Using current social science research in the development of future mobile technology

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1. Introduction

There is a huge amount of technical research and business investment in wireless and mobile technology that could be the basis of future systems available to the public. The current generation of mass market technology is primarily supports one-to-one voice calls and simple messaging. New technologies becoming available – WLAN, and 3G cellular systems most notably, offer the capability of many more services – from mobile internet, through video messaging to wireless gaming. Mobile Digital television and radio will arrive within 2 years. Departing from the traditional mobile phone, the number of devices that can be used wirelessly is also the subject of considerable innovation – with PDAs, smart phones, tablet PCs, wireless game terminals etc. However there are still many uncertainties about who, how and where these services may be used, and what infrastructures and technologies will be built to provide them.

This paper is based on research as part of a technical research project , FLOWS, aimed at creating a sophisticated technical integration of a range of wireless systems on a single terminal. The engineers need models and scenarios for use of this technology that are based on research on existing use of mobile telephones, computers and other ICTs. A method was developed to make this existing research relevant to the engineers , and in the process develop a framework for imagining future users, patterns of use and appropriation.

These convergence terminals are part an essential part of the vision of convergent network systems that is very powerful within the telecommunications and IT industries. Interoperability of different networks, Radio LAN, UMTS, DVB, fixed wireless and 4th generation radio access networks being the dominant, is seen as a way of exploiting the different characteristics of each technology: their bandwidth, mobility characteristics, quality of service, coverage etc. All communication and 'content' could potentially be carried over all radio access networks with an IP core network using common protocols. Full network interconnection on the model of GSM and the Internet should bring huge benefits from 'network externalities'. 'Integration' terminals that can connect to several different radio networks are a fundamental part of a number of technical visions, such as 'always best connection' when the most appropriate connection is chosen depending on availability, price and use, or simultaneous use, the FLOWS concept, where several radio networks are used at the same time.

However it is not just a matter of technical possibilities: this convergence could be used in the realisation of two dominant industry visions: the mobile internet vision and the 'rich voice' wireless world vision, being driven by the IT industry (predominantly US-centred) and the mobile telephony industry (European +Japan) respectively. The social shaping at the level of regulation and industry strategy is discussed in other FLOWS research (Deliverable D12). This shows how these competitive pressures and alternative visions are shaping future wireless, and the challenges faced in bringing them together. For example linking on one terminal, services based on mobile telephony and licenced spectrum on one hand, and the internet and licenced-exempt bands on the other, let alone broadcast-based services. Very important is the battle to control, configure and brand the terminal, between operators, vendors, content service providers and even software platform firms. This challenge is all the more difficult given a climate of uncertainty over what people might actually want to pay for, corporate debt, changes in spectrum regulation, new technologies, and a general desire of corporate and mass market customers to control, if not reduce costs.

Current research is focusing on intermediate and end user studies of newer wireless devices with a domestication and social shaping methodology. This research raises many questions about the convergence trajectory, which the technology project is part of, but also highlights how it raises important avenues for appropriation by user and industrial constituencies that could radically shape the wireless future.

This paper is primarily about developing tools to use social science research as inputs to specific scenarios that engineers will use to test and design a specific technical configuration. This configuration assumes a range of WLAN, UMTS and GSM services which will be available under particular physical, user and business circumstances. The scenarios must therefore imagine a world not too different to today's in which we are expected to have and to use a greater range of wireless connected devices and services, and highlight everyday situations that would test this technology in various ways.

2. Some Definitions

Communication in this field is hindered by different terminologies amongst various specialist groups, especially where the same term (especially service, application, scenario and user) has different meanings for different groups There is no immediate prospect of aligning these usages, which are deeply embedded within the expert communities (for example of telecommunications engineers, computer scientists, social scientists). To aid clarity and communication in the FLOWS project, we have developed and defined a number of more specific terms. The definitions are not intended to be exhaustive, and are presented to offer some consistency in an area beset by very broad and often competing uses of the terminology. Of particular difficulty, as [UMTS02] points out and fails fully to deal with, are the terms service and application, which we hope to have dealt with successfully.

We propose three terms that reflect the specific needs of FLOWS and the development of user and service scenarios: Application Domain, Application Package and Data Application. These definitions make it easier to distinguish what is being discussed, and link user and market based definitions to technical definitions.

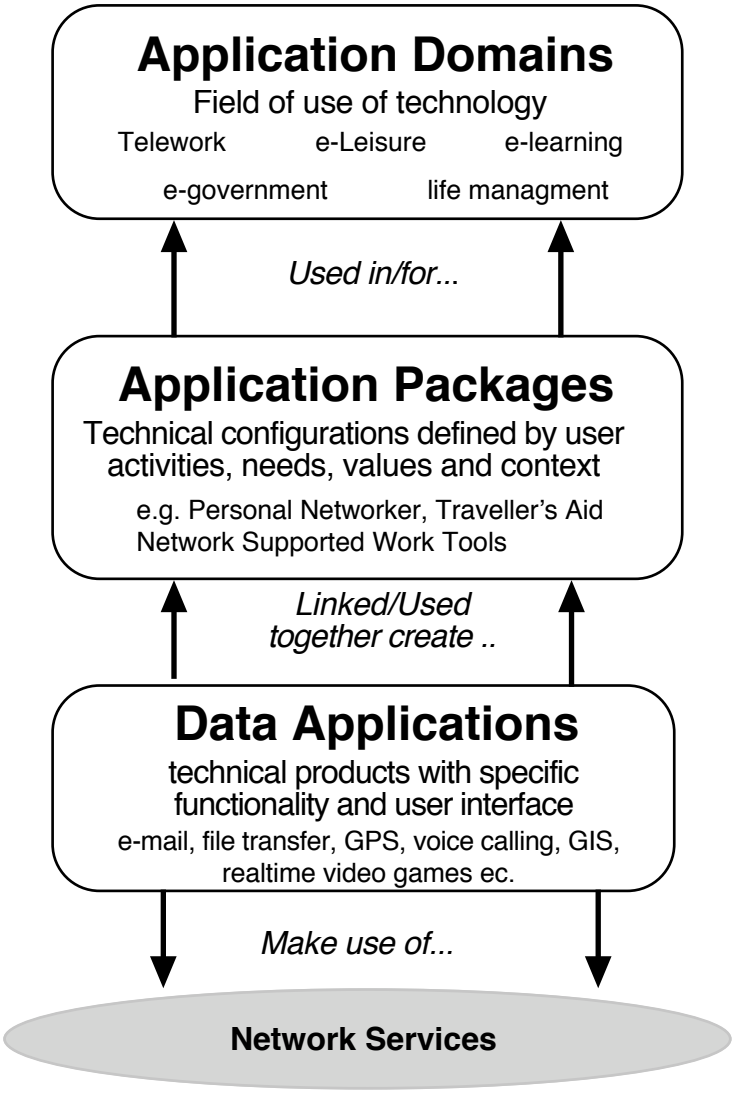

Figure 2-1 Three Definitions of Application

2.1. Application Domain

The term Application Domain links a domain of activities such as education and learning, shopping/retail, leisure, community participation (the "what"), with the enabling technologies or processes that is the "how" (for instance 'e-', 'tele-'), creating applications such as "e-learning". Applications understood in this sense then follow those presented in the EC IST Beyond 3G Cluster Report [B3G02]. When we create analyses and scenarios of business and use, we can use the general term application referring to what people are using the technology for. The classes of application that we refer to in this case depend on the type of analysis we are making; for example, they can be grouped according to functional activities or market sector: e-learning, teleworking, e-leisure; or according to cognitive and social use: belonging, control, intimacy etc.

2.2. Data Applications

Before defining Application Packages, we define Data Applications. These distinguish specific data or information handling applications based on use of computing and communication services, from more general 'user' based applications domains, based on activities that user are engaged in, as just defined.

Data Applications have a much narrower function or specification, both from a technical and end-user points of view, and are used to support a range of user activities. A Data Application is a combination of software and hardware that directly interacts with a user, and are thus defined from a user point of view and a data processing perspective. There description is

essentially *functional.* Data Applications that we are familiar with include e-mail, word processing, FTP, Web browsing, short messaging, voice telephony, P2P messaging, GPS, video on demand etc. There are many more specialist Data Applications designed for particular industries, including mobile surveillance, urban guidance, tourist guides, parcel tracking, etc. [VeCo01]. These Data Applications generate particular demands on service infrastructure, utilising *one of more types of network services*.

Network Data Applications generally require technology installed in the users' device and that of their correspondent in the case of telephony, or application service provider (e.g. e-mail accounts, on-line banking, file server). In telephony and Internet provision, the network service providers generally provide only basic applications, such as voice mail or e-mail (and SMS) servers. All other applications are accessed on third party providers' technology, using the user's device.

The Data Applications that we are familiar with are being reshaped in meaning over time and with technical changes. For example, e-mail can be implemented in different ways, and to the end user, appear to merge with multimedia messaging. A web browser can be used to read e-mail, and the sending and downloading of larger and larger attachments means that it is as much about large file transfer as short message reading. Many specialist applications are increasingly based on the combinations of a limited set of 'standard' Data Applications [WiSt01] using common standards. The way we define a Data Application is very much related to current practice and available technology. As these change our perception of basic data functions changes too. What is at one time a peripheral Data Application, seen as subsection of another application, may become in term a dominant or standard application and vice verse. It is well worth spending some time considering what are the basic underlying data transfer operations associated with existing and perhaps future applications.

For this project, Data Applications are defined not only in general terms of what they provide for the user, but more importantly in strictly limited terms that enable simulations of use to be made in the other FLOWS Work Packages. The quantitative description of each Data Application is often a theoretical model, rather than an empirically derived, statistical model. This is particularly so, since we are dealing with future uses of applications that are largely unknown. What FLOWS has elected to do is to select a small number of well-known applications that represent a sufficient range of demands on network services to be a useful model.

2.3. Application Packages

As well as the meanings of Application Domain and Data Application, we have another use of the word 'application', that refers to how people use a combination of a number of Data Applications together with various network and content services. This combination or package is optimised, or at least suitable, to support activities within an Application Domain, i.e. reflect specific user requirements. We call these groups of Data Applications, *Application Packages***.** In other words, Application Packages use a number of Data Applications to undertake particular tasks, or to support particular activities, relationships, etc., that are identified in the user scenarios and research on the environment of use. An Application Package has a description based on what someone uses a device and service product for and the symbolic meaning they give it. It has a much richer description than the functional description given to a Data Application.

The concept of the Application Package is important when the actual Data Applications that may be available in the future are in some degree uncertain. Application Packages are identified from a user perspective [CoAf01], [Coo02], [HiPu01]. They describe what a user wants from a technology, and the role it plays in their everyday life. The concept is critical in the development of intelligent systems [CoAf01], on which the user can set preferences and establish a profile leading to greater personalisation. The names that are given to them reflect what they do from the users perspective, not from the perspective of the types of data exchanged: e.g. a City Survival Kit describes how many people use their mobile phone today, a use that can certainly be enhance considerably with new technology.

Any device is likely to contain a number of different Data Applications that could be configured together in different ways to produce different packages, e.g. a single device could be used for tele-working, maintaining family intimacy, and media consumption. The existence of

different packages or configurations on that device reflects distinct and separated roles in a person's life [Nipp95] **Error! Reference source not found.**. However we increasingly see packages that enable people to integrate different parts of their life together.

Applications Packages can be strictly defined by application providers and controllers, or shaped by users responding to pricing, quality of service, etc with particular patterns of use. We are familiar with attempts by technology producers to link together a number Data Applications into a single package, but also recognise that standards based interfaces (e.g. web browser, operating system desktop), enable users to configure their own package of Data Applications.

Application Packages are generally supported by a 'matching' *service product* that provides all the Network Services and management that that package requires. However, a user may not find a suitable product from any one supplier, so will buy or obtain several. The value added by the application and device producers is in creating a product that can manage, and switch between the Service Products of the different network suppliers (e.g. UMTS from one supplier and HIPERLAN/2 from another).

3. The Socio-Technical Approach

The basis of technology studies analysis of technology is the idea of the "socio-technical'. Devices, Services and Applications are not just technical, but socio-technical constructs embodied in infrastructure investment, devices, service agreements, business models, and use conditions. The availability and development of technologies are not based solely on what is possible, but what people and organizations decide to make possible [WiSt01] [WiEd96].

An example from mobile telephony is the GSM phone service. The user does not simply buy a device to use voice telephony, but needs access to a range of technologies, services, commercial contracts, social norms, legal rights and restrictions, etc. The service package is:

Service product:

- Wireless voice + connection service + location service
- Network coverage
- Service agreement
- Payment method/agreement
- Time/price/minutes/subsidy
- Roaming agreements
- Wireless device operation license
- Customer Support services

Application Package:

- Phone Device
- Charger + electricity
- Net services - e.g. divert, voicemail, mailbox (Network Data Applications)
- Subsidy – related to integration with Service product
- Insurance for loss or damage

Use context

- Social rules on use of mobile phones (location, topics, sharing, messaging etc)
- Bill-payers rules on use (e.g. parents, corporate)
- Personal usage patterns and meanings (rules, reliance, habits etc)

The particular package shapes how the application is used by the by user, e.g. constant calling, emergency calling, SMS dominating over voice calls, always having the phone on etc,

and whether it is suitable to the application domains they are using it within, and the Application Packages that they use Another example of a social-technical definition of a service/application is *Internet access.* Although we have a common understanding of what this is, it is actually a range of possibilities: a set of possible network services based on a service agreement: pricing, allowed times of use, maximum bandwidth availability, quality of service or particular sub-services, allowed access locations and devices, various network services (mailboxes, caches, content filtering or digital rights or censored content, firewalls etc.). It is therefore important to define precisely a range of factors, even when using an apparently neutral term.

Any new application, service or device has to be analyzed within a socio-technical framework. This means user scenarios are socio-technical, describing not only social and personal activities, but also interaction with the physical world and the world of machines.

3.1. Analysing users' activities and applications

FLOWS D01 suggests a number of different dimensions to understanding users, including concepts such as role, behaviour and community. Studies of wireless technologies and of other information and communication technologies have yielded many different ways to view users, and the way they use technologies. This includes why they use them, how they use them, the motivations and problems they have, etc. Recent collections on use of mobiles include [BrGr01] [KaAa02]. One of the problems with looking at the future is that it has not happened yet. There are relatively few studies on the users of mobiles, but we do have access to research on how people live their lives and work together, which change much more slowly that the technology, so provide us with a good grounding for speculation. Here are a few of the different groups of concepts that can be used to understand the use of ICTs and will be explored more in WP7

- Education, work, entertainment, shopping (selling), communication (Traditional Application Domains)
- Information seeking, browsing, access, communication, transactions, media consumption, play (Information activities)
- Knowledge, Communication, Service, Play, Verification
- Immediacy, Intimacy, Flexibility, Freedom (closeness of human relations)
- Belonging, Playing, Coping, Survival, Balancing, Delivery, Control, Freedom
- Time saving, Time - wasting, Time filling (related to time use).
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The development of quality research and useful scenarios relies on bringing together a range of disparate perspectives: in this case the analysis of the application and use of technologies is greatly strengthened by using multiple frameworks. Later stages of the FLOWS research will include a literature review of the use of wireless ICTs, contextualised within the broader research on ICTs. For the development of the User Scenarios for D6, these concepts will be applied and developed in a basic format.

4. The Context Perspective Framework

There are many ways of looking at the users and usages of technologies, and of mobile or wireless technologies in particular. We can generate categories based on what people use particular devices and applications for, what particular communities of users use technologies for, particular Application Packages, the places that wireless technologies are used etc. Users can be individuals, but also organisations that provide individuals with wireless technology, and the suppliers of technology infrastructure. However the role of this document is to go beyond a person-centred approach, and try and describe the context of use of telecommunications services. This entails describing the locations of use, and the devices and application software use to access them. This approach draws on the sociological,

ethnographical, cultural and geographical study of ICTs in general and mobiles in particular [KaAa02] [LiSø97] [LiBo99] [HaGo01] [G0Me98] [GrMa96], business/design literature on mobile futures [UMT00a] [UMT00b] [ErNo01] [Cook02] [CoAf01] [deEi01] [Wo01] [UMTS01] [UMTS02] [Lehn01] and technical descriptions, mostly from FLOWS Deliverable D01.

We define a Context Perspective Framework that structures the bringing together of material for the creation of user scenarios. This approach reflects a number of different analytic perspectives on ICT use, and the needs of this project. Within this framework we use four perspectives: **Location, People, Device** and **Application Package**. For each perspective a number of characteristics are developed, relevant to the characterisation of services, i.e. in relation to geographic space, number of users, Data Applications, demand for services, quality of service expected etc. Much of the quantitative data for this has already been prepared in FLOWS D01. Within each perspective we develop a number of examples or *context scenarios* identifying relevant characteristics. This provides us with a framework not only to understand service requirements, but also to develop further in-depth user analysis. In particular this framework can be used to develop *user scenarios* based on individual users, relevant to the design of particular applications and interfaces, *market scenarios* of groups of users in a particular location, job, lifestyle, etc, relevant to public policy or market sector, and lastly *Service Provision Scenarios* used to model the location and traffic generated within a particular location. Any user scenario will draw on the context scenarios of a particular user, in a particular place, with a particular device using a particular Application Package. While the context scenarios given here are rather general, in constructing the user and service scenarios, decisions have to be made to specify a particular version of each location, device, package and user.

The context perspectives are not mutually exclusive: users move through particular locations, using particular applications packages, Application Packages are used by a range of different users, and locations are inhabited by a range of different users. This overlap enables us to strengthen the different scenarios by cross-referencing, and also helps generate a large range of possible user scenarios more easily.

In order to identify the characteristics of the various network services, a Data Application (e.g. video streaming) is chosen and the information about where, how and who by can be found easily from the table in this documents, showing the range and constraints of possible uses of the application and the services needed to support it.

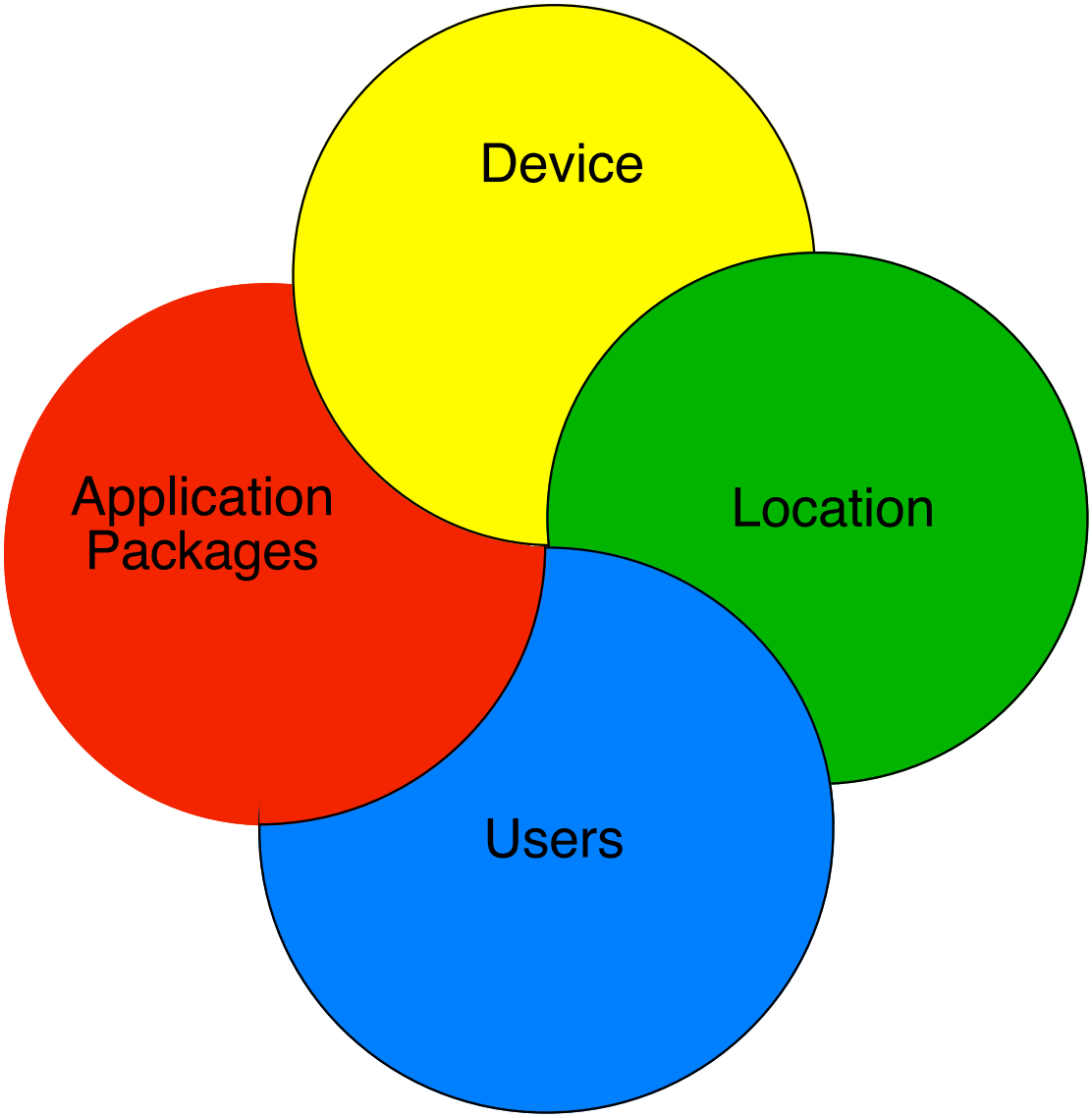

Figure 4-1 Context Perspective Framework

4.1. Location Perspective

A key dimension to the use of mobile and wireless services is the location where they are used. Mobile technology opens up many new spaces to the use of ICTs, and this perspective highlights *particular spaces that people move through and to in the course of activities*, especially those that are by definition related to travel and temporary occupation. The key characteristics of locations are: physical characteristics of the place, number and type of users occupying or passing through the space, time and space distribution of users etc., the applications and services that they use, mobility within the location and limitations, and the infrastructure deployment including cell size. For the social and commercial analysis there are characteristics of control of the space, competition and provision of wireless services, inter-regional and international roaming. Physical descriptions of locations can be obtained from measurements made in studies of radio propagation. Human use of locations is obtained from studies by urban planners and architects, and current wireless use from mobile operating companies.

Examples of locations include airport, railway station, tourist city centre, industrial estates, suburban home, open plan office, school, shopping mall, high street, sports centre or stadium, exhibition centre. It can be extended to rather more restricted spaces such as a car or train too.

FLOWS Deliverable D1 provides a number of reference tables to enable the quantification of locations in terms of topography, geography, and type of wireless cell availability, density and

number of users, and typical use of wireless infrastructure. Appendix A. FLOWS WP2 also provides characterisation of a number of locations where testing will be carried out [LehHof02].

The location perspective forms the basis of the *Service Provision Scenarios*.

4.1.1. Location L2: Shopping Mall

A space located in city centres and suburbs which attracts large numbers of visitors, with varying levels of occupation, depending on time of day, day within the week, and time of year (e.g. seasonal shopping such as Christmas). Shopping malls are perceived as centres of leisure and entertainment and a range of facilities, such as restaurants, cinemas, hairdressers are available in addition to the range of stores. Shopping malls have also become popular teenage hangouts. However some people find them very stressful, and try to spend the minimum time needed shopping. Highly connected mobile devices for consumers are a shopkeeper's nightmare. They enable customers to compare prices, availability and design right in their store.

Physical Characteristics	**Type of users**	**Data Applications**	**Mobility**	**Device**	**Infrastructure**
Indoor open space: with narrow corridors and enclosed shop spaces. Glass, concrete, steel construction Most areas publicly accessible, except for staff only areas (e.g. security control room, staff room, stock rooms, etc…) Outdoor / Indoor space: adjacent areas (e.g. parking, small parks)	Families Teenagers Tourists Other shoppers (young professionals, students) Staff (commercial premises, maintenance, security) Business people	Products information (inc. price, location product within mall and ordering facilities). Bank account access Email MMM News Voice Web browsing Music Games	Walking Browsing Sitting Vehicular (car park)	Basic devices (phone, PDA) Pen size (Ultra portable) Laptop	High provision of infrastructure Public pico and microcell GSM and UMTS, Public WLAN and private WLAN fro shops.

Table 4-1 Location L2 Shopping Mall

4.2. Users/People Perspective

The viewpoint of users, or more correctly people, focuses on the activities, community and resources of individuals or specific groups such as a family, across their entire life-space. It links the high level ideas of life themes and life projects to the everyday management of the life space, performance of activities, consumption and integration into community and organisations. Every individual of course has their own pattern of usage, but we can suggest a number of example types of user around which build a scenario of needs, behaviour, resources, etc. Possible user types include: teenage school child, student on campus, high level travelling business executive, stressed commuter in large city, service engineer, regional sales manager. Users are chosen from a range of people identified in the literature as having particular uses of information and communications, and as being especially 'mobile'. The selection presented offers a heterogeneous range people with different resources, activities

and needs. It tries to balance selection criteria based on traditional demographic factors, lifestyle factors and groups identified in the literature on ICTs and mobile telephony.

The relevant characteristics of the user that we suggest are location, mobility, Application Package application, affordability/resources, flexibility (level of service expectation), including the user profile and devices used. (FLOWS D1, Section 2.3.1. and section 4.1 and 4.2.)

The social and economic themes and characteristics include issues of freedom, independence, control, surveillance, coping, identity, and community.

Example User: Commuter

The suburban commuter uses wireless devices extensively while travelling to and from work during the week, as well as during excursions at the weekend. The offerings of the technology are an essential and integral part of these daily trips, to keep in touch with work and personal network. It also provides distractions from the boredom, stress and routine of travelling, while making useful use of this time. Themes include coping with stress of life, balancing home and work, maintaining personal control and managing family life [GaKi01] [HaGo01] [Kopo99] [CrFo02]

Location	**Mobility Importance**[1]	**Data Application**	**Affordability**[2]	**Flexibility**[3]	**Dependency**	**Device**	**Application Packages**
Train, bus (i.e. public transport) Car Office Supermarket Shopping mall Pub Home Lives within the greater city area and moves around public transport routes to centre and between suburban locations.	Fixed (3) Pedestrian (4) Vehicular (4) Highly vehicular (4)	email, files trnasfer Voice call Time-killing Games Bulletin Boards Web Browsing: Product information – News Travel information access Video clips Music	Medium	Medium	Emotional: high Practical: medium - high	PDA Mobile Fixed PC at work and PC at home (possibly other terminal type)	Personal Networker (heavy) City Survival Kit (heavy) Media Consumption Portal (Heavy-moderate) NSW: mobile office, Intranet (moderate)

Table 4-2 User P3 Commuter

4.3. Application Package Perspective

The Application Package relates to the particular activities that a user is engaged in, and the set of Data Applications and services that are relevant to that activity. The concept of Application Package links the activities of users to the use of the technology. Application

[1] Importance on scale of 1 to 5, where 1 = not important and 5 = highly important.

[2] Level of affordability and resources available to user, including cost of services, devices and support.

[3] Level of flexibility on availability and reliability of services. (i.e. Low flexibility = need for constant availability.)

packages refer to particular activities, such as education, work, leisure, life management, but in rather more focused way than application domain. The Application Package scenarios that we identify include several types of Network Supported Work: the mobile office, corporate intranet connection and Remote monitoring/control System, the Traveller's Aid, the City Survival Kit, the Media Consumption Portal, Personal Networker.

Characteristics of applications identified are: information and communication tasks, Data Applications (see sections 6 and 7 in this document) and usage (time and location). The personal social and economic characteristics include: immediacy, cost, competition in provision, control over provision and use, transferability between devices, and reliability.

4.3.1. Application Packages AP1,2,3: Network Supported Work Tools (NSWT)

Tele-working has traditionally been seen as working from home, but is increasingly recognised as any sort of peripatetic work – people working out of a car, or truck, plane or tractor, or indeed anywhere (airport, building site, oil rig, other people's homes etc.). Application Packages for tele-work we have termed Network Supported Work Tools (after the term CSCW), and include applications for a range of different types of work. Work on Computer supported Cooperative work in mobile environments been developing ideas in this area of several years (e.g. [DiBe96], [DiBe96b]). These tools give flexibility, and enable workers to be on-site in contact, or available wherever they are. This can mean considerable efficiency and effectiveness gains, and reduction in costs. It may mean working at home but being in contact with colleagues at work and with customers through video/voice/data sessions (virtual office). It also means collaboration between geographically separated persons, possibly a group of them. Here, too, the ability of telecommunications to deliver video and sound as well as real-time data allows users to avoid costly and time-consuming travel. Application developers have caught on to this opportunity. A variety of "screen sharing" tools is being developed that provide users with the means to work together in real-time on the same electronic documents while being in eye and ear contact. **Error! Reference source not found.**. These tools not only enable people to work, but also undertake training, and juggle their work and home lives. [GoMe98].

These are three different Application Packages, presented in one table

- **AP1 Intranet Connection**: the mobile is seen as an extension of the corporate intranet, with corresponding expectations. The application enables access to network, to take out and feed in communications and information. People with this package can maintain a presence in a virtual office. It offers a rich variety of office type Data Applications from voice telephony to document sharing

- **AP2 Mobile Office**: rather than being a remote mobile part of an intranet, the mobile office acts as an information and communications hub for its user, enabling them, for example, to run a business from wherever they are.[Laur01]. The independent worker uses network-based applications (voice, mail and web and other application servers) as well as portable devices.

- **AP3 Remote monitoring/control System**: Here the mobile device is often connected another mobile device (e.g. diagnostic tool or surveillance device or other remote machine such as a health monitor, car engine monitor), to enable this system to communicate to a remote human or machine (e.g. remote surgery, engine diagnostics, video surveillance). The remote device can be controlled by a co-located person, remote person or be independent[4].

[4] There could be some justification for splitting this into two: one for telematics, and the other for linking people in occupations with need for a great deal of real time commutation, consultation and control.

4.3.2. Application Package AP6: City Survival Kit

A common use of mobile technology – to cope with the stresses of living and working in a busy city where every activity involve travelling and dealing with the uncertainties of modern life. This package is chosen by the user who is often on the move, trying to make rendezvous, dealing with public transport, paying bills and ordering shopping while travelling, finding out what's on, what is available, and where things are. Location-based application could be important. [Town02], [ShSa02], [Koop99].

Uses	**Data Application**	**Key Values**	**Usage**	**Device**
Shopping Paying bills What's On Keeping up with social network, and work: Messaging, Bulletin Boards, phone Transport info: Train times, traffic Games – time filling and wasting Music – time filling News Television, movies and radio	Web browsing Email messaging Voice call Instant Multimedia messaging Games Video on demand	Coping Freedom Control Awareness Time saving	On public transport or in the car, but also in places en-route. Used in work and personal time.	Basic devices (phone, PDA, laptop) Extended basic mobile phone. Maximobile (pocket size but heavier features) Pen size (Ultraportable) Emphasis on portability and design with some extra functionality.

Table 4-3 Package AP6 City Survival Kit

4.4. Device Perspective

There are a number of possible devices that services can connect to, applications run on, and which offer different levels of portability. The characteristics such as size, shape, power source and Application Packages of a device shape the possible uses, users, usages and connectivity. Of key importance are not only the stand-alone capabilities of the device, but the degree to which it can interconnect with other wireless and wired devices. Many Application Packages will run across a range of devices, and most users will have access to a range of devices simultaneously or in across different parts of the life space, e.g. the phone, laptop or PDA can always be updated from a computer and fixed wire link at home or work on a regular basis – ideal for many asynchronous solutions We will increasingly expect to be able to switch a call or data session from one device to another, or conduct different parts of it over several, not only in the user configured way we are familiar with (e.g. using phone and playing an

online game with a friends), but through an integrated communications system. In its most integrated form this has been termed the virtual terminal [ThVa01].

A device can be configured as the mobile part of an Application Package, and not have any other functionality. The application often implies a particular device. A number of types of devices (or device scenarios) have been identified in Table 4-4.

Characteristics of devices include: portability/wearability [Fort02], human interface, modes of communication (text, voice, image etc), cost of ownership and use, power requirements, processing power, range of Data Applications, locations it can be used, social acceptability etc. Many of these characteristics are given in FLOWS D01 Appendix D (device characterisation), and Appendix C (MT characteristics for various bearer technologies)

Location and device will have a shaping effect on what can be used, or is inappropriate to use (e.g. sending text message/e-mail in library, but not talking on phone.) Locations imply some restrictions on type of use as well as use of particular devices in general, e.g. a laptop can be used on a train, but not the metro at peak hours.

Basic formats	
Size/name	*Description*
Mobile phone	Portability, low-end memory and processing power applications and Application Packages
PDA size	Portability, multimedia data communication. Many possible applications and packages
Laptop	Full computing and interface power, many applications
Extended Basic	
Mini-mobile/ mp3 player	Emphasis on portability (<100g) for basic communications and info, or music playing. Limited by screen size and battery size.
Maxi-mobile	Jacket pocket or handbag size, but heavier on features (big screen, PDA, camera etc)
PDA/GameBoy size	Palm size considerable computing power, carried in bag, some pockets. Clip on keyboards etc.
Web-tablet or PDA+	A5-A4 size. Tablet, PDA with extra devices attached (e.g. GPS,), too big to go in a pocket, but can be carried by hand or in a bag.
Mini-laptop	Scaled down laptop, with keyboard - goes in small bag, many features of PC laptop: bag size, full power, keyboard.
Lap-top computer	Full featured computer with large screen, multiple ports, disks etc. Luggable.
Other Formats	
Vehicle Based	Provides more powerful communications and IT facilities in a mobile location. Provides a hub for portable devices.
Communication hub:	Communications device that is carried separately to other devices, possible to get better signal or to avoid radiation. This could be small or built into briefcase, etc.
Clothing Based	Integration into clothing links telecommunications intimately with the wearing of that clothing (esp. work clothing)
Badge	Highly portable, delivering context awareness and wear presence
Pen or Watch size	Ultra portable

Table 4-4 Device Scenarios

4.4.1. Device D5 Web Tablet/PDA+

The Web Tablet (or PDA+) format is larger than a standard PDA and also much heavier on features. Today web-tablets with a large screen are rare, but the PDA+ is a widely spread format in commercial use (warehouses, shops, utility companies etc) These products tend to be used by corporate/commercial users, who find the ultra-portability of heavier featured devices particularly appropriate.. Cheaper and more fashion oriented designs of the device (see for example POGO[5]) appeal particularly to the youth market and chatterers, with features and uses centred on MP3, media consumption (games, video clips) and personal network applications, where the device offers a larger screen and longer battery life than

[5]See http://www.pogo.co.uk/design/keyfeatures.htm (click on view demo) for a demonstration of how the POGO fits into the life of different individuals.

smaller devices. Often based on a PDA size pocket computer the size could be is made up with features such as a large screen, printer, a camera, larger battery, a small text or music keyboard, hard disk drive, or specialist modules

Characteristics	Mobility	Size / Weight	User	Location	Application Package or Specific Data Applications	Performance	Support Network	Extended features
Portable Built-in antenna or fold out slate Context aware Touch screen, speech, handwriting input Detachable keyboard Screen size (up to approx 11 inch)	Fixed (5) Pedestrian (5) Vehicular (5) Highly vehicular (4)	200x100x50 900g-1500g	Mobile workers (Service Engineer, peripatetic Manager, etc…) Business Travellers Teenagers Chatterers Tourist	Indoor /outdoor Urban /rural E.g. Industrial Estate, Airport, Tourist City Centre, Suburban Estate, Financial District, Shopping Mall, Public/Private transport	Network Supported worktools Personal Networker City Survival Kit Traveller's Aid Media consumption portal	High level and processing power for business / heavier featured devices Standby time up 72 hours	HIPERLAN GSM/GPRS Bluetooth (PAN) UMTS DxB	Bluetooth headset Notebook Desktop Computer Car (docking station) Other peripheral (printers, etc, can b built in t this forma

Table 4-5 Device D5 Web Tablet /PDA+

5. User Scenarios and FLOWS Scenarios:

The aim of this document is to create models for testing, design, simulation and market studies. FLOWS scenarios enable us to link research on people to possible future wireless devices to quantitative descriptions of a number of Data Applications and services. We have chosen to do this through three User Scenarios developed from a combination of *context scenarios* presented earlier in this paper. Linking these User scenarios to the Service Scenario and Access Technology Scenario, a range of FLOWS scenarios are identified that provide a range and depth of test criteria and conditions that can be used in the other Work Packages. Specifically we describe a complete FLOWS scenario (only Scenario 2) – of all the services used and the conditions they are used under, and then highlight a number of individual convergence scenarios will test the functionality of FLOWS technologies. The scenarios were developed though consultation researchers in other work packages over what would satisfy their various requirements on a number of dimensions – from range of Data Applications, to mobility, and range of location.

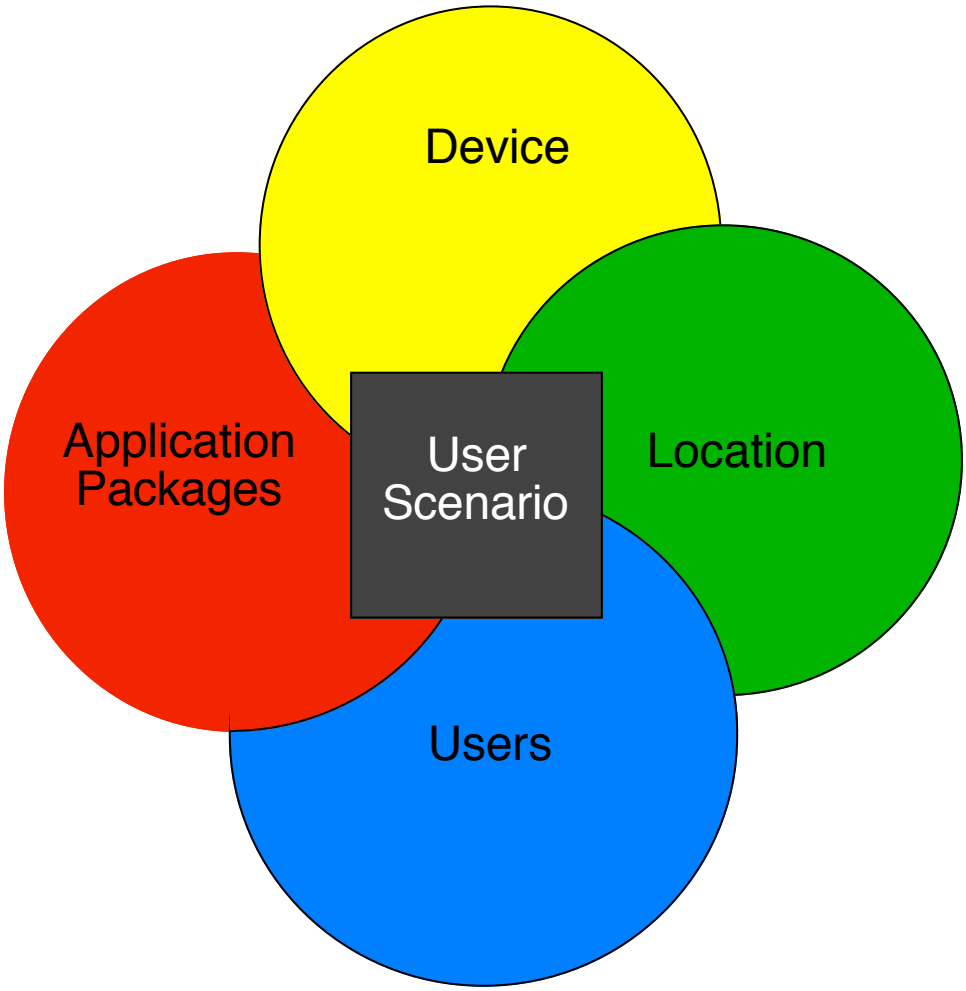

Figure 5-1 Generation of a user scenario from context scenarios

This type of 'story' scenario is common within the industry, either based on purely tacit knowledge of engineers set up to test particular technological configuration, or as a way of illustrating the results of scenario building exercise built on reviewing potential technical trajectory, economic and social trends etc. However we have tried to base it not only on the requirements of the technology under assessment, but also on context scenarios discussed. Here one of the scenarios is given.

5.1. Business Traveller on the Train

This scenario describes a business traveller on a medium distance train travelling from the city, through the suburbs and rural areas, stopping regularly at stations. The main user is conducting business activities with a Network supported Work Tool and some personal communications.

5.1.1. Scenario and Activity description

Access Technology Scenario: UMTS in city and urban parts of journey, HIPERLAN/2 connectivity in stations, GSM connectivity everywhere. Digital Terrestrial broadcast, Bluetooth in each carriage.

Principal User: **P2** (**Error! Reference source not found.**)The user is a business executive who is travelling to a meeting. He is male in his 40s. He needs to communicate with his office, with other colleagues in his organisation and with clients. He has access to on-line resources on his corporate intranet which he uses in his business. He also submits report and documents. He discusses documents with his colleagues on the phone and works on them at the same time. He is available to his colleagues and clients/ business contacts all the time,

but is able to divert calls and messages to a secretary. He has great deal of resources to spend on communication and information exchange.

Home-work management: He has a family, but he travels away from a great deal, and keeps in touch electronically with phone calls every day, images and video messages, and occasional video call. He is also able to check on his young son at the nursery via their webcam.

He has some friends he shares an enthusiasm for old cars with, and other friends he sees on trips frequent trips to the city.

He lives in a suburb, and uses his car, the train and aeroplanes for travel. Most regional trips are done by train due to bad congestion on the roads.

Location: Medium Distance Train**.** The user is on a train that travels from the city centre across country for a trip of several hours. The train travels at speeds of 70kph in urban areas and 130kph in rural areas. It stops every 15 minutes for 3 minutes at stations. The business class coach on the train has power supply for travellers. The stations have HIPERLAN/2 connectivity and the train travels through areas of UMTS connectivity and continuous GSM connection. However it does go through tunnels that take up to 15 seconds to pass through. Within the train there may be 100 people doing similar activities to our user. The train also has 400 students going home for the holidays, who are making extensive use of instant messaging, voice calling, on-line gaming and web browsing.

The Application Packages: Network Supported Work Tools AP1 Travellers Aid, Social Networker. He uses a set of applications that are provided by this employer to link him into the corporate network, and to enable communications with clients and business partner. The firm use a customised product provided by a major vendor that integrates multimedia data over a variety of networks. The package enables all the standard business documents to be worked on and shared, access to the corporate Internet and the Internet for communication, information, and making travel arrangements, placing secure orders and signing electronic contracts. The system will filter messages and webpages for unnecessary images.

He uses an Internet travel company website on the PDA to book hotels and a taxi.

He communicates with his friends and family on a separate integrated mail/messaging account through a web interface and the telephone

The Devices: He has several devices – a small mobile phone, a small PDA and a laptop computer. All the devices are provided by his company and access services provided through a single service provider buying in connectivity from infrastructure companies. He has a large brief case and a jacket pocket to carry them in. Devices cannot be used in a moving car while driving, except to take telephone calls, of listen to e-mails and documents being read. The PDA and phone are seen as more convenient to use than the laptop at particular times, especially on crowded trains at rush hour.

Specific activities:

He will conduct 1-2-1 and multi-way phone calls, upload and download documents up to 10Mb, and on this occasion, a 500Mb video file for a presentation. For 1 hour he will discuss a multimedia document with a colleague on the phone while editing the text it in real time together. During this time he will check his e-mail 3 times in response to alerts, downloading 5 large files to his laptop. He usually checks his e-mail on the PDA, but can synchronise with the laptop and download larger items too. Only one of the downloads is important and must be done immediately, the rest can be done whenever the network connection is fastest and cheapest.

He watches the business news on a subscription TV on demand service.

He looks at his children in the nursery through a low quality video link to his laptop web browser

He receives some small images from his children on his private messaging service, although routed through the company network.

He books a taxi, and checks a map of the place he is visiting.

Specific Data Applications:

File transfer, E-mail/ multimedia messaging, Voice phone call, Synchronous document sharing, Video on Demand, Broadcast Radio, Cooperative Document editing, web-browsing including video stream.

S.1.6 While train is in a small town station engineers take down UMTS coverage of the area for 5 minutes, and system transfers all calls/connection to HIPERLAN/2, GSM and GPRS.

Specific activity	Data applications	Network services	Geographical characteristics	Cell types	Network Availability	Mobility	Device	QoS expectancy
250 users File sharing Phone calls Web browsing	File transfer Voice calls Web browsing	Unrestrained Data transfer Speech Interactive services	Outdoor-urban Indoor-urban Outdoor-suburban	Micro Pico Micro	UMTS HIPERLAN/2 GSM/GPRS	Vehicular Stationary Walking Vehicular-Highly vehicular	Phone, Laptop, PDA	Medium - High

Table 5-1 Convergence Scenario S.1.6 Switching all calls in small town

6. Service Product Scenarios

Looking towards future work, we can use the user scenarios to help define a number of key *service products* in socio-technical definitions, linking characteristics of particular services, delivered by different bearer services, and the requirements for simultaneous use in order to provide a specific marketable service product.

These products are defined by the particular network services they offer, the locations they are offered in, the price at which they are offered, the quality of service promised, extensions to service available, and the market at which they are aimed.

Service Product 1 Mobile Internet/Business intranet access

This service can be sold to corporations to provide their mobile staff with integration to their company' voice, video and data networks in location such as airports, offices, on the motorway, in trains etc. Sold to commercial customers, often as part of a broader service agreement. Users have Network Supported Work tools, and Use multiple devices – phone, PDA and laptop, which may often be provided by the service company.

Service Product 2 Consumer Multimedia calling

A service for people who like to keep in touch, send messages, make low quality video calls or multimedia calls, send personal photos. Access to information is not important. These users have a version of the Personal Networker Package

Service Product 3 Multimedia Consumer service

This is a service based on a mass market consumer who using the Media Portal Package, who principally wants access to media products – to be able to have video on demand, games, download and share music and video files etc. For those with PDAs and PDA+/Webtablets.

Service Product 4 Emergency Service Communications

This provides radio, data and video communication between emergency service workers and their control bases (fixed and mobile). It requires reserved channels, and priority access in certain circumstances. Corporate (government) negotiation of terms, relatively low number of

users. Must work in a wide range of locations, but also respect the sensitive equipment in operating locations.

Service Product 5 Independent business person's service

This person works from a car, and runs their own business. They need to be in touch all day and night, send clients information, advertise, while on the move. They use the Mobile office version of the Network Supported work tools. This product provides office Internet access, multimedia calling, file transfer.

Service Product 6 The City Dweller's Service

This service is for the urban dweller – a chatterer or a commuter - who uses the City Survival Kit or Personal Networker It offers messaging services, and voice calling, basic Internet access for access to network applications such as banking, shopping, travel information etc. The service is for urban use, and is not expected to perform in rural areas.

7. Conclusions and Discussion

7.1. Communication and cooperation

Social scientists have to struggle to define what they can offer in understanding or shaping the development of new technology. This is especially so for those doing user research. Areas of influence in industry include marketing, system configuration, conceptual design and company strategy. In many of these areas commercial consultants, market researchers and internal researchers are the traditional sources of expertise. The FLOWS project is unusual in that social scientists are working as part of a research and development team that is not creating end user products, and is indeed not creating anything physical. We are in roles that are usually taken by engineers who are dipping into user requirements analysis or techno-economic modelling. It is a challenge to find ways to bridge the communication and knowledge gap between research engineers and social scientists!

This project highlighted the significant learning needed to understand the requirements and expectations of the engineers, and the models of users and market that are implicitly used.

7.2. Scenarios for future wireless

This scenario framework provides us with ways to tie a range of user research to the requirements of the engineers, but also opens up an agenda for future research. IT is clear that certain groups of users, places and devices and uses are very little researched, but will be important

Particular areas of research that could be developed in the future: use of information and broadband on wireless devices; locations of mobility; WLAN hot spots; linking home and public spaces; control of technology and use within particular spaces or among particular groups.

Much scenario work is conducted by engineers, with little knowledge of the large amount of research on use of ICTs, and of the methods approaches developed to understand the relationship between technology and people. This paper hopes to provide some useful inputs for those within the industry to incorporate into their work.