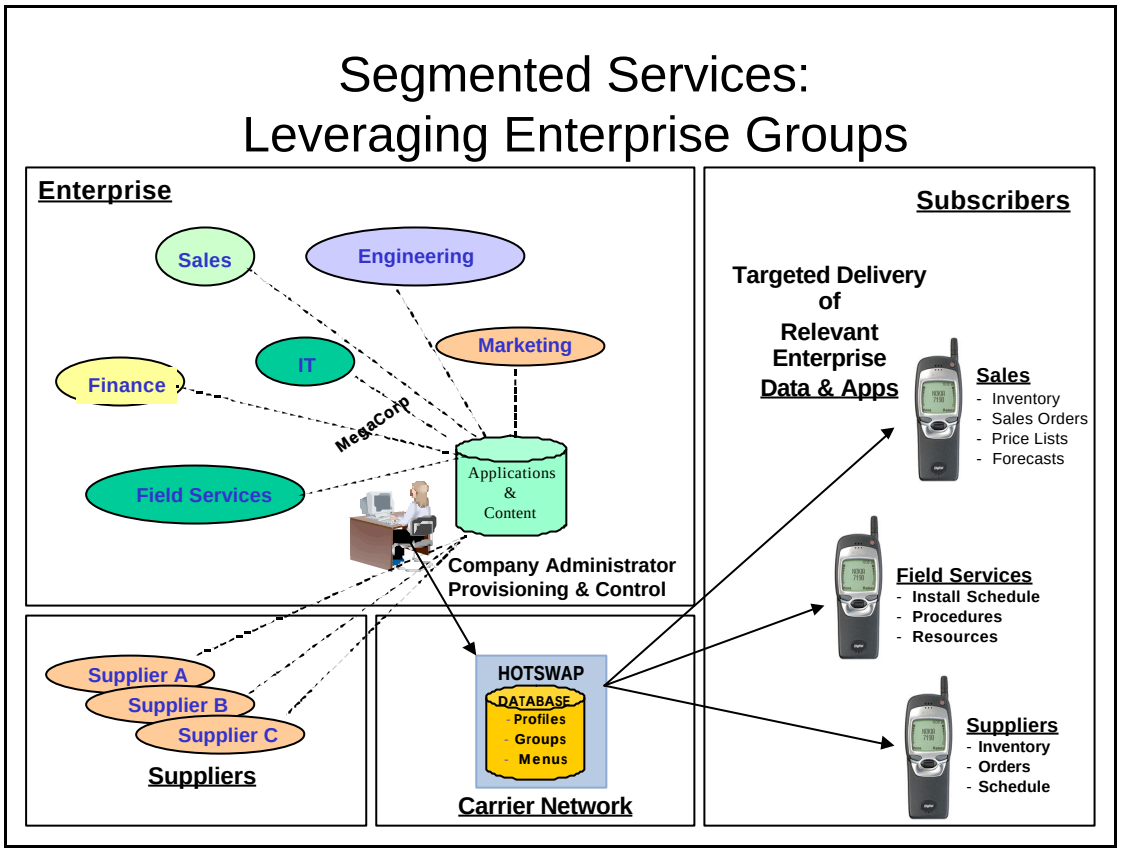
Source: ClixSmart.

The portfolio of personalised services should include the following important services for the mobile user:

- Privacy protection
- Virus control
- Filtering/Spam control

The personalisation aspect of mobile service has different dimensions for an enterprise portal user. Enterprises can tailor the business services for mobile employees, business partners and suppliers based on the group behaviour or individual needs of a person. An example of an application of this concept is shown in Figure 15.

Figure 15. Personalisation services from enterprise portals for employees and partners.



Source: Altawave.

A new set of multi-channel and multi-modal capabilities would provide additional personalisation services for consumers and business users.

3.6 Industry Implications

Table 7 below summarises the significant implications to the industry for technical areas identified in this section.

Table 7. Industry implications summary.

Technical Area	Implications to Industry
APIs	The industry is adopting a convergence approach and needs to move quickly to test and adopt mobile APIs. APIs need to be finalised in the next 1-2 years.
Markup Languages	The industry is adopting a market approach with WML and cHTML. Lack of backward compatibility will inhibit market growth by complicating the content development process and fragmenting the user access. If both languages are supported, the memory requirements for the mobile device will increase. These issues need to be resolved in the near term. The mobile operators need to take the lead in resolving this issue. So many markup languages are causing confusion for the content development community. The industry need to work towards developing a minimum number of markup languages that integrate communication, content access and mobile commerce.
Personalisation	Personalisation is a key differentiator for most 3G services. The personalisation capabilities need to continue to improve in order to provide real value to users that they are willing to pay for. This development will take time and effort. Continued work in the area of profile managers, privacy and security is critical to enable ease-of-use for end users. Standards need to be developed to allow personalisation capabilities to work between networks. The mobile industry has to develop personalised services for consumers and corporate users separately. In the foreseeable future, the home network will provide personalisation. As the 3G infrastructure matures, the serving network may be able to provide personalisation services.

Source: UMTS Forum.

4. Mobile Terminals

This section describes the major technology issues impacting development of mobile terminals. Areas covered include mobile browsers, operating systems, and technology areas of the terminal itself for memory, battery, and displays.

4.1 Important Issues and Trends

Table 8 below summarises the significant trends and issues for the technical areas identified in this section.

Table 8. Issues and trends regarding mobile terminals.

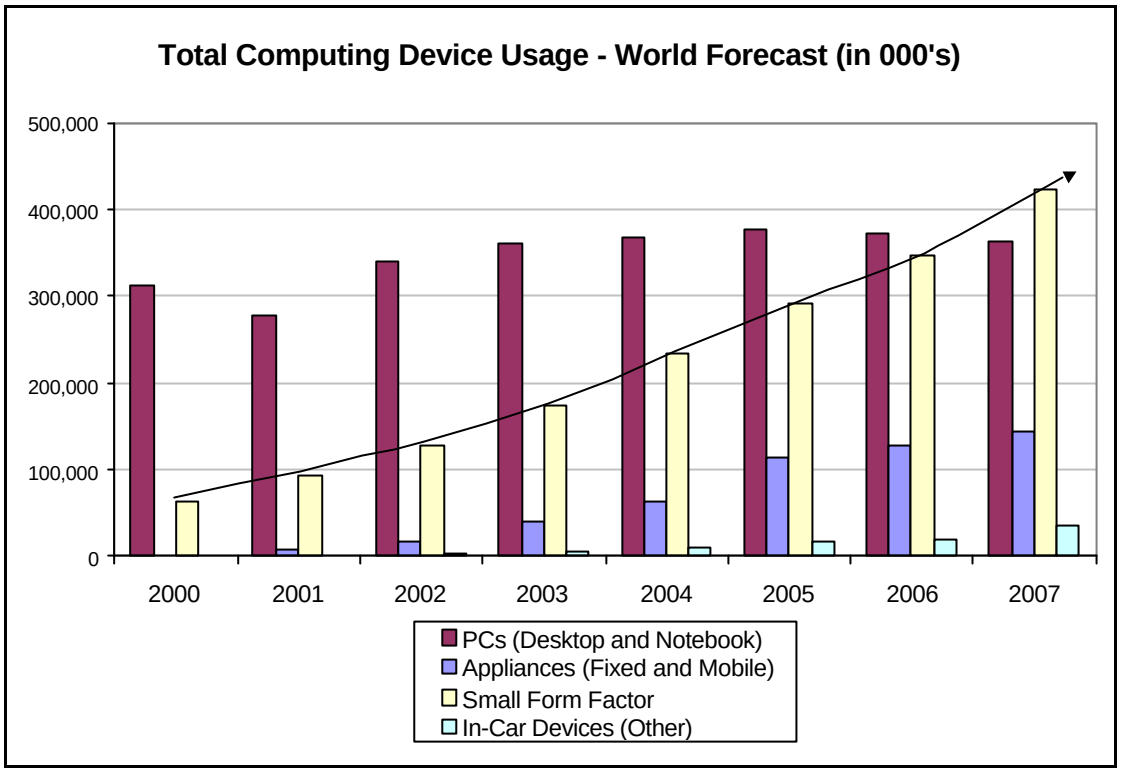
Technical Area	Trends or Issues
Mobile Browsers	Currently, browsers are "burned in" the mobile device. Future direction is to enable software-based, downloadable browsers, but with one factory-installed default. Human machine interface specifications for mobile devices have yet to be defined.
Mobile Operating Systems	A number of mobile operating systems exist in the marketplace today, and more are on the horizon. Linux OS and eCos are two recent developments.
Mobile Terminal Technology	Technological developments currently in progress today are providing more processing power, reducing battery consumption and are providing more memory. The pace of battery technology development is not keeping up with the progress of chip processing power. Display technology is evolving to create high-density colour screens.

Source: UMTS Forum.

In the fixed communication universe, desktop PCs and notebook computers are the two dominant end-user devices. In the mobile data communication market, a multitude of end-user data communication devices has been developed. These devices vary in form factor, functionality, usability and cost. Wearable mobile device concepts have been advanced in the industry. Disposable, pre-paid wireless devices will soon be available at retail outlets.

As seen in Figure 16, small form factor devices will grow to 44% of worldwide computing devices by 2007, up from 17% today.

Figure 16. Small form factor device penetration as compared to other devices.

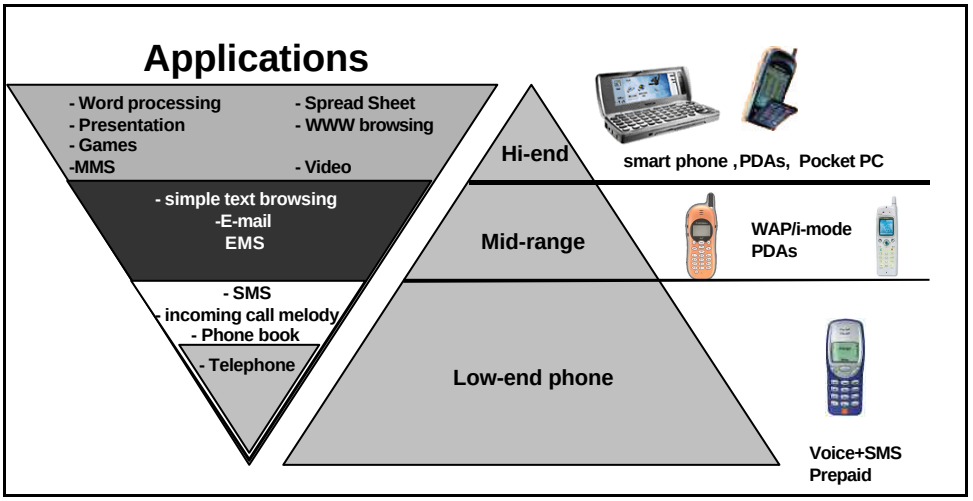


Source: www.researchportal.com.

4.1.1 Mobile Terminal Classification

Figure 17 describes low-end, mid-range, and high-end mobile devices.

Figure 17. 2G, 2.5G and 3G mobile device market segments.



Source: UMTS Forum.

Some markets are seeing saturation in terms of total penetration of currently available devices. Because of rapid changes in technology and device functionality, the replacement market for existing devices is very high. A variety of mid-range and high-end mobile devices are likely to appear to provide a rich user experience of 3G portal services.

4.2 Mobile Browsers

A browser is the most important part of a mobile device from the human machine interface point-of-view. In the fixed Internet world, Netscape and Microsoft Internet Explorer are the two most popular browsers. In the mobile Internet space, various vendors have developed a number of browsers. A summary of selected popular browsers is provided in Table 9.

Table 9. Selected mobile browsers and their applications.

Browser	Application	Ownership	Remarks
UP.Browser, Mobile Browser WAP edition, Mobile Browser Universal	Handheld mobile devices (phones, PDAs) WAP 1.0-2.0, and for 2.5G and 3G	Open Wave Phone.com	Used by 45 device manufacturers on 165 handset models including Alcatel, Siemens, Motorola, and Panasonic
Nokia's WAP browser	Handheld mobile devices (phones and PDAs) WAP 1.0-2.0, and for 2.5G and 3G	Nokia	Ships on Nokia handsets OEM license available
Microsoft Mobile Explorer (MME)	Dual-mode browser for display of both WAP 1.1 and HTML on mobile handsets Focus on corporate applications	Microsoft	Ships on Samsung, Sony, Hyundai, Benfon handsets
Jataayu WAP browser	PDA devices WAP 1.1 and 1.2	Jataayu	Ships on Palm OS v3.1 and above Soon available on EPOC, Windows CE
i-mode browser i-browser	cHTML based devices For Windows OS based devices	NTT DoCoMo (Dominant Service Provider)	Available on millions of devices used in DoCoMo's network.
EZWAP Browser	Operating system independent Intended to be integrated into any machine	EZOS	Available for Windows NT, Windows CE, and Windows 2000 platforms
J2ME	Framework for deployment of JAVA technology in post-PC devices (PDAs, mobile handsets, consumer electronics such as TVs, VCRs, etc.) Two configurations: CDLC and CD, for both devices that are memory constrained or with more robust memory resources	SUN	Shipments on Nokia and LG Telecom Announced use by Ericsson, Siemens, Motorola, Sony, Samsung, NTT DoCoMo Nokia and Borland collaborating to deliver JAVA technology tools for mobile application developers KJAVA version shipping with gAMEiSLIVE mobile entertainment

Source: UMTS Forum.

Most low-end devices including current WAP and i-mode phones come from the factory with "burned in" or embedded browsers. High-speed 3G networks provide the option of downloading browsers to mid-range and high-end devices based on customer choice. The market will find ways to make new browsers available from major portal sites. IBM is also working with 3GPP/ETSI to develop multi-channel and multi-modal browsers for complex application scenarios.

In the last year, J2ME browser has been increasingly popular with many device vendors, and a

number of industry alliances have been announced for inclusion of J2ME browsers in new devices. J2ME is a broad approach to content display and development.

J2ME technology specifically addresses the vast consumer space, which covers the range of extremely tiny commodities such as smartcards or a pager, all the way up to the set-top box, an appliance almost as powerful as a computer. Like the other editions, the J2ME platform maintains the qualities that JAVA technology has become famous for:

- Built-in consistency across products in terms of running anywhere, anytime, over any device
- Portability of the code
- Leveraging of the same JAVA programming language
- Safe network delivery
- Applications written with J2ME technology are upwardly scalable to work with the J2SE and J2EE platforms

The promise of the J2ME platform is to provide a complete, end-to-end solution for creating state-of-the-art-networked products and applications for the consumer and embedded market. J2ME technology enables device manufacturers, service providers, and content creators to gain a competitive advantage and capitalise on new revenue streams by rapidly and cost-effectively developing and deploying compelling new applications and services to their customers worldwide.

A number of human-machine interface (HMI) standards have been defined for the fixed-desktop devices as shown in Table 10. The applicability of these standards for mobile devices needs to be established.

Table 10. Human-machine interface (HMI) standards.

Standard	Application	Comments
ISO 14915	Design of controls and navigation, media combination/individual media requirements, and domain-specific media aspects	Also produced by TC159/5C4/WG5
ISO 9241	Ergonomic requirements for office work with visual-display terminals	Produced by ISO Technical Committee 159
ISO-IEG 11581	Graphical symbols on screen	ISO-IEG Joint Technical Committee 1 is a combined activity of ISO and the International Electrotechnical Commission
ISO-IEG 13714	User interface to telephone-based services-voice and messaging applications	ISO-IEG Joint Technical Committee 1 is a combined activity of ISO and the International Electrotechnical Commission
ISO-IEG 11580	Names and descriptions of objects and actions commonly used in an office environment	ISO-IEG Joint Technical Committee 1 is a combined activity of ISO and the International Electrotechnical Commission

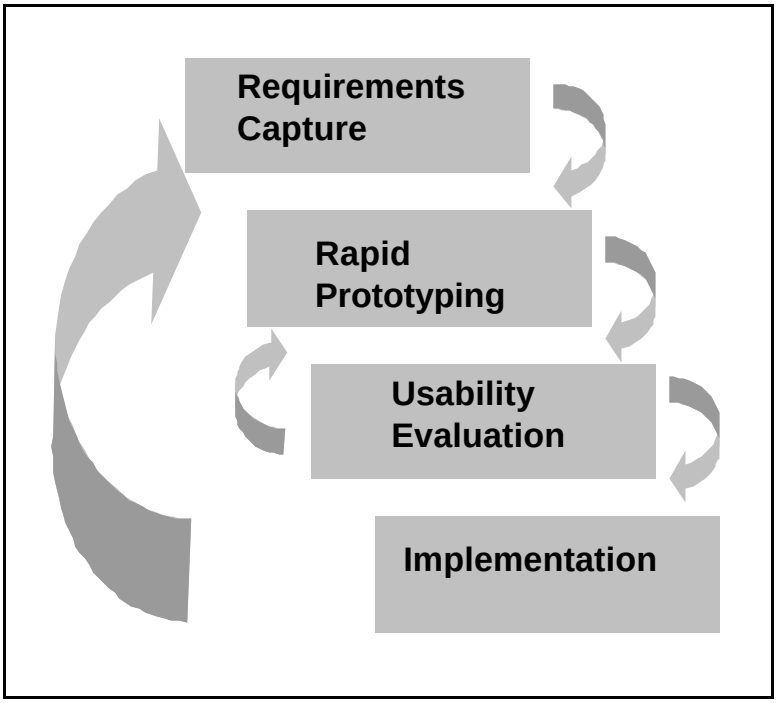
Source: www.iso.ch.

Rigorous testing methodology needs to be deployed in testing the HMI aspect of any new mobile device. The main steps of this methodology are shown in Figure 18.

A successful deployment of this methodology will provide a number of personalised human-machine interfaces based on the service used by the mobile user. A feedback mechanism can be built-in to provide continuous input to the mobile operator to improve the performance of the

HMI.

Figure 18. Methodology for HMI development.



Source: The Human-Machine Interface (HMI) Tutorial (www.iec.org/tutorial),

4.3 Mobile Operating Systems

An operating system is an integral part of a computing device. It provides a number of services such as memory management, configuration management and device interface management, and thus creates a stable application execution environment. In the fixed desktop world, only a few operating systems dominate and Microsoft Windows has the lion's share of the market. In the mobile device universe, numbers of operating systems have been developed. Table 11 compares the operating systems of the major players. The demand for mobile portal services and new device developments may bring about other mobile operating systems in the market.

Table 11. Comparison of major operating systems.

	Windows CE	EPOC	Palm OS	Linux OS
Microprocessor Support	• ARM, SSH3/4, MIPS or Power PC • 206 MHz • Binary format • 32 bit	• ARM M-Core • 32 bit	• Motorola Dragonball • 16 bit • 20 MHz	• Agenda VR3 • 32 bit • 66 MHz
Devices	• PDAs and HPCs	• Phones and PC companions	• PDAs and Symbol devices	• PDAs and handheld computer
Resource Consumption	• Poor • Stripped down from large footprint design	• Small footprint; long battery life	• Small footprint; long battery life	• Small footprint; long battery life
Market Presence	• Growing installed base; weak in Europe	• Small installed base; strong in Europe	• Largest installed base and strong distribution	• Currently None
Presentation Formats	• MME, HTML, WAP browsers	• HTML and WAP browsers	• Web clipping, WAP, proprietary browsers	• HTML and WAP browsers
License Presence	• Excellent with palmtop manufacturers	• Must prove itself with non-phone licenses	• Good license distribution in PDAs	• Open source code

Source: UMTS Forum and SalomonSmithBarney.

PDAs have been around for a number of years and these incorporate Palm OS operating system. Palm OS has the largest share of the market that includes PDAs with mobile access and stand alone PDAs.

The Linux operating system for handheld devices is new and expected by some to change the current view of the mobile operating system market in the coming years. The following points highlight some of the Linux specification and application developments:

- An industry group has recently released the first version of a standard designed to make it easier to write Linux software by guaranteeing those different versions of Linux work similarly. The Free Standards Group released version 1.0 of the Linux Standard Base Specification (LSB). This specification is aimed at reducing the difficulties of getting software such as Oracle's database to run on versions of Linux from Red Hat, Debian, SuSe and others.
- German Linux start-up Tuxia has cut a deal to bring the company into the expanding and potentially gigantic Chinese market for Internet appliances. Tuxia plans to co-develop Linux-based gadgets such as thin-client terminals, set-top boxes, PDAs and Web pads with Beijing Orient Electronics Group, a large manufacturer of electronics and displays.
- Japan's Sharp plans to start selling its Zaurus multimedia PDAs in the US in October 2001; and in Europe, early next year. This device uses Linux as the operating system and JAVA as the application platform. Sharp envisions that applications written in JAVA language can run on any type of computer and a host of devices, allowing Zaurus users to share information with other digital gear, including mobile phones and fax machines.
- A number of other device manufacturers have also announced Linux-based products because of its open and royalty-free source code.

3G Lab and Red Hat has recently announced a new real-time operating system called embedded configurable operating system (eCos) for mobile devices. This system is not based on the Linux platform. 3G Lab and Red Hat believe that an open source based system would be more flexible and address the deep customisation needs of 2.5G and 3G services.

4.4 Mobile Terminal Technology Trends

A harmonised mobile terminal is important for the success of 3G portal services. A number of progressive technological developments will help pave the way for a family of new 3G terminals. These developments include:

- Microprocessor technology
- Memory technology
- Battery technology
- Display technology

4.4.1 Microprocessor Chip Technology

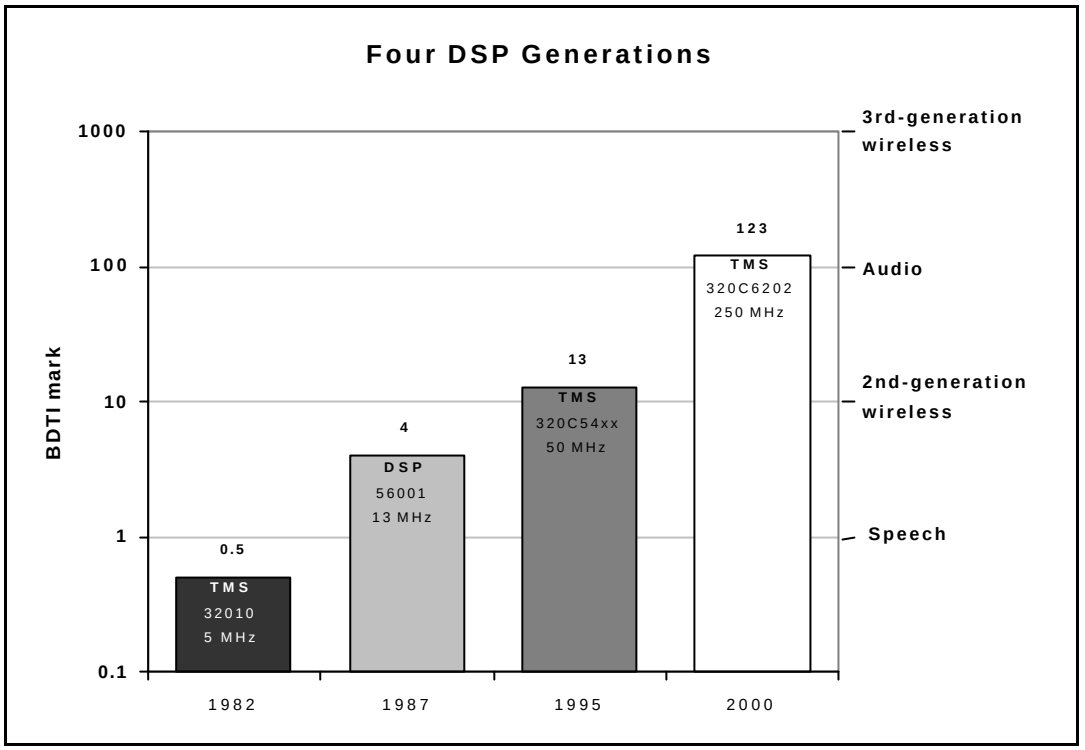
A number of major chip manufacturers have recently announced developments in chips for mobile devices. These include:

- Intel has announced a family of chips named Tualatin for mobile devices. Five different chips under Tualatin trade name will run at clock speeds of 866 MHz, 933 MHz, 1 GHz, 1.06 GHz and 1.13 GHz. These chips are being built using Intel's new 0.13-micron manufacturing process.
- AMD has announced their mobile chips based on their Athlon 4 chip set. A mobile version of Athlon runs at a clock speed of 1 GHz.
- Transmeta has announced its TM 5800 chip for mobile devices. This will be designed with a newer 0.13-micron manufacturing process that will raise clock speed as high as 800 MHz. Transmeta also plans to introduce two additional chips in 2002 to help it become more competitive with Intel.
- Motorola Labs have created a new GaAs on silicon wafer for a family of devices and applications. The next phase of this project aims at growing indium phosphide on silicon. This technology may support clock speeds of 70 GHz.

These improvements in chip technology will reduce battery power consumption by about 20 percent as compared to today's chips.

Digital Signal Processor (DSP) chip is an important part of the mobile terminal system design. Its processing capability and power consumption dictate the practical applications supported by the terminal. The DSP technology has gone through several generations of performance improvement as shown in Figure 19. An order-of-magnitude performance improvement has been achieved during the past four generations of DSPs. The metric for performance measurement in this case was defined by Berkeley Design Technology Inc. (BDTI) and provides a relative level of performance improvement from one generation to the next. This is an active area of research for all major chip manufacturers, and further improvements are expected in the coming years.

Figure 19. Improvement in DSP chips for mobile devices.



Source: Jennifer Eyre, BDTI, IEEE Spectrum, June 2001

Another important chip industry initiative is to develop a complete mobile system on a single chip. Two important developments in this area include - Open Multimedia Applications Platform (OMAP) by Texas Instruments (TI) and "Internet on a chip" by Intel. These single chips combine multiple functions on a single piece of silicon. These more cost-effective single-chip micro-processing engines are being designed to process data and mobile multimedia applications without compromising the battery life.

4.4.2 Memory Technology

Today's mobile handset data storage capacity ranges from 2 Mbytes to 64 Mbytes of flash memory. For new browsers, media players and multimedia applications for 3G devices, more memory will be required.

Intel has identified three promising technologies: "plastic" memory, or polymer ferroelectric RAM (PFRAM); Ovonics Unified Memory (OUM), which uses the same material as rewritable CDs; and Magnetic RAM (MRAM). Intel's vision is to provide 500Mbyte memory in future handheld devices. Intel expects to see OUM based products by the end of 2003.

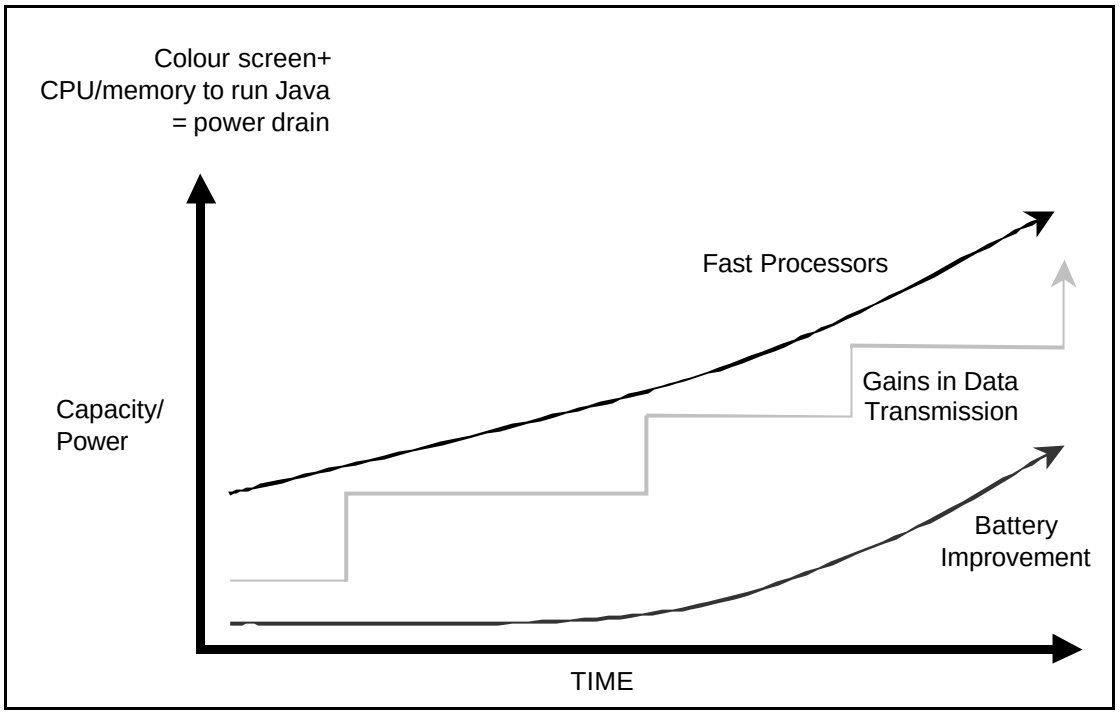
Mobile device-based memory will never be enough for evolving personalisation services and high-end video and streaming applications. Mobile operators need to provide network-based virtual storage for new applications as well as backup storage of all information stored in the mobile device. Protecting customer information is an important part of this virtual-storage service.

4.4.3 Battery Technology

Emerging mobile multimedia services require new terminals with additional processing power for service execution and display on a colour screen. It takes semiconductor manufacturers about 18 months to double the number of transistors on a piece of silicon and thus give a huge boost to the device they run. However, it takes battery makers 5-10 years to achieve comparable

increase in power. The increasing gap between the processing power of silicon and battery power is shown in Figure 20.

Figure 20. Comparison of battery power improvement and chip processing power.



Source: SalomonSmithBarney.

In today's mobile terminals, two types of batteries can be used--primary batteries and secondary batteries. Primary batteries are non-rechargeable and are used in some terminals. The advantage of this type of battery is that the user need not charge the mobile device. However, it is not environment-friendly and is an expensive option for long-term use. Hence, secondary batteries (rechargeable batteries) are the most acceptable solution, giving the best size, weight, talking and data access use time and cost ratio today. A comparison of four types of secondary batteries is shown in Table 12.

Table 12. A comparison of secondary batteries.

	Ni-Cd (Nickel Cadmium)	Ni-MH (Nickel Metal Hydride)	Li-ion (Lithium-ion)	Li-Po (Lithium Polymer)
Advantages	• Charges very fast • It can be cycled 750-1000 times • Easiest to recharge after lengthy storage • Safest of all battery types to ship or store • 30% more effective than all battery types in extreme temperatures	• Less affected by memory • Over 35% greater power capacity than Ni-Cd • No hazardous materials used to manufacture • It can be cycled 350-500 times	• High energy density • Light weight, almost 50% less than Ni-Cd • Self discharge rate extremely low • No memory effect	• High energy density • Lightweight, almost 75% less than Ni-Cd • Self-discharge rate extremely low • No memory effect • Possible to make it in different shape (very thin form factor possible)
Disadvantages	• Looses around 10% of capacity within the first 24 hours • Self-discharge rate after the first day is almost 10% per month • Memory effect • Hazardous material used	• Takes twice as long to charge as a Ni-Cd • Charger may need a temperature sensor for safest recharge • Losses about 20% capacity within the first 24 hours	• Takes 8-15 hours to charge • Can be charged about 250 times. (Newer technology getting better results) • Very costly (>3 times Ni-MH) • Made from hazardous materials • Danger of explosion during corrosion when exposed to moisture	• Takes 8-15 hours to charge • Can be charged about 250 times. (Newer technology getting better results) • Very costly (>3 times Ni-MH)

Source: UMTS Forum.

Battery technology for mobile devices is an active area of research, and incremental improvement is expected during the coming years. But in the long term, better batteries may not be the answer. Because they go through a chemical reaction, they are limited to producing power and being recharged at a certain rate. The following technology seems promising for the future:

4.4.4 Fuel Cells

Fuel cells, a technology in development, do away with the problem of recharging entirely. Users just swap out an empty fuel cartridge for a new one or refill it with fuel and continue on their way.

University of Southern California in Los Angeles, USA, is working on methanol fuel cells for mobile applications. Surya Prakash, a professor of chemistry at the university predicts fuel cells will be commercially available within 5 years. Methanol produces only carbon dioxide and water as its waste products, so it is also environment-friendly.

The downside is that while methanol itself is extremely cheap, the rare metals necessary to create the power cells include platinum and ruthenium, both of which are quite expensive. Therefore, the initial market for such power sources will be from customers willing to pay a premium for convenience and longer life.

4.4.5 Display Technology

A display is an important but only one part of a mobile device design. As described earlier, a number of other advances are taking place in the processor, memory, battery, operating system, and browser technology. Collectively these advances will create a new family of harmonised and user-friendly 3G mobile devices.

A tiny screen on your mobile phone or personal digital assistant (PDA) displays a message or a picture that is captured by the eyes and transmitted to the brain. The quality of this human-machine interface defines the usability experience of seeking multimedia information and entertainment via a mobile device.

Currently there are a number of mobile phones on the market with low quality, backlit and monochrome screens. More recently, a number of PDA manufacturers have shipped devices with sharp colour displays. Most emerging 3G devices are envisioned to have colour displays to enrich the usability experience of users.

Display technology is an active area of research and investigation and following two technological developments will influence the design of new mobile and other screen based devices:

- Organic Light Emitting Diodes (OLED)
- Electronic Ink

4.4.6 Organic Light Emitting Diodes (OLED)

Unlike power-hungry Liquid Crystal Displays (LCD), OLED displays are brighter, sharper, power-friendly, and offer viewing angles of up to 170 degrees. An OLED display is built from a stack of ultra thin diodes. The resulting display is dramatically sharper, brighter, and more vivid than anything possible with conventional LCD phone screens. OLED screens are also self-illuminating, eliminating the need for a backlight. This feature reduces the power requirement for an OLED screen substantially below those of a LCD screen.

The following points summarise the current status of OLED technology development and future direction:

- Working with different standards, Kodak, Cambridge Display Technology, and Universal Display Corp. are leading the OLED development.
- Tohoku Pioneer was the first company to use an OLED display, in its car radio. Motorola followed with a passive matrix OLED in its Timeport mobile phone, a CDMA phone supported by Verizon.
- A number of consumer electronic manufacturers such as Philips, DuPont, Sanyo, Toshiba and others have now signed on to make products with OLED displays.
- Commercial products are due on the market by the end of 2002. The users can expect first-generation OLED products to hit the market at premium prices.

- OLED displays will find applications in digital cameras, small televisions and other small form factor devices.

4.4.7 Electronic Ink

Electronic Ink is another promising technology for screens on mobile devices. It is many times brighter than a LCD screen and draws an order of magnitude less power. The concept of Electronic Ink follows the logic that displays should look very much like print on paper and behave like print on paper. That means the display should be flexible like paper.

Electronic Ink is made up of millions of tiny capsules containing white particles suspended in a dark dye. An electric field causes the particles to move to one side of the capsule or the other, creating either a dark spot or a white spot. An Electronic Ink screen does not require a backlight and it is persistent. The persistent feature means that it does not require a constant supply of electric current to maintain a picture and is thus power-friendly.

4.5 Industry Implications

Table 13 below summarises the significant implications to the industry for technical areas identified in this section.

Table 13. Implications summary.

Technical Area	Implications to Industry
Browsers	The industry has adopted a market approach, with multiple proprietary browsers available. The low-end devices will continue with the current burned-in browsers. Industry consolidation into a few browsers that are downloadable is likely and highly desirable to reduce the complexity of managing multiple environments by operators. Standardisation of human-machine interfaces will be needed as the market matures.
Operating Systems (OS)	Industry has adopted a market approach with some consolidation of available OSs. There will likely continue to be more viable operating systems available in the future. An open standards-based operating system will reduce the cost of a mobile device, as no licensing fee will be required. Linux and eCos developments may impact the market adoption of mobile operating systems.
Terminal Technologies	Insufficient battery life and power consumption issues will impede the ability of 3G terminals to deliver the full potential of mobile multimedia services. Research needs to be intensified in the area of battery technology. If the potential of development such as fuel cells could be realised in the relatively near term, this could significantly impact the growth of the 3G market. Adoption of high-resolution colour displays would impact the growth of 3G services market. The power consumption of new displays can be a factor in this growth.

Source: UMTS Forum.

5. Critical Portal Service Enabling Capabilities

This section discusses the significant technical issues that will impact effective delivery of 3G portal services and their market acceptance. Issues covered are covered in this section include security, billing and payment, quality of service, interoperability and content format

5.1 Important Issues and Trends

Table 14 below summarises the significant trends and issues for the technical areas identified in this section.

Table 14. Trends and issues regarding portal service delivery.

Technical Area	Trends or Issues
Security	The industry believes that end-to-end security is needed, which currently can only be supplied with proprietary solutions. The industry is beginning to appreciate that public perception of security is equally as important as the development of the technology. Open-standard solutions are not yet available, and it is unclear how long it will take to develop and become accepted by the market. Security comprises of authentication for device and user, and transport security/encription. The industry has taken two approaches to addressing these issues: a USIM card combining SIM functions with additional security features; and the USIM contactless smartcard, a second card that combines security with micropayment systems and other personal information. Privacy policies, protecting customer profile and other personal information as well as individual concerns are emerging as significant issues that the industry needs to address. It is recognised as a problem; but as yet, no common solution has been identified. Security is extremely important for all enterprise Intranet/Extranet portals and for m-commerce transactions. Spam and virus controls are important issues to resolve.
Billing, Charging and Payment	Flexible billing systems have emerged that can rate services on a variety of pricing schemes and measurements. There is much uncertainty as to which billing options will be accepted in the market. There is a lag time to develop billing systems once requirements can be defined. The financial industry and manufacturers are working to incorporate micropayment and smartcard technology into mobile devices. Multiple groups are pursuing different objectives; there is little coordination among the different interests. Multiple payment systems will exist in the foreseeable future.
Quality of Service	End-to-end quality of service is required to meet end-user expectations. However, as yet, no industry criteria exist that will define the elements needed. Currently, the major elements are being developed independently, and there is little co-ordination between the different players involved.
Interoperability	Interoperability between components of a portal platform and between multiple terminals and portals has not been addressed.
Content Format	The mobile industry is adopting the open standards currently available for media format and compression. There is also a convergence underway to create unified integrated media standards. Metadata standards are still under development.

Source: UMTS Forum.

5.2 Security

Security is an important aspect of on-line service delivery for a family of 3G portal services. Its appropriate deployment enhances customer confidence to conduct on-line transactions while maintaining the privacy of the transaction information. The industry has recognised that in addition to deploying technological solutions for security, the customer perception of privacy and security needs to be enhanced. This section addresses:

- Translation vulnerability
- Transaction security
- Privacy protection
- Enhanced user identification and authentication

In today's environment, Subscriber Identity Module (SIM) cards used in GSM phones have many security features but do not ensure end-to-end security. Certain security issues have surfaced in the WAP gateway protocol translation. WAP uses WTLS for transport security and is translated into SSL. The WAP gateway in an end-to-end configuration represents a mediation node and translates GSM-security specifics into Internet-security specifics. The danger is that the data can be manipulated in this translation, so end-to-end security cannot be guaranteed without additional measures. The WAP.2 standards have addressed this issue for 2.5 and 3G services.

For 3G transaction services, a Universal Subscriber Identity Module (USIM) has been developed. The USIM is an expansion of SIM that stores user ID and other information to improve security functions. Its key attributes are:

- The USIM authenticates the subscriber and subscriber terminal to the 3G network and also authenticates the network to the 3G subscriber.
- The USIM carries the subscriber data as well as the operator specific data.
- It carries the cryptographic algorithms and public key infrastructure functionality.
- The USIM card can act as a phone book by storing hundreds of phone numbers, e-mail addresses, fax addresses. It can integrate this data with the communication capability of the mobile device.

3GPP has developed a number of specifications to facilitate the development of a standards based USIM card.

The end-to-end security involves the following important elements:

- Portal security for third party content creation and provisioning.
- Portal security for access to content by the end user.
- Network security via encryption.
- Mobile device security by opening the USIM card functionality for accessing portal content.

A collaborative effort between portal and mobile operators is important to address end-to-end security concerns.

A number of manufacturers are developing biometrics technology capable of uniquely verifying user identity. Such a feature will add another layer of security from the user perspective and thus enhance user perception about security. Fingerprint sensor technology is a promising technology for deployment on mobile devices. Availability of a cost-effective commercially deployable solution will add another convenient layer of security on the mobile device for user identification. This will make the entry of a PIN code optional or obsolete, depending upon the type and size of transaction.

Mobile user privacy is another important aspect of on-line information access and mobile transactions. Information-protection privacy laws vary from one country to another and need to be implemented by mobile operators and portal providers at a policy level. Mobile operators need to develop stringent processes to protect user-profiles and other user-defined personal data. Such privacy services may be offered as a part of "personalised service portfolio." Mechanisms need to be developed to monitor the violations of data privacy protection agreements between the user and the mobile operator. Defined Service Level Agreements (SLAs) will include remedies and consequences of such violations within the prevailing laws .

Mobile operators need to proactively implement controls within their networks to minimise the impact of network-wide virus and spam attacks on user terminals. This effort should be designed to combat the rising problem of virus-infected e-mails containing commands that automatically cause recipients' handsets to dial numbers, send e-mails, or freeze the screen. One major attack can lower consumer confidence in the overall acceptance of the service, and thus impact the operator's bottom line.

5.3 Billing, Charging and Payments

Billing is an extremely important marketing capability for appropriately charging for a range of 3G services. A robust and feature rich billing infrastructure would take some time to evolve for most operators. In the meantime, value added services may be charged based on some simplified billing approach. An end-user accepted billing approach is important for the success of a 3G service. An end-user perspective for a range of 3G portal services is shown in Table 15.

Table 15. Examples for billing for 3G portal services from the end-user perspective.

Type of Portal	Service billed by mobile/portal operator	Remarks
Mobile Intranet/Extranet	○	The corporate could receive a consolidated bill for all employees. Extranet partners get their own bill.
Customised Infotainment	◑	The user could be billed for most of the infotainment services. Advertisement based services should be free to the end user.
Multimedia Messaging Service	●	The mobile operator provides multimedia-messaging service and bills the end user. If a portal operator chooses to provide this service, the mobile operator may or may not bill the user depending on commercial arrangements with the portal operator.
Mobile Internet	◑	The mobile operator provides Internet access (mobile ISP) and bills the end user. If a user conducts commerce transactions then the operator may or may not bill the end-user depending on commercial arrangements with the portal operator.
Location-Based Services	◑	The mobile operator provides location-based service. If a portal operator chooses to provide this service, the mobile operator may or may not bill the user depending on commercial arrangements with the portal operator

●	◑	○
End-user gets billed	End-user gets selectively billed	End-user does not get billed

Source. UMTS Forum and Telecompetition, Inc., August 2001.

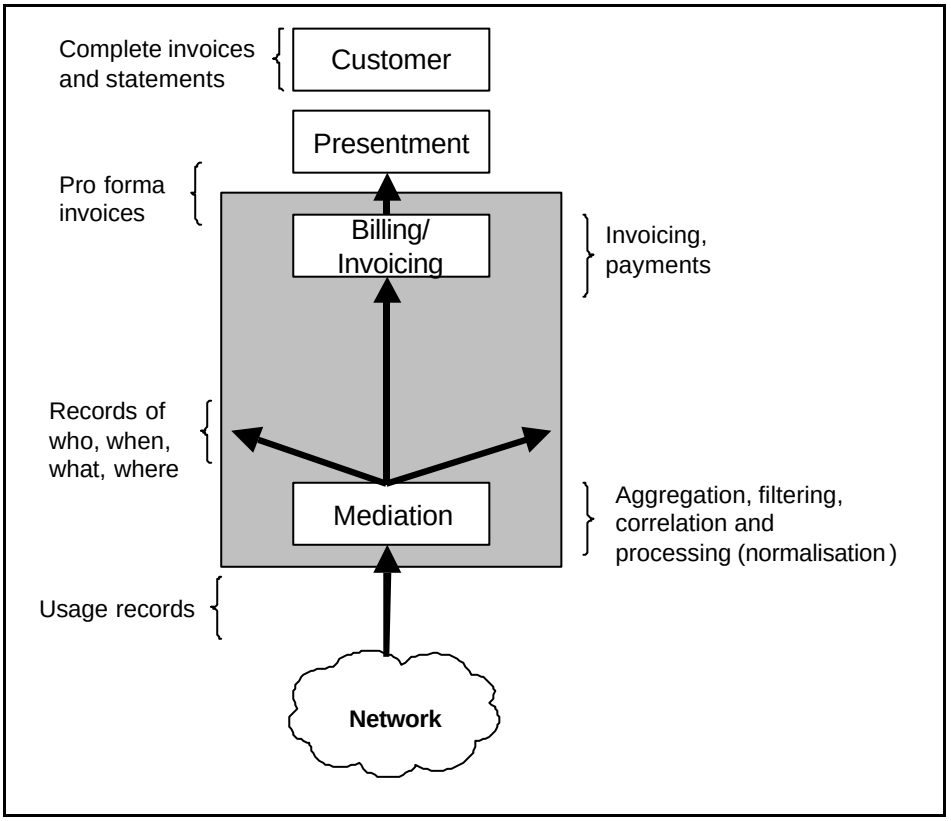
Billing for a variety of 3G services is a very complex area because of its interrelationship with service activation, service provisioning, customer care, payment method, and third party revenue sharing. These issues are addressed in detail in UMTS Forum Reports No. 9 and 13.

Billing software vendors are creating a number of bill presentation and payment options. These options include:

- Bill direct – where customers go directly to the mobile company's Web site to view detailed billing information and make payments.
- Thick model – where bills are sent through a portal, or bill aggregator, such as Yahoo or Bank1. The entire bill, with all of its information and customisation, is contained on the portal's system.
- Thin model – or thin consolidation model, which is also done through a portal, but only gives the customer an envelope of information at the portal–the amount due, due date, etc. A link brings the customer back to the service provider's Web site, where more detailed information is found.
- Direct e-mail billing – where an HTML document is delivered to the customer's e-mail address with all the information contained therein.

Some components of a billing system are shown in Figure 21.

Figure 21. Components of a billing system for portal services.



Source: EHPT USA, Inc.

The ability to rate services on a service-specific basis will be the key to unlocking the value of 3G portal services. 3G Internet billing models may move beyond wireline Internet flat-rate access models to include a variety of charging schemes, including:

- Charging by quality of service -- such as the download rate for e-mail attachments or the audio/video quality of a video call

- Charging by per transaction – such as charging per fax page, per round of golf in an interactive golf game, per instant message, per videoclip; or per photo for digital transmission
- Charging by byte – such as charging based on the file size downloaded (with bytes as the logical measurement)
- Charging by time units

The introduction of real-time billing for 3G portal services would require additional capabilities such as:

- Getting pre-rating data from third party service providers/partners.
- Getting data other than usage and/or subscription data. An example of such data includes "loyalty bonus points" based on loyalty program consideration.

3GPP has defined a number of contents-based charging APIs. The implementation of these APIs will provide an open standards-based environment to enhance the billing capabilities of current billing systems.

Tables 16 provide a summary of the structure of the electronic-payment industry, payment systems, and payment cards and standards-in-progress associated with evolving mobile portal services.

Table 16. Segments of electronic payment industry.

Category	Lead Stakeholder	Description
Electronic Payment Systems	Application developers. Often in partnership with financial institutions.	Provide a back-end application platform for financial institutions and other service providers to manage and process electronic macro and micro payments. Examples: Mondex and Proton
Electronic Payment Cards	Financial institutions. Often in partnership with Internet and mobile-device manufacturers.	Provide a front-end end-user access system that includes some variations of an electronic smartcard, a distribution network of merchants and other retail access points, and various levels of security and other functions. Examples: Visa Cash and Europay
Electronic Payment Standards	Varies by type of standard. Includes Internet Service Providers, financial institutions, mobile-device manufacturers and service providers.	Provide standards and/or a framework to enable easier industry adoption and some uniformity of end-user experience. Examples: IOTP and ECPS

Source: UMTS Forum.

5.4 Quality of Service (QoS)

Customer perceived QoS-based on usability experience is important for the success of a mobile Internet or Intranet service. The user experience depends on the co-ordinated end-to-end QoS between the mobile operator and the portal operator. The performance of the mobile device and portal platform are key elements of QoS. The latency introduced by various fixed Internet and mobile network elements also affects the end-to-end service performance. Propagation effects in a radio environment that also have a significant impact on QoS compound these issues.

Table 17 provides some acceptable delay guidelines for a selected group of services. This area needs to be studied further for a number of small form factor devices including a range of multimedia services and 3G network-speed offerings. The portal content needs to be optimised

to facilitate a rich user experience that matches the mobile device capabilities and available service speed. The upper bound for data rates continues to be reduced due to advances in compression technology.

Table 17. Quality of Service (QoS).

Type	Service	Data Rate	Delay	Delay Variation	Reliability (Frame Error Rate)
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		<3% FER
	Web browsing		4 sec/page	<1 ms	
	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: UMTS Forum Report No. 11, October 2000.

User perception plays a very important role in the acceptance of a mobile service. Examples of user perceptions of computer response time are shown in Table 18.

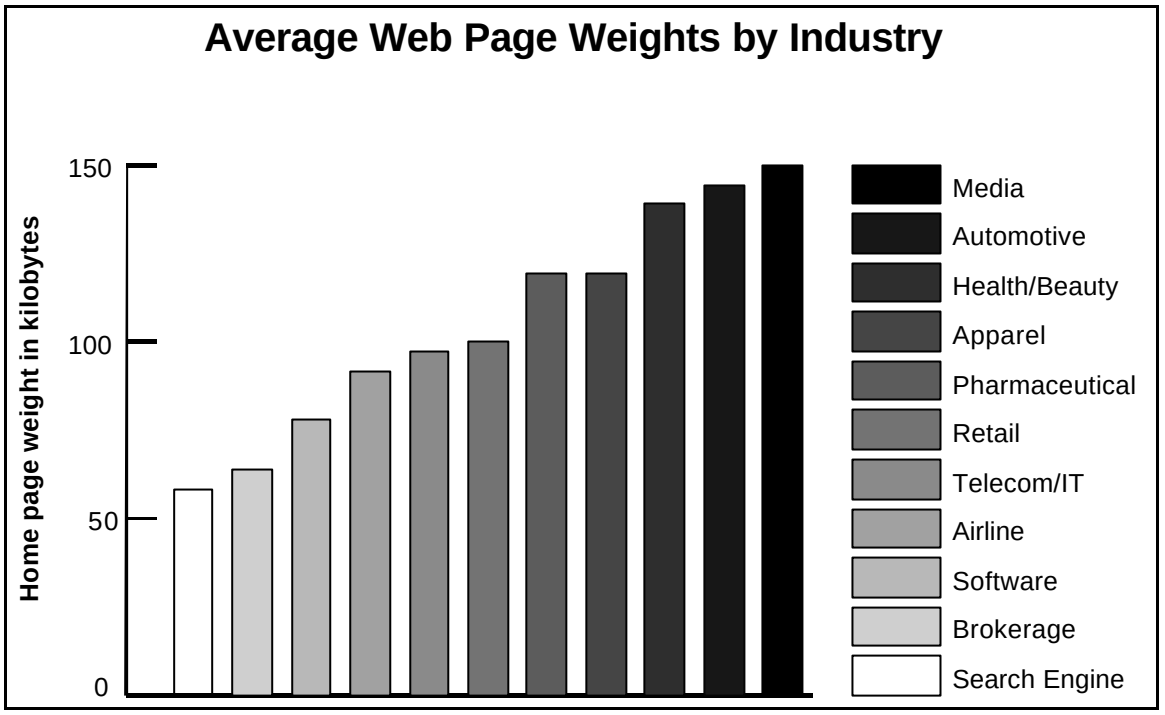
Table 18. Examples of user perceptions of computer response time.

Human Perception	Response Time Requirements
Highly Productive, Fully Interactive	0 to .4 seconds
Fully Interactive	.4 to 2 seconds
Sporadically Interactive	2 to 12 seconds
Break in Contact (computer)	12 to 600 seconds
Poor quality voice	> 150 ms delay

Source: Morgan Stanley Dean Witter, June 2000.

Content optimisation is required at the portal end, based on mobile device processing power and screen-display type and size. A lot can be learned from the design of Web pages from various fixed-Internet Web sites. Jupiter Media Matrix recommends that a Web page weigh between 40 and 50 Kbytes. Based purely on this recommendation, of the 300 sites measured, most are overweight and some excessively so as shown in Figure 22.

Figure 22. Web-page weight industry comparison.



Source: Byte level Research.

Examples of some lightweight Web pages and heavyweight Web pages are listed in Table 19. For the mobile devices, these weights need to be adjusted based on device capabilities.

Table 19. Web-page weight examples.

Web-page Weight	Sites	URL	Kilobytes
Lightweight	Helmut Lang	www.helmutlang.com	2
	Google	www.google.com	12
	Ameritrade	www.ameritrade.com	14
	Lycos	www.lycos.com	30
Heavyweight	Revlon	www.revlon.com	522
	General Motors	www.gm.com	547
	Nickelodeon	www.nick.com	638
	Hugo Boss	www.hugoboss.com	644

Source: Byte level Research.

5.5 Interoperability

Interoperability across many elements of portal platforms and mobile terminals is important in a competitive multi-vendor industry environment. Interoperability has many dimensions and would need on-going interaction among industry participants for creating an end-to-end harmonised portal services market. Some of portal services related areas of interoperability include:

- Portal platform components from different vendors need to inter-operate. Such a capability would ensure that a component from one vendor could be replaced by a component from another vendor without affecting service delivery.
- A user terminal should inter-operate across multiple portal platforms. Such a capability would allow a user to subscribe to portal services from more than one provider.
- Location based databases from multiple providers need to inter-operate. Such a capability would provide a uniform user experience for services from different location databases.
- Interoperability would be needed between multilingual portal platforms and terminals. This capability would ensure that a user could get local information in a specified language.

5.6 Content Format

Media format and level of compression is extremely important for the harmonious creation and delivery of 3G portal services. A number of proprietary and open standards-based options exist in the industry. MPEG family of standards is an example of open industry-based standards for multiple media such as audio, music, graphics and pictures, video and integrated multimedia. Examples of some proprietary media formats include On2.com's video format and Div X multimedia format. Proprietary solutions create a fragmented market and raise the cost of service creation and delivery.

Content formats have many dimensions and a number of standards organisations and industry forums continue to participate in the creation of new standards. The W3C has developed a special format for information about media object types such as music, text, speech, picture and video. This information about information objects is called metadata and the standard is called Resource Description Framework (RDF). Adding metadata features to the family of MPEG standards will enhance the usability of media objects. Metadata can be used for:

- Summarising the meaning of data
- Allowing users to search for data
- Allowing users to select the relevant data
- Restricting users to access certain types of data based on age or other legal considerations and privileges
- Indicating relationship with other sources of data

Music is expected to be a popular 3G mobile service. MP3 is a standards-based format for music, and its characteristics are shown in Table 20.

Table 20. MPEG media format characteristics.

MPEG Audio	MPEG-1	MPEG-2	MP3
Compression	1:4	1:6-1:8	1:10-1:12
Quality	CD	CD	CD
Mode	CD	CD	CD
Bit Rate	384 Kbit/s	192 - 256 Kbit/s	112 - 128 Kbit/s

Source: UMTS Forum.

Tables 21-24 summarise current status and direction of a number of format standards for audio and music, graphics and video respectively.

Table 21. Music and audio content format current status and next-phase evolution.

Music and Audio				
Standard or Industry de facto	**Description**	**Completed**	**In Commercial Use**	**Under Development/ Planned**
MP3	MP3 is the file extension for MPEG, audio layer 3. Layer 3 is one of three coding schemes (layer 1, layer 2 and layer 3) for the compression of audio signals. Layer 3 uses perceptual audio coding and psychoacoustic compression to remove all superfluous information. It also adds an MDCT (Modified Discrete Cosine Transform) that implements a filter bank, increasing the frequency resolution 18 times higher than those of layer 2.[8]	X	X	
MP3PRO	An improved MP3 encoding standard release providing backward compatibility to MP3 and allowing streaming with 64 Kbit/s. Storage required is half that of MP3.	X		
RealAudio	The de facto standard for streaming audio data over the World Wide Web. RealAudio was developed by RealNetworks and supports FM-stereo-quality sound. To hear a RealAudio sound file, you need a RealAudio player or plug-in, a program that is freely available from a number of places. It is included in current versions of both Netscape Navigator and Microsoft Internet Explorer.	X	X	
WMA	Windows Media Audio. For audio content; typically used to download and play files or to stream content.	X	X	
Proprietary/ iMelody	iMelody format specified by the Infrared Data Association is a minimal set of tones that can be used to transfer melodies between devices. It also specifies the duration of each tone.[9]	X	X	
MPEG AAC (MPEG-2 Audio) MPEG-4 Audio	Advanced Audio Coding to provide CD quality sound. Expands bit rates (8-64+ Kbit/s per channel) and sample rates (8-9 kHz). Provides multi-channel sound. An extension of MPEG AAC is contained in MPEG-4.	X	X	

Source: UMTS Forum, July 2001.

[8] From Internet.com: http://webopedia.internet.com/TERM/M/MP3. Html.

[9] Ericcson- Enahnced Messaging Service White Paper, March 2001.

Table 22. Graphics content format current status and evolution.

Graphics				
Standard or Industry de facto	**Description**	**Completed**	**In Commercial Use**	**Under Development/ Planned**
JPEG	Joint Photographic Experts Group. JPEG is a glossy compression technique for colour images. Although it can reduce file sizes to about 5% of their normal size, some detail is lost in the compression.	X	X	
JPEG 2000	JPEG 2000 is a next generation still-image coding standard designed to provide Internet imaging. New enhancements are under development for digital cameras to capture still images as well as video clips.	X	X	
GIF	Graphics Interchange Format. GIF is a bit-mapped graphics file format used by the World Wide Web, CompuServe and many BBSs. GIF supports colour and various resolutions. It also includes data compression, making it especially effective for scanned photos. PNG is an open standard version from W3C.	X	X	
Macromedia Flash[10]	A bandwidth friendly and browser independent vector-graphic animation technology. Flash animation can only be created using the flash animation application from Macromedia Inc.	X	X	
WBMP	Wireless BitMap, a graphic format optimised for mobile computing devices. WBMP is part of the Wireless Application Protocol (WAP[11]), Wireless Application Environment Specification Version 1.1.	X	X	
W3C SVG	Scalable Vector Graphics from the World Wide Web Consortium.[12] SVG is a language for describing two-dimensional graphics in XML. SVG allows for three types of graphic objects: vector graphic shapes (e.g., paths consisting of straight lines and curves), images and text. Currently, a candidate recommendation not yet approved.		X	X
BIFS	Binary Format for Scenes.[13] Description and interactive control language for MPEG-4 systems, based on VRML instruction set.	X	X	

Source: UMTS Forum, July 2001.

[10] Internet.com: http://webopedia.internet.com/TERM/F/Flash.html.

[11] WAP is a trademark of WAP Forum

[12] Source: WM3 web site: http://www.w3.org/Graphics/SVG/Overview.htm8#intro.

[13] PacketVideo Multimedia Technology Overview, page 15.

Table 23. Video content format current status and next phase evolution.

Video				
Standard or Industry de facto	**Description**	**Completed**	**In Commercial Use**	**Under Development/ Planned**
H.263 V2	The H.263 standard, published by the International Telecommunications Union (ITU), supports video compression (coding) for video-conferencing and video-telephony applications. H.263 Version 2 is an improvement upon the original standard, expanding the number and type of source formats and improving scalability. H.26L is ITU's next generation codec (follows H.26).	X	X	
MPEG-4 Video/Visual	MPEG-4 is designed for use with IMT2000 applications for mobile phones. There is a multi-part structure to the standard, including audio and video/visual.	X	X	
QuickTime	A video and animation system developed by Apple Computer-used as the basis for MPEG-4. QuickTime is built into the Macintosh operating system and is used by most Mac applications that include video or animation. QuickTime supports most encoding formats, including Cinepak, JPEG, and MPEG.	X	X	
ActiveMovie	A new multimedia streaming technology developed by Microsoft. ActiveMovie is already built into the Internet Explorer browser and will be part of future versions of the Windows operating system. Supporting most multimedia formats, including MPEG, ActiveMovie enables users to view multimedia content distributed over the Internet, an intranet, or CD-ROM.	X	X	
Real Video	A streaming technology developed by RealNetworks for transmitting live video over the Internet. RealVideo uses a variety of data compression techniques and works with both normal IP connections as well as IP multicast connections.	X	X	
WMV	Windows Media Video (Codec) For video content; typically used to download and play files, or to stream content. Uses the MPEG-4 standard.	X	X	

Source: UMTS Forum, July 2001.

Integrated media standards are important for delivering multimedia content to the mobile device. A summary of standards activities in this area is given in Table 24.

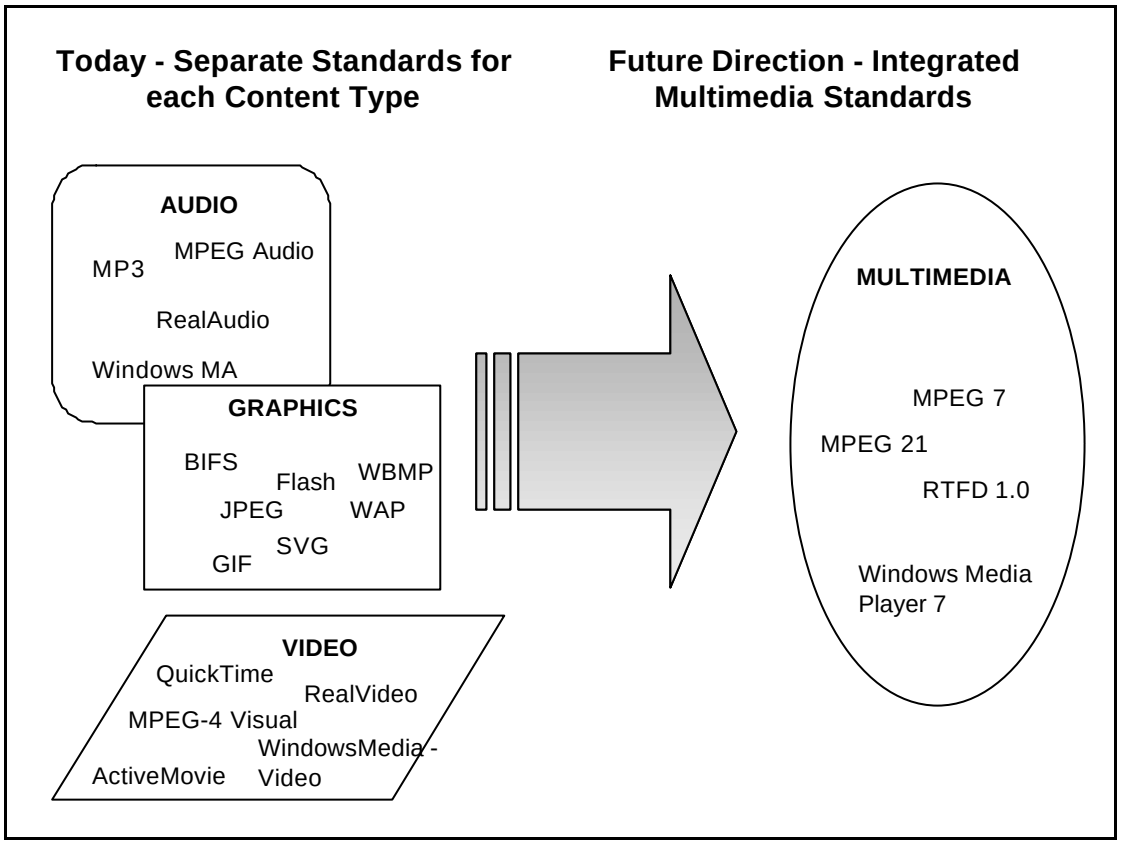
Table 24. Integrated media content format current status and next-phase evolution.

Integrated Multimedia				
Standard or Industry de facto	**Description**	**Completed**	**In Commercial Use**	**Under Development/ Planned**
MPEG-7	ISO/IEC 15938 - Multimedia Content Description Interface: The first phase will be completed in July 2001; the next five parts to be completed in 2002. MPEG-7 provides standards for providing informational data (e.g., metadata) on MPEG content.			X
MPEG-21	ISO/IEC 18034 – Multimedia Framework. MPEG-21 seeks to describe a multimedia framework and vision for an environment capable of supporting delivery and use of all content types by different categories of users in multiple application domains. Vision statement: To enable transparent and augmented use of multimedia resources across a wide range of networks and devices. The Technical Report will be approved in July 2001, and Digital Item Identification and Description approved in July 2002. Call for Requirements on "Rights Data Dictionary and Rights Description Language" response deadline June 2001.			X
RTFD 1.0	Recommended Technical Framework Document Standard recommended by the Wireless Multimedia Forum. RTFD 1.0 describes an end-to-end system model which integrates several codecs and protocols defined by other standardisation bodies such as ISO MPEG-4, ITU H.263, ETSI GSM-AMR, IETF RTP, RTSP and SDP.	X		
Windows Media Player 7.1	Integrated software family that includes a full range of multimedia access devices from desktop PCs to handheld PDAs. Media Player for Pocket PC and palm-sized PC devices is a feature of the MS Windows® CE operating system that enables playback of high quality stereo music and other audio. Currently only supports audio, not video.	X	X	X

Source: UMTS Forum, July 2001.

While individual media format standards are evolving in their own right, there is also a convergence underway to create unified integrated media standards. This convergence of standards is shown in Figure 23.

Figure 23. Convergence of media formats.



Source: UMTS Forum.

While multimedia content format standards define a set of standards for all applications, some industry efforts are underway to define network gaming and advertisement standards for mobile devices. These efforts include:

- Wireless phone makers Nokia, Motorola, Ericsson and a Siemens business unit recently announced a new initiative to create new standards for wireless games. The new group is charged with designing specifications that would allow developers to create network-based games capable of working on several different networks and various mobile handsets.
- Wireless Advertising Association (WAA), a consortium of over 80 companies, is working on advertisement format standards for a number of different form factor devices. Some of the companies in this group include Nokia, AT&T Wireless, Comverse, Lycos, Sprint PCS, QUALCOMM and Microsoft. The establishment of these advertisement specifications will facilitate the development of standards-based advertisements for mobile devices.

5.7 Industry Implications

Table 25 below summarises the significant implications to the industry for technical areas identified in this section.

Table 25. Implication summary.

Technical Area	Implications to Industry
Security	Security is a market perception issue as well as a technical one. Mobile operators need to take the lead in building and managing user confidence. Without a solid confidence level in personal security, the market will never achieve its full potential. There will be different levels of security developed to meet specific-segment application needs. Third party service creation and provisioning related security are yet undefined. Privacy is a critical near-term issue. Failure to adequately protect individual privacy will result in severe market consequences. Mobile operators need to control virus and spam attacks on mobile users by implementing filtering technology.
Billing, Charging and Payments	Unless operators can quickly define their billing requirements more specifically that they will not have the billing systems available in the timeframe desired to deliver market services. A charging mechanism, which gels the pre-paid model and the Internet model has to be developed. Micropayment/smartcard systems will be decided through a market decision. Due to the intense competition in this area, an open standard for micropayments is unlikely to emerge in the foreseeable future. Multiple payment and collection systems increase the cost of service delivery. Operators need to find ways to move customers to an acceptable electronic payment system. It will take some time for a fully functional integrated billing system becomes commercially deployed for scale applications.
Interopera-bility	Interoperability is an industry wide issue. Currently there is no significant effort to address this area comprehensively. It will take some time before industry players comprehend the service delivery limitations without interoperability across multiple portal platforms and mobile terminals.
Quality of Service	There are additional dimensions to quality of service in the mobile environment, due to small form factor and mobility that do not exist in the fixed Internet. To be successful in the market, portal operators need to take these additional dimensions into consideration. Without a co-ordinated effort of portal operators and mobile operators to define and measure the individual quality of service components, operators will not be able to take advantage of additional revenue opportunities. It will be some time before end-to-end QoS capabilities become available.
Content Format	The 3G content developers need to adopt all approved family of MPEG standards. These include MP3, MP3 PRO, and JPEG 2000, MPEG-4. The mobile industry must continue to be actively involved in developing metadata and integrated multimedia standards. Failure to do so may lead to standards that are not optimal for mobile environments. The mobile industry is expected to adopt content format standards as they are finalised.

Source: UMTS Forum.

6. Summary and Minimal Functional Set Analysis

6.1 Summary

The development of 3G portal services will benefit from the availability of a standards based open services architecture and application programming interfaces.

A standards based markup language is equally important for an efficient application development. WML and cHTML languages appear to be converging towards a Basic XHTML markup language.

An open service development framework and a unified markup language will allow content development community throughout the world to rapidly develop needed 3G services. Such an approach will help create a mass market for 3G portal services. A summary of key markup languages and their relative usability for a range of portal services is shown in Table 26. The following points were considered in this analysis:

- WML and cHTML markup languages are converging towards a Basic XHTML standard. Some of the existing fixed Intranet, Internet, infotainment content will be converted to XHTML format.
- VXML will be important for a number of services for the safety of the user in a vehicle.

Table 26. Usable life of markup languages in 3G portal services.

Type of Portal	WML	cHTML	VXML	XHTML	HTML
Mobile Intranet/Extranet	◑	◑	●	●	●
Customised Infotainment	○	◑	●	●	N/A
Multimedia Messaging Services	○	◑	○	●	N/A
Mobile Internet	◑	◑	●	●	●
Location-Based Services	○	◑	●	●	N/A

●	◑	○
Long-term life	Medium-term life	Short-term life

Source: UMTS Forum and Telecompetition Inc., August 2001.

A number of critical capabilities have been identified in this handbook for successful development and delivery of 3G portal services. These capabilities include:

- Security
- Privacy
- Billing and Payment
- QoS
- Interoperability

- Content Format/Compression

A summary of relative importance of these critical service development and delivery capabilities for 3G portal services is given in Table 27. The following points were considered in this analysis:

- Security is extremely important for all enterprise Intranet/Extranet portal services. Although the end-to-end QoS is very important to realise the full potential of a service, it may not be available for all services. Billing is targeted towards the corporation rather than the individual user.
- For all other portals, security is very important for protecting the identity of a user. Security may not be available or needed for all services offered by the portal. Although the end-to-end QoS is very important to realise the full potential of a service, it may not be available for all services. Value-added service billing may not be available in all markets.

Table 27. Importance of critical service enablers for 3G portal services

Type of Portal	Security	Privacy	Interoper-ability	Billing and Payment	QoS	Format/ Compression
Mobile Intranet/Extranet	●	●	●	◑	◑	●
Customised Infotainment	◑	◑	●	◑	◑	●
Multimedia Messaging Service	◑	●	●	●	◑	●
Mobile Internet	◑	◑	◑	◑	◑	●
Location-Based Services	●	●	●	◑	◑	●

●	◑	○
A particular capability is of high Importance	A particular capability is selectively Important	A particular capability is of low Importance

Source: UMTS Forum and Telecompetition Inc., August 2001.

6.2 Minimal Functional Set Analysis

To provide guidance to the industry on ways to facilitate the development and adoption of 3G portal services, a set of criteria has been developed to rank and rate the different available options to develop and deliver these services. In this section, these criteria are outlined along with the recommended minimal functional sets based on these criteria.

In order to analyse 3G portal service development and delivery issues identified in this handbook, three functional sets have been defined to cover the following perspectives:

- Timeframe required for issue resolution and commercialisation into 3G portals **(Functional Set I)**
- Role of industry players in capability selection (**Functional Set II)**
  - Mobile operator
  - Content developer
  - Portal Operator
  - Manufacturer

- Status of issues relative to a number of capability considerations **(Functional Set III)**
  - Current Standards
  - Market Decision
  - Terminal Types
  - Technology

Tables 28-30 contain the legends and rankings of various issues.

Table 28 summarises Minimum Functional Set I, the timeframes required for issue resolution and commercial availability of issues discussed earlier in this document. Some important points considered for this analysis are as follows:

- XHTML becoming a universally accepted markup language for content development.
- XHTML will become the presentation language, though XML and XSL may be the source.
- It will take some time and effort before a full set of customised personalised services become available.
- Market factors will decide whether a lead browser or multimodal browsers and operating systems will succeed.
- There are prospects for development of high-processing-power mobile devices and an order-of-magnitude higher life battery technology within five years.
- There are prospects of high-resolution colour displays for mobile devices within three years.
- It will take some time before fully functional, integrated billing systems become commercially deployed for scale applications.
- Multiple payment methods are likely to continue in the foreseeable future.
- It will take some time before end-to-end QoS capabilities become available.
- The mobile industry will adopt content format standards as they are each finalised.

Table 28. Minimal functional set I - analysis of time frames required for issue resolution and commercial availability.

Report Topics	Key Issues	1-2 Years	3-4 Years	5 Years and Beyond
Markup Language	XHTML Basic	●	●	●
Personalisation	Consumer or Corporate User Capabilities	◑	◑	●
Mobile Terminals	Browsers Operating System Chip Technology Battery Technology Display Technology	◑	◑	●
Security	USIM	◑	◑	●
	Privacy			
Billing and Payment	Billing Flexibility	◑	◑	●
	Multiple payment Methods	◑	◑	◑
Quality of Service (QoS)	End-to-end QoS	○	◑	●
Interoperability	Interoperability	◑	◑	●
Content Format	MP3, MP3PRO, JPEG 2000, MPEG-4, Integrated Media Format	◑	◑	●

Legend – Minimum Functional Set I		
●	◑	○
Issues fully resolved Commercial deployment available	Issues not fully resolved Partial commercial deployment available, based on a mix of proprietary and standards-based solutions	Issues not resolved Commercial deployment not available Not feasible

Source: UMTS Forum and Telecompetition Inc., August 2001.

While all industry players need to co-operate in resolving technical issues, some players have a more dominant role than others do in making the final capability choice. Minimal Functional Set II, Table 29, identifies the role for each type of industry player for the capabilities discussed in this report. Some key points of this functional set are as follows:

- All primary players to work on creating new personalisation services. Enterprises also need to play a big role in deciding the personalised services required for their businesses.
- While software companies and chip manufacturers control development of operating system software and chips respectively, the terminal manufacturer ultimately makes the final capability choice.
- While battery and display manufacturers will lead terminal component development efforts, the terminal manufacturers must drive the process.
- Billing vendors need to develop a phased approach for mobile billing features in order for mobile operators to implement the systems.

Table 29. Minimal functional set II - analysis based on primary industry player's role in capability selection.

Report Topics	Key Issues	Mobile Operators	Manufacturers	Content Developers
Markup Language	XHTML Basic	◑	◑	●
	HTML	◑	●	●
Personalisation	Consumer Capabilities	●	●	●
	Corporate User Capabilities	○	●	●
Mobile Terminals	Browsers	◑	●	●
	Operating System	○	●	◑
	Chip Technology	○	●	○
	Battery Technology	◑	●	○
	Display Technology	◑	●	○
Security	USIM	◑	●	◑
	Privacy	●	○	◑
Billing and Payment	Billing Flexibility	●	○	◑
	Multiple Payment Methods	◑	○	○
Quality of service (QoS)	End-to-end QoS	●	◑	◑
Interoperability	Interoperability	●	◑	◑
Content Format	MP3, MP3PRO, JPEG 2000, MPEG-4, Integrated Media Format	◑	◑	●

Legend – Minimum Functional Set II		
●	◑	○
Industry player to take lead in selection of capability	The industry player will influence selection of capability	Industry player has no role in the selection of capability

Source: UMTS Forum and Telecompetition Inc., August 2001.

Table 30 summarises the issues discussed in this report in terms of several key factors for each topic area.

Table 30. Minimal functional set III - analysis based on standards, market factors, terminal type, and technology capability considerations.

Report Topics	Key Issues	Status of Current Standards	Market Decision	Terminal Types Factor	Technology Capability
Markup Language	XHTML Basic(a subset of WML2.0)	●	●	◑	◑
	HTML	●	●	◑	◑
Personalisation	Consumer Capabilities	○	◑	●	●
	Corporate User Capabilities	○	◑	●	●
Mobile Terminals	Browsers	○	●	●	○
	Operating System	○	●	◑	●
	Chip Technology	○	○	◑	◑
	Battery Technology	○	◑	◑	◑
	Display Technology	○	◑	◑	◑
Security	USIM	◑	●	◑	●
	Privacy	◑	●	◑	●
Billing and Payment	Billing Flexibility	◑	●	○	●
	Multiple payment Methods	◑	●	○	●
Quality of Service (QoS)	End-to-end QoS	◑	●	○	●
Interoperability	Interoperability	○	●	◑	◑
Content Format	MP3	●	●	◑	●
	MP3PRO	◑	◑	◑	●
	JPEG 2000	◑	◑	◑	●
	MPEG-4	●	◑	◑	●
	Integrated Media Format	◑	◑	◑	●

Legend- Minimum Functional Set III		
●	◑	○
Industry-wide issue Widely accepted Most significant portions of an issue are resolved or completed Market issue	Issue relevant to a subset of overall areas of concern Mixed market acceptance Issue only for selected terminal types	A particular issue is not relevant to an area of concern A particular industry segment has no role No solution is available at this time

Source: UMTS Forum and Telecompetition Inc., August 2001.

6.3 Recommendations and Conclusions

The 3G portal study has identified a number of key recommendations for a harmonious development of portal services mass market. The following approaches have been used in addressing identified issues:

- **Convergence** approach works toward a globally accepted open standard combining mobile, Internet, media, and communication concerns.
- **Market Decision** approach where the most dominant player or a small number of strong players create de facto standards, driven by the sheer volume of originally proprietary implementations.
- **Technical Research and Development** approach in which new technology will be developed. This is technology that is not yet available, but necessary to deliver the needed requirements.

Table 31 provides a summary of 3G portal study recommendations and corresponding action needed.

Table 31. 3G Portal Study recommendations.

3G Service Enablers	Key Issues	Recommendation	Action Needed
Markup Language	XHTML Basic (a subset of WML2.0)	Deploy XHTML Basic for all portal content development.	Portal operators and terminal manufacturers to adopt XHTML Basic. Backward compatibility with WML and cHTML browsers needs to be studied.
	HTML	Deploy HTML for mobile business in the public Internet and corporate sector.	Corporate portals and Internet portals shall be extended for mobile Intranet/Internet access.
Personalisation	Consumer Capabilities	Deploy Individual personalised services for consumers.	The mobile industry needs to establish standards for a selected set of personalised services for consumers.
	Corporate User Capabilities	Deploy group-based personalised services for corporate users.	The mobile industry needs to establish standards for a selected set of uniform corporate personalised services.
Mobile Terminals	Browsers	Monitor the development of a lead browser, as this would allow large-scale deployment of 3G portal services.	Promote use of XHTML and HTML micro-browsers. Market forces will determine a lead browser or duel browsers with downloadable options.
	Operating System	Monitor the development of a limited number of lead operating systems, as this would allow large-scale deployment of 3G portal services.	Market factors will determine the number of mobile operating systems.
	Chip Technology	Deploy high performance chips mobile devices for multimedia 3G services.	Terminal manufacturers to adopt recommended content format/compression standards. Terminal manufacturers to specify high performance and low power chips for 3G mobile terminals.
	Battery Technology	Deploy longer lasting batteries would increase the usage of 3G services without interruption between charging periods.	Terminal manufacturers to test high performance batteries and support R&D in fuel cells.
	Display Technology	Deploy higher resolution and lightweight displays on 3G mobile devices.	Terminal manufacturers to test OLED display and support R&D in Electronic Ink display technology.
Security	USIM	Deploy USIM card in 3G terminals. Add IMEI (International Mobile Equipment Identifier) for terminal security.	Mobile operators, terminal manufacturers and financial institutions need to work together to find industry-accepted m-commerce secure solutions
	Transport security	A common security layer protocol should be established for end-to-end security in order to avoid translation of WTLS/SSL.	An industry focus group to study this further with a lead from a mobile operator.
Billing and Payment	Billing Flexibility	Deploy a phased approach towards a comprehensive billing infrastructure.	Billing vendors and mobile operators need to develop a phased approach for mobile billing features toward a comprehensive billing infrastructure. 3GPP and GSMA to lead this effort.
	Multiple Payment Methods	Deploy multiple payment methods with a long-term goal of moving users to electronic payment methods.	Mobile and portal operators need to find ways to promote the use of electronic payment methods.
Quality of service (QoS)	End-to-end QoS	Market factors in QoS specs will be determined by service category.	An industry focus group to study this further with a lead from a mobile operator. 3GPP to lead this effort.

3G Service Enablers	Key Issues	Recommendation	Action Needed
Interoperability	Interoperability	Develop interoperability standards across multiple platforms and mobile terminals.	An industry focus group to study this further with a lead from a mobile operator. 3GPP to lead this effort.
Content Format	MP3, MP3PRO, JPEG 2000, MPEG-4, Integrated Media Format	Use open standards for content development.	Mobile operators, portal operators, terminal manufactures and content developers to support open content format standards.

Source: UMTS Forum.

3G portal services industry is a very young industry with a tremendous momentum for growth. This handbook has identified key trends in technologies that will pave the way for the growth of portal services market. Critical service delivery issues of billing, security, privacy, interoperability, QoS and content format will need a concerted industry effort and resolve to realise the full potential of 3G portal services.

A number of progressive trends have been identified in the processor, memory, battery, display, operating system, and browser technology. Collectively these advances will create a new family of harmonised and user-friendly 3G mobile devices. A richer end-user usability experience on these new devices will promote the growth of 3G portal services.

While the mobile industry has to address all of the technological issues to create a 3G network and marketing infrastructure, it must maintain its focus on the needs of the end-users. It's the end-user who decides the success of a particular service. The end-user needs a simple mobile device and all the complexities of operating system, browser, and media player should be hidden within the technology. Insulating the customer from these technological complexities will provide the ease-of-use and increase the usage of 3G portal services. In the long term an end-user should simply be able to talk to the mobile device and ask for a movie, a song, a selected weather report, customised sports news and/or directions to a restaurant from a 3G portal.

7. Appendix A – Interviews

The following areas of the mobile portal study were explored in interviews of selected subject matter experts:

- Portal services
- Open services architecture
- APIs
- Markup languages
- Personalisation
- Mobile browsers
- Mobile operating systems
- Mobile terminal technologies
- Security
- Billing and payment
- QoS
- Interoperability
- Media content format and compression standards

Table 32. Mobile portal companies interviewed for the study.

Company Name	Person Interviewed	Title	Web site
Terra Lycos	Rick Hutton	Senior Director: Access & Communications	www.lycos.com
Excite Mobile	Eric Engleman	Director, Excite Mobile	www.excite.com
Siemens	Gerhard Wiehler	Director: Corporate System Strategy	www.siemens.com
Sonera	Petri Karjalainen	Vice President, Sonera Zed	www.sonera.fi/english
AltaWave	Tom Green	Chief Technology Officer	www.altawave.com
	Greg Brown	Director of Product Management	www.altawave.com
Wireless Yahoo	Christopher Wu	Senior Manager, Yahoo! Everywhere	www.yahoo.com
NTT DoCoMo	Katsutoshi Ozawa	Director, NTT DoCoMo, Japan	www.nttdocomo.com
	Hiroshi Nakamura	Director, NTT DoCoMo, Europe	www.nttdocomo.com

Source: Telecompetition Inc., July 2001.

8. Appendix B – 3G Portal Handbook Contributors

Telecompetition, Inc prepared this report for the UMTS Forum. Many members of the Forum's project team made significant contributions.

Contact information for Telecompetition, Inc. follows:

Jagdish Kohli
Principal Consultant
jagdish.kohli@telecompetition.com
+1-925-543-5736
+1-925-543-5720(Fax.)

Eileen Healy
President & CEO
eileen.healy@telecompetition.com
+1-925-543-5702
+1-925-543-5720(Fax.)

2694 Bishop Drive
Suite 212
San Ramon, CA 94583, USA

9. Acronyms

2G – Second Generation

3G – Third Generation

3GPP – 3rd Generation Partnership Project

API – Application Programming Interface

B2B – business-to-business

BDTI – Berkeley Design Technology Inc.

BREW – Binary Runtime Environment for Wireless

CEPS – Common Electronic Purse

cHTML – Compact HTML

CXML – Commercial XML

DAB – Digital Audio Broadcasting

DP – Dynamic Profile

DSP – Digital Signal Processor

DVB – Digital Video Broadcasting Project

ebXML – e-business XML

eCos -- embedded Configurable operating system

EMV – Europay-MasterCard-Visa

ETSI – European Telecommunications Standards Institute

FOMA – Freedom of Multimedia Access

GSA – Global mobile Suppliers Association

GSM – Global System for Mobile communications

HMI – Human-Machine Interface

HTML – Hypertext Mark-up Language

IEC – International Electrotechanical Commission

IETF – Internet Engineering Task Force

IMEI – International Mobile Equipment Identifier

IOTP – Internet Open Trading Protocol

ISO – International Organisation for Standardisation

ISP – Internet Service Provider

ITU – International Telecommunication Union

JTC1 – Joint Technical Committee 1

LBS – Location Based Services

LCD – Liquid Crystal display

Li-ion – Lithium-ion

Li-Po – Lithium Polymer

LSB – Linux Standard Base Specification

MAGIC – Mobile Multimedia; Anytime, Anywhere, Anyone; Global Mobility Support; Integrated Wireless Solution; and Customised Personal Service

MHP – Multimedia Home Platform

MME – Microsoft Mobile Explorer

MMS – Multimedia Services

MRAM – Magnetic RAM

Ni-Cd – Nickel Cadmium

Ni-Mh – Nickel Metal hydride

OLED -- Organic Light Emitting Diode

OMAP - Open Multimedia applications Platform

OSA – Open Services Architecture

OUM – Ovonics Unified Memory

PDA – Personal Digital Assistant

PFRAM – polymer ferroelectric RAM

QoS – Quality of Service

SCF – Service Capability Features

SCM – Supply Chain Management

SGML – Standard Generalised Mark-up Language

SIM – Subscriber Identity Module

SLA – Service Level Agreement

TI – Texas Instruments

UMTS – Universal Mobile Telecommunications System

USIM -- Universal Subscriber Identity Module

VoIP – Voice over Internet Protocol

VXML – Voice XML

W3C – World Wide Web Consortium

WAA – Wireless Advertising Association

WAP – Wireless Application Protocol

W-CDMA – Wideband Code Division Multiple Access

WML – Wireless Mark-up Language

WPKI – Wireless Public Key Infrastructure

XML – Extensible Mark-up Language

XSL – Extensible Stylesheets Language

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11. UMTS Forum Members

Table 33. UMTS Forum Members in the operators category

Operators			
Airtel Movil SA	Hellenic Telecomms Organisation	MTC Namibia GmbH	Telecom Italia Mobile
Amena (Retevision Movil SA)	HT-Hrvatski Telekom	NTT DoCoMo Inc	Telefonica Moviles Espana
Bahrain Telecommunications Company	Hutchison 3G UK	Omnitel Pronto Italia	Telenor
Belgacom	ICO Services Ltd	One 2 One	Telfort
BLU S.p.A	Inmarsat	OPTEP-SGPS, SA	Telia Mobile
Bouygues Telecom	IPSE 2000	Optimus Telecommunications	Telital S.P.A.
BT	KPN Telecom	Orange Communications SA	Telsim Mobil Telekom
CEGETEL	KT ICOM	Orange PCS Ltd	Turkcell
Contact MEO Satellite Constellation	Latvian Mobile Telephone Co. Ltd	Panafon SA	VIAG Interkom GmbH & Co
DeTeMobil	LG Telecom	Partner Communications Co Ltd	Vimpelcom
Deutsche Telekom AG	Mannesmann Eurokom	Pele-Phone	Vodacom Pty Ltd
Eircell Ltd	Mannesmann Mobilfunk GmbH	Polska Telefonia Cyfrowa sp. Z.o.o.	Vodafone Group Services Ltd
Emirates Telecommunications Corporation	Max.Mobil	PTK Centertel Sp. Z o.o	Vodafone Airtouch UK Ltd
E-Plus Mobilfunk GmbH & Co KG	MobilCom Multimedia GmbH	Radiolinja	VoiceStream Wireless
EURESCOM GmbH	MobileOne	Radiomobil AS	Westel Mobile Telecomms Co Ltd
Finnet Group	Mobile Telesystems	Rumeli Telekom	Xfera Moviles SA
France Telecom Mobiles	Mobilkom Austria AG	Sonera Corporation	Zao North West GSM
	Mobistar	Swisscom AG	
	MobilTel AD	Tele Danmark Comms Networks	
	Mobitel		

Source: UMTS Forum.

Table 34. UMTS Forum members in the manufacturers category

Manufacturers			
Alcatel	Ericsson Group	Mitel Networks	Siemens AG
Alps Electric Europe GmbH	Freshfield Communications Ltd	Mitsubishi Electric ITCE	Siemens Switzerland Ltd
Anritsu Ltd	Fujitsu FTRC	Motorola GSM Products	Siemens Information & Comms Network SPA
Arraycomm Inc	Giesecke & Devrient	National Semiconductor GmbH	Sigma Wireless Technologies
Ascom Business Systems Ltd	Grayson Wireless	NEC Europe Ltd	Snap-on Tools
Aspex Technology	Hitachi Europe Ltd	Nokia Corporation	Sony Intl (Europe) GmbH
Astrium Ltd	IBM	Nortel Networks	ST Microelectronics N.V.
Bosch Robert GmbH	IFR Limited	Omnisec AG	STN Atlas Elektronik
CMG Wireless Data Solutions Intl BV	Infineon Technologies	Panasonic European Labs	Synopsys Inc
ComDev Wireless	Intel Sweden AB	Philips Consumer Communications	Tait Electronics Ltd
Comnitel Technologies	Intracom SA	Qualcomm Europe S.A.R.L.	TelesensKSCL Ltd
Comverse Network Systems	Lucent Technologies	Rohde & Schwarz GmbH	Telrad Networks Ltd
CSA Ltd	Lucent Technologies (Saudi Arabia)	SAGEM	Texas Instruments
CSEM	Marconi	Samsung	TRAIAN Internet Products AG
DeTeWe Deutsche Telephon AG	Mastel	Sec2wireless Ltd	XACCT Technologies Ltd
EACEM	Matsushita Commercial Industrial UK	Sharp Laboratories of Europe Ltd	Zesium AG
	Matsushita Electric Europe		

Source: UMTS Forum

Table 35. UMTS Forum members in the regulators category

Regulators	
ART	Ministry of Transport & Telecommns
Bundesministerium fur Wirtschaft	National Telecom Agency Denmark
Department of Communications	Norwegian Post & Telecommunications Authority
DLR-German Aerospace Center	ODTR
DTI C113	OFCOM Federal Office for Communications
DTI 8S/8.2	PTS
DTI/RA	Radio Research Laboratory
Great Northern Telegraph	Secretariat d'Etat a l'Industrie
Home Office	Telecommunications Admin Centre
Inst das Comms de Portugal	Ministry of Transport & Comms
Ministero Delle Comunicazioni	Telekom-Control GmbH

Source: UMTS Forum

Table 36. UMTS Forum members in the others category

Others			
ABB	DIX.IT Consortium	InterDigital Comm Corp	Rai Radiotelevisione Italiana
Advanced Network Solutions S.p.A	DSPC Israel Ltd	John Wiley and Sons	Remote-I Corporation
Aircom International Ltd	Edgecom AB	KEVAB - The Base Station Company	Roland Berger & Partner GmbH
Amdocs Ltd	Eltek Energy AS	LCC International Inc	SAG-Abel Komms GmbH & Co KG
Analysys Ltd	ETNO	lit Consulting GmbH	Saville Systems PLC
Andersen	ETS Dr Genz GmbH	Arthur D Little	Schema Ltd
Apis Technical Training	ETSI	LORRIS	Sema Group Telecoms
ATDI S.A.	European Commission	LS telcom AG	SIGMA
B4E GmbH	1rstWAP	Mach SA	SIGOS System integration
The Boston Consulting Group	The Fantastic Corporation	Martin Dawes Systems	Siroyan Ltd
Bull Italia S.p.A	feedback AG	Mason Communications Ltd	Spazio ZeroUno SpA
Cap Gemini Ernst & Young	FTW	Mediacs AG	SpectraSite Transco Comms Ltd
Carrier 1 International GmbH	Future 121 Oy	MediaMobil Comms. GmbH	Telecom Italia Lab SpA
Cellstructures International Ltd	Galaxy Engineering Services	Micromuse Inc/Plc	Telnic Ltd
Centre for Wireless Comms	Global Billing Association	mIQ	TNO Physics & Electronics Lab.
CETECOM GmbH	Golden Bridge Technology Inc	MK International	TTP Communications Ltd
CMG Tell-IT Telecom Consultancy	GPP mbH	Mobile Systems International	Ubiquity
Cognizant Technology Solutions	GSM Association	Netcom Consultants	UMTS IPA
Compaq Telecom	Hadden Telecoms	NIIR - Spectrum Ltd	Unisys
Computer Associates Technology GmbH	IIR Telecoms	Nilcom	Usha Communications Technology
Crown Castle International Ltd	Imagine Broadband Ltd	OVUM Ltd	VDPi-Ingenieure fuer Kommunikation e.v.
Detecon	IMST	PA Consulting Group/UbiNetics	WFI Ltd
Digiquant	Informa Group Telecomms	PrairieComm Inc	Worldzap
	Institut Fur Nachrichtentechnik	PricewaterhouseCoopers	
	Institute for Telecommunications	Primavera Systems Inc	
	Intel Telecom Systems	PTK Centertel Sp. Z o.o	
		Qarana Solutions	

Source: UMTS Forum.

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