iti Techmedia

Market Intelligence Report Communications Services

An initial study of the market for Communications Services, defined as: "The provision, management and delivery of voice, audio/video, data and IT services over wired and wireless communications networks, including consumer and business services, vertical sector industrial applications and broadcast content and signal data"

20 April 2004

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EXECUTIVE SUMMARY

This document provides market intelligence into the sector defined as Communications Services by the Intermediary Technology Institute (ITI) in Techmedia. Communications Services covers a wide range of markets, ranging from broadband home and multimedia mobile messaging to industrial data networks and interactive TV. For the purposes of this document, the definition of Communications Services is:

> *The provision, management and delivery of voice, audio/video, data and IT services over wired and wireless communications networks, including consumer and business services, vertical sector industrial applications and broadcast content.*

The report describes the future market opportunities, challenges, key drivers and the potential functional needs of the Communications Services sector.

Using this acquired knowledge as the base input, the ITI will select those functional needs that have strongest potential market 'fit', and the greatest potential to be a success when utilised within the identified target markets. The functional needs will be used to define potential technology platforms which will then be used as input to ITI Techmedia's programme selection process.

During this process, ITI Techmedia will continue to report to its Membership on progress and results. Members are encouraged to provide comment and input, and to become actively involved in programmes.

ITI Techmedia intends to further develop its knowledge base in this sector. In order that the Membership gain visibility of ongoing developments identified by ITI Techmedia, this Report will be subject to periodic review and re-issue.

The Communications Services sector comprises telecommunications and broadcast services

The world Communications Services sector comprises both telecommunications and broadcast services. By 2008, the combined value of the sector is expected to grow to some USD1.6 trillion.

In the mobile segment, revenue growth will be driven by the combination of growth in subscriber numbers in emerging markets and growth in ARPU in developed markets. As a result, mobile revenue is forecast to show steady growth over the period to 2008, reaching some USD675 billion, representing revenue growth of over 50% from 2003.

In the broadcast services space Digital Audio Broadcast (DAB) services and Digital Video Broadcast (DVB) services are expected to fuel revenue growth. As a result, global revenue from TV services (free-to-air and pay TV) is forecast to reach approximately USD240 billion by 2008.

The Communications Services sector exhibits a number of key trends

The Communications Services sector exhibits a number of key trends, including:

- increasing availability of broadband access
- ongoing pressure to reduce operating costs
- mobile markets approaching saturation in developed markets
- widespread deployment of data-enabled mobile networks and handsets
- increasing need for identification, authentication and authorisation
- increasing media consumption on the move
- personalisation of content and services
- increased speech recognition and human-machine communication

These trends will create opportunities for new technology providers. However a number of large companies exert significant influence over the market, and therefore structural barriers to market entry exist for new technology providers. Such barriers to entry include:

- adherence of incumbents to medium term product and service roadmaps
- a risk-averse culture in the current market environment
- long technology evaluation cycles
- lack of demonstrable end-customer demand for new services
- importance of the international regulatory environment
- importance of international standards

Despite these issues, opportunities remain for companies to develop key elements of technology which become critical to the industry, allowing rapid company growth and profitable returns for the original investors.

In the Communications Services sector, an increased consumer focus on data rather than voice services will create significant opportunities in application-oriented areas. However, these new opportunities require technology suppliers to consider end-to-end service delivery (e.g. technology solutions may have to address network, platform and user device capabilities) in order to ensure the successful delivery of end-user services.

The identified market opportunities exhibit different market size, growth prospects, and functional needs

A number of growth areas have been identified through the market foresighting process, and considered to have significant market impact in the medium to long term. These market opportunities have been identified and developed based on:

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- the views of experts who were asked to consider a ten-year horizon

- market research reports from 'conventional' analysts assessing a five-year horizon.

Where the relevant market data is available, market projections for these opportunity areas have been developed. Figure 1 below summarises the global revenue and projected future growth for a number of these opportunities.
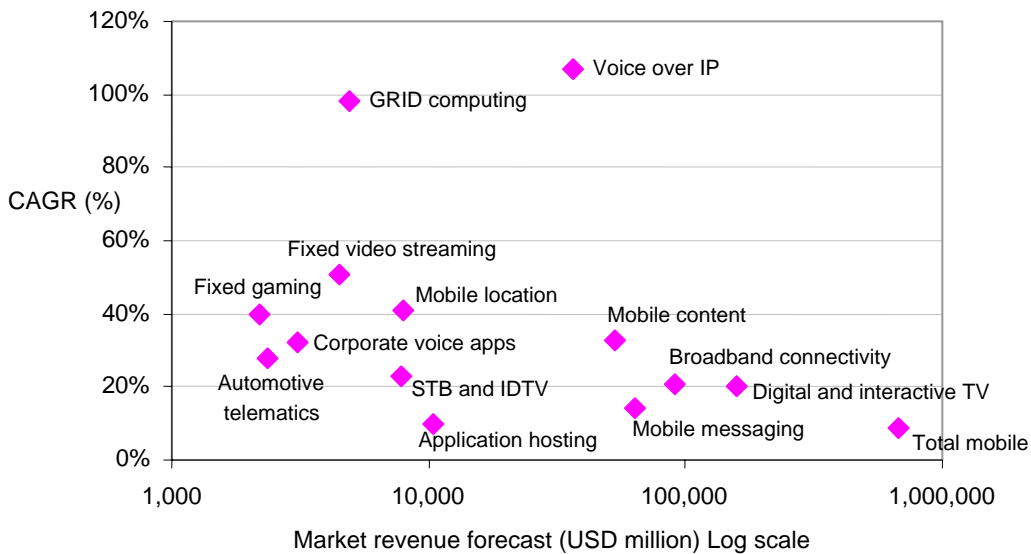

Figure 1:   Revenue and market growth projections for different growth areas [Source: ITI Techmedia]

The various opportunity areas exhibit different market size and growth prospects. In general, the growth areas with projected annual revenues of less than USD10 billion exhibit higher levels of annual growth than those markets with higher revenue projections. Typically, annual growth projections for the different areas lie in the range 20% to 50% in the period to 2008.

Given the revenue and growth potential offered by the different sectors, ITI Techmedia is likely to focus its activities upon emerging markets that that offer strong growth potential, rather than in maturing markets that offer higher revenue opportunity.

Through market analysis the functional needs that underpin the development of these identified market opportunities have been identified.

ITI Techmedia will use this information to identify appropriate Programmes

Using the acquired knowledge in this report as input, ITI Techmedia is undertaking further analysis of the functional needs to select those with the strongest Scottish 'fit' and the greatest potential to be a success when utilised within the identified markets. The selected functional needs will be used as input to define potential technology platforms as part of the ITI Techmedia programme selection process.

1 INTRODUCTION

1.1 Document purpose

The purpose of this document is to provide a 'snapshot' view of the Communications Services sector in order that the Membership:

- have visibility of the market analysis activities undertaken in this sector by ITI Techmedia

- can gain access to market information relevant to the sector

- are provided with an indication of the functional needs that ITI Techmedia will further explore to identify the technology platforms that will form the basis of ITI Techmedia research and development programmes.

This document should not be considered as providing a comprehensive analysis of the competitive environment within the Communications Services sector. Such an analysis is beyond the scope of this document.

1.2 Structure and Content

This document provides market intelligence into the sector defined by the Intermediary Technology Institute (ITI) in Techmedia as Communications Services (see Section 2.1 for the definition of Communications Services). The information captured within the document has been obtained following the principles of market intelligence gathering (otherwise known as foresighting) established by ITI Techmedia. This process is described in an abridged form in Appendix 1.

During the process of developing this market intelligence report, both primary and secondary market data was acquired and collated. Primary data was collected during Market Intelligence Workshops attended by experienced individuals from industry and academia supplemented by face-to-face interviews with key organisations in the sector. This primary data gathering process was augmented by desk research that was used to obtain secondary data from internationally recognized market analysts. Where possible, the source of any data used in this report has been identified.

Section 1: Introduction. This Section covers the background, aims and scope of the Intermediary Technology Institutes (ITIs). It also provides a high level description of the 'Techmedia' areas of focus. Further background information can be obtained on the website www.ititechmedia.com.

Section 2: Market Overview. This Section provides a working definition of the Communications Services sector, highlights the main characteristics of the sector, identifies the main trends, drivers and barriers, and describes generic value chains representing current business practice. This Section provides a framework for the subsequent presentation and analysis of data in Sections 3 and 4.

Section 3: Market Assessment. This Section provides an assessment of the market opportunities identified during the foresighting process. Each opportunity is defined and the main characteristics described in terms of drivers, inhibitors and the functional needs which will need to be met by any fulfilling technologies.

Section 4: Market Data. This Section contains the relevant market size data for each market opportunity identified in Section 3. This type of data is traditionally derived from historical figures, and therefore market projections are best viewed as providing a base reference level from which informed extrapolations can be drawn. Where possible and appropriate, the segments identified in this report are matched to existing market data; where a new market opportunity is identified, a potential market size has been projected.

1.3   Background: Intermediary Technology Institutes (ITIs)

1.3.1   Economic Context

A global driver for economic growth is the development and exploitation of technology both for present needs and future requirements. Successful economies are underpinned by a vibrant research base which extends from basic science through to pre-competitive research and development with a clear focus driven by global market opportunities. Scotland has a reputation for world class research in many fields and already undertakes significant research activity in several areas which have the potential to be strong future market opportunities. In addition to the research base, most developed economies have institutes or organisations that promote knowledge generation and increase commercial exploitation capacity. The establishment of such organisations has had significant economic impact over the long term.

1.3.2   ITIs

The creation of the Scottish ITIs is aimed at increasing the effectiveness of Scottish businesses in the key global market sectors of Communications Technologies and Digital Media ('Techmedia'), Life Sciences and Energy, all targeted to address the particular (research) strengths and (company) weaknesses of the local economy. The ITIs will also interact with each other to identify potential overlap or "white space" market opportunities between Techmedia, Life Sciences and Energy. The creation and development of the Scottish ITIs is a long-term initiative, and will be supported for a significant period of time (>10 years).

The ITIs are in essence, a centre or "hub" for:

- identifying, commissioning and diffusing pre-competitive research that is driven by an analysis of emerging markets

- managing intellectual assets to maximise commercial and economic value.

An active Membership is core to the proposed Institutes. The ITIs are open for Membership to all companies and research institutions, and all Members will be encouraged to actively participate in its activities. ITI strategy and operation will be actively guided and supported by its Members. It is essential to attract Members with a broad global perspective on markets and new technology directions, as well as a local focus to ensure that propositions will be transferred effectively into the Scottish economy.

1.4   Definition of the Techmedia Sector

ITI Techmedia is centred on the development and creation of commercial opportunities encompassing the communications technologies and digital media sectors. The activities of the ITI will bring Scotland's economy to the cutting edge of emerging markets by allowing local companies to access and build upon pre-competitive technology platforms developed by the ITI.

The term 'Techmedia' arose out of the need to reflect the market evolution of communications technologies and digital media. The overall trend in the marketplace is one governed by a value chain ranging from content/application generation through delivery to consumption. Content is no longer considered in isolation from service provision, service provision in isolation from delivery channels, or delivery channels in isolation from enabling and managing technologies.

The following elements are examples of the areas which fall within the Techmedia remit. These elements are best viewed as illustrations. They represent some of the over-arching philosophies and help to place the output of the ITI in context:

- media content: ultimately the product for which the customer is paying, either directly or indirectly
- service provision: the mechanisms for providing customers with content and applications including navigation and payment
- delivery: technologies and infrastructure required to transport the content to the end-user, as well as providing the feedback channels for interactivity
- enabling software and systems integration: technologies and infrastructure required to condition, control and manage the delivery of content/service to the end customer.

One globally accepted trend is the delivery of content and services over multiple channels e.g. the provision of same (or modified) content to be received over mobile devices, through TVs or via PCs. Multi-channel delivery provides one of the core areas of opportunity and, since content consumption is the key revenue generating stream in many of the markets, it is central to many of the drivers that affect future market evolution in the Techmedia sector.

The Techmedia sector is potentially very broad and hence a phased approach to market foresighting has been adopted. The first phase foresighting has concentrated on five major market areas, defined as:

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- **Health**: the delivery of health services including clinical, education and administrative services through the processing, management or communication of information, including video, audio, graphics and signal data.

- **Commerce and Finance**: the conducting of business transactions and the provision of financial services using electronic means, generally involving digital computers, electronic communications and the application of information technology. It includes the buying and selling of goods and services, the transfer of funds and related internal company functions.

- **Learning and Education**: the provision, delivery and administration of learning through the use of new media and network technologies

- **Communication Services**: the provision, management and delivery of voice, video, data and IT services over wired and wireless communication networks. These include consumer and business services, vertical sector industrial applications and broadcast content.

- **Entertainment and Leisure**: the delivery of online digital entertainment and leisure services to end consumers. Specifically, this embraces the market for online music, games and movie services over fixed and wireless networks

This report is a first stage analysis of the market for Communications Services.

1.5   Next Steps

This report describes the results of the market analysis activities undertaken by ITI Techmedia in the Communications Services sector. As such, the report describes future market opportunities, challenges, key drivers and functional needs.

Using this acquired knowledge as base input, the ITI will select those functional needs with the strongest Scottish 'fit' and the greatest potential to be a success when utilised within the identified target markets. The selected functional needs will be used as input to define potential technology platforms, and these platforms will then be used as input to the ITI Techmedia programme selection process.

During this process, ITI Techmedia will continue to report to its Membership on progress and results. Members are encouraged to provide comment and input, and to become actively involved in programmes.

ITI Techmedia intends to further develop its knowledge base in this sector. In order that the Membership gain visibility to ongoing developments identified by ITI Techmedia, this Report will be subject to periodic review and re-issue.

2 MARKET OVERVIEW

2.1 Market Definition

Communications Services covers a wide range of telecommunications services markets, ranging from broadband home and multimedia mobile messaging to industrial data networks and interactive TV. For the purposes of this document, the definition of Communications Services is:

The provision, management and delivery of voice, audio/video, data and IT services over wired and wireless communications networks, including consumer and business services, vertical sector industrial applications and broadcast content.

This definition includes the software used to manage and control networks and services, and, more generally, the concept of IT applications delivered over a network. However, the IT applications themselves are not considered.

2.2 Market Segmentation

In this document, the following market segments are considered:

- mobile communications
- fixed communications
- broadcast services
- business vertical sectors
- business corporate services.

It should be noted that these markets are not mutually exclusive. The mobile communications, fixed communications and broadcast segments represent distinct markets. However, the vertical segments within the business market represent a proportion of the overall mobile, fixed and broadcast segments. The relationship between these segments is illustrated in Figure 2 below.
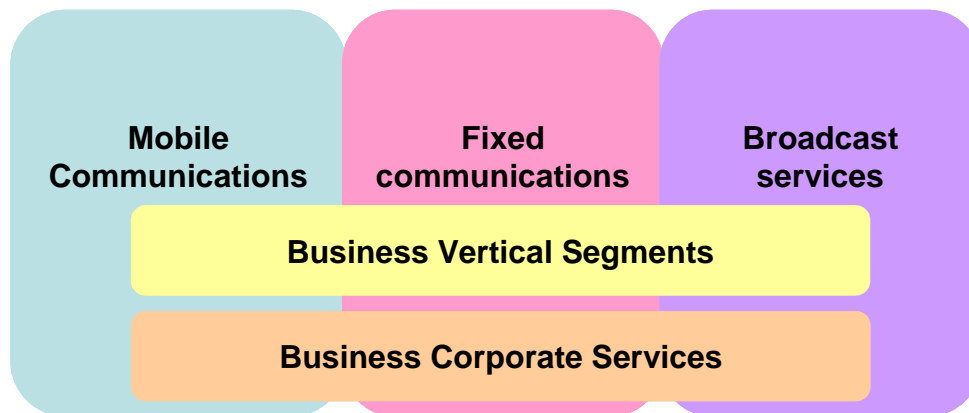
Figure 2:   High-level market segments [Source: ITI Techmedia]

In Section 2.3 below, an overview of each of the high-level market segments illustrated in Figure 2 is provided. In Section 3, major areas within each of the high-level segments are identified and described. Supporting market revenue data for the different areas within each segment is provided in Section 4.

2.3   Market Description

The world Communications Services market comprises both telecommunications and broadcast services. The International Telecommunications Union (ITU) estimate that the world telecommunications (fixed and mobile telecommunications) services market was worth some USD1 trillion in 2002[1]. In the broadcast segment, end consumer revenue in 2002 from licence fees and pay TV subscriptions was some USD160 billion[2]. The importance of the Communications Services market to the world economy is increasing. In 2002, the Communications Services revenue as a proportion of world GDP[3] was 3.7%, up from 3.0% in 1998 – a growth of 22% over the period.

The value of the Communications Services sector is expected to grow to some USD1.6 trillion by 2008[4], as illustrated in Figure 3 below. From 1998 to 2003, the mobile segment has been the main driver of growth in the sector, and this is expected to continue over the period to 2008.

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[1] ITU, http://www.itu.int/ITU-D/ict/statistics/at_glance/KeyTelecom99.html
[2] PWC, Global Entertainment and Media Outlook, 2002-2006
[3] ITI Techmedia estimate based upon World Bank GDP data and ITU telecom data
[4] ITU, PWC, Strategy Analytics, ITI Techmedia
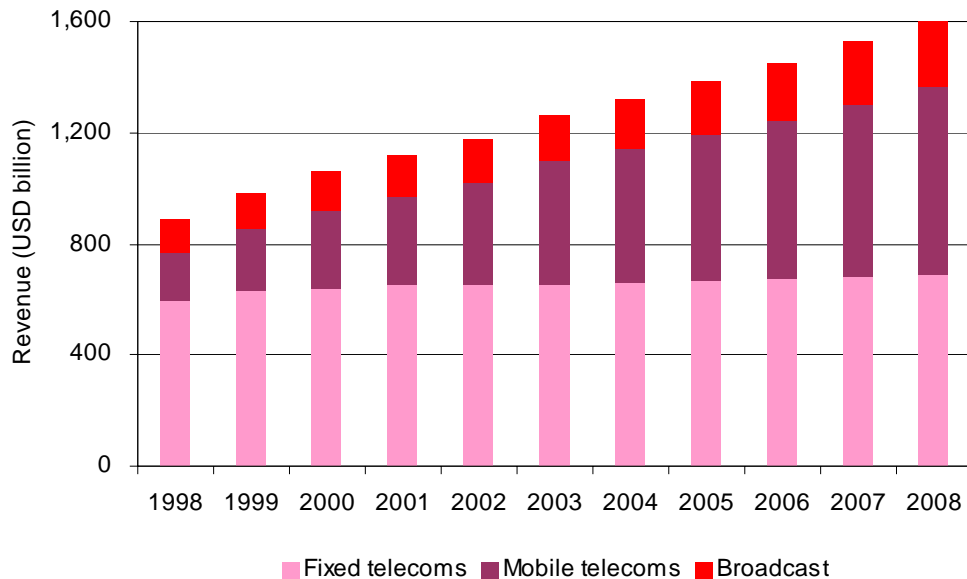
Figure 3:   Global Communications Services revenue, 1998-2008 [Source: ITU, PWC, Strategy Analytics, ITI Techmedia]

The development of the industry in the short/medium term is driven largely by momentum; large equipment vendors like Nokia and multinational operators and broadcasters like Vodafone and News International command the majority of the market and have established medium term product and service roadmaps which are unlikely to change significantly over the next few years. There are many suppliers to these giants:

- large outsourced chip suppliers and equipment manufacturers in the Far East

- specialist network and test equipment vendors

- major telecommunications software suppliers (billing, middleware)

- a plethora of small companies developing specialist software (e.g. mobile games) or specific technologies/equipment (e.g. proprietary Fixed Wireless Access equipment).

Most of the areas addressed by these companies are highly competitive – it is not unusual to find 20-30 companies world-wide developing competing solutions for a specific niche in the market. However the rewards can be significant: many of the major players today have their origins in start-ups whose solutions were adopted by the industry and became a de-facto or actual standard. This is still possible – there are many areas of technology uncertainty where mass-market solutions may yet emerge, for example Voice over WLAN (VoWLAN).

A high level overview of the major segments in the Communications Services sector, reflecting the way the industry is currently organised, is presented in the following Sections.

2.3.1 Mobile Communications

As the market for mobile communications services reaches saturation, many developed countries now exhibit low levels of growth in subscriber numbers. This has significant implications for both mobile operators and terminal vendors. In such markets, mobile operators are placing increased emphasis upon growing revenue by encouraging:

- existing users to increase their expenditure levels

- high spending subscribers to migrate between networks.

In the market for mobile terminals, vendors will encourage users to reduce the life cycle of mobile devices, and hence increase volumes, through the ongoing deployment of new models with increasingly feature-rich capabilities (e.g. cameras, enhanced messaging capabilities) that also open up new revenue-generating opportunities for mobile operators.

In developing markets (e.g. China), increased penetration will be realised only through the acquisition of new, low-spending, subscribers. As such, mobile operators must develop a sufficiently low cost base, in terms of both capital and operating costs, to allow them to be profitable in a low-spending environment. As an example, 'basic' handsets with relatively limited feature sets are being rolled out to new subscribers. However, due to scale economies in terminal manufacture, terminal vendors will be able to deploy increasingly advanced features in these 'basic' handsets.

The deployment of data-capable handsets both in developed and developing markets will provide the opportunity to deploy platforms for the widespread roll out of mobile data services. These services will comprise primarily messaging services, but also services requiring relatively small data transfers such as authentication, colour browsing and simple interactive games. In this way mobile operators will have the opportunity to increase average revenue per user (ARPU) by offsetting declining voice revenue with increasing data revenue. The deployment of such services has required the roll-out of so-called '2.5G' network upgrade technologies such as GPRS and CDMA 1xRTT.

Accompanying this shift in the revenue mix, operators will deploy new network technologies offering higher capacity than is possible on today's GSM and CDMA networks. Third generation (3G) networks will be rolled out initially to address network capacity problems (e.g. in major cities), and then used as a basis for the deployment of more advanced data-intensive services (e.g. video messaging and advanced real-time interactive gaming). However, the demand for high bandwidth mobile data services remains largely unproven. Should voice services remain the dominant revenue stream into the future, mobile operators may choose to utilise greater network capacity to address lower value services including fixed voice services.

Given these general trends it is forecast there will be some 2 billion mobile phone subscribers worldwide by 2008[5], as illustrated in Figure 4 below. Of this total, it is forecast that almost 60% of mobile subscribers will utilise non-voice services by 2008, up from 45% in 2003[6].

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[5] Strategy Analytics Global Cellular Data Forecasts 2002-2008
[6] Strategy Analytics Global Cellular Data Forecasts 2002-2008

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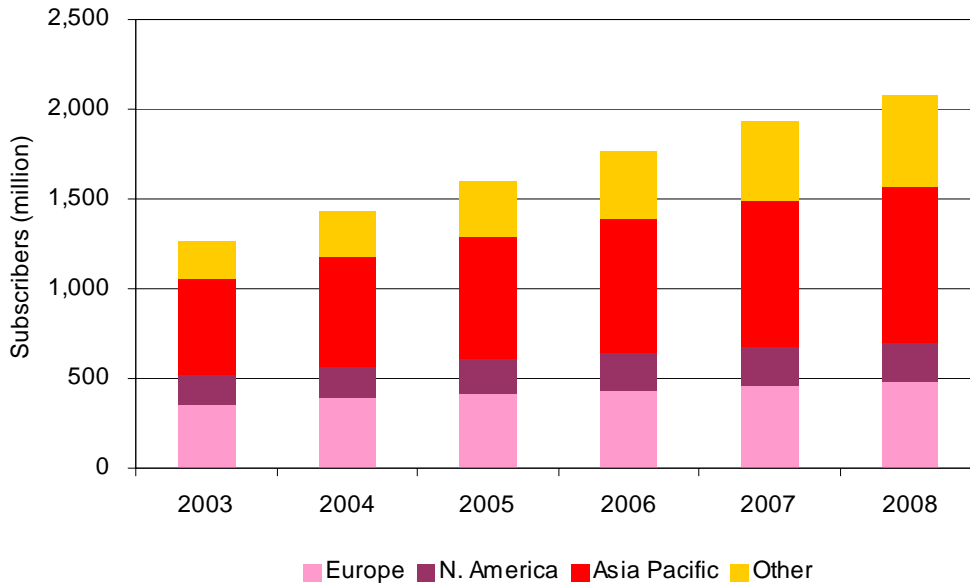
Figure 4:   Global mobile subscribers by region, 2003-2008 [Source: Strategy Analytics]

Mobile revenue is forecast to show steady growth to over the period to 2008, reaching some USD675 billion[7] (see Figure 5 below). This represents a growth of over 50% over the period from 2003.
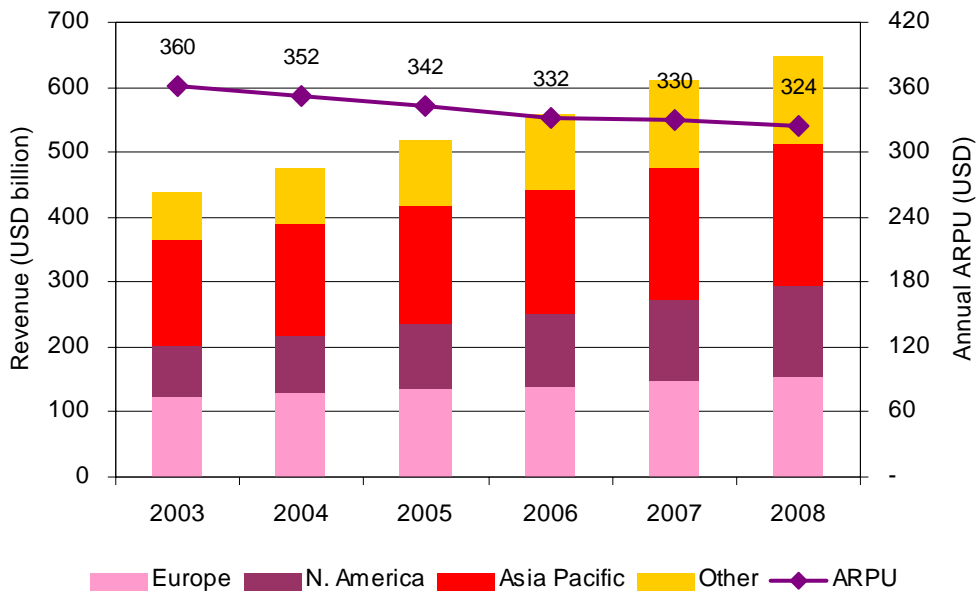

Figure 5:   Global mobile revenue by region and global mobile ARPU, 2003-2008 [Source: Strategy Analytics]

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[7] Strategy Analytics Global Cellular Data Forecasts 2002-2008

Mobile revenue is expected to be driven, in the main, by voice services. However, non-voice services are forecast to account for over 20% of global revenue (USD140 billion) by 2008[8]. Between 2003 and 2008, this represents a growth of almost 150%, and a cumulative annual growth rate (CAGR) of 25%, over the period. Data service adoption is not expected to be uniform across regions. In Europe and Asia Pacific markets, the proportion of mobile revenue accrued from data services is expected to be significantly higher than in other regions.

Despite increased utilisation of data services, global annual ARPU is forecast to fall by around 2% per annum to USD324 by 2008 predominantly due to the growth in low-spending subscribers coming from developing countries.

2.3.2   Fixed Communications

As previously described, the overall market for fixed services is very mature. Although the utilisation of fixed services is expected to grow, this will be offset by declining prices. As a result, overall revenue in the fixed communications segment is expected to remain stagnant to 2008.

Despite revenue stagnation in the fixed communications segment as a whole, specific opportunities exist within the segment. In developed markets, the single most significant growth opportunity is the market for broadband services. This Section focuses upon the market for consumer services, while the market for business broadband services is considered further in Section 2.3.4 below.

With static (though albeit large) voice market revenue, the major innovation in the consumer fixed market has been the emergence of broadband access to the home, based mainly on Asymmetric Digital Subscriber Line (ADSL) and cable modems. These technologies represent an incremental technology enhancement from existing digital telephony and cable TV (CATV) networks, but provide a step change in performance levels when compared to dial-up solutions. The availability of such technologies, however, cannot be justified economically in all areas. Gaps in the supply of these technologies may be filled (slowly) by radio and satellite technologies as governments seek to ensure that rural areas are not economically disadvantaged by not having access to broadband services.

With increasing availability of broadband access services, a steady increase in consumer broadband service take-up can be expected, encouraging investment in, and development of, a new wave of broadband content and services. In addition the emergence of voice over IP (VoIP) services, with quality at least equal to mobile voice services, will apply further downward pressure on the price of voice services. Declining prices may trigger further declines in fixed voice average revenue per user (ARPU) and accelerate the trend towards bundled internet protocol (IP) based services.

Broadband service revenue growth will be limited by the rate at which viable and equitable revenue models between network access providers and content providers can be implemented. As the economic viability of broadband content services becomes proven, the need for a range of content management services, including content storage, content aggregation and digital rights management (DRM), can be expected.

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[8] Strategy Analytics Global Cellular Data Forecasts 2002-2008

As awareness of the benefits of broadband services grows, an increasing proportion of homes will be networked, via low-cost WLAN equipment and deployment of home media gateways (e.g. ADSL/WLAN router/firewall). This could include, for example, Bluetooth enabling a mobile handset to make calls via the fixed IP network. As these technologies become increasingly prevalent, the traditional role of fixed line incumbent operators, mobile operators and broadcasters will come under increasing scrutiny, possibly resulting in the consideration of new, integrated, business models.

In the longer term, as broadband services gain widespread acceptance and adoption, bandwidth requirements in the access network may increase. This may result in the emergence of a 'bandwidth gap' as the capacity limits of existing technologies are reached. In such a scenario, there may be renewed interest in the deployment of higher bandwidth technologies. However, such developments will be applicable only in the longer term, and will require the availability of low-cost technical solutions that will enable the development of a viable business case for high-bandwidth service deployment.

It is forecast that the total number of residential broadband households will reach 2000 million by 2008 (see Figure 6 below).
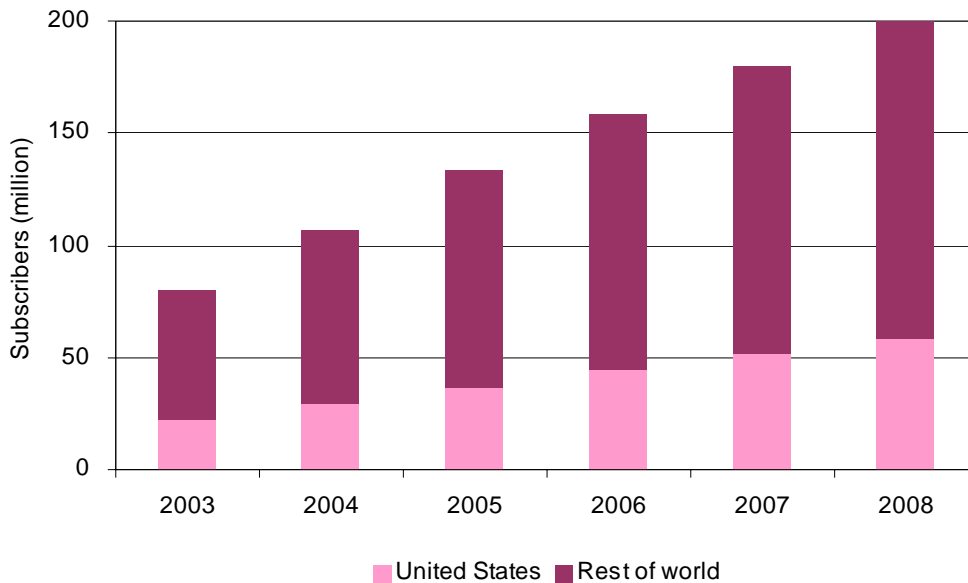
Figure 6:   Global residential broadband households by region, 2003-2008 [Source: IDC]

Residential broadband revenue is forecast to grow to almost USD50 billion by 2008, as illustrated in Figure 7 below. Over the period 2003 to 2008, this represents an average growth of 19% per annum.
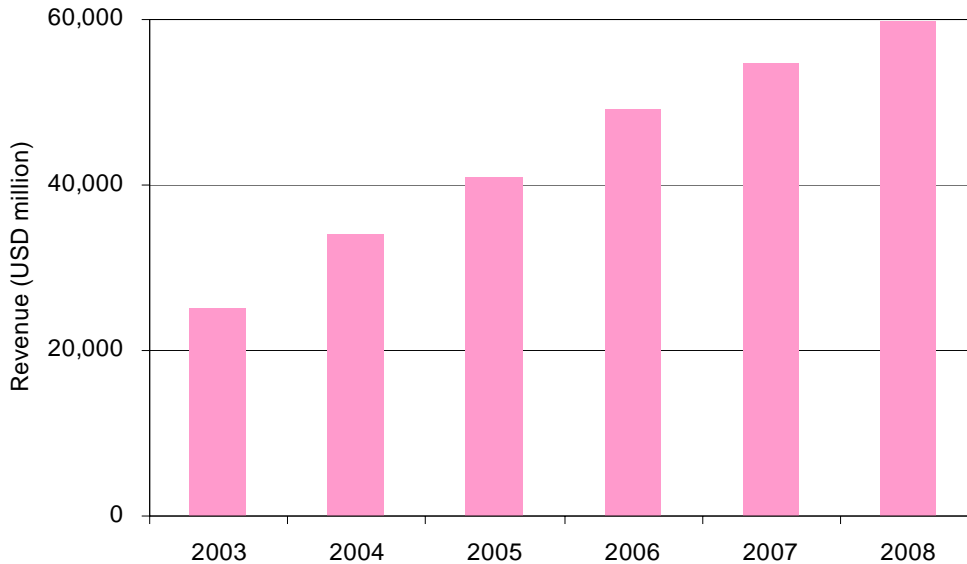
Figure 7:   Global residential broadband revenue by region, 2003-2008 [Source: IDC]

In many developing markets, the availability of fixed services - both voice and data - remains poor, particularly in rural areas. As mobile services have emerged, the penetration of fixed services has been rapidly overtaken. However, since telecom services are only viable in areas of sufficient traffic density, network deployment remains uneconomic in large areas, resulting in very patchy service availability. To address this issue, governments are looking at ways in which the deployment of communication infrastructure can be encouraged in areas that are under-served.

Rural service availability will remain a significant issue in developing markets for many years, and innovative solutions which minimise the cost of deploying and running communication services will remain of interest for the foreseeable future.

2.3.3   Broadcast Services

The broadcast sector is dominated by large organisations with huge buying power. Using this buying power, dominant broadcasters can sign deals that allow them exclusive access to the most attractive and lucrative programme content. As a result, these broadcasters are then able to leverage this content, together with pay per view (PPV) and content-on-demand capabilities to increase subscriber take-up and grow ARPU.

Broadcast services are delivered to the end-user through a variety of different means including terrestrial, satellite and cable networks. Each of these delivery mechanisms exhibits unique attributes. For example, digital cable networks provide a range of services, such as voice and broadband Internet access that cannot be readily delivered using terrestrial or satellite broadcast systems. However, in order to provide the consumer with access to these services, digital cable operators are required to invest heavily in the

provision of connectivity to the home. As a result of these investment requirements, many cable providers are struggling to manage heavy debt burdens.

The position of the dominant operators could potentially be threatened by emerging access mechanisms such as digital TV over terrestrial and broadband networks. This may have some effect upon those organisations with heavy access infrastructure investments, but is unlikely to have any significant effect upon those organisations that currently have the significant content buying power.

More capable devices that enable greater degree of content personalisation, such as hard disk-based personal video recorders (PVRs), are likely to show rapid growth in the medium to long term. This may trigger competing service and product approaches between edge-of-network and network delivered content delivery business models. The trend towards greater personalisation will drive increasing demand for new content navigation models that provide greatly enhanced content search and selection capabilities for the end-user.

Broadcasters have demonstrated considerable interest in opportunities afforded by mobile data services. It is likely that Digital Audio Broadcast (DAB) and, in the longer term, Digital Video Broadcast (DVB) capabilities will be integrated into mobile devices, with consequent implications for the split of mobile data revenue between mobile operators, handset providers and broadcasters.

Given these trends, global revenue from licences and pay TV services is forecast to reach approximately USD240 billion by 2008 (see Figure 8 below). Although Europe and North America comprise the majority of this revenue, revenue growth is expected to be higher outside these markets.
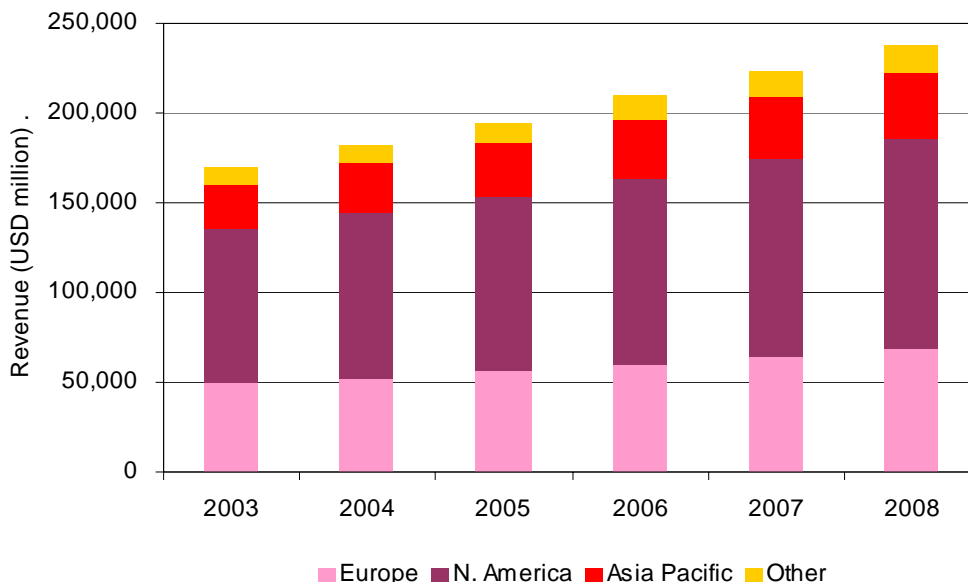
Figure 8:   Global broadcast revenue by region, 2003-2008 [Source: PriceWaterhouseCoopers]

2.3.4 Business Vertical Sectors and Business Corporate Services

The market for business communications services is considerable. In Europe, it is estimated[9] that business communications services account for some 50% of the total Communications Services market. The total business market may be considered as comprising two distinct segments – corporate and small/medium enterprise (SME). In terms of investment in Communications Services, the profile of these segments is quite different – corporate organisations, despite accounting for only 40% of total business revenue, are estimated to account for 55% of communications services revenue[10].

For corporates, key issues are efficiency gains, cost savings and minimising risk. Hence converged IT and telecommunications networks, based around IP networking, will slowly gain acceptance. The deployment of wireless office networks will also grow both through networks provided by the corporates themselves, and by operators extending their corporate service offerings into the office environment. The technology and networks are now in place to enable the delivery of enterprise mobile data applications that enhance organisational efficiency. In addition there will be growth in fixed networks and applications, particularly where older legacy networks and applications will be replaced by more cost-effective, standards-based solutions (e.g. the public sector).

For SMEs and SOHOs key issues include the availability of broadband access and the utilisation of applications enabled by broadband access. As these barriers are overcome, it is forecast that the number of business broadband subscribers will increase from 17 million in 2003 to over 50 million by 2008 as illustrated in Figure 9 below.

Figure 9:   Global business broadband subscribers, 2003-2008 [Source: IDC]

By 2008 it is forecast that global business broadband access revenue will reach USD30 billion as illustrated in Figure 10 below.

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[9] ITI Techmedia estimate
[10] Cap Gemini, Unlocking the SME market, February 2003

Figure 10:   Global business broadband access revenue, 2003-2008 [Source: IDC]

The take-up of broadband access services in itself creates new revenue opportunities including security, enhanced networking, voice and IT service provision. These services will provide a platform for the delivery of higher value applications such as integrated supply chain management and SME level network-delivered IT applications (starting with anti-SPAM, storage, remote backup etc.). As network quality and reliability develops, more advanced applications will become possible, leading to a slow re-emergence of the ASP model for specific network-hosted applications (e.g. mesh applications and remote desktop).

2.4   Market Trends and Drivers

A number of trends and drivers are affecting, or will affect, the Communications Services sector.

> *A **trend** is a discernible pattern of change, which can be linear, accelerating or decelerating. An example of a trend is: the average age of the UK population is increasing.*
>
> *A **driver** is a factor which directly influences or causes a change in a specific market. An example of a driver based on the above trend is: the need for easier to use interfaces in mobile phones making them accessible to the ageing population.*

The overall major trends impacting the Communications Services sector are discussed below.

2.4.1 Current Trends and Drivers

Important trends and drivers in the Communications Services sector include:

1. Increasing availability of broadband access in developed markets, leading to a significant base of broadband-enabled homes

2. Need to control operating costs in order to maintain margins as the price of services is driven down by competitive pressure

3. Lack of availability of capital for significant new fixed network rollout or upgrade, in particular for the upgrade or construction of 'last mile' network solutions

4. The imminent arrival of VoIP as a mainstream voice service

5. Falling equipment costs due to scale effects, resulting in price declines in end-user and network equipment

6. Mobile markets approaching saturation in developed markets (everyone who wants a mobile already has one)

7. Widespread deployment of data-enabled (e.g. GPRS, CDMA 1x) mobile networks and increased take-up of data-enabled mobile handsets, leading to a significant base of data-capable mobile phones

8. The deployment of next-generation (e.g. W-CDMA, CDMA 1x EVDV) mobile networks in the next few years, enabling the delivery of mobile data services with higher bandwidth requirements at lower cost

9. The emergence of WLANs, and the opportunity (and threat) this presents to fixed and mobile network operators

10. Corporate IT spending limitations and desire to minimise risk

11. Regulation and political issues, e.g. competition regulation, spectrum licensing, service obligations (for incumbent operators), price controls for operators with significant market power

2.4.2 Key Trends and Drivers – Identified by an Expert Foresighting Group

The general sector trends identified in Section 2.4.1 above have been complemented by the opinions of an expert group convened by ITI Techmedia in January 2004. The group, which included organisations such as BT, Vodafone and Ofcom, identified the following additional key trends likely to impact the sector:

1. Ageing population – in developed markets the relative number of people over 50 years of age is large and growing, requiring tailored devices and systems

2. Increasing need for identification, authentication (I am who I say I am) and authorisation (I have the authority to act) in order to enable transactions and establish user and network identity

3. Increasing media consumption on the move using robust, broadband network access from anywhere and portable playback/viewing devices

4. Personalisation of content and services will evolve with services and devices able to be simply configured to individual user needs

5. Automated translation of content reflecting globalisation of services and products and the need for communication across cultural boundaries

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6. Voice recognition and machine communication as people increasingly interact with intelligent machines and devices

2.4.3   Barriers to Market Entry

The Communications Services sector is an industry dominated by a number large players including:

- national and international network operators and service providers such as BT, Vodafone, AOL and DoCoMo

- global equipment vendors such as Nokia, Cisco and Nortel

- specialist players in areas such as billing systems or mobile software infrastructure such as Convergys and HP).

There are significant barriers for technology suppliers in selling to these companies:

- They have multi-year product and service roadmaps which are well established and may be difficult to change in order to incorporate a relatively minor new product or service offered by technology suppliers. Even if the concept is good they may lack the resources to examine the implications of the new concept for the business

- Customer demand is often unproven, making the case for investment difficult to justify

- The risk of change is too high. For example new smart antenna technology could provide higher capacity in a mobile network but is unproven and may give rise to quality problems and network downtime. The operator sees no reason to risk current large and highly profitable revenue streams by making the change

- Evaluation timescales are long. Typically an operator will run R&D trials, set up a test site and then move to a limited commercial deployment to evaluate a new communications technology, all of which may take as much as 2 years. The technology supplier must have the funding to support itself and the trial for this period before it has any hope of significant revenue

- Reliability of new technologies need to be proven, and this may entail extended periods of testing prior to commercial deployment

- The overall regulatory environment within different regions may impose specific requirements upon new technologies

- Technology suppliers may need to ensure their products are compliant with new standards which are continually being developed. The standards are primarily being developed to ensure interoperability (e.g. between networks or between services and devices) and to ensure compliance with prevailing regulatory requirements. Technology suppliers therefore need to determine a standardisation strategy that may involve:

  - waiting until standards are set and then develop technology to be compliant (and risk being late to market and up against many competitors)

  - developing technology in the expectation it will meet emerging standards (and balance risk of timescale and adoption)

or

- developing technically superior technology and hope to set the standards (with the associated risk of non-adoption)

Despite these issues, opportunities remain for companies to develop key elements of technology which become critical to the industry, allowing rapid company growth followed by a profitable exit for the original investors, typically via a trade sale. In this context timing and technology selection is critical.

2.5 Value Chain Analysis

Value chain analysis is a widely applied technique that is used to explore the specific activities through which entities can generate revenue within a particular industry sector. The techniques of value chain analysis can be applied to all sectors of the economy, although the nature of the value chain will differ between sectors. In this analysis, the value chain concept is used to illustrate the way in which:

- the introduction of new services creates opportunities across value chain elements
- functional needs can have impact across different value chain elements.

A generic Communications Services value chain is shown in Figure 11 below, along with broadcast, fixed and mobile examples showing the roles and examples of key players.

	Content Creation	Application Creation	Content Aggregation	Application Hosting	Core Network Provision	Service Provision	Access Network Provision	Customer Equipment Provision
Mobile service	Polyphonic tune	Ringtone download	WAP site	Data centre	e.g. BT network	e.g. Virgin Mobile	e.g. T-Mobile network	e.g. Nokia mobile device
Fixed service	Online game	Multiplayer host	Games portal	Data centre	e.g. BT network	e.g. Tele2	e.g. Telewest	e.g. Terayon Cable modem
Broadcast service	e.g. sports authority	e.g. Electronic programme guide	e.g. BSkyB	Data centre	e.g. BT	e.g. BSkyB	e.g. Crown Castle	e.g. Sony Digital TV

Figure 11:   Communications Services value chain [Source: ITI Techmedia]

The elements in the value chain are briefly described in Figure 12 below.

Content Creation	Origination of the content used within the application used by the end user
Application Development	Development of the applications used to deliver network-based IT services and content to the end user, including content packaging and content management applications etc.
Content Aggregation	Bundles content from different sources for presentation to the end-user
Application Hosting	Environment where the servers hosting a variety of end user applications and content reside
Core Network Provision	National backbone network provider; includes connection to different countries, internet peering, wireless backhaul from mobile base stations etc.
Service Provision	The operator who provides service directly to the customer, including transaction processing, billing, technical support, customer care etc.
	The service provider will typically own the billing relationship with the end user
Access Network provision	Provides connectivity that enables end user access to end user applications
Customer Equipment Provision	Device that allows the end user to interact with applications and access content

Figure 12:   Elements in the Communications Service value chain [Source: ITI Techmedia]

The value chain described above is too complex for an initial analysis of functional needs as described in this report. As a result, a simplified value chain has been produced that comprises four key segments:

- Network: elements relating to the provision of device connectivity

- Applications: elements relating to the provision of applications provided to end users

- Devices: elements relating to devices utilised by end users and machine sensors

- Service provision: elements relating to the interaction with the end customer

The mapping of the key segments to the Communications Services value chain to the elements in the simplified value chain is illustrated in Figure 13 below.

Service	Content Creation	Application Development	Content Aggregation	Application Hosting	Core Network Provision	Service provision	Access Network Provision	Customer Equipment Provision
Network					✓		✓	
Application	✓	✓	✓	✓				
Device								✓
Service provision						✓		

Figure 13:   Simplified value chain mapping [Source: ITI Techmedia]

The application of the simplified value chain to the analysis of functional needs is provided in Section 3.

3   MARKET ASSESSMENT

This Section summarises a number of growth areas identified through the market foresighting process, and considered to have significant market impact in the medium to long term. These market opportunities have been identified and developed based on:

- the views of experts who were asked to consider a ten-year horizon
- market research reports from 'conventional' analysts assessing a five-year horizon.

These growth areas constitute sub-segments of the high-level market segments described in Section 2.2 and, for convenience, are described under these market segments. For each of the identified growth areas, the following is described:

- brief description of the growth area
- drivers and inhibitors that will impact upon the rate of market growth
- functional needs that support market growth, together with an illustration of the area of the value chain impacted by the functional need
- roadmap highlighting the indicative timing (i.e. when the particular need is required by the mass market) of some of the identified functional needs.

A brief description of the various functional needs described in this Section is provided in Appendix 3.

3.1   Mobile Communications

As previously discussed, mobile operators have invested significantly in the deployment of data services in order to encourage revenue growth. However, end-user demand for mobile data services remains unproven, and so the market opportunity for mobile data services in the longer term may be larger or smaller than currently envisaged. The nature, and revenue potential, of the mobile data market must therefore be considered uncertain.

Despite this uncertainty, ITI Techmedia is of the opinion that the mobile data service markets will continue to represent a high growth, high revenue opportunity. Further analysis of the impact of a smaller than expected mobile data market upon any investments will be undertaken.

As a result of the foresighting process, four areas are considered to offer considerable potential within the mobile data services market:

- mobile interaction and data applications
- location-based services
- mobile messaging
- mobile content.

3.1.1 Mobile interaction and data applications

As a result of the foresighting process, ITI Techmedia has identified mobile gambling and gaming applications as key markets in this space. These are analysed below.

Gambling is a large industry that has a high reliance upon communications infrastructures as a key enabler. The mobile device represents a new channel for the delivery of real-time applications to users irrespective of time and physical location. Gaming is enjoying significant growth in the area of multi-user interactive applications. Like gambling, the mobile device represents a new channel for the delivery of real-time interactive applications independent of time and physical location.

Drivers and inhibitors

Major drivers and inhibitors that will affect the take-up of mobile interaction and data applications are described in Figure 14 below.

Drivers	Inhibitors
Convenience of access for the gambler	There is a relatively small population of regular gamblers
Delivery of context relevant background information/statistics	Most of the value in this market goes to the market maker
Growth of multi-player games (network effects)	Price-sensitive consumers
Demographics – adoption by junior/youth segments	Device limitations
Adoption by older users	Lack of handheld console vendor/mobile operator partnerships
	Lack of established DRM/charging mechanisms
	Tailoring to the many different handset platforms

Figure 14 : Mobile interaction and data applications, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of mobile interaction and data applications, together with their area of application within the simplified value chain, are illustrated in Figure 15 below.

Functional needs	Network related	Application related	Device related	Service provision related
Application development platforms		✓	✓	✓
Camera phone support technologies		✓	✓	✓
DAB/DVB capabilities		✓	✓	✓
Data encoding algorithms		✓	✓	
Device download and storage mechanisms	✓	✓	✓	✓
Flexible displays			✓	
Handset configuration platforms		✓	✓	✓
Heuristic Learning		✓		✓
High capacity short range wireless systems	✓		✓	
High capacity wireless networks	✓		✓	
Longer battery life, e.g. using micro fuel cells			✓	
Multi-mode devices (e.g. GPRS/WLAN)			✓	✓
Network management	✓	✓		
Network-based entertainment platforms		✓	✓	✓
Personalisation and service usability		✓	✓	✓
Presence		✓	✓	✓
Push technology (triggering applications on mobile devices)		✓	✓	✓
Push to talk		✓	✓	
Smart antennas	✓		✓	
Turbo graphics		✓	✓	
Up- and down-stream adaptive bandwidth provisioning	✓		✓	
Video telephony with QoS	✓		✓	✓

Figure 15: Identified functional needs, mobile interaction and data applications [Source: ITI Techmedia]

Roadmap

Figure 16 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.

Figure 16:   Mobile interaction and data applications, 2004-2008 [Source: ITI Techmedia]

3.1.2   Location-Based Services

Location-based services utilise position information to enhance existing, and develop entirely new, end-user services and applications. Currently, the take-up of location-based services is limited in most markets, although location-based service take-up has enjoyed some growth in Asia-Pacific markets. Significant growth in this area is likely to occur only from 2005 onwards as location-finding technologies become proven and end-user applications are developed.

Drivers and inhibitors

Major drivers and inhibitors that will affect the take-up of location-based services are described in Figure 17 below.

Drivers	Inhibitors
Higher value of context relevant information	High operator infrastructure costs (for technologies other than cell-ID)
Enabler for advanced messaging services, gaming etc.	Need to develop location-sensitive applications
Personal applications/ messaging based on location	Charging premium rates for location data is difficult

Figure 17 :   Location-based services, drivers and inhibitors [Source: ITI Techmedia]

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Functional needs

Functional needs that support the development of location-based services, together with their area of application within the simplified value chain, are illustrated in Figure 18 below.

Functional needs	Network related	Application related	Device related	Service provision related
Application development platforms		✔	✔	✔
Advanced location technologies	✔		✔	✔
Intelligent agents		✔		
Location-aware services		✔	✔	✔
Location-dependent personalisation		✔	✔	
Network-based location	✔			

Figure 18:   Identified functional needs, location-based services [Source: ITI Techmedia]

Roadmap

Figure 19 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.
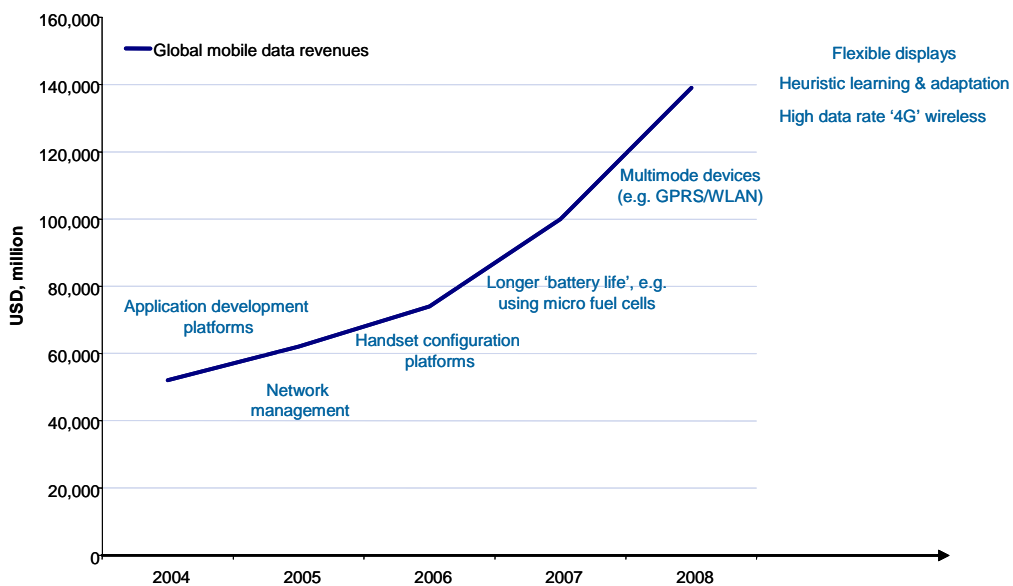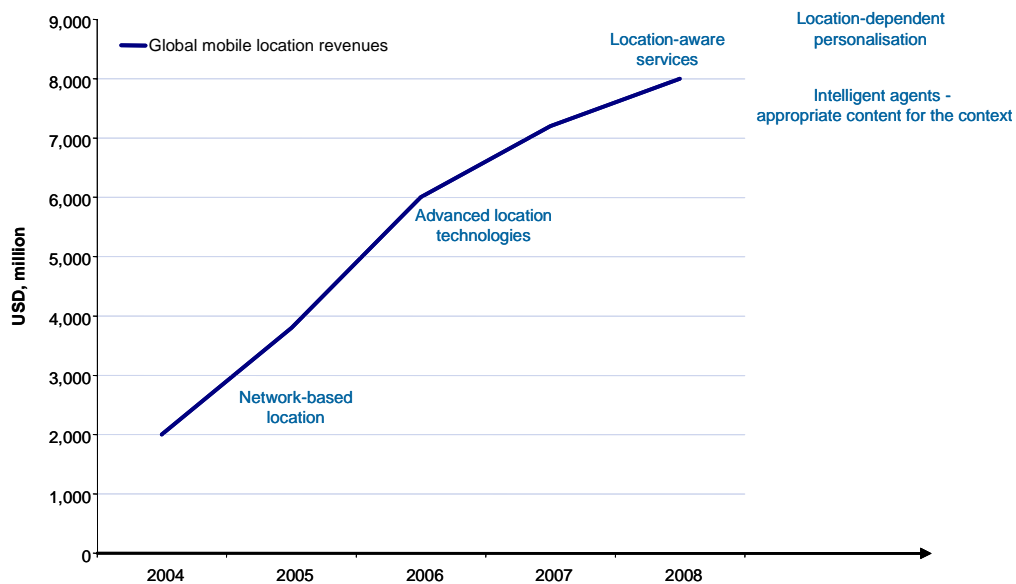

Figure 19:   Location-based services functional needs [Source: ITI Techmedia]

3.1.3   Mobile Messaging

Mobile messaging applications cover the provision of both person-person and machine-machine interaction. As such, messaging includes the 'legacy', but still highly profitable, Short Message Service (SMS), and also includes multimedia messaging and video messaging services. As the capabilities of messaging services evolve, the range of applications that can be supported will expand to include personal interaction, information and entertainment.

Drivers and inhibitors

Major drivers and inhibitors that will affect the take-up of mobile messaging are described in Figure 20 below.

Drivers	Inhibitors
Messaging will be 50% of mobile data revenue in 2008 – text, video, photo etc.	Roll out of MMS-capable phones (with GPRS) required for more advanced messaging
'Adult community' messaging	Device and service usability is an issue (small screens, low resolution etc.)
Desire for mobile email access	A lack of commonly accepted standards is slowing market development down
Regional subscriber growth (building the potential user base)	Network issues (QoS) delay the development of a large market
Need for mobile operators to offset voice ARPU dilution	

Figure 20 :   Mobile messaging, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of mobile messaging services, together with their area of application within the simplified value chain, are illustrated in Figure 21 below.

_____

Functional needs	Network related	Application related	Device related	Service provision related
Application development platforms		✓	✓	✓
Camera phone support technologies		✓	✓	✓
DAB/DVB capabilities		✓	✓	
Data encoding algorithms		✓	✓	
Turbo graphics		✓	✓	
Handset configuration platforms		✓	✓	✓
High capacity wireless networks	✓		✓	
High capacity short range wireless systems	✓			
Mechanisms for elective advertising – discretionary on the part of users		✓	✓	
Multichannel gateways	✓		✓	
Multimodal interfaces (i.e. speech, gesture, lip movement etc)		✓	✓	
Packet technologies for wireless WANs	✓		✓	
Personalisation and service usability		✓	✓	✓
Presence		✓	✓	✓
Push to talk		✓	✓	
Up- and down-stream adaptive bandwidth provisioning	✓		✓	
Video telephony with QoS		✓	✓	✓
Wearable communications devices			✓	

Figure 21:   Identified functional needs, mobile messaging [Source: ITI Techmedia]

Roadmap

Figure 22 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.

Figure 22:   Mobile messaging functional needs, 2004-2008 [Source: ITI Techmedia]

3.1.4   Mobile Content

Mobile content applications relate to the delivery of value-added content to mobile devices including music, news, sport, adult content, advertising, mobile commerce etc. with video, audio and payment.

Drivers and inhibitors

Major drivers and inhibitors that will affect the take-up of mobile content are described in Figure 23 below.

_____

Drivers	Inhibitors
Service quality and delivery issues are being solved (2.5G data networks are rolled-out and 3G networks will follow)	Length of time and difficulty in agreeing business models and distribution agreements between telecommunications service providers and content providers
User demand for immediate access to content wherever they are, and on the move	Marketing mobile content is difficult (due to the need to gain opt-in for advertising and the risk of alienating users)
More capable devices, e.g. phones capable of storing and playing music (MP3) will soon become mass-market	There are short-term quality issues and limitations in networks and devices, e.g. GPRS roaming
	Effective DRM is needed – there is a lack of adopted DRM standards
	Lack of standards for content streaming
	Price-sensitive consumers not willing to pay for services

Figure 23 : Mobile content, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of mobile content services, together with their area of application within the simplified value chain, are illustrated in Figure 24 below.

Functional needs	Network related	Application related	Device related	Service provision related
Automatic translation of language and content		✓	✓	✓
Charging paradigms / mechanisms				✓
Compression protocols (voice coding, video coding, data compression)		✓	✓	✓
Content-on-demand		✓	✓	✓
Content-specific indexing models and semantic encoding		✓	✓	
Copy protection mechanisms and DRM standards		✓	✓	✓
Device download and storage mechanisms	✓		✓	✓
Device memory pre-loaded content	✓		✓	✓
Flexible displays			✓	
Improved power management			✓	
Longer battery life, e.g. using micro fuel cells			✓	
Multichannel gateways	✓		✓	
Network-based entertainment platforms	✓	✓		✓
Tools for mobile content creation		✓	✓	
Up- and down-stream adaptive bandwidth provisioning		✓	✓	
Streaming platforms		✓	✓	✓

Figure 24:   Identified functional needs, mobile content [Source: ITI Techmedia]

Roadmap

Figure 25 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.
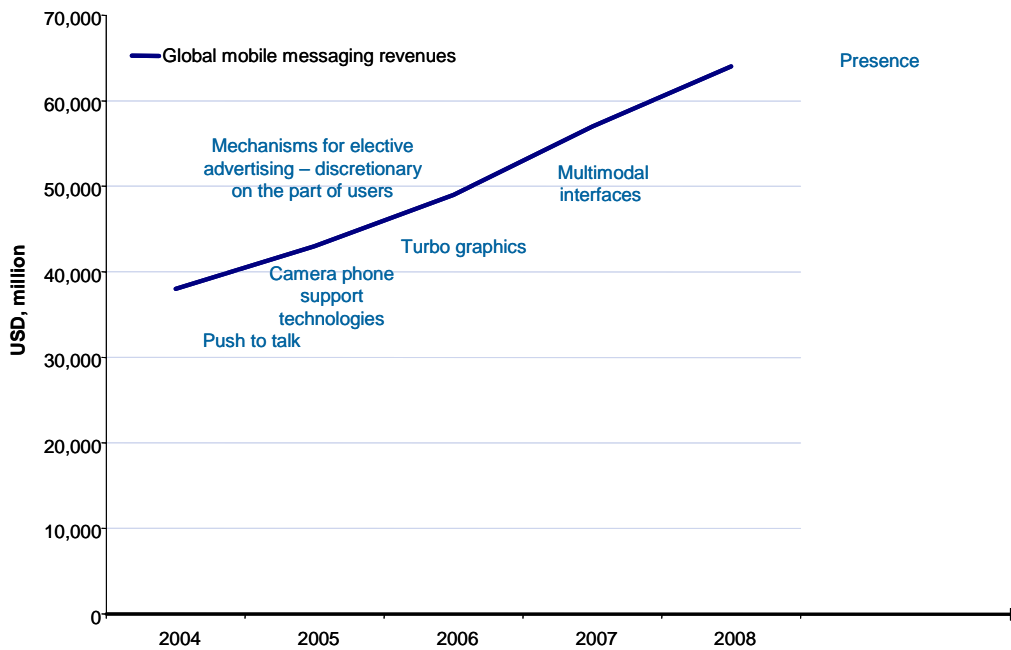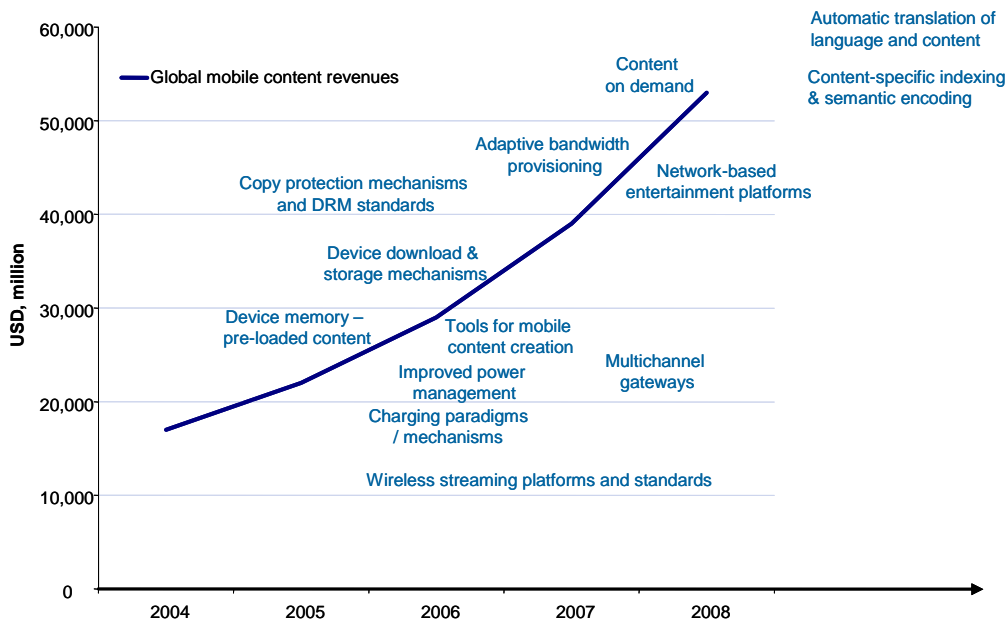
Figure 25:   Mobile content functional needs, 2004-2008 [Source: ITI Techmedia]

3.2   Fixed Communications

Capabilities such as ADSL/cable modems and WLAN have given users an appetite for bandwidth and connectivity, leading to the development of a substantial base of broadband homes. This provides an opportunity for content and services to generate additional revenue, which will trigger a wave of interactive and content-based services.

As a result of the foresighting process, five areas have been identified that are considered to offer considerable potential within the fixed communications services market:

- broadband content and services
- home integration
- networked home
- voice over IP
- billing and charging on distributed networks.

3.2.1   Broadband Content and Services

This area refers to broadband content delivered to the home, e.g. music and video, including premium content of interest to specific users. Continued development in music, gambling, games and adult content is expected to spur growth in this area.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of broadband content and services are described in Figure 26 below.

Drivers	*Inhibitors*
Increasing proportion of households with broadband	Difficulty in establishing effective relationships between large media companies and service providers
Increasing proportion of households with home networks (wired and wireless)	Free/illegal services reducing users' willingness to pay (e.g. music download)
Acceptance and willingness to pay for downloaded/ streamed content	Competition for users' entertainment spend
Growth in digital players for online music and video	
Demand for secure home transactions/ retail activity	
Increasing consumption of virtual media (i.e. purchase online or download) rather than physical media	

Figure 26 :   Broadband content and services, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of broadband content and services, together with their area of application within the simplified value chain, are illustrated in Figure 27 below.

Functional needs	Network related	Application related	Device related	Service provision related
Automatic translation of language and content		✔		
Charging paradigms / mechanisms	✔			✔
Compression protocols (voice coding, video coding, data compression for browsing)	✔		✔	✔
Content-on-demand		✔		✔
Content-specific indexing models and semantic encoding to reduce the difficulties in finding content		✔		✔
Copy protection mechanisms and DRM standards		✔		✔
Fibre to the home	✔			
Heuristic learning and adaptation to user behaviour		✔	✔	
High speed symmetric data connections (e.g. VDSL)	✔			
Home content storage		✔	✔	
Multichannel gateways	✔	✔	✔	
Network-based entertainment platforms		✔		✔
Streaming platforms		✔	✔	✔
Up- and down-stream adaptive bandwidth provisioning	✔		✔	
Video bandwidth with QoS management	✔		✔	✔
Video telephony with QoS	✔		✔	✔

Figure 27:   Identified functional needs, broadband content and services [Source: ITI Techmedia]

Roadmap

Figure 28 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.

_____
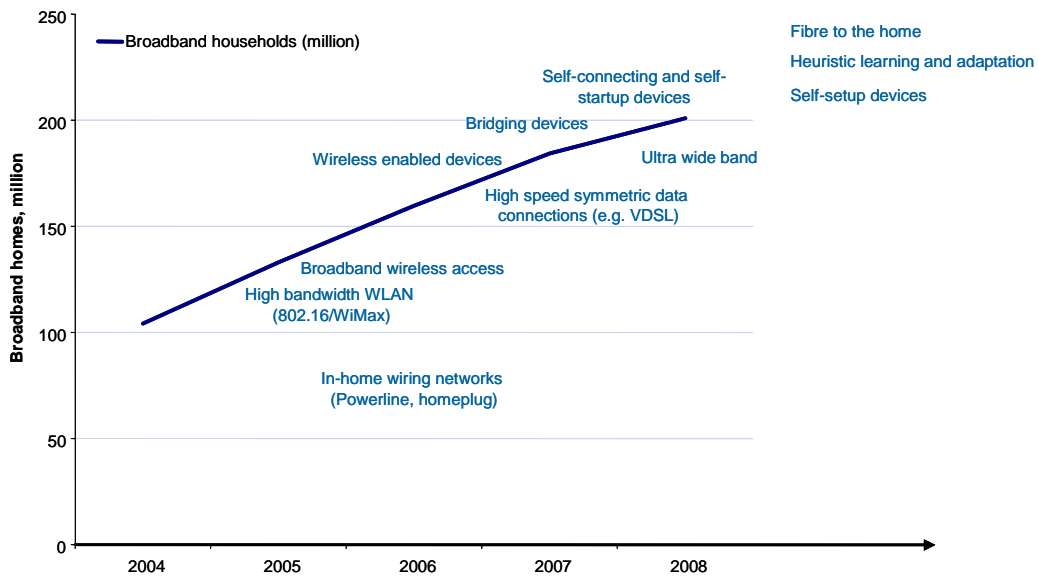
Figure 28: Broadband content and services functional needs, 2004-2008 [Source: ITI Techmedia]

3.2.2 Networked Home

The networked home concept relates to the provision of interactive entertainment, email and internet services via the broadband-enabled networked home. Such interactive services will include gaming, gambling, person-to-person applications. In this context three applications have been explored:

- *Home working:* Home working will grow, building on bandwidth, multiple connections and the availability of multi-service types e.g. videoconferencing
- *Machine-to-machine (telemetry):* In the home this will cover communications with domestic appliances e.g. fault monitoring, servicing
- *Personal communications (with video):* Broadband video connections will allow the development of 'true' online communities and personal communications services.

In addition, it will become increasingly important to hide all equipment and cables, with an emphasis on 'hidden' devices and 'natural' user interfaces rather than physical device interfaces. Systems should contain 'plug and play' capabilities that require no configuration procedures by the end user. This may require distributed intelligence or intelligence built into the platform.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of networked home applications are described in Figure 29 below.

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![iti Techmedia logo]

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Drivers	Inhibitors
Growth in home working, and desire for access to office facilities in the home	Traffic impact/imitations (e.g. backhaul capacity, contended DSL performance)
Cost saving in domestic appliance servicing (avoiding engineer call out)	In-building wireless network performance
Network access from any room in the home	Broadband availability
	Complexity of device setup and interoperability

Figure 29 :   Networked home, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of networked home applications, together with their area of application within the simplified value chain, are illustrated in Figure 30 below.

Functional needs	Network related	Application related	Device related	Service provision related
Bridging devices			✓	
Broadband wireless access	✓		✓	✓
Fibre to the home	✓			
Heuristic learning and adaptation to user behaviour		✓	✓	
High bandwidth WLAN	✓		✓	
High speed symmetric data connections (e.g. VDSL)	✓			
Home content storage		✓	✓	
In-home wiring networks (Powerline, homeplug)	✓			
IP Centrex		✓	✓	
Natural user interface		✓	✓	
Self-connecting and self-setup devices		✓	✓	
Video telephony with QoS	✓		✓	
Voice over IP	✓		✓	✓
Voice over WLAN	✓		✓	✓
Wireless enabled devices	✓		✓	
Ultra wide band	✓		✓	

Figure 30:   Identified functional needs, networked home [Source: ITI Techmedia]

Roadmap

Figure 31 below illustrates the timing of functional needs identified above from 2004 to 2008 and beyond.
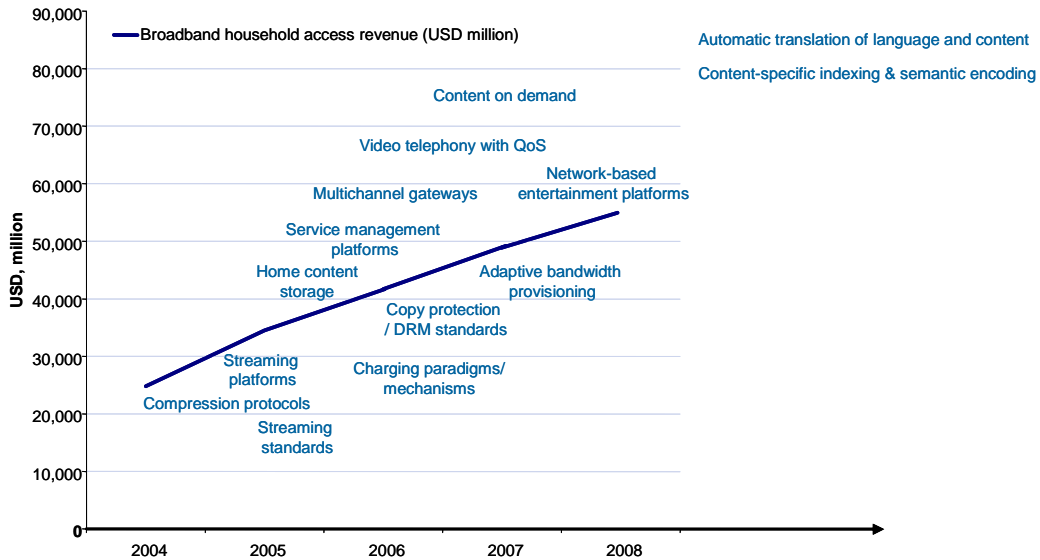
Figure 31:   Networked home functional needs, 2004-2008 [Source: ITI Techmedia]

3.2.3   Voice over IP

There will be significant growth in Voice over IP (VoIP) as broadband connections become more widespread. This will be based on cheaper voice call packages for consumers, extending to videoconferencing and network-based telephony services (IP Centrex). Corporates will pursue VoIP solutions that increase productivity and lower cost of ownership, including IP-PBX, unified communications and contact centre applications.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of broadband content and services are described in Figure 32 below.

Drivers	Inhibitors
Growth in VoIP service availability provided by emerging service providers	No specific items identified
Incumbents converting trials into large scale product launches	
Improving quality of VoIP calls	

Figure 32 :   Voice over IP, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of voice over IP applications, together with their area of application within the simplified value chain, are illustrated in Figure 33 below.

Functional needs	Network related	Application related	Device related	Service provision related
Charging paradigms / mechanisms		✔		✔
High data rate '4G' wireless	✔		✔	
IPv6	✔			
Service management platforms for decentralised networks	✔	✔		✔
Voice over WLAN	✔		✔	✔

Figure 33: Identified functional needs, Voice over IP [Source: ITI Techmedia]

Roadmap

Roadmap is subject to further investigation and is not provided in this report.

3.2.4   Billing and Charging on Distributed Networks

The end-point model of IP networks does away with the centralised network model, upon which all current billing mechanisms are based. Billing mechanisms will need to be developed in order to accommodate convenient, user-friendly ways for consumers to be charged for content.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of billing and charging applications are described in Figure 34 below.

Drivers	Inhibitors
Revolutionary changes in online content distribution	No specific items identified

Figure 34 : Billing and charging, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of billing and charging applications, together with their area of application within the simplified value chain, are illustrated in Figure 35 below.

_____

Functional needs	Network related	Application related	Device related	Service provision related
Charging paradigms / mechanisms	✔			✔
Service management platforms for decentralised networks	✔	✔		✔

Figure 35:   Identified functional needs, billing and charging [Source: ITI Techmedia]

Roadmap

Roadmap is subject to further investigation and is not provided in this report.

3.3   Broadcast Services

Broadcasting is an industry with huge momentum, and is in the process of moving to a digital environment via digital satellite, digital cable and digital terrestrial TV. Broadcasting will evolve as interactive services develop which use 2-way networks. Other forms of entertainment are also expected to compete for users' leisure time.

As a result of the foresighting process, two areas are considered to offer considerable potential within the fixed communications services market:

* broadcast content and interactive TV
* broadcast networks.

3.3.1   Broadcast Content and Interactive TV

Broadcasters are focused on growing viewing figures and/or subscriber numbers and increasing ARPU from their existing subscriber base via premium content packages and Content-on-demand services. Interactive services are likely to remain of low importance in revenue terms in the short/medium term. Interactive services will include enhanced TV (voting), games, gambling and email but all are forecast to have a relatively low usage and revenue impact.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of broadcast content and interactive TV services are described in Figure 36 below.

_____

Drivers	Inhibitors
Provision of premium content, multi-channel packages, specialist channels and value added services	Cost of consumer devices
Free-to-air digital TV taking off with cheap adapter devices	Business models – vertical integration (e.g. Sky) versus DTTV
IPTV at trial stage in Europe, developing more rapidly in Asia Pacific	Complex relationships with content providers
	Long life cycle of TVs

Figure 36 :   Broadcast content and interactive TV, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of broadcast content and interactive TV services, together with their area of application within the simplified value chain, are illustrated in Figure 37 below.

Functional needs	Network related	Application related	Device related	Service provision related
Adaptive bandwidth provisioning	✓		✓	
Charging paradigms / mechanisms				✓
Compression protocols (voice coding, video coding, data compression for mobile browsing)	✓		✓	
Content aggregation and syndication mechanisms		✓		✓
Content-on-demand		✓	✓	✓
Content-specific indexing models and semantic encoding		✓		✓
Copy protection mechanisms / DRM standards		✓	✓	✓
Flexible displays			✓	
Heuristic learning and adaptation to user behaviour		✓	✓	
High speed symmetric data connections (e.g. VDSL)	✓			
Intelligent agents		✓		
High definition services	✓	✓	✓	✓
Mechanisms for elective advertising – discretionary on the part of users		✓		
Middleware		✓	✓	✓
Service management platforms	✓	✓		✓
Storage-based products (in the home)			✓	
Streaming platforms		✓	✓	✓
TV search engines		✓		✓

Figure 37:   Identified functional needs, broadcast content and interactive TV [Source: ITI Techmedia]

Roadmap

Figure 38 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.
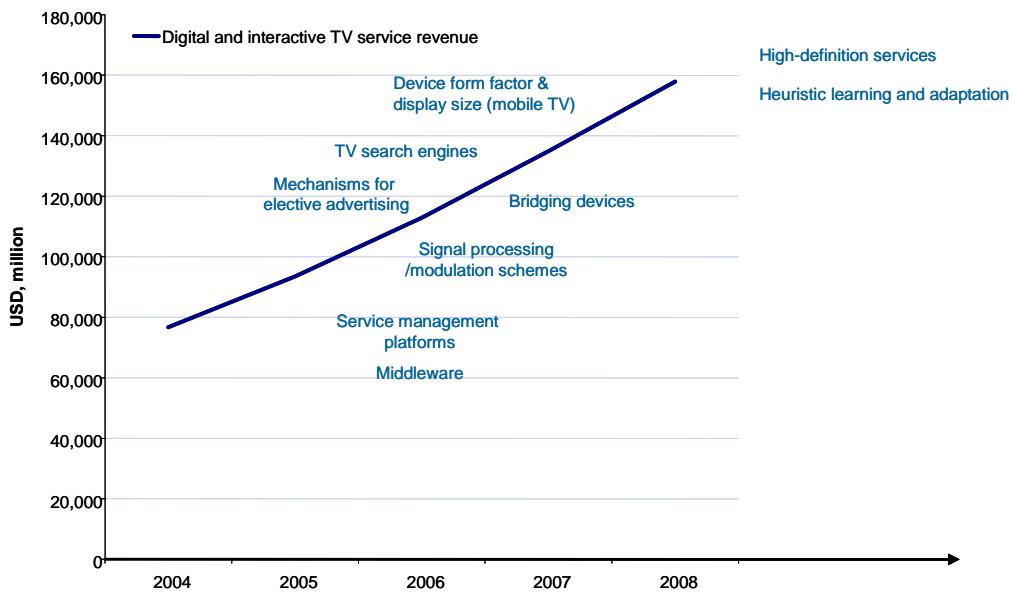
Figure 38:   Broadcast content and interactive TV functional needs, 2004-2008 [Source: ITI Techmedia]

3.3.2   Broadcast Networks

Broadcast networks will slowly increase in functionality to 'compete' with interactive services provided over fixed networks. This may lead to the emergence of new offers, e.g. devices with pre-loaded content, 'edge' devices allowing immediate access to content stored in the local network or services based over high speed symmetric data connections.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of broadcast networks are described in Figure 39 below.

Drivers	Inhibitors
De-centralised intelligence at the network edge	Cost of advanced devices (e.g. PVRs)
'Symmetric' connectivity will increasingly be required, allowing a 'zero delay' model to emerge	Cost of providing ubiquitous broadband networks

Figure 39 :   Broadcast networks, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of broadcast networks, together with their area of application within the simplified value chain, are illustrated in Figure 40 below.

Functional needs	Network related	Application related	Device related	Service provision related
Adaptive bandwidth provisioning	✔		✔	✔
High speed symmetric data connections (e.g. VDSL)	✔			
Signal processing/modulation schemes (higher wireless network capacity and QoS)	✔		✔	
Streaming platforms		✔	✔	✔

Figure 40: Identified functional needs, broadcast networks [Source: ITI Techmedia]

Roadmap

Roadmap is subject to further investigation and is not provided in this report.

3.3.3 Content Creation, Delivery, Management and Storage

Broadcaster demand for content continues to grow as broadcasters compete for viewing hours and customer spend, particularly by providing premium content and multiple specialist channels. Charging for specific content will become increasingly important to maintain ARPU. Aggregation or federation of content (bringing content together to supply to consumers as they want it) will grow, in part enabled by significant improvements in content and digital rights management. Use of semantic encoding, in the form of metadata to store content description information, and search engines will be important for users to find content

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of content creation, delivery, management and storage applications are described in Figure 41 below.

Drivers	Inhibitors
Opportunities for highly localised/ regional TV content generation and delivery will arise. TV which is 'truly localised' will develop.	Difficulty of creating partnerships for content delivery
Increasing broadcaster demand for content to keep and attract customers	Lack of agreements on copyright, copy protection and their technical implementation. (Digital rights will go beyond Copyright laws and extend to 'Digital privileges', the basis of which will be bestowed by government. This complexity may encourage free TV and copy free programmes)
Increasing availability and lower costs of broadcast bandwidth	
Requirement for enabling 'open access' to the digital world	

Figure 41 : Content creation, delivery, management and storage, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of content creation, delivery, management and storage applications, together with their area of application within the simplified value chain, are illustrated in Figure 42 below.

Functional needs	Network related	Application related	Device related	Service provision related
Compression protocols (voice coding, video coding, data compression for mobile browsing)	✔		✔	✔
Content aggregation and syndication mechanisms		✔		✔
Content-on-demand		✔	✔	✔
Content-specific indexing models and semantic encoding		✔		
Bridging devices			✔	
Copy protection mechanisms / DRM standards		✔	✔	✔
Intelligent agents		✔		✔
Intelligent edge of network storage devices			✔	
Streaming platforms		✔	✔	✔
Tools to reduce the cost of the content creation process		✔		
TV search engines		✔		✔

Figure 42:   Identified functional needs, content creation, delivery, management and storage [Source: ITI Techmedia]

Roadmap

Figure 43 below illustrates the timing of key functional needs identified above from 2004 to 2008 and beyond.
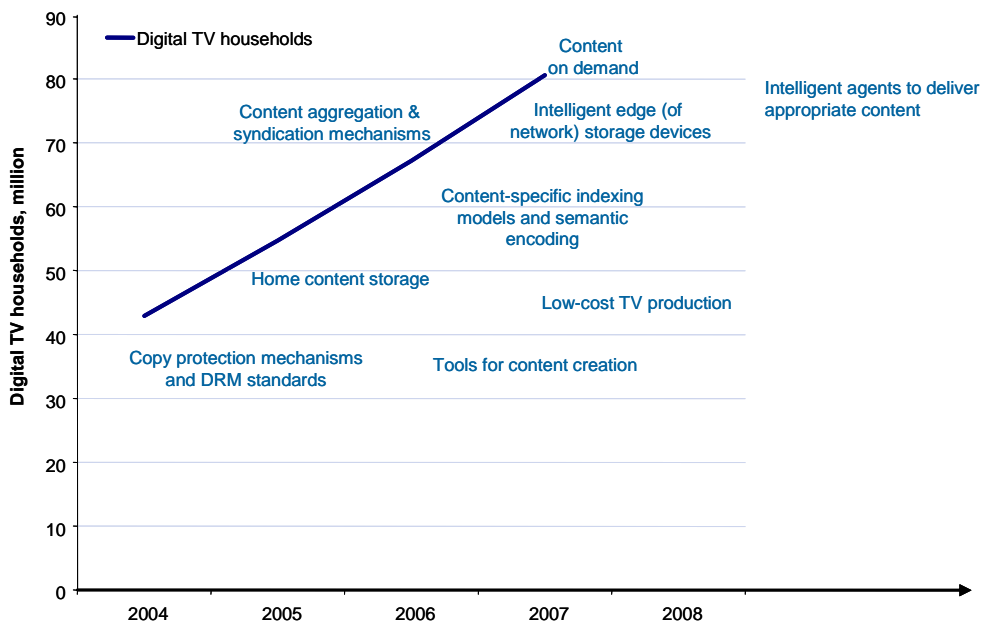
*Figure 43: Content creation, delivery, management and storage functional needs, 2004-2008
[Source: ITI Techmedia]*

3.4 Business Vertical Sectors

Business vertical sector requirements relate to the provision of Communications Services to vertical industry segments. As such, this sector can be considered to be a sub-segment of the mobile communications, fixed communications and broadcast segments.

As a result of the ITI Techmedia foresighting process, a number of areas are considered to offer considerable potential within the business vertical sectors:

- Automotive telematics
- Aviation – in-flight entertainment
- Public sector
- Leisure and hospitality
- Machine-to-machine communications (telemetry)
- Retail
- Security
- Transport – supply chain and logistics

It should be noted that Roadmaps are not provided for these areas.

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3.4.1 Automotive Telematics

There will be a significant increase in the use of automotive telematics, including emergency/crash notification, roadside assistance, integrated traffic information, congestion charging and tolls.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of automotive telematics applications are described in Figure 44 below.

Drivers	Inhibitors
Move from high end systems to mass market factory fit and aftermarket supply	No specific items identified
Deployment of off-the-shelf communications technologies into the car	
Increasing demand from users for traffic/road information	

Figure 44 : Automotive telematics, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of automotive telematics applications, together with their area of application within the simplified value chain, are illustrated in Figure 45 below.

Functional needs	Network related	Application related	Device related	Service provision related
Advanced antennas			✔	
In-car wireless networks	✔		✔	
Dynamic routing		✔	✔	
High functionality positioning systems		✔	✔	
Location-aware services		✔	✔	✔
Network-based location	✔			✔
Ultra wide band	✔		✔	

Figure 45: Identified functional needs, automotive telematics [Source: ITI Techmedia]

3.4.2 Aviation – In-flight Entertainment

The provision of in-flight communications services and passenger entertainment plays an important role for the airlines. These services represent an additional opportunity for revenue generation, either through the ticket price (as part of a differentiated product offering) or through one-off purchases (e.g. in-flight telephony services). As such, service innovation within this sector is expected to grow.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of in-flight entertainment services are described in Figure 46 below.

Drivers	Inhibitors
Demand for better in-flight entertainment and lower cost business communications services	Aviation industry downturn impacting deployment in the short term
Service differentiation	Economies of scale critical
New revenue streams for airlines	Passenger reluctance to use high cost services
	Aeroplane major overhaul intervals

Figure 46 : In-flight entertainment, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of in-flight entertainment services, together with their area of application within the simplified value chain, are illustrated in Figure 47 below.

Functional needs	Network related	Application related	Device related	Service provision related
Cabin networks	✔		✔	
Robust, lightweight displays			✔	
Satellite antennas for in-flight	✔			✔

Figure 47: Identified functional needs, in-flight entertainment [Source: ITI Techmedia]

3.4.3   Public Sector

Spending on public sector networks and communications services will be increasingly important - in 2003 this was estimated to be 19% of the total outsourced network services market[11]. This will include citizen information and support services e.g. housing with in-built (personal) monitoring, home help for the ageing population, migrant workers etc. Social diversity will force unification in support structures across counties. Systematic methodologies and approaches will be needed to deal with these issues and contain costs.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of public sector applications are described in Figure 48 below.

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[11] Datamonitor, Opportunities in managed network services, Dec 2003

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Drivers	Inhibitors
Evolving legislative requirements	No specific items identified
Cost reduction of public services by providing support services in-home (e.g. health) and by reduction in human intervention (e.g. automation of social services)	
Increasing focus on individual needs	
Increasing efficiency by information sharing	
Reducing purchasing costs	

Figure 48 : Public sector, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of public sector applications, together with their area of application within the simplified value chain, are illustrated in Figure 49 below.

Functional needs	Network related	Application related	Device related	Service provision related
Authentication		✔	✔	
Automatic expert first response		✔		✔
Automatic translation of language and content		✔		✔
Behaviour blocking		✔		
Camera phone support technologies		✔	✔	✔
Heuristic learning and adaptation to user behaviour		✔	✔	
Location-aware services	✔	✔	✔	✔
Network-based security platforms	✔			✔
Peer-to-peer networks ('parasitic networks')	✔			
Presence		✔	✔	✔

Figure 49: Identified functional needs, public sector [Source: ITI Techmedia]

3.4.4 Leisure and Hospitality

There will be growth in Communications Services used in hotels, restaurants and exhibition centres, including solutions for streamlined booking, ticketing and check-in, customer feedback and retention, visit enhancement, visitor monitoring, visualisation (3D immersion) and information provision.

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Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of leisure and hospitality applications are described in Figure 50 below.

Drivers	Inhibitors
Marketing and sales tools	No specific items identified
Efficiency/cost improvements	
Improved management of low-cost workers, over longer distances	
Automation of routine tasks	
Productivity benefits and safety improvements	

Figure 50 :   Leisure and hospitality, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of leisure and hospitality applications, together with their area of application within the simplified value chain, are illustrated in Figure 51 below.

Functional needs	Network related	Application related	Device related	Service provision related
Charging paradigms / mechanisms				✓
Heuristic learning and adaptation to user behaviour		✓	✓	
Mechanisms for elective advertising – discretionary on the part of users		✓	✓	
Natural IVR		✓		✓
Presence		✓	✓	✓
Robust, lightweight displays			✓	
Streaming platforms		✓	✓	✓
Video telephony with QoS	✓		✓	

Figure 51:   Identified functional needs, leisure and hospitality [Source: ITI Techmedia]

3.4.5   Machine-to-machine Communications (Telemetry)

Machine-to-machine communications for monitoring and control will be significant in several major industries including manufacturing, utilities, transport, automotive and healthcare. Telemetry will be used for a range of applications including remote monitoring, automatic logging and process control. This could include large scale deployment of low-cost embedded sensors with built-in micro location and

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communications capabilities. Target deployment could include parking meters, traffic control and vending machines, and could also have application in consumer markets.

Machine-to-machine monitoring and communication could trigger a change in charging methods and business models from sale-based to rental-based/metered.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of telemetry applications are described in Figure 52 below.

Drivers	Inhibitors
Legislation (safety, liability, competition)	Change in business models and operations is required
Availability of cheap, off-the-shelf communications and location technologies	Capital spending constraints
Move towards a service provision model	
Move away from vertical 'industry sector' applications running on legacy networks to a layered structure	

Figure 52 :   Telemetry, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of telemetry applications, together with their area of application within the simplified value chain, are illustrated in Figure 53 below.

Functional needs	Network related	Application related	Device related	Service provision related
Advanced antennas	✔		✔	
Contactless location/identification – item-level RFID	✔		✔	
Dynamic logistics networks	✔	✔	✔	✔
Improved power management			✔	
Smart sensor networks	✔	✔	✔	✔
Location-aware services	✔	✔		✔
Longer 'battery life', e.g. using micro fuel cells			✔	
Network-based location		✔		✔
Peer-to-peer networks ('parasitic networks')	✔			
Self-healing systems/ networks	✔			
Signal processing/ modulation schemes (higher wireless network capacity and QoS)	✔		✔	
Software-defined radio	✔		✔	

Figure 53: Identified functional needs, Telemetry [Source: ITI Techmedia]

3.4.6 Retail

Communications Services in the retail environment are used to support a variety of applications, including supply-chain and in-store. Supply chain applications focus on efficiency gains and logistics, whilst in-store solutions are targeted at improving customer retention/market share via 'queue busting' (using mobile POS terminals) and provision of context relevant, location-based and personalised information to increase sales conversion rates.

Drivers and inhibitors

No specific drivers and inhibitors are identified.

Functional needs

Functional needs that support the development of retail applications, together with their area of application within the simplified value chain, are illustrated in Figure 54 below.

![iti Techmedia]

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Functional needs	Network related	Application related	Device related	Service provision related
Dynamic logistics networks	✓	✓	✓	✓
Natural IVR		✓		
Robust, lightweight displays			✓	

Figure 54:   Identified functional needs, retail [Source: ITI Techmedia]

3.4.7   Security

There is an ongoing, urgent need for robust communications networks, robust storage systems and heightened security. This requires secure networks, managed (network) security services and security monitoring.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of security applications are described in Figure 55 below.

Drivers	Inhibitors
Corporate liability increasingly important	Public sector funding constraints
Specific legal requirements (healthcare, finance, government)	Legacy software and systems
Importance of maintaining business continuity	Poor interoperability
Increasing sophistication of threats and attacks on security	

Figure 55 :   Security, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of security applications, together with their area of application within the simplified value chain, are illustrated in Figure 56 below.

Functional needs	Network related	Application related	Device related	Service provision related
Ad-hoc networking	✔		✔	
Advanced firewalls	✔		✔	✔
Behaviour blocking		✔		
Biometrics		✔	✔	✔
Camera phone support technologies		✔	✔	✔
Decentralised and localised systems	✔			✔
Federated identity management		✔	✔	✔
Location sensors	✔		✔	
Longer 'battery life', e.g. using micro fuel cells			✔	
Managed authentication services		✔		✔
Network-based security platforms	✔	✔		✔
Peer-to-peer networks ('parasitic networks')	✔			
Push to talk		✔	✔	✔
Self-healing systems/networks	✔			✔

Figure 56:   Identified functional needs, security [Source: ITI Techmedia]

3.4.8   Transport – Supply Chain and Logistics

Transport (supply chain and logistics) is based on low cost, mobile employees performing routine tasks spread over wide geographies. Introducing communications solutions into logistics/supply chains can improve efficiency and management in areas such as asset tracking, reducing inventory and supporting vending and online order fulfilment.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of supply chain and logistics applications are described in Figure 57 below.

Drivers	Inhibitors
Need for improved efficiency and cost savings	Low cost base industry
Management of low skill workers	Capital spending constraints
Improved customer responsiveness	

Figure 57 :   Supply chain and logistics, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of supply chain and logistics applications, together with their area of application within the simplified value chain, are illustrated in Figure 58 below.

Functional needs	Network related	Application related	Device related	Service provision related
Advanced antennas	✔			
Dynamic logistics networks	✔	✔	✔	✔
Heuristic learning and adaptation to user behaviour		✔	✔	
Intelligent agents		✔		✔
Item-level RFID	✔	✔	✔	
Location sensors			✔	
Location-aware services		✔	✔	✔
Network-based location	✔	✔		
Peer-to-peer networks ('parasitic networks')	✔			

Figure 58: Identified functional needs, supply chain and logistics [Source: ITI Techmedia]

3.5 Business Corporate Services

The corporate services market as a whole is relatively mature. However, corporate entities can be expected to continue to invest in areas where operating efficiency gains can be identified.

As a result of the ITI Techmedia foresighting process, a number of areas are considered to offer considerable potential within the business corporate services sector:

- Application hosting
- Corporate fixed networks
- Corporate mobile devices and services
- Utility computing and storage
- Corporate wireless networks
- Corporate voice.

It should be noted that Roadmaps in these areas are subject to further investigation, are not provided in this report.

3.5.1 Application Hosting

Application hosting is re-emerging as companies look to reduce PC administration costs and seek to develop a shared application infrastructure across countries. For example T-Systems and BT are offering hosted products. This will be associated with a revival of the Application Service Provision model.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of application hosting services are described in Figure 59 below.

Drivers	Inhibitors
Demand for enhanced system flexibility and reliability	Licensing models not agreed
High overheads of PC management and support	Reluctance to move away from fixed cost purchase
Software vendors developing hosted applications	
Requirement for systems to impact directly on business profitability	
Need for common application infrastructure	

Figure 59 : Application hosting, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of application hosting services, together with their area of application within the simplified value chain, are illustrated in Figure 60 below.

Functional needs	Network related	Application related	Device related	Service provision related
ASP-delivered applications		✓	✓	✓
Charging paradigms / mechanisms				✓
Enterprise content-delivery networks	✓	✓		✓

Figure 60: Identified functional needs, application hosting [Source: ITI Techmedia]

3.5.2 Corporate Fixed Networks

In corporate networks, the short term emphasis is on securing greater value from existing systems. In the longer term, moves to develop web services to resolve specific problems and/or to converged voice and data networks to reduce costs will be made.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of corporate fixed network services are described in Figure 61 below.

Drivers	Inhibitors
Growth in business use of converged devices	'New' services (e.g. videoconferencing) still not adopted as a mainstream business application
Move to outsourced solutions to save costs	Fear of loss of control
Move to converged networks to reduce costs	Device proliferation – intelligence needs to be in the network, not in the devices
Outsourcing networks and business processes ('network services')	Large corporates will retain IT/network capability in-house

Figure 61 :   Corporate fixed networks, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of corporate fixed network services, together with their area of application within the simplified value chain, are illustrated in Figure 62 below.

Functional needs	Network related	Application related	Device related	Service provision related
Behaviour blocking		✔		
Charging paradigms / mechanisms				✔
Ethernet MANs	✔			
General Multi Protocol Label Switching	✔			
High speed symmetric data connections (e.g. VDSL)	✔			
IPv6	✔		✔	
Network-based security platforms	✔	✔		✔
Packet voice with QoS	✔		✔	
Self-connecting and self-setup devices		✔	✔	
Service management platforms for decentralised networks	✔	✔		✔
Video telephony with QoS	✔		✔	✔
Voice over IP	✔		✔	

Figure 62:   Identified functional needs, corporate fixed networks [Source: ITI Techmedia]

3.5.3   Corporate Mobile Devices and Services

Corporate mobile solutions will be tailored for specific vertical segments and tasks, e.g. pharmaceutical sales force automation. The vertical leading sectors adopting such solutions will be transport, utilities, finance, insurance, property and healthcare. Mobile field service and mobile sales will be the lead applications.

Professional services firms will adopt mobile solutions such as mobile email when there is a business case – currently users are individual purchasers.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of corporate mobile devices and services are described in Figure 63 below.

Drivers	*Inhibitors*
Growth of mobile connectivity solutions for efficiency and cost savings	Personal digital assistants (PDAs) currently not selling to corporates
Development of mobile web services	Cost benefits of enterprise mobility need to be demonstrated
Outsourced solutions	Lack of ROI case for mobile email
Growth in integration, middleware, security and management	Security concerns
Increased device functionality at specific price points	

Figure 63 :   Corporate mobile devices and services, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of corporate mobile devices and services, together with their area of application within the simplified value chain, are illustrated in Figure 64 below.

Functional needs	Network related	Application related	Device related	Service provision related
Application development platforms		✔		✔
Device download and storage			✔	✔
Handset configuration platforms		✔	✔	✔
Longer 'battery life', e.g. using micro fuel cells			✔	
Middleware	✔	✔	✔	✔
Push technology		✔	✔	✔
Service management platforms				✔
Smart sensor networks	✔	✔	✔	✔
Video telephony with QoS	✔		✔	✔
Streaming platforms		✔	✔	✔
Voice over WLAN	✔		✔	✔

Figure 64:   Identified functional needs, corporate mobile devices and services [Source: ITI Techmedia]

3.5.4   Utility Computing and Storage

Grid computing (including computing, data and application grid) technologies can be used to provide inexpensive access to a global utility computing, application and data resource. Grid objectives include reducing the total cost of ownership, efficiency improvements in computing, data and storage, and supporting the creation of virtual organisations for applications and data. This is related to the use of network storage for data, e.g. corporate data, mobile messaging content and application data.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of utility computing and storage applications are described in Figure 65 below.

Drivers	Inhibitors
Increased computational needs for processor-intensive applications	Falling cost of semiconductor and storage components
Increase utilisation of computing resources	Loss of control of IT/resources
Data management/update challenges	Set-up/migration costs
Collaboration in distributed and virtual organisations	Organisational politics/issues
Need for widely dispersed teams to work together	The required centralisation of IT infrastructure
Increase in the capabilities of commodity technologies	
Increased emphasis on scalable computing	
More robust and capable communications infrastructures	
Falling cost of semiconductor and storage components	

Figure 65 : Utility computing and storage, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of utility computing and storage applications, together with their area of application within the simplified value chain, are illustrated in Figure 66 below.

Functional needs	Network related	Application related	Device related	Service provision related
ASP-delivered applications	✔	✔		✔
Business continuity infrastructure and redundancy	✔	✔		✔
Charging paradigms / mechanisms		✔		✔
Grid computing	✔	✔		✔
Middleware	✔	✔	✔	✔
Resource management tools for distributed computing environments		✔		✔
Storage/SAN management	✔	✔		✔
Systems for managing and monitoring utility computing services and ensuring flexibility and reliability		✔		✔

Figure 66: Identified functional needs, utility computing and storage [Source: ITI Techmedia]

3.5.5 Corporate Wireless Networks

Deployment of wireless office networks, based on WLANs but also including other wireless technologies, is growing. Leading vertical markets adopting WLANs will be manufacturing, education and finance/professional services.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of corporate wireless networks are described in Figure 67 below.

Drivers	Inhibitors
WLAN becoming standard in notebooks	Budget constraints and achieving ROI
Affordable WLAN equipment (access points etc.)	Security concerns
Increases in employee productivity	System integration and interoperability between differing standards
Improved security and management tools	
Increasing home use drives business use, and vice versa	

Figure 67 :   Corporate wireless networks, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of corporate wireless networks, together with their area of application within the simplified value chain, are illustrated in Figure 68 below.

Functional needs	Network related	Application related	Device related	Service provision related
Advanced antennas	✔		✔	
High bandwidth WLAN	✔			
High data rate '4G' wireless	✔		✔	
Peer-to-peer networks ('parasitic networks')	✔			
Packet technologies for wireless WANs	✔			
Signal processing/ modulation schemes (higher wireless network capacity and QoS)	✔		✔	
Software-defined radio	✔		✔	
Ultra wide band	✔		✔	
Voice over WLAN	✔		✔	✔

Figure 68:   Identified functional needs, corporate wireless networks [Source: ITI Techmedia]

3.5.6 Corporate Voice

There will be increasing use of speech engines (text to speech) and voice recognition. Natural language understanding will become increasingly widespread, leading to a shift in the value chain from platforms and enabling software (speech recognition and text to speech) to applications and services. Voice applications will be deployed particularly in financial services, healthcare, retail and tourism.

Drivers and inhibitors

Major drivers and inhibitors that will affect the evolution of corporate voice applications are described in Figure 69 below.

Drivers	Inhibitors
Increased efficiency by reducing human intervention	No specific items identified
Increasing need for voice authentication	
In the long term speech engines will be a commodity	
Need to use voice for automation	

Figure 69 :   Corporate voice, drivers and inhibitors [Source: ITI Techmedia]

Functional needs

Functional needs that support the development of corporate voice applications, together with their area of application within the simplified value chain, are illustrated in Figure 70 below.

Functional needs	Network related	Application related	Device related	Service provision related
Contextual recognition		✔	✔	
Multimodal interfaces (i.e. speech, gesture, lip movement etc)			✔	
Natural IVR		✔		
Natural user interface		✔	✔	
Self-connecting and self-setup devices		✔	✔	

Figure 70:   Identified functional needs, corporate voice [Source: ITI Techmedia]

4 MARKET DATA

In this Section market data, where available, is provided for the market areas identified in Section 3.

4.1 Mobile Communications

4.1.1 Total Mobile Service Revenue

Global mobile service revenue (including voice and non-voice services) is forecast to reach USD675 billion by 2008 as illustrated in Figure 71 below. Players are the leading national mobile operators.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	477,000	521,000	563,000	620,000	675,000	9%

Figure 71: Global mobile service revenue, 2004-2008 [Source: Strategy Analytics]

Of this total, global non-voice revenue is forecast to reach USD140 billion by 2008 as illustrated in Figure 72 below. Non-voice revenue includes revenue from location-based services, mobile messaging and mobile content. The value of each of these segments is described separately in Sections 4.1.2 to 4.1.4.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	51,000	62,000	75,000	99,000	140,000	28%

Figure 72: Global mobile non-voice revenue, 2004-2008 [Source: Strategy Analytics]

4.1.2 Location-Based Services

Global mobile location revenue is forecast to reach USD8 billion by 2008 as illustrated in Figure 73 below. Players in this sector include the major operators and equipment vendors, and specialist software and hardware vendors such as Openwave and Webraska.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	2,000	3,800	6,000	7,200	8,000	41%

Figure 73: Global mobile location revenue, 2004-2008 [Source: Strategy Analytics]

4.1.3 Mobile Messaging

Global revenue from mobile messaging (including SMS, MMS and video messaging) is forecast to reach USD64 billion by 2008 as illustrated in Figure 74 below, pushed by the leading mobile operators and brands (e.g. Vodafone Live).

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	38,000	43,000	49,000	57,000	64,000	14%

Figure 74:   Global mobile messaging revenue, 2004-2008 [Source: Strategy Analytics]

4.1.4 Mobile Content

Global mobile content revenue is forecast to reach USD53 billion by 2008 as illustrated in Figure 75 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	17,000	22,000	29,000	39,000	53,000	33%

Figure 75:   Global mobile content revenue, 2004-2008 [Source: Strategy Analytics]

It should be noted that different information sources make different market forecasts. For example, when mobile content revenue is considered by service (as illustrated in Figure 76 below) the implied market value in 2008 is around USD87 billion.

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Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
Advertising/ marketing	2,000			700		-30%
Betting/ Gambling					16,000	
Email				11,000		
Entertainment					30,000	
Gaming					7,000	
Adult content	100				1,000	78%
MMS service Revenue					22,000	
Music download	1	24	147	464	1,080	527%
Sport					4,700	
Streamed media	100	300	1,000	2,600	5,700	175%

Figure 76:   Global mobile content revenue, 2004-2008 [Source: various[12]]

4.2   Fixed Communications

Estimated 2007/2008 revenue ranges for fixed line consumer markets are shown in the following Sections.

4.2.1   Broadband Content and Services

Subscription Video Streaming

Global revenue from broadband home devices and services is forecast to reach USD4.5 billion by 2007 as illustrated in Figure 77 below. Main players are the major ISPs such as

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[12] Challenges and Risks in the US$ 700M Mobile Marketing Opportunity, Strategy Analytics, Feb 2003
Mobile Gambling: Casinos, Lotteries and Betting, 203-2008, Juniper Research
Will Channel Immaturity Put the Brakes on an $11B Enterprise Mobile E-mail Opportunity?, Strategy Analytics, Jan 2003
Global Cellular Data Forecasts (2003 - 2008), Strategy Analytics, May 2003
Mobile Gaming: Download Applications to Drive $7 Billion Market, Strategy Analytics, Mar 2003
Wireless Porn Opportunity Limited to $1 Billion in 2008 but AT&T Wireless and Match.com Point the Way Toward Adult Service Revenue Growth, Strategy Analytics, April 2003
Managed MMS Infrastructure Solutions Become Crucial for Market Share, Strategy Analytics, Dec 2003
Emulating i-Tunes Builds $1 Billion Mobile Music Market, Strategy Analytics, Sept 2003
Global Cellular Data Forecasts (2003 - 2008), Strategy Analytics, May 2003
Real Networks Leads the Pack in Driving the $6 Billion Wireless Media Streaming Market, Strategy Analytics, Sept 2003

MSN, AOL, Yahoo and RealNetworks as well as country operators such as FastWeb in Italy.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	1,300	1,800	2,900	4,500		51%

Figure 77:   Global subscription video streaming revenue, 2004-2007 [Source: In-Stat/MDR}

Fixed Gaming

Global revenue from fixed line gaming services is forecast to reach USD2.2 billion by 2007 as illustrated in Figure 78 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	800	1,000	1,400	2,200		40%

Figure 78: Global fixed line gaming revenue, 2004-2007 [Source: In-Stat/MDR]

4.2.2   Broadband Home

Global revenue from broadband home access services is forecast to reach USD60 billion by 2008 as illustrated in Figure 79 below. Although strong growth in subscriber take-up is expected, revenue growth is eroded as a result of ongoing price declines. The market is dominated by fixed telecommunications operators and ISPs.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	33,968	41,039	49,142	54,613	59,870	15%

Figure 79:   Global broadband access revenue, 2004-2008 [Source: IDC]

4.2.3   Voice over IP

Global revenue from VoIP services (IP-PBX, Videoconferencing, Contact Centre and Unified Communications) is forecast to grow to USD36.5 billion by 2008 as illustrated in Figure 80 below. The market will be divided between fixed line telecommunications operators and new entrant IP-based operators.

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Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	2,000	3,000	6,000	14,000	36,500	107%

Figure 80:   Global VoIP service revenue, 2004-2008 [Source: ABI]

4.3   Broadcast Services

4.3.1   Broadcast TV service revenues

Global subscriber revenue broadcast TV services (including pay TV and licences) is forecast to reach USD238 billion by 2008 as illustrated in Figure 81 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	182,560	194,907	209,852	223,347	237,711	6.8%

Figure 81:   Global TV service revenue, 2004-2008 [Source: PriceWaterhouseCoopers, ITI Techmedia]

Digital and interactive TV services are forecast to take an increasing proportion of global TV service revenue. Global revenue from digital and interactive TV services is forecast to reach USD158 billion by 2008 as illustrated in Figure 82 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	76,608	93,474	112,786	134,829	157,902	20%

Figure 82:   Global digital and interactive TV service revenue, 2004-2008 [Source: Strategy Analytics]

4.3.2   Set top boxes (STBs) and interactive digital televisions (IDTVs)

European revenue from STBs and IDTVs is forecast to reach USD7.9 billion by 2008 as illustrated in Figure 83 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	3,500	4,900	5,800	6,700	7,900	23%

Figure 83:   Global STB and IDTV revenue, 2004-2008 [Source: Strategy Analytics]

4.4 Business Vertical Sectors

ITI Techmedia has attempted to source market data forecasts for the various vertical sectors described in Section 3.4. However, it has not been possible to provide market data for the following segments:

- Aviation – in-flight entertainment
- Public Sector
- Leisure and Hospitality.

4.4.1 Automotive Telematics

Automotive telematics are in-vehicle applications enabling a vehicle user to send and receive information (audio, data and images) and make use of positioning capabilities.

Examples include:

- dynamic navigation, information and entertainment services with mobile or other traffic alert services, e.g. Trafficmaster, Honda InterNavi, Mercedes DynAPS/COMAND
- Emergency and Roadside Assistance (ERA) services triggered by a simple button or airbag activation, for example OnStar, BMW Assist, Mercedes TeleAid, Volvo OnCall, Fiat Connect.

The global value of the automotive telematics market is forecast to reach USD2.4 billion in 2008, as illustrated in Figure 84 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	893	1,196	1,565	1,939	2,367	28%

Figure 84:   Global automotive telematics revenue, 2004-2008 [Source: Strategy Analytics]

4.4.2 Machine-to-machine Communications (Telemetry)

The global value of the machine-to-machine market is forecast to reach USD6.2 billion in 2007[13]. Players in this segment include major device vendors (Nokia, Kyocera) and specialists such as Opto 22 and Wavecom.

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[13] Strategy Analytics

4.4.3 Retail

Retail communications services include fixed network services and vertical sector mobile solutions. The value of retail industry services in Western Europe is forecast to reach USD693 million in 2005, up from USD460 million in 2004[14].

Players in this market include large IT service firms, mobile operators and specialists such as Symbol Technologies (portable shopping systems) and Hypertag (context relevant information).

4.4.4 Security

Security services include WAN security solutions (e.g. firewall and VPN management), security consulting and managed security monitoring. The global value of the security market is forecast to reach USD5.9 billion in 2007, as illustrated in Figure 85 below.

Security vendors include the main fixed telecommunications operators and IT service firms as well as specialists like Counterpane, Guardent and Symantec.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	2,300	3,500	4,500	5,900		37%

Figure 85:   Global network security services, 204-2007 [Source: In-Stat/MDR]

4.4.5 Transport – Supply Chain and Logistics

Transport (supply chain and logistics) communications services include fixed network services and vertical sector mobile solutions for wholesale and distribution applications. The value of the supply chain and logistics market in Western Europe is forecast to reach USD620 million in 2005, up from USD404 million in 2004[15].

Players in this market include large IT service firms, mobile operators (e.g. Vodafone) and specialists such as Symbol Technologies (package code scanners), AirIQ (wireless despatch systems) and Aether (automatic vehicle location).

4.5   Business Corporate Services

4.5.1 Application Hosting

Application hosting revenue (including application service provisioning) in Western Europe is forecast to exceed USD11 billion by 2008, as illustrated in Figure 86 below.

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[14] Datamonitor
[15] Datamonitor

Players in this market include major telecommunications operators (BT, T-Systems) and large software vendors (e.g. Siebel, Oracle). This is likely to be associated with a revival in the ASP market, which is forecast to reach USD1 billion over the same period, targeted at the lower end of the large corporate market.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
Application hosting	7,212	8,084	8,842	9,573	10,375	10%
Application Service Provision	509	598	702	840	1,014	19%

Figure 86: Western Europe applications hosting and ASP revenue, 2004-2008 [Source: Ovum]

4.5.2   Corporate Fixed Networks

Managed network services consist of outsourced corporate networks and associated services (voice and data). This market is forecast to reach almost USD4 billion in Western Europe by 2005, up from USD2.7 billion in 2004[16].

4.5.3   Corporate Mobile Devices and Services

The value of the global corporate mobile device market (communicators, voice-PDAs, PDAs and handheld PCs) purchased as part of an enterprise mobile solution is forecast to reach USD8 billion in 2006, up from USD3 billion in 2004[17].

4.5.4   Utility Computing and Storage

Global utility computing delivery (GRID) revenue is forecast to reach USD4.9 billion by 2008, as illustrated in Figure 87 below.

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	316	787	1,619	3,471	4,888	98%

Figure 87:   Global utility computing delivery (GRID), 2004-2008 [Source: Insight Research]

4.5.5   Corporate Wireless Networks

Global corporate wireless LAN revenue is forecast to reach USD1.3 billion by 2006, up from USD929 million in 2004[18].

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[16] Ovum
[17] Datamonitor

4.5.6 Corporate Voice

Global voice application revenue is forecast to reach USD3.1 billion in 2008, as illustrated in Figure 88 below. These figures include revenue from voice applications, voice enabling applications and voice platforms and services (i.e. excluding voice call revenue).

Revenue (USD million)	2004	2005	2006	2007	2008	CAGR%
	1,015	1,319	1,754	2,367	3,100	32%

*Figure 88:   Global voice application revenue, 2004-2008 [Source: Datamonitor]*

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[18] Datamonitor

APPENDIX 1: THE MARKET FORESIGHTING PROCESS

The foresighting process for market identification, which is at the heart of the ITI activity, has been established to meet three main objectives:

- to identify and define the potential for new and emerging global markets, over a three to ten year horizon

- to provide an objective basis for assessment and comparison of any defined markets

- to identify and define key functional needs and platforms which will support market development.

A market foresighting process has been created and adopted by ITI Techmedia. Using the experience and expert advice of organisations recognised as having best practice capabilities in this field, it is designed not only to meet the objectives detailed under 'Market Identification' above, but also to take into account other relevant factors including sector specifics, timescales and resource needs. The main elements of the process are shown in simplified format below.
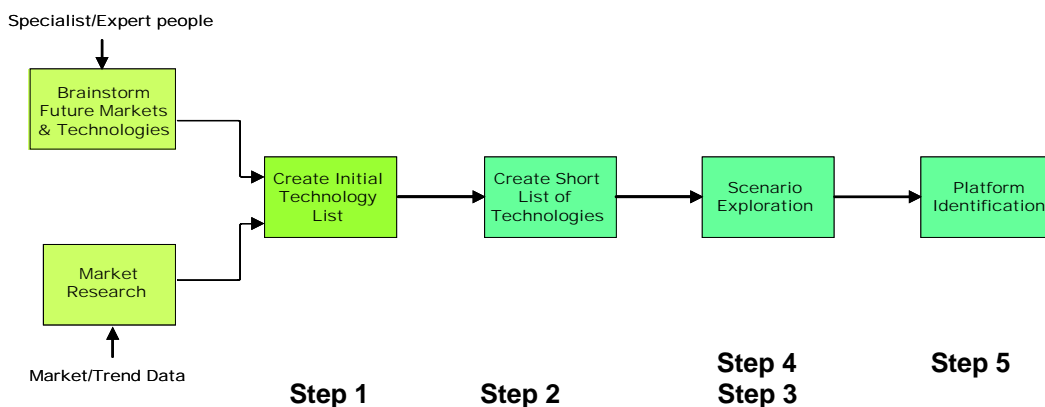
Step 1 identifies a vision for the market opportunity, the challenges, key drivers and market and technology barriers. This is achieved using specialist market knowledge, input from expert individuals in organisations across the sector, product and service companies, research organisations through to regulatory and other government offices. This is then enhanced by existing market knowledge to estimate the possible market size, timing, geographies, and demographics to create views of the value chain, the main stakeholders and resultant business models.

Step 2 creates a long technology list relevant to the individual sectors, which is in turn reduced in Step 3 to a shortlist, using input from technology experts. The process so far identifies the functional needs that best fit the market characteristics and hence highlight the most likely technology winners.

The functional needs and markets are validated in Step 4 via a process of scenario planning, a common tool used in foresighting environments. This uses example events to test if market and functional needs meet overall objectives and targets.

Step 5, the final step, identifies a resultant technology platform. A technology platform is defined as a cluster of connected technological capabilities comprising discrete technologies which together define a system with multiple potential applications.

The market foresighting process and the usefulness of functions within it are subject to ongoing evaluation and refinement throughout, based on experience gained in the first phase.

APPENDIX 2: GLOSSARY OF TERMS

2.5G	General Packet Radio Service (GSM data service)
3G	Third generation GSM
ADSL	Asymmetric Digital Subscriber Line
ARPU	Average Revenue Per User
ASP	Application Service Provision
Backhaul	Communications link to take aggregated traffic from an exchange to the backbone network
Centrex	Network-based business telephony services
CDMA	Code Division Multiple Access
CPE	Consumer Premises Equipment
DAB	Digital Audio Broadcast
DECT	Digital Enhanced Cordless Telephony
DRM	Digital Rights Management
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Module
DVB	Digital Video Broadcast
EPG	Electronic Programme Guide
FSO	Free Space Optical
FTTH	Fibre To The Home
FWA	Fixed Wireless Access
GPRS	General Packet Radio Service (2.5G)
GSM	Global System for Mobile
HDD	Hard Disk Drive
HDTV	High Definition TV
IDTV	Interactive Digital Television
IP	Internet Protocol
ISP	Internet Service Provider
ITI	Intermediary Technology Institute
IVR	Interactive Voice Response

M2M	Machine-to-machine
MAN	Metropolitan Area Network
MMS	Multimedia Messaging System
PBX	Private Branch Exchange
PC	Personal Computer
PDA	Personal Digital Assistant
PON	Passive Optical Network
POS	Point Of Sale
PPV	Pay Per View
PVR	Personal Video Recorder. Device for recording TV programs onto a hard disk (or other digital memory)
QoS	Quality of Service
RFID	Radio Frequency Identification
SME	Small medium enterprise
SAN	Storage Area Network
Softswitch	Software based telecommunications switch
SOHO	Small Office Home Office
SP	Service Provider
STB	Set Top Box
USD	US Dollars
UWB	Ultra Wide Band
VDSL	Very high speed Digital Subscriber Line
VoIP	Voice over Internet Protocol
VoWLAN	Voice over Wireless Local Area Network
VPN	Virtual Private Network
W-CDMA TDD	3G data technology (Wireless Code Division Multiple Access Time Division Duplex)
WLAN	Wireless Local Area Network
WPAN	Wireless Personal Area Network

APPENDIX 3: FUNCTIONAL NEEDS DESCRIPTION

Adaptive bandwidth provisioning	Dynamic assignment of available bandwidth to end user device based upon the nature of the content to be provided
Ad-hoc networking	Short-lived networks created dynamically where networked applications are required
Advanced antennas	Antenna technology that enables the reception of information including radio, digital mobile and satellite services
Advanced firewalls	Advanced electronic blocking mechanism that will not allow unauthorized access to networked devices.
Advanced location technologies	Ability to locate the geographic position of end user devices
Application development platforms	Environment for the creation and delivery of corporate applications
ASP-delivered applications	A third-party entity that manages and distributes software-based services and solutions to customers across a wide area network from a central data centre
Automatic expert first response	Applications that provide automated intelligent first-line support
Automatic translation of language and content	Near real-time translation of information for delivery to the end user via the end user device
Behaviour blocking	Identification and prevention of possible network security breaches before the breach occurs
Biometrics	Authentication techniques that rely on measurable physical characteristics that can be electronically verified
Bridging devices	Multifunction home entertainment user devices
Broadband wireless access	Radio access networks for high-speed data networks
Business continuity infrastructure and redundancy	Combination of networks, applications and end user devices that reduce the likelihood of failure of business processes
Cabin networks (interference-free)	Network technology that is robust to the various sources of interference that are present in the aeronautical environment
Camera phone support technologies	End user device with integrated camera capabilities that support sophisticated photography applications and camera resolution beyond VGA
Charging paradigms / mechanisms	Innovative mechanisms for the charging of end users for the consumption of communications services
Compression protocols (voice coding, video coding, data compression)	Coding systems that compress and decompress information for onward transmission
Contactless location/identification – item-level RFID	Provision of radio tags for individual items as an enabler for applications such as retail outlet 'smart shelves'
Content aggregation and syndication mechanisms	Platforms for the aggregation and syndication of broadcast content

Content-on-demand	Low-cost delivery of content to the end user on request by the end user
Content-specific indexing models and semantic encoding	Unambiguous categorisation of information to enable the intelligent indexing and machine processing of that content
Contextual recognition	Speech recognition aided by the context of the conversation
Copy protection mechanisms and DRM standards	Provide secure distribution, and disable illegal distribution of content distributed via communication networks
DAB/DVB capabilities	Digital audio and video broadcast reception capabilities on end user device
Data encoding algorithms	Coding of data for onward transmission over a communications network e.g. for purposes of improved robustness
Decentralised and localised systems	local cells that can continue to function in isolation of the wider network
Device download and storage	Capabilities that enable the download to, and storage of content and applications on, an end user device
Device memory preloaded content	Content which is loaded on the device memory before acquisition
Dynamic logistics network	Real-time re-configuration of supply chain networks
Dynamic routing	Sensors and applications that enable the dynamic provision of route guidance information to vehicles
Enterprise content delivery networks	Management and distribution of rich media content throughout the wider enterprise, which may include suppliers and customers
Ethernet MANs	Application of Ethernet LAN principles over a shared infrastructure in urban areas
Federated identity management	A system that allows individuals to use the same user name, password or other personal identification to sign on to the networks of more than one enterprise in order to conduct transactions.
Fibre to the home	High-capacity fibre network connection to the home
Flexible displays	Displays that can be rolled, scrolled or folded when not in use
General Multi Protocol Label Switching	Packet network control technology that enables high-speed routing and discrimination
Grid computing	Co-ordinated and secured sharing of computing resources among a dynamic collections of resources
Handset configuration platforms	Capability to customise the 'look and feel' of end user devices
Heuristic learning and adaptation to user behaviour	Learning by discovery based upon the mode of operation of the end user
High bandwidth WLAN	High-capacity, low-range radio networks for the networking of end user devices

High capacity short range wireless systems	Radio-based technologies for application in the local area that provide a spectral efficiency significantly in excess of existing base IEEE 802.11b technologies
High capacity wireless networks	Radio-based technologies for application in the wide area that provide a spectral efficiency significantly in excess of existing base GSM and CDMA technologies
High data rate '4G' wireless	Communications technology that will allow one end user device to roam seamlessly over different wireless networks that utilise different technologies
High definition services	End user video services and devices that support High Definition resolution capabilities (more than double the resolution of conventional TV)
High functionality positioning systems	Sensors and applications that utilise vehicle positioning information to provide information services to drivers
High speed symmetric data connections (e.g. VDSL)	High-capacity symmetric data connection
Home content storage	Ability to store information on an end user device in the home
Improved power management	Reduction of the power consumption of end user devices
In-car wireless networks	Short-range radio network technology that is robust to the various sources of interference that are present in the automotive environment
In-home wiring networks (Powerline, homeplug)	Utilisation of home wiring for the networking of end user devices
Intelligent agents	Identify, locate and deliver relevant information from an information source to the end user based upon such factors as context and criteria specified by the end user
Intelligent edge of network storage devices	Network devices which intelligently cache content to maximise delivery performance
Intelligent interfaces and standards	Intelligent entity mediating between two or more interacting agents that possess an incomplete understanding of each others' knowledge
Interface from digital storage to local broadcasting/caching allowing 'immediate access'	Interface to enable near real-time storage of, and access to, broadcast information
IP Centrex	Provision of business voice services over an IP network
IPv6	Internet protocol that greatly expands the available IP address space
Location-aware services	End user services that utilise geographic position information of end user devices
Location-dependent personalisation	Customisation of end user services based upon the geographic position of end user devices
Longer 'battery life', e.g. using micro fuel cells	Battery storage capabilities for end user devices that provide a considerable improvement in battery life over existing lithium ion technology
Managed authentication services	End user authorisation system provided by a third party.

Mechanisms for elective advertising – discretionary on the part of users	Delivery of commercial advertising to end user terminal under the control of the end user
Middleware	Software that enables interoperability of applications across network devices e.g. for corporate/vertical applications
Multichannel gateways	End user device access to applications via multiple communication channels
Multimodal interfaces (i.e. speech, gesture, lip movement etc)	Human-machine interaction using natural language and other normal human communications methods
Multi-mode devices (e.g. GPRS/WLAN)	End user devices that support a wide range of air interface technologies
Natural IVR	Interactive voice response systems that respond to natural language prompts as opposed to keypad entry prompts
Natural user interface	Capabilities that enable end user interaction with end user devices without the use of keypads
Network management	Applications, services and hardware that enable the correct functioning of communications networks
Network-based entertainment platforms	Environment for the creation and delivery of mobile entertainment applications
Network-based location	Ability to locate the geographic position of end user devices based upon network-provided information
Network-based security platforms	Secure systems which work across networks
Packet technologies for wireless WANs	Ability to provide reliable packet delivery over a wide area wireless environment
Packet voice with QoS	Provision of voice services over an IP network with dynamically-controllable voice quality
Peer-to-peer networks ('parasitic networks')	Network in which each end user device is a network node, and has the ability to communicate directly with every other network node
Personalisation and service usability	Ability to configure end user devices and services to the specific needs of the end user
Presence	Virtual environments re-creating real world experience
Push technology (triggering applications on mobile devices)	Delivery of pre-defined information set to the end user device without prior searching and identification by the end user
Push to talk	A half-duplex, two-way, communication service that works like a "walkie talkie"
Resource management tools for distributed computing environments	Tools for the optimal utilisation of distributed computing resources
Satellite antennas for in-flight	Antenna technology that enable the in-flight reception of information including radio, digital mobile and satellite services
Self-connecting and self-setup devices	Capabilities that enable the automated addition of additional home devices to home networks
Self-healing systems/networks	Ability of systems and networks to dynamically adapt to handle variability of resources, user requirements and faults

Service management platforms	Applications in the support of the management of end user applications over distributed networks
Signal processing/modulation schemes (higher wireless network capacity and QoS)	Digital signal processing capabilities for the delivery of information at different quality levels over wireless networks
Smart antennas	Network antenna technology that directs radio signals towards active end user devices
Smart sensor networks	Networked distributed sensors with signal processing
Software defined radio	Wireless communication in which the transmitter modulation is generated or defined by a computer, and the receiver uses a computer to recover the signal intelligence
Storage/SAN management	Operation and management of a collection of computers and storage devices connected over a city-wide network and dedicated to the task of storing and protecting data
Storage-based products (in the home)	Consumer products with the capability to store content
Streaming platforms	Ability to deliver a continuous flow of information to an end user device in a multi-vendor environment
Systems for managing and monitoring utility computing services and ensuring flexibility and reliability	Systems for the management, by a service provider, of the availability of computing resources and infrastructure management to the customer on an on-demand basis
Tools for mobile content creation	Platform for the development of content for consumption by mobile end users
Tools to reduce the cost of content creation	Platform for the low-cost development of content
Trading grid	Infrastructure that supports the trading of grid computing resources
Turbo graphics	Support of sophisticated graphics capabilities (e.g. 3D graphics) for display on portable high resolution colour screen
TV search engines	Platforms that enable simplified searching of available television content
Ultra wide band	High-bandwidth wireless system for personal area networks
Up- and down-stream adaptive bandwidth provisioning	Dynamic assignment of bandwidth based upon the characteristics of the application and/or end user requirements
Video telephony with QoS	Ability to undertake a real time video communication between two or more parties where a defined quality of video communication is assured by the network
Voice over IP	Transmission of voice services using Internet Protocol-based broadband packet networks
Voice over WLAN	Provision of voice services over a wireless IP network
Wearable communications devices	Clothing-mounted end user communications device
Wireless enabled devices	End user devices equipped for home networks that support wireless connectivity