



Technology Futures and Digital Inclusion **Research Report**



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The findings in this report are those of the authors and do not necessarily represent those of the Department for Communities and Local Government

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Online via the Communities and Local Government website: www.communities.gov.uk

October 2008

Product Code: 08 RPD 105574/E

ISBN: 978-1-4098-0635-6 web

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“The future is already here, it’s just unevenly distributed”

William Gibson

Chapter 1

Overview

The developments in digital technology over the last decade have been rapid and widespread. There is no reason to believe that the coming decade will have any less change. The developments in digital technologies have been matched by widespread adoption in the UK of digital radio, TV and the internet.

The challenge of the last decade was digital inclusion, but as more and more of the population see the benefits of digital technologies the challenge now becomes one of understanding *offline consequences of the online world*. These consequences may be for people, businesses and communities who cannot, will not or just don't understand digital technologies.

Furthermore, the developments of digital technologies can be impacted by geographical factors as the costs of deployment of the network infrastructure for some technologies are distance dependent.

The increasing use of online technologies for access to retailing, banking, travel, entertainment and government services means that online access to these services is fast becoming a utility. We expect them to be there – in the way we expect clean water, electricity or telephones to be part of the fabric of society and the economy. In turn, expectations of reliability and availability will match the growing dependence on these technologies.

We can consider digital inclusion as having three aspects:

First, **the amplification of existing social divides** by the ongoing developments in technology. For instance, people with low skills, the elderly or those with disabilities¹ may feel that technology can be an additional barrier to overcome in order to participate fully in the economy and society.

Second, **the creation of new types of inequality** caused by developments in technology. For instance, the creation of services that only exist in the online world exclude those who do not have access. With more job opportunities being made available online

¹ The following is according to the UK's Office for National Statistics' Labour Force Survey, Sept – Dec 2006, for people of working age only:

* Nearly one in five people of working age (6.9 million, or 19 per cent) in Great Britain are disabled

* Only about half of disabled people of working age are in work (50 per cent), compared with 80 per cent of non disabled people of working age

* There are currently 1.2 million disabled people in the UK who are available for and want to work.

it can be argued that we may widen the gap in opportunities to access employment along with changes in the skills needed for employability. Research shows that there is a 3-10 per cent wage premium for jobs involving computer/Internet use. Many jobs are now advertised solely online and recruitment processes are increasingly electronic and ninety per cent of new jobs require ICT skills.²

Finally, and more positively, **the emergence of new opportunities** by developments in digital technologies. For example, we are increasingly familiar as a society with satellite navigation in vehicles. GPS, the global positioning system, the key technology behind this will soon be standard in the chips built into many mobile phones. This will facilitate new types of location based services. Given the large numbers of mobile devices in the UK, new services may become available which are more widely available than those that require a computer.

These three aspects are not mutually exclusive. Circumstances may compound individual inequalities in access to services. To illustrate this, consider the two hypothetical cameos below, which capture some aspects of the challenge of digital inclusion.

An elderly woman with diabetes and failing eyesight lives in a small rural village. The local sub-post office closes down. The nearest shop is five miles away and the bank branch in the nearest town faces closure. She feels she is too old to use a computer and they are too expensive anyway. She doesn't understand digital television and is quite happy with her existing set.

The challenge here is that both public and private and potentially third sector service provision might compound existing inequalities and create new sources of exclusion.

Survival after a heart attack is greatly enhanced by early treatment. The time from phone call to arrival in A&E creates an inequality between those living in towns near to a hospital and those in rural and remote areas. The ability to put technology into an ambulance could potentially allow a patient to be monitored and treated en route to hospital and tackle some aspects of an existing health inequality.

In this case would the technology infrastructure be such that it would be economic to deliver to rural areas or would it further exacerbate an existing divide?

There are many candidate technologies in the market today and in development which may have a significant impact on society and the economy. Therefore, it is not realistic to be fully comprehensive in listing all the technologies and all the potential impacts on digital inclusion. But for the purposes of this strategy, a taxonomy of technologies and how they interact is outlined below which provides a framework for thinking about possible technology directions and their impact on digital inclusion.

² www.ehampshire.org/introduction/c-106.html

Chapter 2

Industry trends in digital technologies

Many of the trends which will shape IT futures in the next decade have been in place for the last few decades. IT will continue to get smaller, cheaper, faster and more functional and integrated. It will also consume less power.

There are two underlying trends in the digital technology industries which are central to most of the key developments which can be foreseen in the next few years. These are *connectivity* and *convergence*.

Today it is possible to listen to radio on a TV, the internet or a mobile phone. It is possible to watch TV over the internet. In South Korea, the deployment of TV on mobile phones is already widespread. Until the recent past the devices that we have at home or at work have been discreet. We watch a TV, we listen to a radio, we play on a games machine, we phone on a mobile, we take pictures with a camera and we listen to music on a CD player. At work and home we use a PC or a Mac for internet browsing and office work.

These distinctions have significantly blurred and will continue to do so over the coming years. The idea of the convergence of computers and communications has long been a goal of the telecommunications and computer industries. With this digital convergence, there is a convergence also of the media industries of film, TV, music, and print and publishing.

The Government has established a Convergence Think Tank between DCMS and BERR³ with three overarching themes to review the impacts on industry and the consumer.

- open markets
- empower consumers and citizens
- provide universal access to high quality content

While the process of convergence has been in train for some decades, the outcome of convergence is fraught with uncertainty, notably in its impact on business models, but also on which devices and services the user and businesses will adopt in the converged world. This provides many uncertainties in the regulatory regime needed for the converged world.

³ See <http://www.culture.gov.uk/Convergence/>

Technology innovation is frequently associated with business model innovation. For instance, the emergence of the MP3 player and the Apple iPOD has changed the way in which users buy and consume music. It also has impacted the ability of the recording industry to protect its intellectual property. In turn, the impact on music retailing and distribution is highly disruptive.

Along side this process, there has been a growth in *connectivity*. As consumers have moved from chemical to digital photography there has been a change in how we use these devices. Many, if not most, mobile phones are also digital cameras, both still and video. The use of a short-range wireless standard known as Bluetooth enables users to transmit pictures from a mobile phone to a computer. Some digital televisions have slots for the memory cards in digital cameras which enable digital photos to be displayed on a television. A new consumer product has also been made possible, the digital photo frame. Many of the new generation of flat screen televisions, both LCD and plasma, can be connected to a personal computer.

Along side this has been the emergence of the Internet and the World Wide Web. In little over a decade the Internet and the WWW have moved from an academic community to over a billion users worldwide. They have evolved from an online publishing medium to an increasingly interactive set of services, covering retail, finance and travel, for instance, alongside many community building and social networking sites.

It has acquired sound, image (still and motion) media. It has also allowed for pages to be constructed on demand to become a database driven medium. There are two areas of focus for its future development, known as Web 2.0 and Web 3.0. These developments can be misleading in that there is no formal definition of them. Broadly speaking, Web 2.0 is a collection of facilities that create a network of people rather than a network of information. The aim of Web 2.0 is to support community building, online collaboration and information sharing. There are many different views of what Web 3.0 will mean but common views include changes in the way applications are built to create greater flexibility, more artificial intelligence and increased semantic capabilities.

The internet is a network of networks. In the past we have had separate communication networks for TV, radio, phone (fixed and mobile) and computers. Each network has used its own communications protocol. IP, the internet protocol, is a global standard which has been developed and continues to develop with a goal which its advocates argue is "IP over everything, everything over IP". That is to say that whatever mechanism or technology on which media are carried, IP will support that medium and that whatever service can be delivered digitally can be carried over the internet. One example of a service that this has enabled is VOIP, Voice over IP.

There are many competing services now which enable voice and video calls over the internet. Another example is IPTV, or television over the internet.

As the broadband network infrastructure has developed, new business models for software have become feasible. The IT industry uses two terms to describe these developments Service Oriented Architecture (SOA) and Software as a Service (SaaS).

In SOA, the software industry is moving away from monolithic software products to software built around business processes. These processes in turn are loosely coupled to create modular reusable software components that can be tailored to build distributed computing systems.

With SaaS, instead of users having to install and maintain software on their own PCs and Servers, the application is hosted on the internet and delivered with new business models, such as on demand pricing. One of the most well-known examples of this is www.salesforce.com which provides an on demand customer relationship management suite of software. This type of approach is widely expected to support small and medium Enterprises (SMEs) as it reduces the upfront capital costs of computing and relieves small businesses from in house technical support. The growth of SOA and SaaS is expected to grow with the availability of high availability broadband networks. This externalisation of the IT infrastructure from organisations is one of the disruptive changes expected within the IT industry over the next decade.

The term cloud computing has come to be the favoured term for this trend. A number of industry consortia have announced that they are setting up cloud computing research and infrastructure capabilities. Cloud computing builds on and develops from notions of utility computing and grid computing which have been used within the industry for some years

One feature of this approach to software is that many of the well known internet applications, such as Facebook, Google and Yahoo have opened up their applications by publishing interfaces which allow for software developers to build their own applications on top of the software provided by the supplier.

In turn, this modularisation allows users to mix services from multiple sources to create "mash ups". This means that from a user perspective a seamless interface can be created to support their needs even though the raw data and services come from different organisations. The increasing choice of personal devices combined with the ability to mix and match different digital resources is the technological infrastructure that provides support for the personalisation of services to individuals and communities.

The value of all this technological innovation depends then on the availability of information and services that underline this IT infrastructure. This leads us into the difficult area of intellectual property and digital rights management.

Balancing the rights of creators and owners of intellectual property in digital media and the rights of users and consumers is an area with considerable challenges.

There are groups who are concerned that the extension of copyright into digital media has led to extensions of ownership rights that have undermined traditional notions such as “fair use”; important in underpinning public libraries as a social resource. A variety of approaches have been explored such as the Creative Archive⁴ and the Creative Commons⁵ to provide new intellectual property mechanisms for the digital media.

Another approach to tackling this challenge has been the Growth of the Open Source Software (OSS) movement, notably with the development of the Linux operating system. In this model, software is developed and distributed under a permissive license regime and allows for collaborative communities to build, modify and distribute software. The users of software are thought of as co-creators and developers, rather than as customers and consumers.

This background to the evolution of the digital industries allows us now to turn to the framework for discussing the future directions of these technologies.

A Framework for Digital Technologies and Services

User Devices	Personal Services	Third Sector Services
	Infrastructure Services	Private Services
	Network Infrastructure	Public Services

The diagram above provides a framework to explore how the technological developments of the next decade will change how information is created in digital media and distributed over networks. It also provides a way of analysing the services provided.

Rather than a focus on individual technologies, such as RFID, the internet or WiFi for instance, the impact of these technologies on society and the economy arises from their integration into the “information platform”.

From the perspective of the user, they use a computer, a mobile phone, a digital TV or DAB radio for instance to access information, entertainment and services provided by the digital infrastructure. These and other **user devices** access a **network infrastructure** that may be a fixed communications network, a mobile network or a satellite network. From the user perspective they may be using multiple networks to access information and digitally-delivered services.

⁴ www.creativearchive.bbc.co.uk/

⁵ www.creativecommons.org/

A number of technologies are required to provide **infrastructure services**. These services include: search, security, locality-based services, digital rights management and payment services.

Similarly there are a group of technologies which provide services for the individual. These **personal services** include privacy technologies, identity services and accessibility features – required for personalisation of delivery and for various disabilities.

In turn, there are services delivered by the public, private and third sectors which can be accessed by the citizen and consumer by digital means. The underlying technologies in many cases are similar. It is useful to draw distinctions at this stage, because the pace of developments, resources available and the motivations for service developments in the three sectors mean that different combinations of technologies can be seen and different levels of maturity. In tackling digital inequality it is useful to consider how experience in one sector might inform developments in other sectors. For instance the social networking site Facebook might provide some lessons for building health communities online. To illustrate this, a recent report from the think Tank DEMOS included the idea of “Dr Finlay’s Facebook” as an example of the future of digital healthcare⁶. It may be that these ideas do not translate well into public service delivery for particular communities, but may well have a role for some groups, such as younger people.

These sectors are of course, not exclusive. Entertainment can come from the public service broadcasters as well as commercial providers.

Many **private sector services** already have a significant online presence such as banking, retail, and travel.

The **public sector services** include HMRC’s online self-assessment, NHS choices and DVLA along with many local authority services.

The **voluntary sector** is increasingly using digital media to support fund raising, campaigning and self support networks such as patient groups.

⁶ <http://www.demos.co.uk/publications/thetalkingcure>

Chapter 3

The network infrastructure

The UK infrastructure for network communications has much strength in terms of its deployment and capability. Coverage across the UK for TV, radio and internet in the digital era stands well against international comparisons, but this is no cause for complacency. Digital radio is today available over the internet, on mobile, Freeview, Sky and cable networks. TV is available on DTT, satellite, cable and internet. The UK has many wireless (Wifi) hot spots in places such as airports, cafes and hotels. Access is also available on public transport. As an example, the coach services from Oxford to London provide wireless internet access. Satellite navigation systems have taken off rapidly in cars, taxis and freight over the last few years. Public internet access is provided by the network of UKOnline centres, public libraries, internet cafes and the voluntary sector.

The development of the UK's broadband network infrastructure is already the subject of much activity. The Caio independent review for the government is looking at the barriers to rolling out high-speed, next-generation broadband networks in the UK.

In parallel, OFCOM is carrying out a wide ranging review of next generation access networks. In particular, the regulator is looking at the promotion of future high speed broadband networks in new build housing developments.

The Broadband Stakeholder Group (BSG) has published a report called "Models for efficient and effective public sector interventions in next-generation broadband access networks"⁷. The BSG has also published a framework for evaluating the value of next generation broadband.⁸

Access to high-speed broadband is widely thought of as the 21st century utility alongside utilities which have provided us with electricity, clean water and telephony as universal services.

The challenge for government and industry is that the technologies continue to develop so that there is little certainty over how fast broadband networks will need to be to meet the needs of society and the economy in the near or long term. Only a few years ago ISDN at 64K was sufficient for many needs. Then ADSL at 512K was acceptable. Today, many broadband users have access to networks in the 1Mb to 8Mb ranges. Different views on the future run from 10 to 100 Mb and beyond. Comparisons internationally illustrate that this is far from resolved.

⁷ http://www.broadbanduk.org/index.php?option=com_content&task=view&id=292&Itemid=7

⁸ www.broadbanduk.org/value

This uncertainty makes building the business case for universal service at any given level complex. Therefore understanding how the regulatory regime may need to evolve and the rationale for government intervention if and when necessary is highly uncertain.

It is this challenge which is the core subject of the Caio review⁹.

There is a wide array of networking technologies for fixed, mobile and broadcast networks. The long term solution for fixed networks around the developed world is fibre to the home. Fibre optic cables once laid have the capacity to upgrade the speed of the networks but the cost of universal cable with uncertainties on revenue models makes this unattractive. Current expectations on new build housing developments is that for groups of over a thousand homes that fibre is economically feasible. The economic case for the roll out of fibre to brown field developments is less clear than for new build environments. Many countries in their broadband plans have specific actions identified for rural and remote areas. The costs of a fibre infrastructure are distance related, so sparse communities provide specific challenges from a revenue generation standpoint.

The costs of digital satellite bandwidth have been and are expected to fall significantly over the coming years. This provides another potential route to make high speed broadband available which does not have the challenges of fibre in terms of distance related costs. On the other hand, thought needs to be given to the return path when increasing interactivity rather than broadcast type models are needed.

In the mobile telephony world we are in the uptake of third generation mobile networks 3G from the pervasive GSM/2G mobile phones standard. Developments of the next technologies, 4G, are underway within the standards bodies for deployment on a timescale of 2012-2015. The focus is on wireless networks in the 100Mb to 1Gb range. These network speeds are expected for both indoor and outdoor networks. It is expected that 4G protocols will be fully internet integrated so that internet access will become increasingly seamless 'anytime, anywhere and on any device'.

There are also other technologies that allow for broadband networks in specific areas. Wireless mesh networks, based on the standard IEEE 802.11s allow for resilient radio based networks both with fixed and mobile infrastructures. These networks have been developed from military applications but can now carry voice and data traffic. They are flexible networks with a wide variety of applications including emergency operations. This type of network builds on the wireless technology, Wifi, found in many homes today offering between 11 and 54 Mb networks around the home.

⁹ <http://nds.coi.gov.uk/environment/fullDetail.asp?ReleaseID=354760&NewsAreaID=2&NavigatedFromDepartment=True>

Another technology WIMAX, based on the standard IEEE 802.16, provides a wireless standard over larger areas, with distances in miles. It is a technology that is used to connect the Wifi Hot spots found today in cafes, hotels and airports but is also a candidate technology for providing broadband access on the local loop, the “last mile”, in areas where broadband access might otherwise be uneconomic.

The UK has a sophisticated digital television infrastructure with cable, satellite and digital terrestrial, DTT, networks.

The set top boxes used by Sky for instance also provide connection back to the network through the fixed telephone. This type of network infrastructure provides the simple interactivity of current TV service.

When we describe broadband networks, the principal focus to date has been on the download speeds. The upload speeds are normally much slower. A 1Mb download network may have, for instance, a 128K upload speed. For most applications today this network asymmetry has not been an issue. High quality video conferencing is an example of an application where the uploading and downloading speeds need to be the same.

However, future applications may require a greater focus on the upload speeds also. Again there is a lack of clear evidence today for the requirement, demand and pricing for these potential applications. It is likely that as broadband networks become more pervasive more sophisticated applications will support innovative products and services in commerce and telehealthcare where high speed upload speeds are necessary.

The UK is one of the leading nations on digital radio with the development of digital audio broadcast. A new standard DAB+ provides higher quality. UK services of DAB+ are due to be launched in 2009. DAB+ however is not backward compatible with DAB and so many users will not be able to use their existing sets.

To summarise, the UK has a sophisticated infrastructure today for TV radio and Internet on which to build. Technologies exist in the fixed, mobile and satellite spaces which could provide a level of broadband capability that will cope with the different challenges of urban and rural areas. These technologies can integrate to provide a level of service across the UK. There are many challenges for the regulator, government and industry in terms of Spectrum allocation, pricing and business models and competition policy.

What we can learn from internationally is that we consistently tend to underestimate bandwidth requirements. Within the developing world Pakistan is a leader in Wimax technology and has been able to leap generations of network infrastructure. Japan and South Korea have very high-speed fixed networks today and has found that the more bandwidth provided, the greater the demand. South Korea also has a developed national mobile TV network.

A few years ago, the UK had to reorganise the telephone numbering system because of increasing demand for new and innovative services such as facsimile and Direct Dial, DDI. The success of the internet is itself causing a similar depletion of available numbers and addresses. A key component of the Internet is its addressing system the Domain Name System, DNS. ICANN (the Internet Corporation for Assigned Names and numbers) the global body supervising the DNS voted in June 2008 to open up the internet addressing regime to allow for more addresses than those we have become increasingly familiar such as .com , .uk, and .org. It has also provided the increased capability to create addresses in varies character sets, such as Arabic and Chinese. At the same time a new addressing regime for the internet known as IPv6 increases vastly the number of addresses. Over the next decade we will see the growth on new networks based on the new addressing regime. It is too early to tell how these new freedoms will be exploited by citizens, the Government and Industry.

No single technology is likely to be economically dominant or viable for all terrains and all applications. Technologies exist today and are in development which can be integrated together to provide broadband levels of service to the whole of the UK. The convergence on the internet protocols of mobile networks will over the network increase the potential for end to end seamless broadband access, but the transition is neither simple nor certain.

From this overview of the network infrastructure, it is important to consider the devices which will be connected to the infrastructure to provide the interface for users of the digital networks.

Chapter 4

The User Devices

Today, access to digital services is predominantly via the computer, desktop and portable, with the PC dominant and the Apple Mac and some Linux desktops.

One development which has been underway for many years now is the development of the electronic book or e-book. In the way that many consumers have changed how they buy and consume digital music, a number of approaches have been tried to make this available for text. The Arts Council has recently sponsored a report, called read:write from the Institute for the Future of the Book which captures the challenges facing the publishing industry in the digital era.

Other devices are beginning to add access beyond the familiar computer. Many mobile phones and personal digital assistants (PDAs) provide email access and some internet functionality. The most familiar of these devices is the Blackberry. Later this year, the next generation of chips in mobile phones will come attached with the Global Positioning System, GPS as standard. GPS is the technology behind SATNAV. Intel is researching a new class of devices which use GPS outside vehicles. There are many challenges, but a satellite navigation system for walkers may well become feasible within a few years.

In December 2007, the Alzheimer's Society supported the electronic tagging of dementia sufferers. Many dementia sufferers feel a compelling urge to walk, with 40 per cent getting lost when they wander. The Alzheimer's Society said electronic tagging would allow patients to do this without causing distress to themselves or their families. The charity released guidance on tracking technology and called for more research into the possible merits of electronic tagging.

This type of innovative use of digital technologies would be possible, with a mobile phone as one candidate approach.

Digital televisions and set top boxes provide another route for online access. Internet television, IPTV such as the BT Vision service, provide yet another route. The set top boxes used to access most digital TV provide a slow speed return path with enables access to some online services through the "red button" interface on many TV remote controls.

In the run up to digital switchover a new generation of set top boxes is in development which blurs the boundary between the personal computer and the set top box, providing messaging and other interactive services below the current price floor for personal computing.

The current generation of games consoles, Microsoft Xbox 360, Sony PS3 and Nintendo Wii offer online gaming experiences but are also offering some online services. The arrival of the Nintendo Wii has brought new users to gaming. The novel motion-sensing interface and the availability of new classes of games such as bowling and the Wii Fit have encouraged some unexpected groups, such as the elderly, to embrace the online gaming world.

In the workplace, many organisations are adopting “thin client” technologies. Instead of the user maintaining software on a local computer, a simpler device attaches to the network with data and applications hosted in the network. This approach will increasingly be available to the home as network speeds increase. This can deliver three classes of benefits to the end user: lower cost devices, easier maintenance and reduced energy costs.

What this illustrates is that there is no shortage of routes for people who are currently not benefiting from digital technologies to take a first step. The UKOnline centres have shown that any preconceptions we may have about specific groups not being able to use these technologies can be challenged by evidence. With suitable support, case studies exist which show that the elderly and those with disabilities, two of the largest groups among those currently not using digital technologies, can embrace the benefits for their own lives.

For many people who do not use digital technologies, when asked it is frequently found that they are not convinced of the relevance of these technologies to their lives.

Microsoft UK has announced a PC designed with the elderly in mind. This will have an interface that is simplified and be preloaded with applications tailored to the needs of the elderly.

Because of the UK's long-term investment in computers in schools, there are many devices that have been developed for education purposes to allow a wide variety of groups with physical, emotional or learning difficulties to access technologies. They have largely been developed by small companies or charities. Many of these devices may have a wider potential than school education. However, few of the organisations have the capacity or motivation to spread their ideas to the wider market.

The key challenge in the near future is that many of these devices are becoming smaller with more functionality built in. For an individual who has not used a digital device, the move to a device that is a phone, a camera, a global positioning device using the GPS service and an internet connected device all at once may become daunting. Very small key boards and screens are also a barrier for those with visual impairment or motor-control impairment.

However, as the digital network becomes increasingly pervasive, new specialist devices will undoubtedly appear. Three areas are already active – telecare, home security and intelligent metering.

NeAT is an example of what is possible today. Newham Advanced Telecare (NeAT) is a system that extends the Newham Network Community Alarms Service. A range of sensors in vulnerable peoples' homes sends alerts automatically to the control centre if problems are detected. The sensors monitor and detect changes as they occur and alert the person before a situation gets out of control. For instance, many people fall in the bathroom when they get out of bed to go to the toilet during the night. A sensor in the bed can be set so that if a person gets out of their bed during the night and doesn't return within say 20 minutes, an alarm is sent to the monitoring centre who phones the person to see if they are OK. If there is no reply it is very likely that the person has fallen and help will be sent.

This means a call for help can still be triggered even if the person has fallen and can't physically reach a cord or button, or is too distressed or otherwise unable to do so.

Basic sensors can, for example, send an alert if:

- smoke is detected
- abnormal heat is detected in the kitchen
- the sink or bath has overflowed

More advanced systems can send an alert if something unusual happens, such as the gas having been left on, or the water supply not having been used for a prolonged period.

The ability to create a new generation of network connected intelligent home metering devices potentially provides cost savings to the utilities. Apart from cost savings, the data collected on energy and water usage might be used to support novel tariffing to alleviate fuel poverty. The use of smart metering might also be justified on wider contributions to society, notably on tackling climate change.

What digital convergence also provides is the potential for device *divergence*. This enables the creation of devices with single functions to be designed and created for particular groups. For instance, in South Korea a digital watch has been developed specifically for diabetics. The advantage of this approach is that the wearer can benefit from digital advances but does not need to understand the digital world as the features are embedded in familiar objects.

SMARTlab, the Digital Media institute at the University of East London, is a centre of research looking at the intersection of technology, disabilities and creativity. Their focus is moving beyond access devices to creating new devices, exploiting advances in digital technologies that allow all users to express their creativity, in many different formats. Their research is undertaken with people from their three main target communities (women, people with disabilities and youth at risk/young people). Their universal design ethos aims at these under-served segments of society and co-creates new tools and platforms, which are then applied to the full spread of community users, on a global scale.

Some examples of their work illustrate what is possible now and may be in the market in the near future:

The first is a haptic chair. This is a chair operated by hydraulics, with a simple USB interface and integrated touch and breath sensors. It enables a severely handicapped child (or adult) to interact with a personalised virtual world, so that the chair moves for and with the body of the 'user', who can engage viscerally as well as virtually, and can empower her/himself and become the centre of a dynamic engagement platform. The chair, part of the SMARTlab's award-winning TRUST Project, uses game technologies and customised assistive technologies combined, to create stimulating environments for all.

The second example is a wheelchair which can be moved by a person with cerebral palsy under their own control. The chair is steered via Bluetooth control taken from signals from a mobile phone, which operates text via either stick or eyegaze (eye-tracking) cues, which then controls and corrects the steering using a gyroscope. Using this new system, those with little or no voluntary physical movement can not only move independently, but can also dance!

One final example of SMARTlab's work in this space: the team are developing wearable computers, in a line of 'smartfashion' with embedded biosensors that can help with health, well being and communications. They have an example of a Tee shirt which has sensors built into it, for a patient with emphysema. The sensors monitor the patient's health in real time and send data to a local PC. A range of locative mobile ('serious') games using the fashions and biosensors are in development.

Although these examples have been developed for specific projects, the underlying technologies may well have wider applicability, not only for the core user groups but also for the elderly, and for all.

Elsewhere, pilot projects around the world have looked at taking all kinds of common appliances and making them internet aware. Internet fridges, washing machines and sewing machines illustrate what is possible.

As the Nintendo Wii illustrates, the notion of a keyboard and mouse as the access devices for the digital world can be challenged. Over the next few years a variety of advanced touch based, voice based and multimodal interfaces are likely to come to market. Examples of these already exist in niche applications, but these novel interfaces can make access to the digital world more suited to the choice of the individual rather than the system.

Which of these will come to market when and what their business models will be is highly uncertain. However, the scope for innovative products and services increases with the capacity and pervasiveness of the network infrastructure.

Chapter 5

Infrastructure services

Search

While there are many millions of websites, search engines are among the most widely used. Google, Yahoo, Microsoft Live Search are the most well known general search engines. Services such as Ask, for commercial information and Yell for Yellow Pages are examples of specialist search services. The ability to access text, images, videos and sounds has opened up information in a way unimaginable only a few years ago.

The availability of search in a wide variety of languages also supports those for whom English is not their first language. The “Power of Information” Independent Review for the Cabinet Office provides a comprehensive survey of how public sector information could be opened up and how digital technologies can create new channels between government and the citizen. For example, Google is free to users and supported by advertising revenues. The ability to target advertising to specific users online, it is argued, provides a more effective channel between suppliers and customers than traditional media. The challenge over the next decade may well be whether the advertising backed model will fully support the extension of online services from 60 per cent of the population to 70 per cent and above. As the focus moves to more hard to reach groups and communities, it is not certain that these groups will be economically attractive to advertisers.

Research by UCL’s Centre for Publishing has indicated that older people get higher failure rates on search engines. Research may be needed to understand if and how older people get less value from these services.

Security

As with many new technologies, fear of the unknown can be a barrier for many people. New notions of identity theft, spam, phishing attacks, viruses and Trojans create both a language barrier and a fear factor for new entrants to the online digital world. Public campaigns for online safety and child protection online help many to feel secure but also raise concerns for others. The subscription models for anti virus software also may be a barrier for others.

Some Internet Service Providers (ISPs) provide a range of security services for the consumer. The growth of thin client based online services may also be an approach that reduces the fear factor for some of those not online today by passing these responsibilities to the service provider.

Locality-based services

These technologies can be illustrated by the example of satellite navigation in vehicles. The ability to use SATNAV to find a nearby Italian restaurant or an historic monument relies on the user having a device which the infrastructure can geographically place. This type of service will increasingly be part of the offerings of mobile phone operators. Much experimentation has already occurred globally with these services. We are today in an era of experimentation and trialling and it is not yet clear what consumers will wish to pay for, or what alternative business models may emerge.

How the public sector could exploit this development is not yet clear. Earlier, we described how the Alzheimer's Society believes that electronic tagging of dementia sufferers might help both sufferers and their carers. The extension of this to wider health services is a clear possibility.

If an individual is taken ill, the ability to locate a nearby A&E or GP surgery via the mobile phone could be very powerful.

Location-based services can support economic and social goals. For instance in Malta, many historic buildings have a number on them which if dialled allows the user to find out about the location. This has been done to support tourism and culture. It extends the location-based audio programmes available in many museums and galleries to the open air.

Also, with digital mapping such as Google Earth, Streetmap and Multimap, new services are becoming possible. During the recent petrol strike, the BBC was able to maintain a real-time view of the areas of difficulty by allowing viewers and listeners to send them details on their local petrol stations and to make this available by their website.

The use of location-based technologies can help during flooding to allow the emergency services to communicate with and to receive local intelligence from the affected communities.

Digital rights management/IPR

These technologies allow for digital rights holders to commercialise their music, films and other media while protecting them from software piracy. The Apple iPod and MP3 players have changed how their users buy and consume music. The BBC's iPlayer and Channel 4's 4OD are illustrating how the availability of these services changes their interaction with their TV audiences.

Ensuring that public services are available on the majority of appropriate devices so that they do not distort the market, or that IPR systems prevent access to the public audiences will be a cause for concern. To achieve the maximum benefits for the consumer and citizen, the development of technical standards and interoperability of the devices and their software is a key challenge. A proliferation of standards may act as a barrier to including some of the groups currently excluded.

The developments of new models of Intellectual Property regimes such as the Creative Commons, Open Access and the Creative Archive may well require support with public awareness programmes.

For instance, a user may think they have bought a piece of music, when they have actually licensed it for a specific platform. The potential for the accidental criminalisation of consumers by the complexities of the digital world needs to be guarded against.

Payment services

For commercial transactions to be securely enabled over the internet, payment technologies have and are being developed, such as Paypal.

In the UK we still have a significant section of the population who are unbanked and do not have credit cards. The majority of e-commerce transactions require these facilities. However, a number of services are in development which allow for cash cards and cash top ups, using smart card and RFID tagged cards, similar to the London Transport Oystercard.

Many online commerce sites offer lower prices than in traditional retail stores.

It is quite possible that the overlapping group of the socially excluded with the digitally excluded could find themselves paying higher prices, or receiving poorer service unless new payment services are developed and recognised by online retailers.

Chapter 6

Personal services

Accessibility

For many people with disabilities, it is easy to believe that digital technologies are an additional barrier to their capacity to fully integrate into the wider society and economy. In fact there are many technologies which can be deployed which lower the barriers for individuals and allow them degrees of autonomy.

A well known example of these technologies is the voice box that has allowed Stephen Hawking, the noted Physicist, to continue working despite motor neurone disease for over 20 years.

The long-term investment in schools computing has led to many innovations in physical devices and software to provide means for children with autism, dyslexia, and various physical handicaps to access learning in ways that the traditional classroom cannot.

TECHDIS (www.techdis.ac.uk) provides a service for HE, FE and Workplace learning to support accessibility and inclusion to learning for adults. There are many features in standard software applications which enable them to be tailored to specific needs of individuals. However, the combination of skills in technology and learning is not widespread thus limiting the take-up of existing facilities, let alone future potential. Simple examples include the choice of colour schemes to help individuals with colour blindness access the internet.

The Web Access Initiative¹⁰ is a global body supporting the developments of strategies, guidelines and resources to allow people with disabilities to access the resources of the internet. Many websites, but by no means all, already use the WAI guidelines to meet their obligations under the Disability Discrimination Act, DDA.

Many of these approaches may well have wider applicability to access for public and private services. A lack of awareness and the underdevelopment of mechanisms to allow for the diffusion of accessibility innovations is a major challenge.

What also needs to be considered is how the education of design students can fully exploit new technologies to ensure that new products and services are developed to meet the needs of the diverse communities and individuals in the UK.

¹⁰ <http://www.w3.org/WAI/>

Privacy and identity management

We have considered security as an aspect of the service infrastructure. For the user, the complementary services are identity management and privacy.

To overcome the fear factor mentioned earlier, technologies exist and are being developed which provide the user with the capability to protect their data and to reduce the potential for fraudulent transactions arising from theft of a user's online identity.

For many users, registering with multiple websites, each with their own passwords or identity systems can be confusing and difficult.

Part of the development of Web 2.0 is a system called Shibboleth¹¹. This system allows a user to register with one body and for that organisation to act as a guarantor of the identity of an individual when accessing another organisation. It is designed to work both within an organisation and across multiple organisations.

For instance, a user might register with their GP. When visiting a hospital, the identity of the individual could be confirmed from the GP. This approach could allow for the user to experience the NHS as a single organisation while allowing for local autonomy of the many bodies within the NHS.

There are many ways in which the identity of the individual can be established including pin codes, passwords and biometrics, such as fingerprints.

The challenge is less in the technology than in building mechanisms which enable consumers and citizens to trust that their needs for privacy and security are being managed appropriately in the online world. Mechanisms also need to be developed to allow for dispute resolution between authorising bodies.

Shibboleth is one of a number of potential approaches to authorising the user's identity. One of the key challenges here will be the ability to scale the solution to millions of users with acceptable performance.

Digital agents

One additional way in which access and usability of the digital world is increased is the creation of software called digital agents. These are software tools which bundle together a variety of tasks on behalf of the user and hide the complexity from that user.

Two examples may illustrate public and private possibilities.

¹¹ <http://shibboleth.internet2.edu/>

A digital agent could be created which manages the complex process of house moving for the user and alerts the user of progress and problems. This would interact with the systems of the estate agent, the solicitor and a building society for instance. Given the stress associated with house moving this approach might be valuable both economically and socially.

At the same time, the online world has provided a boost to people researching their family history. The creation of a digital agent might make the user aware of possible services which they hadn't thought of, such as war service records and open up the public records in novel ways.

Many of these facilities will be developed by the private sector. How these services might be developed and supported for the public and voluntary services needs to be considered. The Open source community is a model which may be appropriate for some of these developments. A community of online genealogists may well provide tools for fellow enthusiasts.

Whether and how Government should intervene is not yet clear.

Chapter 7

Private sector services

The private sector is leading in the adoption of Web 2.0 technologies and adopting practices from successful social networking sites such as Facebook to change the way that it interacts with its customers.

Many ecommerce sites use the accessibility features of the Web Access Initiative to open up digital channels to customers with disabilities.

As ecommerce has largely just become commerce for many of the population, the areas of experimentation have moved to V-Commerce or Virtual Commerce.

A well known example of this new potential approach is Second Life.¹² (In second life, a user can create a 3D software character, known as an avatar to represent them in a virtual world.)

Many companies have set up islands within Second Life. There are examples of virtual shopping malls in which the user can shop for real goods which will be delivered in the real world. Whether this will be a niche application or a major phase in the next generation of retail is not yet understood.

These rich media 3D worlds may be hard for people with visual impairments to navigate. With an ageing population and the number of people with some degree of visual impairment, research may be needed to ensure that if this approach takes off that design features in the virtual world or viable alternatives are available to ensure that we do not create new classes of exclusion.

A key challenge for the private sector is to build payment solutions for the ecommerce world for those today unbanked and without credit cards. If those not online today are to benefit from e-commerce then payment solutions such as cash top up cards which command the confidence of the users will be crucial to widening the uptake of e-commerce.

One area which is in development within the private sector is new solutions for the fulfilment of e-commerce. The physical delivery of goods, especially at Christmas, is a challenge for the digital world. Improving confidence in this area may well lower the barriers for those groups who are not yet comfortable with ordering goods online.

¹² www.secondlife.com

The changing way in which consumers buy and consume music, and increasingly video, has been disruptive for the whole supply chain. The business model innovation surrounding the Apple iPod and MP3 players have moved a large chunk of commerce from physical goods to digital downloads, and from physical retail stores to websites. There may well be lessons for other sectors other than the media on how business model innovation might make digitally delivered services more attractive to the wider population.

Finally, many countries have established targets to ensure that the design of physical and virtual goods take into account the ageing of the population, the changing demographics in terms of language and culture to ensure that devices and services are designed to include the widest possible sectors of society.

The UK as a major exporter of design in many sectors of the economy could be a major beneficiary of this emerging challenge if industry and design educators can ensure that the new generation of designers are fully open to the possibilities of digital services. In this, the potential for both economic and social benefits could be significant.

Chapter 8

Public sector services

While many of the technology issues are being driven by the private sector, the government has a number of key challenges where its actions will have significant impact on the wider uptake of the benefits of digital technologies.

First, the public sector is a major source of information. The Power of Information review has provided a comprehensive panorama of the potential for opening up government information.

The adoption of Web 2.0 approaches by government would allow private and voluntary sectors to take feeds from government sources and create mashups with their own information sources. The ability for organisations to personalise information for specific communities means that government does not have to do it all. Many community groups could become more self sufficient in their information needs by bottom-up activity.

Of course, government needs to consider how and where it might need to intervene if public information was abused to the harm of the community. An area of concern might be health information, where confidence in the reliability of information is essential. How health information from public sources could be exploited to reach hard to use communities while ensuring safety will be important to many of those groups currently excluded.

The second area is in the creation of digital only services. HMRC plans to withdraw some non electronic channels in 2011 to maximise its efficiency. NHS Choices is a growing portal of information for the public and clinicians to assist in patient choice.

In some cases digital channels will complement existing channels while elsewhere there may be a withdrawal from existing channels to the public and business.

In considering these options, the roles of UKOnline Centres, Public Libraries, Citizens Advice Bureaus and Post Offices for those without home access to digital interactive services will be central to ensuring that existing divides do not widen.

For instance today over 300 UKOnline centres have access to NHS Choices as part of their core programme.

We have previously mentioned Second Life as a virtual world. Alongside the private sector use of virtual life, there are public sector approaches which exploit these virtual worlds. In

education, for example, the Serious Games Institute at Coventry University¹³ is researching public sector uses of virtual worlds, V-Government. They have their own virtual lecture theatre, so that they can run conferences at the institute which can be attended in parallel by avatars in Second Life.

Finally, the UK is a rich source of cultural information in our museums, galleries and archives. For many people, access to these resources through digital channels can be a motivator to getting online.

The digital channels open up access to resources from major institutions like the British Library, but also small and specialist museums to a wider public than possible in the physical galleries.

The digital world offers interactive possibilities that go beyond what a traditional museum could deliver. An example of this is British Library's "Turning the Pages"¹⁴ which enables the user to interact with some of the great treasures of the Library. Many major collections contain far more artefacts than they are able to display. We also have an increasing body of digital only resources such as photography collections.

The availability of local information is one of the factors that motivate some sectors of the community to become engaged with the digital world. It is here that national bodies can work with community groups to enrich content. The British Library's National Archive of newspapers at Colindale has digitised over 3 million pages of national regional and local newspapers.

The Digital Preservation Coalition¹⁵ including among its members the British Library, the National Archives and The Council for Museums, Archives and Libraries (MLA) is leading widespread work to understand the needs for digital preservation, the technical standards to underpin the work and promote best practice. The UK has much strength in cultural preservation which is important to this new work.

Some sectors of the private sector will undoubtedly benefit from this work where they have needs for long term data storage, such as the insurance sector.

The Creative Archive Group including the BBC Channel 4 and the BFI¹⁶ is leading work to open up the cultural archives and establish clear licensing regimes for exploiting their digital content. These regimes are simpler for the user to understand so that fear over accidental piracy can be addressed.

¹³ see <http://www.seriousgamesinstitute.co.uk/>

¹⁴ <http://www.bl.uk/onlinegallery/ttp/tpbooks.html>

¹⁵ <http://www.dpconline.org/graphics/>

¹⁶ http://creativearchive.bbc.co.uk/archives/creative_archive_licence_group/index.html

Chapter 9

Third sector services

A major challenge for the third sector, recognised by the Office of the Third Sector, is the capacity to innovate. It is funding an innovation exchange for the third sector to address this issue.¹⁷

While there are some good examples of charitable and social enterprise exploitation of the digital world, lack of resources and skills are often cited as holding back the potential of the third sector to fully engage in the delivery of digital services.

One example in Health is Patient Opinion. Patient Opinion was founded by Paul Hodgkin, a GP who wanted to find a way to make the wisdom of patients available to the NHS.

With Patient Opinion, patients and carers can find out what other people think of local hospitals, hospices and mental health services. Many people share the story of what happened to them or their family when they were ill. The aim of Patient Opinion is that patients and carers can feedback in their own words, based on what the service was like and share ideas about how it could be better.

The interaction between public and third sector services is important in achieving the full potential for those currently not served by the digital world. Many third sector bodies are trusted by some of the vulnerable and hard to reach groups not yet online. The opening up of public sector information along with skill and capacity building in the third sector provides a route for community groups to tailor information from public and private sources along with their own information to create relevant and targeted services. This partnership approach has the potential to increase the relevance of digital services to those excluded today. It also may allow community groups to be self-supporting and increasingly autonomous in meeting their own information needs.

¹⁷ http://www.innovation.gov.uk/innovation_exchange/

Chapter 10

Actions for tackling inequality

The outline above provides a background to the technology developments of the next few years and their use to create relevant and useful services to support economic goals alongside digital inclusion.

There are a number of areas where consideration should be given to actions which can support digital inclusion.

1. The Caio review, alongside the work of the Broadband Stakeholder Group (BSG) are leading on the UK's broadband infrastructure. While fibre to the home is considered for new construction work and increased wireless penetration will make the UK infrastructure pervasive, some rural and remote communities may be unable to access these infrastructures economically. Mesh networks, for instance, may be an approach which could serve these communities and provide higher speed access closer to that available in urban areas. There may also be potential to pilot location-based services for both public and private sectors to understand what the demand for these services may be.
2. What may make the digital infrastructure increasingly useful and economic for the widest possible sector of the population is the stimulation of innovative products and services based on new classes of user devices. The example of the South Korean diabetes watch illustrates the type of socially beneficial innovation here. Developments in smart metering would be another example.
3. In infrastructure services there seems to be limited need for intervention. Payment services for the unbanked and those without credit cards would be a development that can support improved digital inclusion. Some consideration should be given for Research on the social dimensions of the digital world. One example of the need for this is research at UCL's Centre for Publishing which has shown that people over 55 get 70 per cent zero returns on searches, much higher than for younger groups. It is not clear why this should be.
4. In personal services today there are many features in hardware and software products which can lower the barriers to inclusion for those with disabilities. The UK in education has many innovations in this space. These innovations have much wider applicability to society and the economy. How the current capabilities could be further exploited would stimulate further work to improve accessibility in future products and services.

5. The increasing adoption of Web 2.0 approaches by the public sector, alongside the opening up of public information can help stimulate private and third sector activities to target groups currently not benefiting from digital technologies.
6. The private sector exploitation of the digital infrastructure needs little intervention. The stimulation of business model innovation for sectors outside the media may be helped by awareness raising campaigns alongside the technology innovation strands. Confidence in e-commerce fulfilment is being addressed by new approaches. This will in time lower the barrier for those who have yet to buy or bank online for instance.
7. The voluntary and third sectors have good examples of the use of digital world. The opening up of public information alongside skill and capacity developments, such as the Innovation Exchange for the Third Sector can help make the digital technologies more relevant and useful to those not currently exploiting them. It also provides an important route for enabling communities to become self-supporting and autonomous in meeting their information needs.

