

Picture of Now Research 2006: Pervasive Computing

Full Research Report: Pervasive Computing (2 of 3)

WP2.2 Business Modelling

Deliverable 2.2.1

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Abstract (for dissemination)	<p>This report looks at one of the key aspects of the project: pervasive technologies. We wanted to look at the current state of these technologies to:</p> <ul style="list-style-type: none"> • Explore the components that provide some support for ubiquitous services • Identify the current barriers for using these components to support mass participation <p>The study is one of the three core elements of the project 'participation, pervasive and environment'. Each section has been written to be of value on its own though many of the themes recur.</p>
Key Words	Pervasive computing, environment, mass participation, market research, trends, mobile, internet

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About this report

This report looks at one of the key aspects of the project: pervasive technologies. We wanted to look at the current state of these technologies to:

- Explore the components that provide some support for ubiquitous services
- Identify the current barriers for using these components to support mass participation

The study is one of the three core elements of the project 'participation, pervasive and environment'. Each section has been written to be of value on its own though many of the themes recur.

The report is organised as follows:

- Report 1 covers mass participation
- Report 2 looks at pervasive computing (this document)
- Report 3 reviews environmental projects

Aims of this research

Participate explores convergence in pervasive, online and broadcast media to create new kinds of mass-participatory events in which a broad cross-section of the public contributes to, as well as accesses, contextual content - on the move, in public places, at school and at home.

Participate is a three year collaborative Research and Development project, supported through the Technology Programme with grant funding from the Department of Trade and Industry (DTI) and the Engineering and Physical Sciences Research Council (EPSRC).

Our consortium blends expertise in online services, pervasive computing, broadcast media, sensors, event design and management, and education. Our partners are BT, Microsoft Research Cambridge, BBC, Blast Theory, ScienceScope, University of Nottingham and the University of Bath.

For more information on Participate please visit:

<http://www.participateonline.co.uk/>

For more information on the Technology Programme and EPSRC please visit:

http://www.dti.gov.uk/innovation/techprioritiesuk/about_the_programme/index.html

<http://www.epsrc.ac.uk/>

The three pillars of Participate are:

- Mass participation
- Pervasive computing
- Environment

Why should you read this document?

This report and accompanying web resources has been produced to provide a 'picture of now' of activity for 2006 in this area. It aims to inform the project and act as a starting point for anyone starting out in a similar area. It looks at issues of technology, design and content in previous work. We were particularly interested in identifying the barriers to 'going mass'.

This is not however a detailed technical document. For technical information we recommend IEEE Pervasive Computing (www.computer.org/pervasive) or (www.ubicomp.org) as international centres of excellence.

Nor is it a business review of current / future pervasive services. We expect to deliver those findings as we progress as part of one of the work packages.

This study is part of three activities around WP2 Methods & Modelling.

- **Study 1: User Research - Understanding user motivations in participation – due September 2006**
- **Study 2: 'Picture of Now 2006' - Mass participation, pervasive computing & environment (this report)**
- **Study 3: 'Foresight analysis of Participate project' – Phase 1 interviews and analysis – due October 2006.**

Participate expects to publish updates to this research periodically for the duration of the project.

Methodology

We investigated over a hundred projects and services relevant to at least one of the key aspects listed above. All involved some level of user participation and use of technology, though these couldn't necessarily be described as 'mass participation' or 'pervasive computing'. Relatively few had explicitly environmental concerns though in many cases 'locatedness'¹ was important.

Selected projects were identified by the Participate partners initially. Other projects were identified from other recommendations and by desk research of marketing material, academic work, industry analysis, commentary and speculation on various good, bad or just plain ugly websites. For those services which are run commercially, it was often difficult to access detailed information.

Many people contributed their knowledge and gave access to their projects to the creation of this report and they are listed in the credits. There is also a separate appendix document that gives a brief overview of each of the 120+ projects and services we investigated.

Some questions to ask yourself as you read this document are:

- What are the other 'pervasive' or 'ubiquitous' technologies in 2006?
- What will 'mass' mean in an on demand / long tail world?
- What is participation in the environment?
- Are there other barriers we haven't mentioned?

A small disclaimer

There is a great deal of current development in our three areas of interest and we have no doubt missed many more examples.

We make no apology for any incompleteness but encourage you to add to our public conversation on the subject at www.participateonline.co.uk

We hope the results are useful and stimulate more activity in these exciting areas.

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Produced by BBC Research & Innovation for Participate

¹ Users' absolute or relative location in some way affects their experience

1 The state of things

The picture conjured up by 'pervasive' or 'ubiquitous' computing is one of seamless networks where everything talks to everything else. The terms are generally used interchangeably, though pervasiveness seems to imply an embeddedness that ubiquity does not. So we might say that internet access is ubiquitous whereas mobile devices are pervasive.²

Adam Greenfield's definition of the pervasive computing-enabled experience he calls 'everyware'³:

"It involves a diverse ecology of devices and platforms, most of which have nothing to do with "computers" as we've understood them. It's a distributed phenomenon: the power and meaning we ascribe to it are more a property of the network than of any single node, and that network is effectively invisible. It permeates places and pursuits that we've never before thought of in technical terms. And it is something that happens out here in the world, amid the bustle, the traffic, the lattes, and gossip: a social activity shaped by and in its turn shaping, our relationships with the people around us."

We're not yet at the stage envisioned here. It seems we're at least ten years away from widespread use of technologies like Wireless Sensor Networks.⁴ Yet to quote William Gibson: *"The future is already here; it's just unevenly distributed."*

We will briefly consider current profusion of consumer digital technologies; the internet, mobile devices, television and other elements that may support a 'pervasive' future.

1.1 Internet at home

A significant proportion of UK has become accustomed to increasingly ubiquitous access to networked resources. The worldwide web – one of the internet 'killer apps' – is just fifteen years old. Howard Rheingold's 'Virtual Communities' from 1994 doesn't even mention it. But to someone of twenty it's always been there.

- **69%** of UK adults used the internet at least once in Q1 2006⁵
- **73%** of internet users access the internet daily or several times a week⁶
- **43%** of UK homes had broadband connections by end Q1 2006 (an increase of over 10% since end 2005)⁷

Not surprisingly, usage is **lowest** among older people and **highest** among young people. Less than 20% of those aged 65+ had used the internet in the last three months compared to over 80% aged 16-24 (Feb 2006).⁸

- **84%** of those earning £37,500 or more a year were 'current users' of the internet compared with only 29% of those earning less than £12,500 (2005).⁹

The proportion of online homes with broadband connections is now 73% (June 2006) up from 54.4% the previous year. This increase is partly due to a price war among providers.¹⁰ Package deals, such as

² <http://www.futurelab.org.uk/viewpoint/art71.htm> last accessed 25 September 2006

³ Greenfield, Adam (2006) Everyware: The dawning age of ubiquitous computing, New Riders, pg 16

⁴ http://www.globalwatchservice.com/StaticPages/DisplayDocument.aspx?DID=1035824&url=http%3a%2f%2fwww.oti.globalwatchonline.com%2fonline_pdfs%2f36494MR.pdf last accessed 19 October 2006

⁵ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 169

⁶ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 169

⁷ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 145

⁸ <http://www.citizenonline.org.uk/statistics> last accessed 26 August 2006

⁹ http://www.oii.ox.ac.uk/research/oxis/oxis_20050520.pdf last accessed 26 August 2006

¹⁰ <http://news.bbc.co.uk/1/hi/business/5278856.stm> last accessed 26 August 2006

TalkTalk's 'free broadband forever' offer subscribers substantial savings on internet connections and calls from landlines.¹¹

There are many publicly available studies that explore issues around internet use in the home in detail so we will not focus heavily on it. The Ofcom report "The Communications Market 2006" contains much useful information. Two other good sources are the Oxford Internet Surveys (OxIS)¹² and the Pew Internet and American Life Project.¹³

1.2 Mobile devices

The big development in pervasive technology over the last eight years is the near universal ownership of mobile phones.

- 85% of the UK population own a mobile phone
- The average handset is used for only 18 months¹⁴
- 84% of UK mobile users send at least one SMS message a month
- 22% of have voted as part of a TV or radio programme (e.g. Big Brother) via SMS in quarter ended January 2006 – far higher than in US or Germany¹⁵

Mobile industry revenues grew by 9.7% year on year to £13.1 billion, while traditional landline revenue fell by 7.5% to £10.1 billion.¹⁶

Mobile operator subscriber numbers are:¹⁷

- O2 (including 1 million Tesco subscribers) – 17 million
- T-Mobile (including 4.3 million Virgin subscribers) – 15.3 million
- Orange – 14.9 million
- Vodafone – 14.8 million
- '3' – 3.5 million

Retail revenues are:¹⁸

- Vodafone - £3.7 billion
- O2 - £3.3 billion
- Orange - £2.1 billion
- T-Mobile - £2.2 billion
- '3' - £0.9 billion

Voice calls and texting remain the most common uses of mobiles. The number of SMS messages sent annually in the UK in April 2006 was up 40% since 2005 (and up over 130% from 2004) to a current figure of over 100 million messages sent daily.¹⁹

However, there's also been a huge increase in phones that can play music and take photos:

¹¹ <http://www.talktalk.co.uk> last accessed 26 August 2006

¹² <http://www.oii.ox.ac.uk/research/project.cfm?id=8> last accessed 26 August 2006

¹³ <http://www.pewinternet.org/> last accessed 26 August 2006

¹⁴ <http://technology.timesonline.co.uk/article/0,,19510-2189680.html> last accessed 26 August 2006

¹⁵ <http://www.techworld.com/mobility/news/index.cfm?NewsID=5515> last accessed 26 August 2006

¹⁶ http://www.ofcom.org.uk/media/news/2006/08/nr_20060810 last accessed 26 August 2006

¹⁷ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 151

¹⁸ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 152

¹⁹ http://www.text.it/mediacentre/sms_figures.cfm last accessed 26 August 2006

- Nearly **51%** of mobile users across UK, US, France and Germany have a camera phone²⁰
- Nearly **30%** of UK mobile users sent picture messages at least monthly²¹
- Over **80%** of camera phone owners take at least one photo a month²²
- Nearly **20%** of UK mobile users listen to music on their phones daily or weekly (July 2005)²³

1.2.1 Mobile Internet

Most mobile customers now potentially have some kind of internet access from their mobiles, mainly using GPRS or slower WAP connections.

After spending large amounts on securing licences to set up third generation (3G) networks, mobile carriers are hoping to convert their customers to the new higher bandwidth services. Their early efforts to recoup costs concentrated on getting business laptop users to use the 3G networks for internet access. There's now more focus on encouraging internet access from consumer mobile handsets, e.g. many operators launched mobile TV services in 2005. There are over **4.5 million** 3G subscriptions in the UK (Q4 2005)²⁴

UK mobile carriers are also moving away from 'walled gardens' and now offer access to the open internet. Estimates vary considerably on how many people are actually using the mobile internet:

- **6%** of UK adults access the internet via a portable device²⁵
- **11%** of UK users have browsed the web using a mobile (May 2006)²⁶
- **15%** of UK users browsed news and information at least monthly on their mobiles (based on quarter ended June 2006)²⁷
- **27%** of UK users have surfed the web using a mobile (August 2006)²⁸

The differences may be explained by lack of clarity about what respondents mean by 'surfing the web'. Some people may realise that downloading a ringtone via WAP is actually using the internet, others may think only using a mobile web browser counts.

Other UK monthly mobile usage figures based on the quarter ended June 2006²⁹ include:

- **6.6%** of subscribers used personal email
- **5.7%** purchased a ring tone
- **4.3%** downloaded a mobile game
- **4.1%** used mobile Instant Messenger
- **2.2%** purchased wallpaper or screensaver

²⁰ <http://www.mmetrics.com/press/PressRelease.aspx?article=20060807-photo-messaging>
last accessed 26 August 2006

²¹ <http://www.mmetrics.com/press/PressRelease.aspx?article=20060807-photo-messaging>
last accessed 26 August 2006

²² <http://mmaglobal.com/modules/wfsection/article.php?articleid=445> last accessed 26 August 2006

²³ http://www.breakingnewsblog.com/mp3players/archives/worldwide_use_of_music_on_cell_phones_gaining_wide_acceptance last accessed 26 August 2006

²⁴ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> last accessed 26 August 2006

²⁵ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 170

²⁶ http://www.netimperative.com/2006/05/10/Mobile_Internet last accessed 11 August 2006

²⁷ <http://www.mmetrics.com/press/PressRelease.aspx?article=20060807-photo-messaging>
last accessed 11 August 2006

²⁸ <http://mobhappy.com/blog/1/2006/08/09/is-the-wap-glass-14-full-or-34-empty/>
last accessed 11 August 2006

²⁹ <http://www.mmetrics.com/press/PressRelease.aspx?article=20060807-photo-messaging>
last accessed 11 August 2006

Interestingly, many of these figures are a decrease on previous usage – particularly those involving purchasing or downloading.

The barriers to adoption are typically based on cost (the perceived lack of clarity on paying per byte of content) and poor user experience (interface and navigation issues). We will discuss these further below.

1.2.2 Bluetooth

“Bluetooth, [is] a short-range wireless communication technology aimed at replacing the use of cables for connecting mobile and/or fixed devices such as mobile phones, headsets, MP3 players, printers and PDAs.”³⁰

Bluetooth is now available in significant number of new handsets:

- 40% of UK phones are expected to have Bluetooth by the end of 2006³¹.

The primary market push for bluetooth has been around the sale of hands-free units. However, there has also been some adoption of bluetooth as a peer to peer network, particularly by younger users.

At present, there appear to be few, if any, ways to access internet services via Bluetooth. However we are seeing companies appear offering ‘bluecasting’ services, typically for marketing and advertising in public spaces.³² Reliable figures for actual use of these functions are hard to find but in they’re probably very low. Few people leave ‘discoverable’ Bluetooth connections on, though the numbers of people using it to exchange files with peers is likely to be much higher.

Current barriers to use appear to be: concerns over security, lack of awareness of its functionality and poor user experience. The main advantage of Bluetooth over, say SMS, is that peer-to-peer communication is free.

1.3 Wifi and Wimax

Wifi describes a wireless standard operating in unlicensed frequencies. Users can connect to an access point (within about 100m) in a wireless local area network (WLAN) and access the internet if the point is a ‘hotspot’ i.e. has internet connectivity³³. Wifi enabled devices such as games consoles can also connect directly to each other to form ad hoc peer to peer networks – usually within smaller ranges of around 30m. Wimax also describes a wireless standard that provides higher bandwidth than wifi and is thought to be more suitable for creating mesh networks.³⁴

Meanwhile, wireless networks are becoming common in homes and offices. Wireless hotspots provide internet access in more and more public places – usually for a price or to encourage customers to linger in cafes. Particularly in the US, university campuses and municipal authorities are creating larger areas of continuous wi-fi coverage. Access is often free to the end-user.

- The number of UK hotspots almost doubled between June 2005 and June 2006 to 14,600³⁵
- Milton Keynes will soon launch the country's first wireless city-wide WiMax network³⁶
- Operators have plans for large-scale wireless networks in many other cities³⁷

³⁰<http://www.ofcom.org.uk/research/cm/cm06/overview.pdf> page 45

³¹<http://news.bbc.co.uk/1/hi/business/4966118.stm> last accessed 26 August 2006

³²<http://www.bluecasting.com/> last accessed 29 August 2006

³³<http://www.ofcom.org.uk/research/cm/cm06/overview.pdf> pages 44-45

³⁴<http://en.wikipedia.org/wiki/Wimax> last accessed 26 August 2006

³⁵http://www.ofcom.org.uk/media/news/2006/08/nr_20060810 last accessed 26 August 2006

³⁶http://www.theregister.co.uk/2006/08/21/pipex_miltonkeynes_wimax_wireless/ last accessed 26 August 2006

Once the infrastructure is in place, there is potential for offering services other than just internet access. From summer 2006, Houston Texas will use wi-fi to manage its parking meters. As the system develops, users will be able to pay using their mobile phones. New Yorker Rob Kelley is compiling a list of uses for city-wide wi-fi networks.³⁸

Wi-fi coverage in the UK tends to be much patchier. However, there are efforts to build community shared wi-fi networks:

- The UK's largest community free wireless network has recently launched in areas within a 4km radius of Norwich city centre³⁹

The village of Wray in Lancashire finally got broadband via a mesh network set up collaboratively by the community itself and several local organisations including Lancaster University.⁴⁰

In 2006 Spanish company FON launched in the UK. Users can get cheap wireless routers in exchange for making their broadband connections available to other 'foneros'. (At the time of writing this would appear to breach the terms and conditions under which most ISPs offer broadband to their customers and we have been unable to ascertain take-up by consumers.)

Most wireless-enabled devices are laptops and PDAs. However, devices like ordinary mobile phones and mobile game consoles increasingly have wi-fi capabilities. For example, SONY PSP and Nintendo DS consoles are capable of forming ad hoc wifi networks with other players up to around 30m apart.

1.4 Television

It's easy to forget about broadcast media but access is truly ubiquitous and must be considered as part of the mix for ubiquitous services. The original Stapler concept, for example, included capturing and viewing content via TV though that was not implemented in the final BT Collect London Zoo trial.

TV is increasingly a digital medium:

- 30% of homes have switched entirely to digital TV⁴¹
- 72.5% have multichannel on their main sets⁴²
- 7 million homes have no access to digital TV⁴³

Television is often considered a passive medium⁴⁴ but it has become more interactive with the migration to digital services over last 8 years. Pressing the red button adds extra channels and functionality and with 'upstream' capability offered by services like Sky+ can even be used for tv-commerce services like gambling.

The distinctions between TV and online media are starting to blur. Organisations like the BBC are starting to broadcast live over the web and the BBC's new iPlayer will make programmes available for a limited period after the initial broadcast.

Meanwhile, TV is becoming more 'on demand'. Subscribers to Sky+ (personal video recorder service) increased 46% in the twelve months to Q1 2006 to 1.4 million⁴⁵. There are also new devices such as

³⁷ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 133

³⁸ <http://nycwireless.net/MuniNetworkApps> last accessed 9 August 2006

³⁹ <http://news.zdnet.co.uk/communications/0.39020336.39280291.00.htm> last accessed 26 August 2006

⁴⁰ <http://www.newswireless.net/index.cfm/article/2349> last accessed 29 August 2006

⁴¹ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 185

⁴² <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 197

⁴³ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 197

⁴⁴ Though as commentators like Brenda Laurel and Richard Harper might point out, this reputation for passivity is unfair. TV provides shared experiences, stimulates interaction between viewers and builds communities around programmes like Doctor Who and Eastenders.

⁴⁵ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 189

the Slingbox that allows people to programme their media devices and access content on them over the internet while they're away from home.⁴⁶ Services like Homechoice and the imminent BT Vision deliver enhanced 'on demand' services to TV over IP.

Of course, this ubiquity might not always be desirable as the following quote shows:

It is increasingly possible to travel around the globe and yet feel you have never left home. The blandness of some hotel chains that makes Ontario no different from Bratislava has been true in radio for sometime, but now the same has spread to television, aided and abetted by the Slingbox that is able to bring your choice of media from your front room across the world to your PC⁴⁷.

In the long-term, it might not matter much. TV reach among younger audiences is falling:

- down 2.5% among 25-34 year olds in 2005
- down 2.9% among 16-24 year olds in 2005

This is hardly a surprise when much of the traditional role of TV is now done better online. What is the role for broadcast in an 'on demand' age? Will there be a difference – production values aside – between the BBC and YouTube as a supplier of content?

The barriers Ofcom identifies to wide uptake of IPTV are mainly infrastructural: to do with bandwidth limitations or digital rights. However, the authors also raise an interesting user experience issue. We just are in a different frame of mind when watching TV screen than when using a computer and we set up our "viewing environments" differently to match.⁴⁸

The point about "viewing experience" and the following quote suggest why there will continue to be a role for broadcast. Interestingly, the quote is from 2006 and it is by one of the digerati Jane McGonigal (pervasive game pioneer and theorist):

Kiyash and I are cancelling our NetFlix service. No time, and I've always been more of a TV girl myself. I love love love the liveness and imagined community of TV (someone else is watching this right now)... it's why I don't Tivo (yet). Whenever I'm with VCs or entrepreneurs who want to know what to make, I always say IM for live TV. PLEASE!!! I want my buddy list for who's watching what. It would make me feel WAY cooler for having Parental Control on right now if I happened to know that some friends were too. When I first went away to college, I used to make TV dates with my dad... usually Law & Order. We would both watch the show live and then call each other after it was over. Wow, this was going to be a rapidfire list and now I'm sharing my deep personal feelings about TV, which I think now and forever is my most cherished medium and artistic format.⁴⁹

Will broadcast TV live on mainly for communal viewing of live events or 'finished products' on a decent screen?

Kensington Vision, an 18-month community TV/online initiative in Liverpool, gives us some idea of what form distinctive participatory broadcast services could take. Residents could access services online and over set-top boxes.⁵⁰ Participants received production training to make their own video diaries. There were question time sessions with local politicians and the project culminated in the K-Factor talent competition – all broadcast on the website.⁵¹

⁴⁶ <http://www.slingmedia.com/uk/slingbox/> last accessed 15 August 2006

⁴⁷ http://www.broadbandtvnews.com/archive_uk/050506.html last accessed 1 September 2006

⁴⁸ <http://www.ofcom.org.uk/research/cm/cm06/main.pdf> page 115-116

⁴⁹ <http://avantgame.blogspot.com/2006/02/you-d-make-such-exquisite-corpse.html>

last accessed 30 August 2006

⁵⁰ <http://www.merseyside-cis.org.uk/2005/11/29/lessons-from-a-community-technology-project/#more-147>

last accessed 30 August 2006

⁵¹ <http://www.kensingtonvision.org/> last accessed 30 August 2006

1.5 Positioning technologies

Considering technologies beyond connectivity, other technologies of specific interest to Participate are related to identifying a user's position. Location is implicit in both 'pervasive' and 'environment'. There is a wide variety of technology in use to accomplish this and some examples are discussed below.

All positioning methods have some limitations, whether of coverage in different environments, precision, permanence, technical overhead for developers or accessibility to a wide usership. Different factors will determine what's most useful for any given project or service.

1.5.1 Assumption

One simple way of gauging position is just to assume the person is in the intended location when they make contact. Coast Mobile and Yellow Arrow both used this method.

The BBC created twelve audio walks to accompany the Coast series. A phone number was publicised at various points along the walk. Users calling a number were assumed to be on the walk and they heard a short piece of audio that was very specific to a location.

Counts Media's Yellow Arrows is essentially a toolkit that participants can use for their own purposes (e.g. class teaching, location based gaming or events) as well as contributing to a hosted resource. Each Yellow Arrow sticker displays a unique code. Texting the code to a dedicated number retrieves a message someone else wanted to associate with that place.⁵²

1.5.2 2D datacodes

2D datacodes is an umbrella term covering a variety of different formats e.g. sema codes, QR codes or spotcodes. In Japan 2D datacodes are widely used for requesting information, for instance after reading an ad in a magazine. 60% of new Japanese phones now come with datacode reader software for use with the phone's camera.⁵³ Users take pictures of the code glyph, the software interprets the image and sends the appropriate request for more information.

Reader software isn't usually pre-installed in UK phones but it can be downloaded. The BBC Collect pilot and BBC Coast⁵⁴ have successfully demonstrated the use of 2D datacodes to aggregate BBC content relevant to the user's location.

Semapedia uses datacodes called to link physical items with relevant Wikipedia entries. Players of US urban hunt game ConQwest identified hidden treasures by their datacodes and submitted images of the codes to prove they had been found.

Datacodes can also be issued to mobile phones. The phone is scanned when the user arrives, replacing the need to collect paper items like marketing coupons or cinema tickets.⁵⁵

1.5.3 GPS

Global Positioning Satellite (GPS) is widely used in Japan and will soon be essentially ubiquitous there: Japanese legislation on emergency location is making GPS a mandatory feature for all new phones from 2007. Most US mobile carriers have also chosen to implement GPS in handsets to comply with FCC emergency services requirements. Phone users can't typically access or share their GPS coordinates directly though it is sometimes possible to enable this function.

⁵² <http://yellowarrow.net/index2.php> last accessed 29 August 2006

⁵³ http://www.smartmobs.com/archive/2006/07/07/gr_code_hyperl.html last accessed 9 August 2006

⁵⁴ <http://www.hpl.hp.com/techreports/2006/HPL-2006-120.html?mtxs=rss-hpl-tr>

last accessed 15 September 2005

⁵⁵ <http://www.mobiga.com/> last accessed 19 October 2006

In Europe, where mobile cell ID is used for emergency services, GPS has been less widely used. Handheld receivers have been available for some time and are used in activities like Geocaching.⁵⁶ However, this has been a niche market to date.

GPS-based navigation systems are now becoming increasingly common in UK cars. TomTom, the European market leader, has also released versions for PDAs and mobile phones (though these usually need an additional hardware component to receive GPS)⁵⁷.

- Integrated GPS sales in Europe/Africa/Middle East (EMEA) increased by nearly 97% from Q2 2005 to Q2 2006⁵⁸

It's a sign of the growing importance of GPS in the UK, that the Ordnance Survey has remapped its digital assets to use latitude/longitude and moved away from its own National Grid coordinate system.⁵⁹

It is worth noting that GPS coverage can be poor indoors and in urban environments with tall buildings. GPS precision is not very granular – so a user may not experience any changes to what they see or hear even if they have moved quite a distance.

Despite these disadvantages, the Mobile Bristol initiative⁶⁰ successfully developed many GPS-enabled located media applications (aka 'mediascapes') such as Savannah, Queen Square Riots and CitiTag. Hewlett-Packard, one of the Mobile Bristol partners, continues to use GPS with new proprietary versions of the mediascape authoring system.

The Webpark consortium also used GPS to create location-sensitive guides to Swiss national parks and the commercial spin-off company Camineo is now marketing the system.⁶¹

1.5.4 Mobile Cell ID

Cell ID can also be used for positioning though cells boundaries are unstable and the dimensions vary, so overall precision is less good than for GPS.

Most UK mobile carriers (apart from 3) have 'location enabled' their networks so the position data is available commercially. There are, however, restrictions on who can access this data and for what purpose: the vast majority of organisations and phone users don't have direct access to the data (with the exception of Nokia series 60 phones). Instead, access is via trusted service providers.

BBC Springwatch used cell ID information (via service provider MX Telecom) to automatically log the locations of users submitting observations by phone.

1.5.5 Wi-fi triangulation

The basic position can be found by knowing a user is within range of a base station of some sort e.g. a wi-fi hotspot. More accurate positions can be calculated using triangulation (i.e. using three such points).

Wi-fi triangulation was used by the BBC for a recreation of the Battle of Culloden. The software was developed as an internal project and installed temporarily on off-the-shelf hardware for use on the actual battlefield.

The US company Skyhook has developed a commercial Wireless Positioning System (WPS). Skyhook maintains a database of wi-fi hotspots. The database is kept up to date by employing people to drive

⁵⁶ <http://www.geocaching.com/> last accessed 29 August 2006

⁵⁷ <http://www.tomtom.com/> last accessed 29 August 2006

⁵⁸ <http://www.canalys.com/pr/2006/r2006081.htm> last accessed 29 August 2006

⁵⁹ <http://www.edparsons.com/?p=221> last accessed 10 August 2006

⁶⁰ <http://www.mobilebristol.co.uk> last accessed 29 August 2006

⁶¹ <http://www.webparkservices.info/> last accessed 29 August 2006

around cities looking for hotspots.⁶² The WPS is used by the Loki application to provide content that's automatically relevant to the user's location e.g. search for local services and information like weather and traffic.⁶³

Intel's Placelab system uses the known positions of several types of base station (phone masts, Bluetooth stations and wi-fi hotspots) to provide more accurate positioning than any single method would afford.⁶⁴

1.5.6 RFID and NFC

Connectivity technologies that can also be used for positioning are Radio Frequency Identification (RFID) and the shorter-range derivative Near Field Communications (NFC). Use of RFID and NFC tags using are widespread in Japan, Hong Kong and South Korea. The systems are also becoming more common in Europe and the US. Most current uses are in areas like stock control, tracking freight or in smart cards like London's Oyster card.

For example, Hong Kong's Octopus card works using a form of RFID to pay for public transport but also serves as a debit card of sorts. It can be used to pay for goods in convenience stores, for making calls from phone boxes or even to pay for haircuts.

There's a lot of industry commitment to use of NFC for payments. RFID and NFC usually require dedicated cards and readers but this may be a passing phase. The Octopus chip for example has been integrated into watches and in at least one type of Nokia phone.

RFID and NFC tags usually move and are scanned by stationary readers (in contrast to 2D datacodes). But there are now phones that contain readers. Again, Nokia has released an add-on 'NFC shell' for its 3220 phone but these RFID and NFC readers are hardware-based which puts them at a disadvantage over software-based 2D datacode readers.

There are security issues since it has been found that the tags can be hacked. There's also a lot of concern about privacy issues as and when the use of RFID / NFC tags becomes commonplace and possibly even mandatory.⁶⁵

1.6 More information

The following resources may be useful to people wanting more information on locating and positioning technologies:

1. Roussos, G (2002) Location Sensing Technologies and Applications. Available online at: http://www.jisc.ac.uk/uploaded_documents/tsw_02-08.pdf
2. Radianse Inc. (2003) Indoor Positioning Systems in Healthcare: A Basic Overview of Technologies. Available online at http://www.cimit.org/pubs/jps_in_healthcare.pdf
3. Pondering Primate (blog about datacodes and other physical/virtual world connections) <http://theponderingprimate.blogspot.com/>
4. Touch (blog about applications and implications of RFID and NFC) <http://www.nearfield.org/>

Finally, consider **Figure P.1 Level of end-user technology** on the following page. The following diagram shows how well-established the technology used by various activities is:

⁶² http://news.com.com/W_i-Fi+used+for+location+services/2100-7351_3-5754288.html

last accessed 29 August 2006

⁶³ <http://smartspace.squarespace.com/smartspace/2006/4/21/wayfinder-interview-jed-rice-skyhook-wirelessloki.html> last accessed 29 August 2006

⁶⁴ <http://placelab.org/> last accessed 29 August 2006

⁶⁵ <http://www.govtech.net/news/news.php?id=99453> last accessed 29 August 2006

- **Universally accepted:** Cars, TVs, phones, pens
- **Well-established:** Websites, software downloads
- **Emerging:** Datacode readers, mobile software
- **Specialised:** Customised devices, sensors, restricted-software
- **Very specialised with live support:** PDAs for live action, wearables, unique items

To 'go mass', an activity will probably need to use more established technology though it is not impossible to do this using more specialized kit. Over 80 million people have done a tour using AntennaAudio content which usually requires quite specialized devices. However, this is over the course of 25 years and the various museums and sites are seen as the host by participants.

There appears to be a trend towards using better established technology e.g. Blast Theory's latest game Day of the Figurines uses SMS for most of the participation (rather than PDAs in live sessions as in previous games).

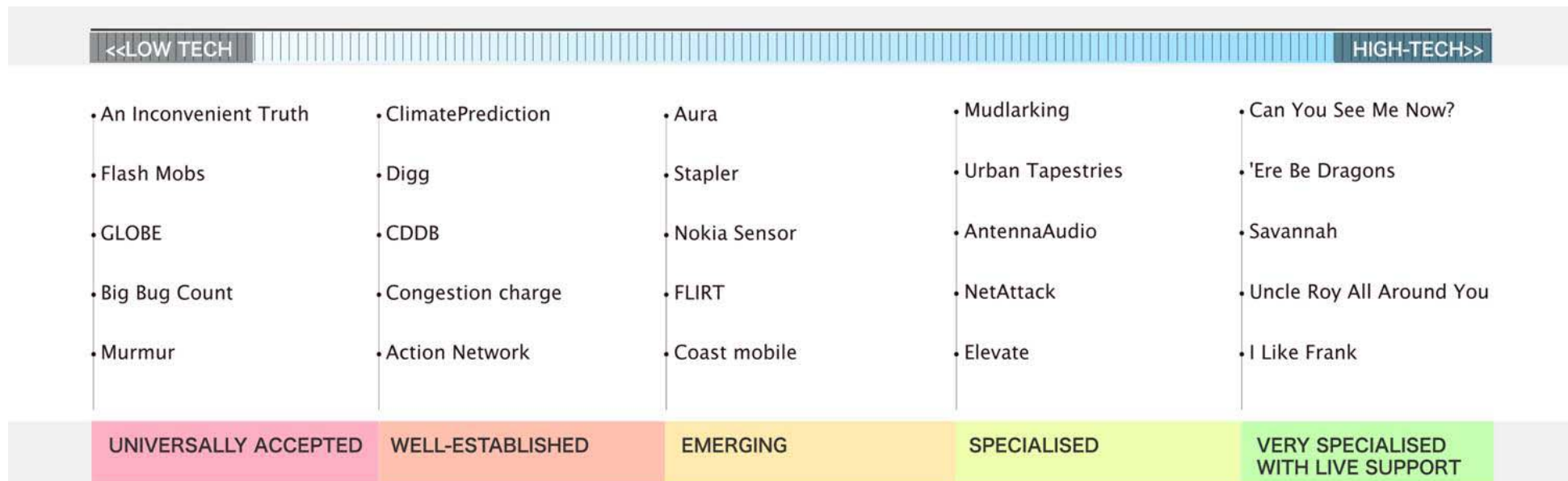


Figure P.1 Level of end-user technology

2 What are the technical barriers to going mass?

There are many reasons why certain technologies and services fail to move from the experimental phase into the mainstream and remain as niche activities. Focusing on pervasive computing, we can look at current technologies to consider the barriers to future adoption.

If we look to Japan as the early adopter of all technologies, it seems only a matter of time before using mobile devices for activities like web surfing becomes completely mainstream in the UK. More people in Japan now use mobile phones than PCs to access the internet.⁶⁶

Why is this? Will we see the same adoption in the UK or are our cultural differences so distinct that the comparison is pointless?

A recent finding suggests that there are some real barriers to more widespread use of the internet using mobile phones. 44% of people in the UK who tried mobile data services for the first time during the 2006 World Cup said they won't be doing it again any time soon.⁶⁷

On the other hand, the current obstacles may be masking real interest in these services:

"I think it's pretty remarkable that WAP has progressed this far and it's certainly not a case of 73% DON'T use it, as most journos have spun the story, but that usage has passed the Innovators, moved through the Early Adopters and sits somewhere in the Early Majority community ... The survey went on to state such bleeding obvious "issues" that people were put off by slow loading sites, poor navigation and the fact that 25% of sites were simply inaccessible via a mobile. For me, the fact that 27% of people persevere and put up with these real issues is the truly remarkable stat."⁶⁸

2.1 Current barriers to using the mobile internet

So what are the issues that make mobile internet unattractive?

2.1.1 Difficulty of initial set up

The first barrier is possibly the hardest to overcome. Just initialising GPRS, Bluetooth or Java can be a complex task. Similarly, if people need to download applications to their phones (e.g. datacode reader software) this is a real barrier to use.

For example, few phones come with GPRS activated and it's often unclear whether people need to contact the phone company or change settings on their handsets to do this. People may not even know if their phone is GPRS-compatible.

Setting up Bluetooth can be equally problematic to new users of Bluetooth services. The team coordinating BBC's Planet Earth 'bluecasting trial' in early 2006 discovered that the wide variety of handsets meant that instructions for getting started vary considerably. This makes it difficult to explain the process to people looking at a located "call to action" – say, on a big screen in a train station.

2.1.2 Cost

Using mobile phones for anything other than chat and texts can be expensive. The actual costs are not necessarily obvious or easy to calculate. Mobile internet access is usually charged by the amount

⁶⁶ <http://www.fiercemobilecontent.com/story/japan-more-mobile-internet-users-than-pc/2006-07-05>
last accessed 11 August 2006

⁶⁷ <http://www.160characters.org/news.php?action=view&nid=2070> last accessed July 27 2006

⁶⁸ <http://mobhappy.com/blog1/2006/08/09/is-the-wap-glass-14-full-or-34-empty/>
last accessed 11 August 2006

downloaded which can be very costly for rich media content. (The sample figure given by BBC Mobile is £2 per MB downloaded⁶⁹)

Organisations like the BBC will not ask licence fee payers to spend further large amounts to participate. The BBC's anecdotal experience with services like BBC Bitesize java version for mobile confirms that that any extra cost is a real barrier to participation especially for young people.

High cost was the single biggest reason cited by UK users who tried mobile content for the first time during the World Cup and who said they would not use these services again.

This is a particular problem for ongoing services. If people don't know in advance how long it'll cost to use a service they are reluctant to try it. One of the key reasons the Japanese mobile game Mogi didn't take off, was the unpredictability of costs due to lack of unlimited data plans.⁷⁰

Very few people in the UK are on unlimited data plans which are mainly aimed at business users and are typically expensive. The recent price reduction of T-Mobile's Web-n-Walk – an unlimited use open internet access add-on – for £7.50 a month might change the landscape considerably.

2.1.3 Appeal of products & services

For adults at least, phones are primarily for communication. The limited range of content sites available to date simply hasn't appealed. There are now moves to address this, and email and Instant Messaging applications are seen as some of the most promising for taking mobile networking mainstream. In Japan, some of the most popular mobile internet applications are those classed as Mobile Social Software (MoSoSo).⁷¹

The T-Mobile Web-n-Walk offer explicitly promotes the aspect of unlimited email access. The 3G carrier 3 is linking up with companies like Yahoo! to provide IM and other services. Bluetooth-based messaging application Mobiluck claims over 1 million users worldwide (though the vast majority are using the free version). There's a host of similar applications such as Nokia Sensor, Streethive and uLocate.

This isn't really participation in the sense the project wishes to explore but it does prove the point raised before: people are willing to go to some trouble for functions that genuinely interest them.

Some of the best-known web 2.0 services⁷² are also expanding into the mobile arena. New applications like ShoZu make it easy to upload images to photo sites like Flickr. In the US (where the 'walled gardens' seem alive and well) MySpace wants to have its mobile applications pre-installed by the big mobile operators by 2007.⁷³

Finally, and most obviously, if users are spending money on mobile services they expect to get good value. It seems current offerings are often not good enough. There's certainly some evidence that the mobile games industry at least isn't producing compelling wares.⁷⁴

Overall, it is important and obvious to remember that mobile services are different from internet or television services. People simply use mobile content differently and 'snacking' is far more common. Tracks and clips currently work better on mobiles than albums or long programmes. This can be seen as an intolerable compromise of integrity or an exciting creative challenge.⁷⁵

⁶⁹ <http://www.bbc.co.uk/mobile/web/faq.shtml#q4> last accessed 11 August 2006

⁷⁰ http://www.akebonobashi.net/Ubicomp2005_Mogi.ppt#34 last accessed 29 August 2006

⁷¹ <http://www.s5w.com/News/GPS-Red-Herring.html> last 19 October 2006

⁷² <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html>

last accessed 26 August 2006

⁷³ http://www.businessweek.com/technology/content/may2006/tc20060530_170086.htm?campaign_id=rss_tech last accessed 11 August 2007

⁷⁴ http://www.marketwire.com/mw/release_html_b1?release_id=126397 last accessed 29 August 2006

⁷⁵ <http://www.activemediatech.com/Business%20world/Businessworld.htm> last accessed 29 August 2006

Mobile operator 3 is rising to the challenge. Its SeeMeTV service had 4 million downloads of thirty-second videos created by its subscribers in less than five months. Creators get a small slice of the download revenues which earned them £100,000 in total by March 2006. The initial popularity means 3 is now expanding the service.⁷⁶

2.1.4 User experience

A huge 75% of mobile phone users who request more information about a product and are sent a message with a call to action never follow it through.⁷⁷ There are many reasons why this might be the case but poor user experience is certainly one of them.

Partly because of the devices' small sizes, it's often much less apparent what's going on. The user needs to navigate complex menus. Similar functions, e.g. text messages and service messages, are often accessed via completely different menu options. Applications can be interrupted by incoming calls or text messages.

Where equipment is on loan (e.g. the PDAs used by BT's Elevate or the Blast Theory games) it's possible to address this – usually by reducing the options so there's very little scope for a user to go wrong. However, this isn't usually viable on a large scale. (See figure 9)

A recent BBC news article suggests one way forward for mobile interfaces. Since different types of navigation work for different functions (e.g. iPod's clickwheel, a phone's numberpad, a PDA's touchscreen) then users and applications should be able to flip between them depending on what's most appropriate to the task at hand.⁷⁸

People surfing the web on a desktop machine do not normally need to remember URLs or create bookmarks: they know it will be easy to find the information again. This isn't the case with mobile devices. One of the main reasons for low use of the mobile devices to submit species sightings to BBC Springwatch was that users simply needed to remember too much information. We have already said that browsing on mobiles is difficult. Mobile search is also a problem though this looks likely to be addressed in the near future.⁷⁹

There's some imaginative thinking on future applications for voice recognition⁸⁰ and currently some interest in voice searches on mobiles.⁸¹ But maybe, as Mobhappy suggests, this is just old-school thinking.⁸² On the face of it, voice recognition seems highly suitable for personal devices that users carry with them and that have already been trained to recognise their owner's voices. Very few of the projects and services we looked at used voice recognition. Why is this?

Nor did we find much activity on gestural interfaces and orientation though BT Elevate abandoned use of a digital compass because of technical problems with the device. There is work underway in this area. A new Japanese mobile service uses direction as well as position to download relevant information to a phone.⁸³ Research at City University indicates that using orientation adds interesting dimensions to the user experience: much more granular changes in orientation than position can be registered, which in turn means quicker updates to what a user sees or hears with the technology are possible.

⁷⁶ <http://www.three.co.uk/news/h3qnews/pressnewsview.omp?collcid=1019745742912&cid=1141636528184&index=8> last accessed 29 August 2006

⁷⁷ <http://mobhappy.com/blog/1/2006/07/10/what-a-waste/> last accessed 8 August 2006

⁷⁸ http://news.bbc.co.uk/1/hi/programmes/click_online/5244584.stm last accessed 11 August 2006

⁷⁹ <http://mobhappy.com/blog/1/2006/06/06/battle-lines-drawn-up-for-mobile-search/> last accessed 29 August 2006

⁸⁰ http://future.wikia.com/wiki/Speech_recognition last accessed 29 August 2006

⁸¹ http://www.technologyreview.com/read_article.aspx?id=16725&ch=infotech

last accessed 29 August 2006

⁸² <http://mobhappy.com/blog/1/2006/08/11/voice-based-mobile-search/> last accessed 29 August 2006

⁸³ <http://mobhappy.com/blog/1/2006/07/04/the-mobile-is-a-virtual-mouse/> last accessed 29 August 2006

Other developments are underway to tackle issues around mobile interfaces. Embedding mini projectors in phones for example, would increase display size.⁸⁴

2.1.5 Development costs and testing

The other significant barrier to providing services for mobile devices is the variety of different platforms in use. In consequence, the time and money needed to develop for mobiles is far greater than developing for the desktop-based environment.

Many of the projects we looked at were technical trials that used a very limited range of user devices and these were usually provided for participants. The limited trials were often very successful but scaling up to reach the diverse range of end-user devices owned by the potential participants is an entirely different matter.

It's not just the initial release that will be more expensive. One of the hallmark features of many successful web 2.0 services is the rapid identification of what elements are working well and feeding this back into the development cycle very rapidly. The more versions that need to be maintained, the more difficult this will be.

In time, increasing standardisation on Java might help, but even mobile Java isn't genuinely device-independent. At least seven versions of an application must be developed to cover a reasonable range of handsets.

Alternatively, web browsers may become the dominant way of accessing online services from mobiles (as they are in the desktop environment).

Another issue that affects development costs is rights. For broadcasters like the BBC, it should be possible to repackage existing material to some extent. However, for content like music, rights for mobile are usually negotiated differently from internet or broadcast rights. Depending on the production methods the entire soundtrack may be lost if the music can't be removed separately.

2.1.6 Ongoing support

Many projects we investigated needed ongoing coordination and technical expertise to run them successfully. This was particularly true where participation was at very specific times and places e.g. in scheduled sessions. Examples include Savannah, Uncle Roy All Around Me or BT Elevate.

Again, this is a barrier to scaling up – numbers will be limited if the original project team is always needed. BT Elevate overcame this using a partnership with a local SME called Clicks and Links⁸⁵ who took over the coordination and training role so the trials could continue without BT's direct involvement.

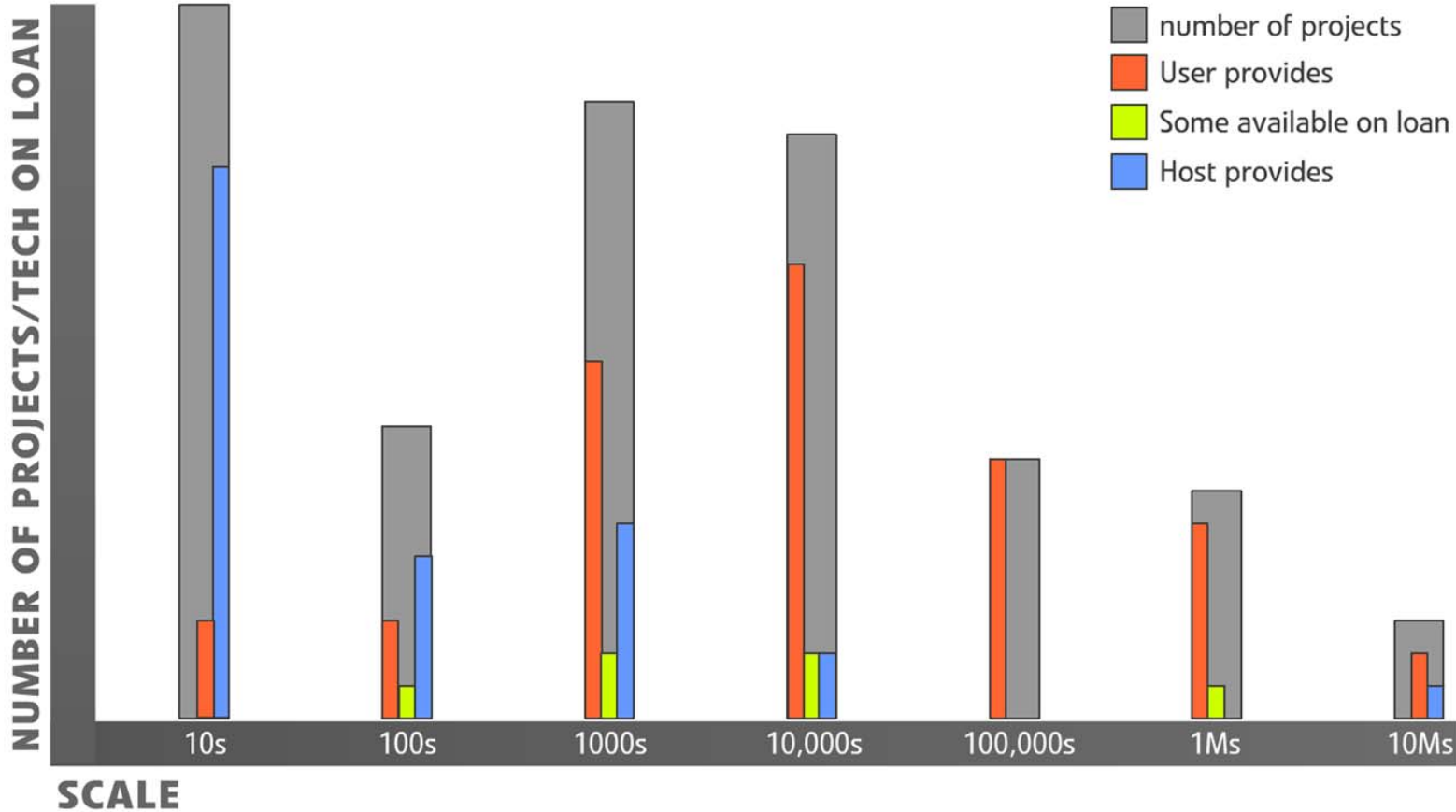
Finally consider **Figure P.2: Who provides end-user technology?** On the following page. At very small scales, it's possible to provide the technology that participants need. BT Elevate, Ambient Wood and Bio-mapping are all examples where the small numbers of participants were lent the devices they needed to take part.

It is generally much easier to scale up if participants use technology they already own, though again AntennaAudio is an interesting exception.

⁸⁴ http://www.wired.com/news/technology/0,70942-0.html?tw=wn_index_1 last accessed 29 August 2006

⁸⁵ <http://www.clicksandlinks.com> last accessed 29 August 2006

WHO PROVIDES END-USER TECHNOLOGY?



3 Where are things going?

3.1 Convergence and seamlessness

3.1.1 The future is bright...

Although it's disheartening if 44% of first-time users say they will not use mobile services again, that still leaves 56% who might. New services using mobile seem to be gaining critical mass. So overall optimism seems justified.

However, the direction in which mobile devices and networks are heading is uncertain at the moment.

3.1.2 Devices

In many ways, there seems to be a trend towards mobile phones replacing standalone devices like mp3 players and digital cameras. Nokia describes itself as "the world's largest manufacturer of digital music players" and has recently bought a music download company.⁸⁶

On the other hand, there's a buoyant markets for the new mobile games consoles.⁸⁷ Sony has released a new device called the 'mylo' that uses wi-fi and Skype instead of mobile networks (though this is available in the US only where wi-fi networks are more pervasive)⁸⁸. There's also evidence suggesting that many people are using multiple handsets.⁸⁹

High-end phones by manufacturers like Nokia appear to be mutating back into computers and come with wi-fi and even Voice over IP (VoIP) clients or podcasting applications. Sales of 'smart phones' by Nokia and like Blackberry and Palm were up 55% in Q1 2006 from the previous year.⁹⁰

But there's also a trend towards 'back to basics' phones which appeal to older people.⁹¹

Another developing area is feedback on sports performance. This sort of technology doesn't have to be prohibitively expensive. Nike and Apple have created the Nike+iPod Sport Kit which gives users realtime analysis of their running performance.⁹² Users can also upload their data to monitor improvement and challenge friends to beat their times.⁹³

3.1.3 Networks

Similarly, it's not clear how much of a threat wi-fi is to the mobile carriers but some telcos are hedging their bets. BT has released a hybrid phone which uses a broadband connection for VoIP calls and switches to the mobile networks once out of range.⁹⁴ T-Mobile in the UK has banned use of VoIP by its customers but may be planning to make a proprietary VoIP service available.⁹⁵

⁸⁶ http://www.reghardware.co.uk/2006/08/08/nokia_buys_loudeye/ last accessed 29 August 2006

⁸⁷ <http://news.bbc.co.uk/1/hi/business/5209346.stm> last accessed 29 August 2006

⁸⁸ <http://news.bbc.co.uk/1/hi/technology/5255236.stm> last accessed 29 August 2006

⁸⁹ <http://technology.timesonline.co.uk/article/0,,19510-2189680.html> last accessed 29 August 2006

⁹⁰ http://www.theregister.co.uk/2006/04/28/smart_mobile_sales_skyrocket/ last accessed 29 August 2006

⁹¹ http://www.springwise.com/telecom/mobile/phone_for_boomers_their_parent/

last accessed 29 August 2006

⁹² <http://ptech.wsj.com/archive/solution-20060719.html> last accessed 26 August 2006

⁹³ <http://www.nike.com/nikeplus/#overview> last accessed 26 August 2006

⁹⁴ <http://www.btfusionorder.bt.com/> last accessed 29 August 2006

⁹⁵ http://news.zdnet.co.uk/communications/3qgprs/0_39020339_39267682_00.htm

last accessed 29 August 2006

3.1.4 Ubiquity

Another of the suggested hallmarks of 'web 2.0' services is that they're designed for use with more than one type of device.⁹⁶ However, as Mogi analyst Ben Joffe noted, "ubiquity does not necessarily mean the same service on all devices".⁹⁷

We've seen that the lack of standards is a particular barrier to extending ubiquity to mobile devices. Ideally, the mobile aspects of a service should be more than simply a "bolt-on".⁹⁸

Mobile as a medium has its own distinctive opportunities and limitations and these are still being explored.⁹⁹

Overall, we need standards and skills to provide appropriate levels of access to the same services using different devices. This will be for technical reasons (such as display, bandwidth) and because the device being used will represent different user needs and contexts.

Some of these needs may map to the different roles and levels of engagement we examined in the Mass Participation section. For example, the Blast Theory games often rely on online players using computers who direct (or misdirect) street players using mobile devices.

In other situations mobile may indicate less rather than more commitment - 98% of mobile gamers play while doing something else.¹⁰⁰ Computer-based gaming, in contrast, is seen as more "hardcore".¹⁰¹ Broadcast media seem more passive but also more communal.

Ultimately, what will be the distinctive properties of different devices and media?

3.2 Going mass

The projects we have looked at prove that many interesting mobile applications are currently possible. The more advanced kit is not in the hands of many users yet so much of the activity is very small scale. This may all be about to change, though the technical landscape is still very fragmented. This uncertainty presents real issue for Participate. If we really want to 'go mass' we need to aim for devices people already own.

There have also been interesting uses of well understood mobile functions in areas as diverse as political activism and marketing. Projects and services like Yellow Arrow, Dodgeball (MoSoSo) and Botfighters (mobile game) have used a combination of SMS messaging and host websites very successfully. In the latest game Day of the Figurines, Participate partner Blast Theory has moved away from using technology that demands high levels of coordination and technical support.

So a key issue for Participate will be whether to:

- Use really established tools.
- Hope that some technical front runners will become apparent in the near future.
- Layer the experience so that people with lower tech devices can still participate but owners of the latest kit can do more interesting things.

⁹⁶ http://www.oreillynet.com/pub/a/oreilly/tim/articles/architecture_of_participation.html

last accessed 1 September 2006

⁹⁷ http://www.akebonobashi.net/Ubicomp2005_Mogi.ppt#35 last accessed 29 August 2006

⁹⁸ http://www.trendcatching.com/2006/03/mobile_social_s.html last accessed 29 August 2006

⁹⁹ <http://www.newpolitics.net/reports/media/mobile-media/NPI-Mobile-Media-Report.pdf>

last accessed 29 August 2006

¹⁰⁰ <http://www.futurelab.org.uk/research/conference/10conf01.htm> last accessed 29 August 2006

¹⁰¹ <http://news.bbc.co.uk/1/hi/technology/4151431.stm> last accessed 1 September 2006

4 Food for Thought

We've raised several issues around the current state of pervasive computing and how things might develop. If you want to explore any of these further there are many useful sources available. We hope the following questions and resources act as a useful starting point.

4.1 Aperitifs

- Are we heading towards convergence on a single mobile device?
- How do we design for different levels of technology?
- Is the 'everyware' scenario really on the horizon?

4.2 Digestifs

- Smartmobs (blog about mobile technology and crowds) www.smartmobs.com
- Ofcom (2006) "The Communications Market 2006" Available online at <http://www.ofcom.org.uk/research/cm/cm06/>
The report is a comprehensive overview of the current state of UK communications technology and markets and likely developments.
- Adam Greenfield (2006) "Everyware: The dawning age of ubiquitous computing", New Riders

4.3 Post-prandial exercises

- Submit a species observation by SMS for the next series of Springwatch
- Capture a 2D datacode and request information
- Go geocaching

5 Credits

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ABOUT PARTICIPATE

Participate explores convergence in pervasive, online and broadcast media to create new kinds of mass-participatory events in which a broad cross-section of the public contributes to, as well as accesses, contextual content - on the move, in public places, at school and at home.

Participate is a three year collaborative Research and Development project, supported through the Technology Programme with grant funding from the Department of Trade and Industry (DTI) and the Engineering and Physical Sciences Research Council (EPSRC).

Our consortium blends expertise in online services, pervasive computing, broadcast media, sensors, event design and management, and education. Our partners are BT, Microsoft Research Cambridge, BBC, Blast Theory, ScienceScope, University of Nottingham and the University of Bath.

For more information on Participate please visit:

<http://www.participateonline.co.uk/>

For more information on the Technology Programme and EPSRC please visit:

http://www.dti.gov.uk/innovation/techprioritiesuk/about_the_programme/index.html

<http://www.epsrc.ac.uk/>

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