

# Mapping the Future of Convergence

## UK Radiocommunications Agency

### Event Listing

Card Number

## Markets

### Consumer Markets

- 2001 **Neighbourhood Networks Successfully Deployed Nationwide** (reused from 1999) 1  
The success of the Redbricks project in inner-city Manchester has been replicated in more than 50 similar UK districts. The Redbricks community created its own neighbourhood network with services such as local maps, notice boards, training opportunities, and crisis response. Government and EU grants fund the low-cost schemes.
- 2002 **Average Internet User Keeps Fewer Than 20 Bookmarks** (reused from 1999) 2  
Most Internet users cannot be bothered to keep organised bookmark files. Many use the Internet for specific purposes, tending to use only a few sites that offer them access to all the services they use on the Internet.
- 2003 **Distance Learning Embraced by Old and Young** (reused from 1999) 3  
Low-cost PCs, many course offerings on the local and national level, and government-subsidised Internet connections have helped bring higher education to thousands of new students. Distance learning helps people of all ages in rural areas, as well as those with child-care commitments or those with work schedules that interfere with regular school attendance.
- 2003 **Mass Market Consumers Attracted to Simpler Interactive Digital TV** (reused from 1999) 4  
A growing number of consumers are finding that simplified interactive services delivered to them by their Digital TV provider are easier to use and more reliable than the Web. A recent study showed a growth in time spent in front of the TV and a decline in time spent on the PC using the Internet, reversing the trend of the past few years.
- 2003 **Multi-Player Online Games Are "Killer App" for Online Services of All Types** (reused from 1999) 5  
The online multi-player game is the leading "application" driving demand for new network services, both wireline and wireless. On broadband wireline connections, games with full 3D graphics and new virtual reality features are extremely popular. Hand-held game units (online version of Gameboy) with wireless interfaces are also extremely popular. Kids of all ages are hooked on these games, which drive online usage more than any other service, except messaging.

- 2003 **PCs Are Now in >60% of UK Homes** (reused from 1999) 6  
PCs are now widely bought by families and single people throughout the UK. The number of homes with at least one PC or notebook is over 60%. The availability of low-priced PCs spurred this new growth. New web-based services are also attracting first-time buyers. (In an August 2000 survey by Oftel, an estimated 45% of UK homes had one or more desktop PC.)
- 2003 **Personal Communications Remains Largest Online Activity** (reused from 1999) 7  
A recent survey of users' online activities (both home and business) reveals that the Net is used for three broad types of activity: (1) communications, (2) information, and (3) commerce. Of the three, communications (mainly e-mail, chat, and conferences) remains by far the largest online activity, rivaling the telephone in many homes and businesses in terms of the number of personal interactions per day.
- 2004 **30% Decline in Fixed Telephone Revenue over Past Three Years** 8  
Telecom providers in the UK have seen the revenue stream from traditional wireline phone services decline steeply over the past few years. Increasing competition has driven prices down, but a more significant effect is substitution by wireless services. Especially among young people, there is an increasing trend not to bother with a wired phone and to rely entirely on mobile phone services. (In 1999, 19% of Finnish households had only mobile phone service.)
- 2004 **Consumers Won't Pay Extra for Broadband Access** (reused from 1999) 9  
Less than half of all consumers in the UK are willing to pay much extra for high-speed network access, mobile services (certainly not 3G), digital TV set-top boxes, or new HD TV monitors. Many object vehemently when there are proposed increases in basic telecom charges to cover new broadband universal services, TV licence fees, or any forced upgrading of equipment.
- 2004 **Public Embraces Digital Radio Services** (reused from 1999) 10  
Digital radio services are booming and consumers have now shown a clear preference for the CD-quality sound that digital broadcasting delivers. Digital radios are everywhere: in your car, TV, computer, mobile phone, and your PDA. There is pressure to open up more spectrum for DAB. AM services may be converted to digital operation and spectrum allocated at 1.5GHz could also be made available.
- 2004 **UK Citizens Preference to Stay at Home is at Highest Levels in Ten Years** 11  
A combination of factors drive UK citizens to stay at home more. Traffic and public transport delays have increased, further promoting the greater use of telecommuting. Crime statistics have worsened, making people more fearful of going out at night for out-of-home entertainment. Recent surveys indicate that people are spending more hours per week in their homes than ever before in the past decade.
- 2006 **Internet Is a Major Entertainment Medium** (reused from 1999) 12  
Surveys show that the Internet now accounts for at least 40% of the average family's home entertainment time, eating into time spent watching TV, watching videos, listening to music, or playing video games. Internet entertainment includes interactive multi-person games, talk shows, performances, and multi-media coverage of sporting events.

2008 **Video Rental Stores Have Largely Disappeared** (reused from 1999) 13

With the widespread availability of affordable Digital Video Recorders and most consumers well used to Video on Demand, demand for video rental has all but evaporated.

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## Business Markets

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2003 **Number of Homes with Businesses Doubles** (reused from 1999) 14

Government reports show that the number of home-based businesses has climbed dramatically throughout the UK, doubling in four years. Large numbers of households now serve as "headquarters" to at least one commercial enterprise. Some homes play host to two or more.

2004 **Remote Meeting Technologies Widely Embraced in Business** 15

Broadband services enable sophisticated video conferencing that combines shared data views with high-quality voice and video. Over slower connections, data conferencing systems offer shared viewing and editing of documents and electronic white boards, along with voice conferencing. Audio-only conferencing is increasingly rare. The total number of remote meetings attended by the average business user has gone up by 25% over the past three years as the new meeting technologies catch on.

2005 **30% of European Companies Adopt Wireless Solutions for Their Offices** (reused from 1999) 16

Mobility in office computing is beginning to take off in the European business world. The years of messy cabling in offices appears to be over. Wireless links enable a user to set up a laptop anywhere in the building. Using the standard facilities of Windows, documents can easily be routed for printing, faxing, or mailing to any other device.

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## E-Business

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2004 **70% of B2B Commerce Is Conducted via the Internet** (reused from 1999) 17

70% of all business-to-business commerce is now conducted electronically via the Internet or private extranets using open Internet standards such as XML (the eXtensible Markup Language). XML-based B2B commerce is rapidly replacing older approaches based on Electronic Data Interchange (EDI) standards. EDI approaches were only adopted by a limited number of companies due to their cost and difficulty of implementation. Internet B2B is adopted much more widely.

2004 **Number of Virtual Companies Increases by Factor of Ten in Three Years** (reused from 1999) 18

The number of firms that have spurned physical functions, facilities, and physical retail presence and exist only in cyberspace (e.g., Egghead Software) has increased by a factor of ten over the last three years. These firms also delegate responsibility for tracking and efficiently moving their physical products to companies such as FedEx and UPS, whose business in this area has exploded.

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## E-Commerce

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- 2002 **Fraud Loss in Electronic Markets No Worse Than in Traditional Markets** (reused from 1999) 19  
Despite earlier fears of massive electronic fraud schemes, merchants, card issuers, and banks find that losses related to online credit card fraud are comparable to losses in traditional markets.
- 2003 **Consumer Savings on E-Commerce Justify Cost of High-Quality Internet Access** (reused from 1999) 20  
Studies show that consumers believe they save significantly with Internet shopping. They are thus increasingly willing to pay for higher speed or higher quality Internet access because they see the economic benefit of having it.
- 2003 **Local Advertisers Shift to Web Advertising, Including Mobile Internet Sites** (reused from 1999) 21  
Local advertisers have found the Web to be a much better way to target the customers they want to reach than local broadcast TV, radio, or billboards. They are spending much more to get their ads and brands on local websites. They especially like working with websites that focus on mobile users seeking local information, directions, etc.
- 2003 **Neighbourhood Delivery of Net-Purchased Goods Is Cheap, Fast, and Ubiquitous** (reused from 1999) 22  
Delivery services have sprung up in response to the rise in Internet-based purchasing by consumers and small businesses. These services cater to the needs of individual customers in ways that the big national and international delivery firms can't. People often have things sent to a virtual address at the local delivery service, which knows when and where to get the goods to you best. Some offer on-demand delivery within 30 minutes of calling them.
- 2003 **Retail Giants Use Mobile Services to Keep in Constant Touch with Customers** (reused from 1999) 23  
Retail megabrands like Tesco and Virgin have heavily subsidised mobile services and terminals for use by their customers. They have taken mobile telecom services and created tie-ins to other parts of the business. Virgin notifies travelers of delays while Tesco invites in-store customers to use their mobiles to get a guide to special sales within the store. Prominent buttons on these fully web-enabled mobile terminals point customers to information and services within the brand.
- 2004 **30% of New Music Releases Are Delivered over the Net** (reused from 1999) 24  
Buyers now download one-third of their new release music purchases electronically. Customers either digitally record music themselves onto their own media or "rent" music for a limited time period.

2004 **The Walled Gardens All Have Unlocked Gates** (reused from 1999) 25

As mainstream consumers have gained confidence in navigating the full Internet, and filtering software can effectively block unwanted content, few tolerate limitations on their choice any more and walled gardens have effectively reverted to the earlier convenience-based model of a portal. This is true for access via interactive digital TV and mobile data services, as well as traditional wireline Internet access.

2006 **Electronic Terrorists Still Successful in Seriously Disrupting Internet Services** (reused from 1999) 26

Hacking has turned from a pastime of rebellious teens to one of international terrorists. Espionage efforts are now often directed at infiltrating key network and computing facilities for major e-commerce providers, banks, and telecom service providers. Continuing attacks disrupt network usage and, in some cases, cause real damage to software and stored data. Government efforts to combat the attacks are overwhelmed by the variety, ingenuity, and sheer number of threats.

2007 **15% of Consumer Retail Purchasing (by Value) is Done via Internet or iDTV** 27

A large portion of consumer population now use the Internet or their interactive Digital TV systems to buy goods or services. By total value, the B2C e-commerce channel now represents at least 15% of total spending in the UK. This is fueled by the fact that large purchases (autos, airline tickets, wine and spirits, etc.) are often the ones made through this channel.

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## Industry Structure

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### Telecom Service Providers

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2002 **Fixed and Wireless Operators Offer Micro-billing Services to Websites** 28

Both fixed and wireless providers of Internet services are offering billing services to website operators. These billing services aggregate charges for a user and then append them to the monthly access service bill. This scheme makes it affordable to charge for even small items such as a research article or a piece of digital music. The operators get a few percent of the charges as their fee, just as the credit card companies do.

2002 **Private Sector Supports Subsidies for Broadband Roll-Out** 29

Private companies support subsidized roll-out of broadband for their customers and potential customers. This facilitates richer experiences in shopping and increased revenue. Subsidies show up in the form of reduced service charges for first year, big discounts on terminals, waiving of installation fees, etc.

2002 **Telcos Buy into Portals and High-Quality Content** (reused from 1999) 30

In a quest for value-added, UK telcos have been investing in portals and content, such as sports teams, software, games, and business information/services. They often buy the rights to deliver existing content, but sometimes they buy the content outright.

2004 **Flat-Rate Charging Standard for Consumer "Always On" Broadband Access** 31

Broadband wireline access to homes in all major metropolitan areas in the UK is now priced on a monthly flat rate basis, regardless of usage. Broadband services are always on and do not have connect time charges associated with them. Although many broadband providers originally tried to charge by volume of data received, this proved to be completely unacceptable to consumers who demanded a predictable, fixed bill.

2006 **Cable Is the Strongest Platform for Converged Services** (reused from 1999) 32

The poor reliability and customer service of the 90s is long forgotten as the now-consolidated cable sector, with better broadband performance than DSL and better interactivity than satellite, has forged links with content providers and mobile network operators to become the cornerstone of converged services.

2006 **Most Consumers Have a Single Communications Provider** (reused from 1999) 33

Consolidation in the market and people's desire to deal with a single provider led to an outcome where over half of all consumers in the UK deal with only a single provider for basic communications (fixed and mobile voice, Internet, and TV). They may have many higher-level service and content providers.

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## Mergers, Acquisitions and Alliances

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2001 **ISPs Merging with Content Providers** (reused from 1999) 34

Three major ISPs have merged with the UK's main commercial content producers --Carlton, Pearson, and Granada. This provides direct competition for the BBC's online services and provides the ISPs with priority access to the broadcasters' libraries.

2002 **Funding for Investment in Internet Services Revives** 35

Interest by investors in funding Internet-related startups and further network infrastructure upgrades finally revived. Although investment dried up for over a year after the initial bursting of the Internet stock market bubble in spring of 2000, it is now strong again, as the Internet-related companies that have survived have shown strong profitability and growth.

2002 **Portal Sites Consolidate** (reused from 1999) 36

Yahoo, AOL, and Microsoft now have an unassailable position as the dominant portal sites. Second-tier players, unable to compete on all-in-one services, have seen their advertising revenue collapse and have either been subsumed or have resorted to smaller specialised niches.

2002 **Wireless Operator Mergers and Alliances Limit Competition for Spectrum** 37

In effect, there are only five major wireless operator groups globally now. In some cases, there have been explicit mergers between smaller players. In other cases, there are strong alliances. The result is that competition for spectrum auctions is dampened in most markets.

- 2003 **AOL and Time Warner De-Merge** 38  
 In the end, it didn't really make sense to combine content creation with distribution. After a few years of trying to make it work and finding that the different parts of the media giant were stumbling over themselves, AOL-Time Warner followed AT&T, BT, and other big giants and broke itself up into several pieces.
- 2004 **Over Supply of Telecom Services Results in Numerous SP Failures** 39  
 The limitless demand for broadband services (both wireline and wireless) did not materialize as forecasted by the pundits. In reality, far too much investment was poured into the telecom sector. At first there was a devastating price war in a desperate effort to get market share and attract customers. In the end, many companies went under. Today, there are far fewer players in the UK telecom market.
- 2005 **"Industrial Ecosystem" Models Prevail over Vertical Integration** (reused from 1999) 40  
 Due to constantly changing needs of businesses and consumers, the most flexible approaches to providing products and services are winning out. The ecosystem model (where one or a few large "anchor" players are complemented by an array of value-added partners, suppliers, and service providers) is winning over vertically integrated strategies (where a single provider tries to supply everything customers need). This is measured by growth and profitability of players using each strategy.

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## Wireless Operators

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- 2001 **GPRS Pricing Fosters Wireless Net Usage and "Always On" Services** 41  
 Anxious to build familiarity with using the Internet on the move, UK GSM operators launch GPRS services that are priced to encourage growth in usage. Most have opted to go with pricing by bit volume rather than connect time, to support use of "always on" services. Off-peak discounts are especially popular and allow segmentation of the market between business users (who will pay more) and consumers.
- 2003 **In-Building and Public Wireless Services Merge** (reused from 1999) 42  
 A single phone and service are now able to support telephone service within the home or office and in transit. In some cases, a single phone can receive public wireless signals as well as in-building, "cordless" phone or wireless LAN signals. In other cases, mobile cells have shrunk to the point where signals can reliably penetrate buildings. Most people use only a single phone for all their needs, whether inside or outside.
- 2005 **40% of UK Mobile Traffic Is Carried by Virtual Operators** (reused from 1999) 43  
 Since Virgin and Carphone Warehouse set the trend in late 1999, Virtual Mobile Network Operators have proliferated; they now account for 40% of combined 2G and 3G traffic.
- 2005 **More UK Devices Access the Internet via Public Wireless Services than Wired Ones** (reused from 1999) 44  
 The smart, IP-capable, mobile phone was an instant success when it was introduced in the early part of the decade. PCs quickly took to using wireless access services. (This excludes private short-distance wireless links, like Bluetooth, that are connected to the Internet via wired services.)
- 2005 **Price per Mbps for UMTS Is at Least Twice That of Wireline Network** (reused from 1999) 45  
 The price paid for wireless bandwidth is at least twice that for bandwidth on the wireline network.

- 2005 **Private Mobile Radio Services Convert to Public Mobile Data Services** 46  
Taxi cab drivers were already using mobile phones anyway. With packetised mobile services so inexpensive, it became unnecessary and more costly to have specialised PMR systems for taxi dispatch and similar uses.

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## TV Broadcasting

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- 2002 **Hybrid Programming that Combines Internet with Broadcast TV a big Hit** 47  
A number of new hybrid programming concepts have been introduced into the market over the past two years. Typically, these combine a regular broadcast TV program with a sophisticated interactive website that keeps viewer attention during the intervening week between program broadcasts. Programs involve solving puzzles or searching for something where clues are given via the website, or submitting home videos via the website, etc.
- 2002 **UK Broadcast TV Networks Make Feeds Available via Internet** (reused from 1999) 48  
Like radio stations before them, the free-to-air broadcast TV networks have decided that they stand only to gain audience by making their feed available via streaming video on the Internet.
- 2003 **Interactive TV Doubles Participation in Electronic Shopping** (reused from 1999) 49  
Many non-PC owners in the UK now shop electronically without knowing or caring whether they are interacting with the Internet. Approximately half of online shoppers only shop through their TV.
- 2003 **Mass Market Pay-Per-View TV Event (or Series) Available on Internet Only** 50  
A mass market pay-per-view event (e.g., sports match) or series (e.g., "ER" ) is purchased by an Internet "broadcaster" and made available on the Internet exclusively, thereby shutting out the traditional TV window. It is now possible that certain programming will be made available on the Internet before being made available via video stores or syndicated for broadcast TV re-runs.
- 2004 **Compression Enables Doubling of Channels and Services for Broadcast Digital TV** 51  
New compression techniques are significantly increasing the capacity of spectrum allocated to Digital TV broadcasting. These improvements limit the need to allocate more spectrum to DTV.
- 2005 **Penetration of Pay TV in the UK Has Plateaued at less than 60% Ceiling** (reused from 1999) 52  
Rapid growth of pay TV penetration in the early 2000s occurred as digital cable, satellite, and terrestrial broadcast services competed fiercely for audiences. Now, there has been little change in penetration levels in the last two years. Households who are content with free-to-air services are typically older, do not have children, and have no interest in sports.

- 2007 **Cable Company Switches to Fully IP-Based Version of Interactive TV** (reused from 1999) 53

A major cable company has gone to a completely IP-based approach to transmission of TV signals (compressed with MPEG4) to sophisticated PCs and set-top boxes in the home. This allows for more efficient use of bandwidth, easier combination of TV content with other Internet services, and implementation of on-demand delivery of content to individual homes. Since all the mobile and fixed carriers use packets, it became obvious that the cable companies should too.

- 2007 **Terrestrial Over-Air UHF-TV Broadcasts to be Discontinued** (reused from 1999) 54

UK broadcasters plan to pull the plug on terrestrial broadcast of TV. With widespread use of cable and other wired delivery of TV programming in urban areas (much of it on the Internet) and a full set of satellite broadcasters available to meet the needs of rural areas, there is little justification for devoting spectrum to terrestrial over-air broadcasts. Subsidies (e.g., for dishes) will be made available where needed.

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## Internet-Based Services

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- 2002 **Consumer Protests Shut Down Most Tracking of User Behaviour on Net** 55

Internet retailers and service providers are finding that they must be extremely careful with any attempts to monitor consumer usage of their services. Consumer power can be easily concentrated and directed via Internet advocacy groups. Sites that attempt to track user behaviour are quickly identified and made the target of major boycott campaigns. In this way, consumers themselves enforce their desire for privacy on the net.

- 2002 **Internet Fad Fades** 56

The failure of Internet businesses has continued. Very, very few of the dotcom concepts introduced during the late '90s have been anything but dotbombs. Internet usage has peaked and this year actually saw a decline in terms of number of people who regularly use it and total number of hours of Internet usage across the UK.

- 2002 **Sportal Secures Major Cricket Series Coverage** (reused from 1999) 57

Sportal, the leading UK Internet sports website, has signed a deal with the ICC cricket authorities for exclusive live coverage of a major series. It plans to target office workers and professionals who can track match progress from place of work, alongside other Internet-related tasks.

- 2003 **Subsidised Access Dominates Consumer Use of Basic Internet in the UK** (reused from 1999) 58

The dominant pricing model for consumer content and access on the Internet and Digital TV (DTV) is to make the basic services nominally cheap or free to customers by supporting them with advertising, transaction, or helpline revenues. Charging extra for premium content also helps support the cost of delivering the basic services.

- 2003 **Web-Based Retailing Simplifies Consumer Purchasing of Network Services** (reused from 1999) 59  
A new generation of web-based retailers of converged communications and Internet-based services are doing well. Capable of helping consumers order terminals and services of all types, they make choosing, installing, and paying for the growing number of services available much easier for consumers. They even aggregate service bills and give the consumer a single bill per month. They combine Dell with Carphone Warehouse and Amazon.
- 2004 **Consumers Flock to Anonymous Digital Payment Services** (reused from 1999) 60  
Consumers have seen that the benefits of the anonymity of cash transactions extend into cyberspace. As more individuals buy and sell goods and services over the Internet, they seek to use anonymous digital payment services to avoid creating traceability. The Net is quickly becoming the equivalent of a cash economy. The early leaders in these services, such as American Express with its Private Payments, have become very successful.
- 2004 **Internet Accounts for 60% of Communications Traffic in UK** (reused from 1999) 61  
Internet traffic has continued to grow rapidly since the first measured number of 17% of all UK traffic in 1999. Major drivers include conversion of voice communications to IP (VoIP), e-commerce, interactive games (including ones with a gambling aspect), rich business communications (e.g., enhanced audio and video conferencing), and conversion of business networks from SNA to TCP/IP and standards like XML.
- 2005 **Widespread Adoption of Single Personal Communications Identifier** (reused from 1999) 62  
The ongoing development of converged communications services has led to the adoption of new numbering and addressing schemes that enable a person to have a single identifier for all types of communication (voice, e-mail, video mail, paging, etc.).
- 2008 **Peer-to-Peer Funds Transfer via the Net Takes Off** 63  
Similar to the explosion of peer-to-peer in digital transfer of music, video and data, peer-to-peer transfer of funds is taking off both among corporations and their suppliers, and individual consumers on the Net. In such a system, value can be transferred device-to-device or computer-to-computer without participation by a financial services company. The big payment-system operators are presented with the possibility of being largely disintermediated.

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## Technology

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### Mobile Wireless

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- 2003 **Lack of Radio Skills Holds Back New Technology Development** 64  
Even though there is great interest in further application of wireless communication to new products in industrial and consumer segments, there is a serious lack of people with the knowledge and skills to do the radio engineering required. The result has been consistently slower rollout of new wireless standards and technology than originally predicted.

- 2004 **Health Scares Slow Growth of Fixed and Mobile Wireless Services** (reused from 1999) 65
- Health and environmental concerns limit the availability of base station sites and the growth of fixed and mobile wireless services. It is increasingly difficult to obtain approval to place new base stations in both rural and urban settings. Continued concern over the effects of wireless radiation have slowed adoption of new personal wireless devices. Even though there are plenty of studies to the contrary, the public remains skeptical.
- 2004 **High-Bandwidth Wireless LANs Selling Well in Homes and Schools** 66
- The increasing number of consumer electronic devices requiring connection to cable, Internet, telecom, or other feeds has led to rapid growth of low-cost wireless networking products for the in-home market. Student use of laptops and wireless hand-helds also make wireless LANs popular for most schools. Wireless LANs are a natural for the home and school market where it is difficult to re-wire for data connections. Approximately 15% of homes and 40% of schools in the UK now have a wireless LAN.
- 2004 **Packetisation of Mobile Networks Increases Capacity 25+%** (reused from 1999) 67
- Packet approaches to communications are universally accepted as more efficient than circuit switched ones. This is now true in mobile networks as well. Early use of packetised voice services proved successful in terms of quality. Given the increased network efficiency, operators converted quickly to packet approaches. Approximately 25% more traffic can be handled on a packetised mobile service than on one using circuit switched techniques.
- 2004 **Study Shows that Single Shared Base Station Net Could Increase Capacity by 25%** (reused from 1999) 68
- A recent study of wireless network usage in the UK has concluded that operating a single network of base stations as a common resource to all wireless service providers could increase overall capacity in the wireless infrastructure by about 25% while improving the quality of service. With rising concerns over the proliferation of base stations, this study is seen as pointing the way toward the next step forward in capacity improvement without deployment of many new sites and antennas.
- 2004 **UMTS Fails to Take Off in UK** 69
- Calling UMTS "the ISDN of the new millennium," or "the greatest telecom debacle since Iridium," pundits are saying that the newly deployed UMTS systems are not being adopted. On the one hand, GPRS is fast enough for many applications, including most e-commerce, while true broadband 3G services and terminals are too expensive for most users. Adoption rates for the first couple of years of UMTS in UK have been much slower than operators expected.
- 2006 **Digitalization, Intelligence, and Processing Power Increase Spectrum Efficiency** (reused from 1999) 70
- Digitalization of transmission, along with constant increases in intelligence and processing power of terminals and network elements, has enabled further improvements in use of the radio spectrum. More users can share available frequencies. Compression is also more and more effective. Signal processing allows good operation despite high noise levels.

- 2007 **Pico-Cells Plus Optical Backbone Creates Wireless Broadband Capability** (reused from 1999) 71

Technology for passive pico-cells allows for very high-bandwidth (100's of Mbps) wireless connections within a small area (radius of 100m). These wireless links then connect to optical fibre backbones to create a broadband end-to-end service.

- 2008 **Fewer than Half of All Mobile Devices are Sold for Use by People** (reused from 1999) 72

More mobile devices are now used for applications other than personal use. Examples include mobile monitoring units installed in automobiles and other forms of transport, mobile send/receive units used for remote product monitoring and telemetry, and mobile communications links used by computers. (NTT DoCoMo estimated in 1999 that by 2010 only one-third of its "customers" will be people.)

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## Wireline

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- 2003 **10Gbs Ethernet LANs Take Off in the Market** (reused from 1999) 73

The next step up in building-level networks has been taken with the market acceptance of 10Gbs Ethernet.

- 2004 **Fixed-Mobile Convergence Becomes a Reality** (reused from 1999) 74

As operators merge their fixed and mobile networks, and solutions such as low-cost GPS receivers enable location information to be automatically available, it becomes straightforward to offer a personalised service via the most convenient network available to the user. It is cheap and easy to add mobility services to fixed networks.

- 2004 **Optical Backbone Links Widely Operating at 40 Gbps** 75

The next step up in broadband optical backbone technology is now in widespread deployment. The OC768 network technology based on Dense Wave Division Multiplexing (DWDM) is now reliable and is the standard for new backbone upgrades and deployments. OC768 was scheduled to go into the first networks in the first half of 2001.

- 2005 **Optical Links Found in 25% of City and Metropolitan Access Networks in UK** 76

Optical transmission technology is reaching down into the access networks and is no longer just a backbone technology. In denser urban and metropolitan areas, the rising demand for network bandwidth has driven the deployment of optical transmission systems at ten or more gigabits per second in links to larger businesses, public services, and schools.

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## Internet

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- 2001 **Internet Content Blocking Is Widely Deployed** (reused from 1999) 77

Many types of groups deploy content-blocking technology. China makes the headlines for such actions, but the practice is common. Corporations, for example, block sites that use too much bandwidth; webcasting sources are often blocked. Some community-oriented sites gain users by blocking access to sites with content unsuitable for children.

- 2004 **Hybrid Satellite and Terrestrial Systems Best Choice for Rural Internet Access** 78

The most cost-effective way to deliver higher-speed Internet services to rural homes is to combine satellite broadcast of the high-bandwidth data and media content with a terrestrial

back-channel via traditional wireline telephone lines. The system works well except where consumers want to originate high-bandwidth content like digital photos or movies. Sending a recordable CD via the Royal Mail is still the most affordable way to send that content to someone else.

**2005 Internet Multicast Widely Available and Effective** **(reused from 1999)** 79

Multicast transmission is now commonplace on the Internet. Content providers can efficiently send the same programming to as many endpoints on the network as needed, without sending duplicate packet streams.

**2006 Over Half of DAB Bandwidth Contains IP Packets** 80

The DAB system has been an important source of additional capacity for bandwidth-hungry IP applications. News, financial data, software updates, and all kinds of media data (e.g., MPEG-compressed images, music, and video) are packaged into IP packets and addressed to one or more destinations. Cheap DAB receivers are being incorporated into PCs as well as mobile webphones. Broadcasting of CD-quality music was not all that popular and is the minority application on the DAB airwaves.

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## Devices

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**2002 Bluetooth Wireless Links Allow Plug and Play for All Kinds of Net Appliances** 81  
**(reused from 1999)**

Bluetooth is a standard for short distance (100m) radio frequency (unlicensed) links between devices that was standardised by a broad industry consortium in 1998. Bluetooth interfaces are now widespread and able to support a plug and play mode of integration among dissimilar manufacturers of components. Bluetooth allows components of PCs, PDAs, and webphones to interact easily when in close proximity. It is also used for smart home appliances to reach a Net interface device in the home.

**2002 In-Home Firewalls are Selling Well** 82

Recent scares about how hackers can get into your home computers through always on broadband Internet access services have led a large portion of subscribers to purchase relatively inexpensive home firewalls. These small boxes sit between the broadband modem and your PC or home LAN and protect against intrusion.

**2002 Mobile Phones Are Both An Electronic Wallet and Digital Identification** **(reused from 1999)** 83

The battle for the electronic wallet has been won by the mobile phone. Phones are used to pay for all kinds of things in virtual and physical worlds. Local short-distance wireless connections (e.g., Bluetooth) to POS terminals allow local payment. Mobile phones also connect to PCs using Bluetooth to provide secure payment and identification for PC-based Web sessions. Mobile phones, in effect, now contain all the features of what were previously called smart cards.

- 2002 **Sales of Web Appliances Very Strong** (reused from 1999) 84  
 The range of consumer "Web appliances" launched by Intel, 3Com, and others has stormed the market. They provide high-speed Internet access and offer limited tasks such as mail retrieval, online shopping, and information gathering. Equipment providers focus on providing telecom operators and service providers with a cost-effective platform for their services. These devices are also easier for the average consumer to learn how to use than fully featured PCs.
- 2004 **More MP3 Players Sold in UK than Traditional "Walkman" Devices** 85  
 MP3 players that pull digital music in MP3 format off the Internet and store it for replay while on the move have proven to be very popular. In the UK, these devices now outsell traditional small portable devices that use traditional tape, CD, or mini-CD media formats with recorded music (e.g., Sony Walkman).
- 2004 **Multimedia Kiosks Are Everywhere** (reused from 1999) 86  
 The use of multimedia-based kiosks has expanded far beyond their initial application as a source of information for visitors to Disney World. They are now prevalent in airports, libraries, bank branches, pharmacies, auto showrooms, employment offices, and real estate offices.
- 2004 **Voice Control, Touch Screen, and Handwriting Effectively Replace Keyboards** (reused from 1999) 87  
 The combination of voice control, handwriting recognition, and touch screens has rendered it unnecessary to have a real keyboard for most uses of Internet, databases, and Microsoft Office/Windows. E-mail is steadily turning into person-to-person voicemail. People who write for a living still use keyboards, but most PC and PDA users do not need to any longer.
- 2005 **Most Users Own Only a Single Personal Mobile Device** (reused from 1999) 88  
 Following a period where end users bought an increasing number of devices (notebook PCs, mobile phones, pagers, Internet capable PDAs, memo takers, etc.), device convergence has proceeded to the point where you can now easily buy a single device that provides all of the services and capabilities you need. There are many types of combinations on the market aimed at different market segments and professions, but any single user now typically carries around only a single device.
- 2006 **Wearable Computers Become Common in Many Computer-Assisted Professions** (reused from 1999) 89  
 Continued miniaturization, higher-speed mobile data links, improvement in voice control, and other user interface innovations have led to increasingly usable forms of wearable computers. In many professions, from health care to construction to logistics to factory work, these computer systems are built into uniforms and designed to interact with other specialized computer systems in the work place. Increasing productivity and safety, and the need for constant computer access, drive the increased use.
- 2007 **Miniature Refuelable Fuel Cells Spur Growth in Untethered Devices** (reused from 1999) 90  
 Miniaturised versions of fuel cells are now in production use for many kinds of devices where access to a power plug is impossible, expensive, or undesirable. Fuel cells are very light and can run for over a month continuously before needing refueling. They are also seen as far more environmentally friendly than advanced chemical batteries that present a disposal problem. With both communication and power available without wires, there is a surge in both portable and remote location applications.
- 2007 **Software Radio Facilitates Universal Comms Device** (reused from 1999) 91  
 The ability of software radio to configure itself to different modulations and frequencies opens up the prospect of a single device that combines GSM/UMTS/Bluetooth/W-LAN/GPS/DAB, etc.

2007 **Virtual Displays Overcome the Hand-Held Limitation** (reused from 1999) 92

The availability of very small, high-resolution displays viewed by retinal projection frees the hand-held device from its main constraint and stimulates the use of mobile access.

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## Fixed Wireless

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2006 **20% of UK Homes Access Internet via Broadband Fixed Wireless** (reused from 1999) 93

Broadband fixed wireless services have been very successful in meeting consumers' needs for high-speed network access reliably and at low cost. One-fifth of all UK homes are now served by some form of fixed broadband wireless, rather than a wired connection into the home.

2010 **Ultra Wide-Band Radio Proves Successful** (reused from 1999) 94

The early claims for the ability of UWB to offer very high bandwidth with wide-area coverage prove correct. UWB systems are also successful as in-building wireless LANs. UWB systems are being deployed widely both outside and inside.

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## Applications

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2002 **Applications for Teens are Major Drivers of Growth in Broadband Services** 95

Internet-savvy teens are demanding broadband connections from their parents. Innovative applications aimed at teens such as AOL-Time Warner's "Instant Video Messenger" and MTV's "Create Your Own Music Video" are very successful. Teens can now create their own music videos on MTV's site, where they build videos from thousands of pictures, graphics, and sound recordings. MTV features a daily prime-time program showcasing the best user-created videos.

2002 **Intelligent Agent Software Widely Used** (reused from 1999) 96

User agent software comes in many forms. The simplest are filters, set up as profiles, that screen and organise information sought by individual customers; some have limited routing capability. More complex network agents actively seek information from the network regarding particular information or services requested by a customer. An agent can find information for a user while driving, and then read it aloud.

2002 **Interactive Gambling is First Major Wireless Data Services "Killer App"** 97

Gambling is extremely popular (estimates range as high as 75% of population participate in some form of gambling) and for some people it is an addictive behaviour. Wireless service providers quickly latch onto gambling as a highly successful application. Everything from the public lottery to Las Vegas-style gambling with convincing graphics is offered on popular wireless data devices.

2003 **Non-Communication Uses of Radio Also on the Rise** 98

Although communication systems get all the headlines, there is also a steep rise in other applications of radio technology for things such as ground-probing radar systems, doppler systems for distance measurement, etc. Scientific and astronomical uses for radio also remain important.

2006 **20% of GP Consultations are Held Remotely** (reused from 1999) 99

Encouraged by the rapid take-up of NHS Direct, the government has promoted educational programmes, and selectively financed investment in the necessary hardware, for remote

consultations to become common for routine ailments and/or more far-flung patients.

2006 **Monitoring Devices Are Major Wireless Data Application** 100

Monitoring the health, safety, and location of children, the elderly, and pets is a major application of the new generation of miniature wireless data devices. Over five million of these devices are now in use in the UK. Medical monitoring devices can report temperature, heartbeat, blood O2 levels, etc. with non-invasive probes. For serious conditions, specialized probes can be used. Simpler devices report the location of a pet, child, or senile person that may not be able to communicate by mobile phone.

2007 **Government Funds Major Program to Optimize Highway Utilization** 101

The Government cites increasing highway delays as a top drain on productivity. With stiff resistance to building more highways, the only choice is to optimize use of existing roads by implementing usage fees based on time of day, in-vehicle dynamic routing displays, signals that alter timing based on traffic levels, full computer control of vehicles in some lanes allowing denser packing at higher speeds, automated collision avoidance to reduce accidents, etc. All need 2-way radio links in vehicles.

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## Converged Services

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2001 **Peer-to-Peer Technologies Thwart Attempts to Control Content Piracy** 102

Even though illegal sharing of copyrighted digital content via services such as Napster and MP3.com was controlled by strong threat of legal action, the newer forms of digital content swapping appearing on the Internet will not be so easily stopped. These peer-to-peer services such as Gnutella have no central server and there is no easy way to trace who is using them. They fully distribute storage and software across thousands of machines on the network in a constantly changing way.

2002 **Major Studio Offers Digital Distribution and Funds Exhibition Upgrades (reused from 1999)** 103

A major studio announces that it will make all newly released films available to cinemas in digital format and will subsidise the equipment needed to show the digital movies. It cites as its reasons lower reproduction and distribution costs, as well as flexibility to adjust dynamically the number of screens where a film opens. Celluloid will still be available, but digital will be discounted.

2005 **Content Owners Have Confidence in IPR Protection Measures (reused from 1999)** 104

Encryption, embedding, micro-payment, and other technologies to protect Intellectual Property Rights have improved substantially. Imperfections remain, but the major content owners accept them in order to profit from the booming demand created by widespread narrow- and broadband access.

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## Video Technology

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2004 **Manufacturers Stop Selling Analogue TVs in the UK** 105

Manufacturers have stopped selling analogue TVs in the UK and have cleared out existing inventories. They now offer only digital TV-capable sets in the UK.

2005 **DVRs become Centre of the Home Network, Displacing PC Server as Archive** 106

Digital Video Recorders (DVRs--e.g., TiVo, and ReplayTV) now have high-speed Internet

connections as well as broadcast TV feeds. They feature very large (400GB+) disks initially designed to store recorded TV programs, but now also used to store digital music, photos, and movies. They have become the centre of the home network and the primary storage archive for personal digital content. PCs are still used as another type of terminal to access the network, but have lost the race to become the home server.

**2005 Most New TVs and PCs Have Very Similar Functionality** 107

Newly purchased TVs and PCs are increasingly capable of the same functionality. PCs easily receive video content, while TVs (and their set-top boxes) have fully interactive interfaces and large disks for storing recorded content or data. It is now possible to do practically any routine operation on either device. High-end PCs are still needed for certain business or industrial applications, and there are still low-end "dumb" TVs, but in the main consumer market the two devices are largely interchangeable.

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## Regulation and Government

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### Communications Regulation

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**2003 UK Government Prohibits Use of Strong Encryption Without Permit** 108

The UK Government has taken the stance that strong encryption must be regulated in order to prevent criminals from hiding their communications. The Government will routinely scan wireline and wireless communications and, if it detects use of prohibited forms of encryption, it will prosecute the originators. Those wishing to use strong encryption must register with the authorities and provide means to de-crypt their transmissions if a court orders so in an investigation.

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### Competition Regulation

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**2002 EU Competition Authority Refuses to Allow Telecom Mega-Mergers** 109

The EU Competition Authority has ruled against most recent merger attempts on the part of European telecom companies. Further reduction in competition is seen as bad for consumers and will limit experimentation with new technologies and services. Both cross-border mergers, mergers of companies focused on different technologies (e.g., cable and wireless), and mergers of infrastructure players with content players are now very difficult to get approved.

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### Government Policy

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**2004 Government Stimulates Broadband Access Development in Outlying Areas** 110

The Government's program of bringing broadband digital services to all citizens faces its greatest challenge in outlying rural areas. Here, the Government must stimulate deployment of new technology either through development grants or by partially subsidizing (relatively high) monthly service costs on behalf of these households. A variety of technological solutions are tried, including hybrid satellite-terrestrial systems, powerline networks, and various forms of terrestrial wireless.

**2005 Government Promotes Development of Socially Worthy Web Content (reused from 1999)** 111

As the Web has increased in importance as a cultural, educational, and civic medium, the

Government has begun to promote the development of socially desirable content that commercial interests alone would not be likely to support.

2008 **Government Mandates Broadband Access as Universal Service** 112

The UK Government has now required that telecom service providers include basic broadband access as part of universal service offerings to the general public.

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## NEW EVENTS

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2003 **Spectrum Policy Dominated by Need for Generating Government Revenue** 114

2005 **Use of Unlicensed Spectrum becomes So Intense that Devices are Unusable** 115

2004 **Public Services in Unlicensed Spectrum Compete with 3G, Undermining 3G Operators** 116

2008 **Wireless Breakthroughs Allows 10-Fold Capacity Increase and 1/10th Cut in Power** 117

We are now at a point that wireless systems have ten times the capacity that they did at the beginning of the decade. At the same time, improvements in processor and display technologies have cut power consumption by a factor of 10.

2007 **Mesh Radios Greatly Increase Spectrum Efficiency and Lower Cost of Nets** 118

Peer-to-peer networking through local transmitters allows free neighbourhood wireless networks and reduces the need for public infrastructure.

2005 **Government Introduces Policies to Encourage Home Working** 119

Incentives include tax breaks for equipment, increased road use fees, etc.

2008	<b>Integrated Device that Access All Wireless Networks Enters the Market</b>	120
	Single device that can work with bluetooth, wireless LANs, 2.5G, 3G, etc.	
2005	<b>Lack of Development of High-Level Device Language Scuppers Wireless Home</b>	121
	Inability for home appliance and utility systems makers to agree on common standards makes it impossible to network your intelligent home devices together in any reasonable way.	
2004	<b>File Sizes are So Big that Wireless E-mail is Unusable</b>	122
	(Thanks to Microsoft and other software makers) the size of e-mail messages has consistently grown. No longer content with simple text messages, most people send HTML-enhanced mail with images, sound, etc. All of this makes for messages that take forever to deliver over relatively slow wireless data connections.	
2005	<b>Government Continues to Mandate Telecom Services that May Use Spectrum</b>	123
2005	<b>Mass Storage (e.g., large disk drives) are Standard in all but Low-end TV Sets</b>	124
	After the early success of products like TiVo and ReplayTV, all TV and settop box manufacturers have included mass storage in their products, allowing consumers to digitally record programs and access them easily at any time.	
2004	<b>Key Components for Delivery of Fibre Drop in Price by 75% since 2000</b>	125
	Components like media converters, gigabit ethernet interfaces cards, connectors for fibre, etc. are now much more affordable as amount of fibre use has grown.	
2003	<b>Universal Open Standards Accepted for Broadband</b>	126
	Standards package including IPv6, API for interactive audio-visual services, home wireless networking, etc.	
2005	<b>High Resolution, Widescreen (16x7) Displays become the Norm for Home Viewing</b>	127
2007	<b>Celluloid has Disappeared as a Film Exhibition Medium</b>	128
2005	<b>The Digital Divide has a Significant Effect on Job Prospects</b>	129
	People who don't have the skills to use the new media well or who don't have it at home are increasingly unable to find best jobs or rise up to better positions within their current employer.	
2004	<b>Government Introduces a "National Grid" of Content for Education and Science</b>	130
	This stimulates parents to purchase broadband access.	
2002	<b>Content-Distribution Mergers are Commonplace</b>	131
	Competition authorities permit mergers between AOL/TW and telcos (or similar combinations). This creates a vertically integrated, "closed access" content-to-delivery giants.	

2004	<b>Mobile Banking is an E-Europe Initiative</b>	132
	This is a key enabler for mobile commerce and will be promoted as part of both the e-Europe and single market policy drives.	
2005	<b>Internet Quality of Service Issues Resolved</b>	133
	Internet has sufficient quality of service and availability to challenge the PSTN for telephony communication.	
2004	<b>Personalized "Push" Technology Creates More Demand for Wireless Services</b>	134
2004	<b>Data Protection for Location-Based Services are Sorted Out</b>	135
	Wireless will be a key enabler to deliver universal location-based services. However, data privacy concerns inhibit the take-up. These issues are now sorted out in a consistent and robust manner.	
2008	<b>Bandwidth into the Home is More than Adequate for Content Available</b>	136
2003	<b>Interactive Satellite Services are Taking Off</b>	137
	Interactive (2-way) broadband multimedia satellite system brought into service across Europe and is doing well from a commercial point of view.	
2004	<b>UK Government Auctions Off Portion of Analogue TV Spectrum</b>	138
	UK Government announces full switchover to digital TV in 2010 and that in 2010 it will auction off a number of (currently) analogue TV frequencies for other use. The announcement is made in 2004 for the switchover in 2010.	
2005	<b>More Mobile Spectrum Allows Next Leap in Usage</b>	139
	New spectrum (e.g., 5Ghz) is released for mobility. This increases supply and a reduction in 3G data tariffs. This in turn leads to a large increase in mobility demand.	
2003	<b>AOL Goes Bust</b>	140
2005	<b>Satellite Ka-Band Return Path becomes Affordable and Widely Available</b>	141
2005	<b>Lack of Quality Content Limits the Viability of Broadband Networks</b>	142
2005	<b>The Government Requires that All New Homes are Prepared for Wireless/Wired Comm.</b>	143
2004	<b>Delivery of Television to Mobile Devices is a Major Market</b>	144
	People on trains and busses, as well as those in the back seat of a car, can all enjoy TV while on the move. People with wireless cards in their laptops want TV delivered wherever they are. There are even wireless-enabled video walkman devices in use.	
2007	<b>Flat Screens become Ubiquitous and are Used for Accessing both PC and TV Content</b>	145
2002	<b>Major Environmental Protests Delay Infrastructure Development by Years</b>	146
	Protests against 3G masts, road digging, concerns over radiation exposure, all delay rollout of 3G	

The WRC approves:

- rebalancing of spectrum opportunities
- shift from broadcast to telecomms
- UK wins only limited rebalancing of spectrum policy it deserves (e.g., UMTS phase 2)

**Total 146 events**

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