

DESIGNING FOR MOBILE AND DISTRIBUTED WORK: TECHNOLOGY USE IN REMOTE SETTINGS.

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TECHNOLOGIES TO SUPPORT MOBILE WORK AND COLLABORATION

2. INTRODUCTION

The last twenty years have borne witness to a fast changing technological landscape that has seen computers move from mainframe machines to pocket sized devices. Most recently, two of the significant elements of this changing environment have been the rapid proliferation of mobile technologies, on the one hand, and the decreasing cost of mobile telecommunications service provision, on the other. In addition, the last few years have seen the beginning of a convergence of mobile communications and data technologies in parallel with an influx of a variety of newly designed standards, protocols and technologies which seek to allow for more flexible interconnection of hand-held information devices. There is also an increasing interest by the telecommunications industry into supporting mobile data connectivity in addition to voice-based communications. While data transfers are currently possible using existing technologies and standards, new technologies, such as the pocket PC and the Nokia Communicator 9210, as well as new technological infrastructure, such as WLAN, bluetooth, GPRS and 3G aim to support increased levels of flexibility, speed and processing power for data communication devices. Little is known about how these technologies will change existing work patterns and modes of collaboration between co-workers already in a state of flux by the introduction of tele-commuting and hot-desking in the 90's. Although not technological driven in our research at Brunel we do, however, seek to explore the potentiality of new technologies from a user-centred perspective. To this end, the following section of the report provides a brief summary of the developments to date of the most currently employed technologies used to support collaboration in mobile work.

2.1 The laptop - Moving away from the desktop?

"These attempts to shrink the size of the PC are useful; they do enhance the power and flexibility of the machine. But they should not be seen as a means to simplify the device. When you take a difficult machine and make it smaller it remains just as difficult, except now it has an inferior pointing device, an inferior screen and an inferior keyboard...the small size makes them useful for travel. But the average person who has difficulties with the desktop PC will have the same difficulties with the small PC nothing fundamentally has changed." (Norman: 1999:110)

With the move from mainframe to PC, visionaries in the 1970's foresaw an even more radical move from PC desktop to mobile computing device. For example, Alan Kay of Rank Xerox, envisioned a notebook style portable device called the Dynabook which could handle users information needs and also boasted wireless network capabilities. It was not until the end of the decade though that one of the first laptops - if not *the* first - was designed in Britain by William Moggridge for Grid Systems Corporation. One fifth the weight of any comparable computer in terms of performance this was the computer of choice for NASA on the space shuttle program of the early 1980's. This was followed in 1983 by the, Gavilan Computer, which already featured much that we take for granted of laptops today with floppy drive and touchpad mouse. 1984 saw the entry on the portable arena of the Apple 11c - but by today's standards this bulky and heavy notebook computer

could not really be viewed as a laptop. The first laptop from IBM was to follow in 1985 though with the introduction of the PC Convertible, named because with a few add-on peripherals, it could become a desktop machine. Like today's laptops it could run on battery or AC Adapter. It was viewed as a great success by both the buying public and IBM. Today laptops, both the Apple or IBM clone versions, are a key feature of many a mobile traveller's possessions. However despite its proliferation many problems remain with regard to the laptop. Fundamentally, unlike radio's or T.V.'s, and akin to their desktop counterparts, we are often forced to sit through a booting up process or at least an application start up process when wanting to use any of its data handling features. On the move this can make all the difference between rescheduling an important meeting and losing a client (when their cell phone cuts out during the laptops booting up process). In addition there is also the perennial problems of weight, bulk, connectivity problems (both complexity and speed), short battery life, the need to make space to work and the incompatibility laptop software can have with other mobile device software. These problems have resulted in many mobile workers leaving their laptops in the office and looking at other more flexible mobile devices to fulfil much of their informational and communication needs while on the move.

2.2. The Mobile Phone - The flexible communication device

Combining both the technology of the radio with the land-line telephone - the mobile cellular phone had as its first incarnation with in-car telephones. These relied on large transmitters in the vehicle and the amount of users was restricted because of the amount of bandwidth that could be allocated. However, with the birth of the cell phone and its reliance on cell technology many more people could use cell telephones concurrently - this surfaced initially in the military as a strategic communications device and was then adapted to the needs of mobile business people (Bergman, 1999:170). However, it was not until the cost of mobile telephony decreased radically at the end of the 90's and digital phone technology came of age that the use of mobile telephones could grow to their current phenomenal status in modern societies. With the advent of WAP technology in Western countries and Imode technology in the East the use of the phone as a device to communicate web data and email - and not just voice data - has emerged to mixed reviews. In particular, with regards to WAP and its unfamiliar WML, the large uptake of WAP enabled phones, previously envisioned, has not occurred. On the other hand Imode has largely been a success in its Japan homeland attributable probably to its use of a language for its web pages similar to HTML and its ability to provide 'constantly-on' Internet connection for its users. When assessing mobile phone technology to date, it too, like all mobile devices, can be seen to have many challenges to overcome. There is the physical problems of the device itself, for example, extremes of temperature - heat, cold or dampness can damage phone handsets and make them inoperable, whereas battery life can restrict usage of the phone to an unacceptable degree. There is the size of the screen - forever decreasing in size with smaller and smaller handsets flooding the market - severely limiting the web viewing or email reading experience of users. Like all mobile devices there is also the obvious problem of inputting alphabetical data into a device primarily conceived for numerical input. Moreover, there are the everyday problems of lack of network coverage, inability to use the device in locations such as the underground or basement of houses and limited ways to record the data that colleagues and friends are communicating to the user on the other end of the phone. However, despite its inadequacies, as the available literature in the area demonstrates, the mobile phone is the most flexible device that mobile workers currently have to allow them to co-operate and collaborate with others while on the move and many novel ways to use it have been identified (O'Hara et al., 2001). In addition to its use for voice, the use of SMS texting - with its guaranteed costing - has taken root among the younger generation and looks likely to continue for some time to come.

2.3 The PDA -The mobile information appliance?

"Small devices do pass the test, devices that are true first steps towards appliances. These are specialized tools, sometimes called Personal data assistants (PDAs). Some are quite valuable demonstrating that there is a demand for such devices, if properly designed" (Norman, 1999:110).

1993 saw the introduction of the first PDA from Apple called the Newton MessagePad at the Spring Consumer Electronics Show in Chicago. These small information devices were named PDAs (personal digital assistants) by John Sculley, the former CEO of Apple Computer, and were sold as the ultimate information gadget - their forerunner being the 1980's small electronic organizers. Sculley argued that PDAs would become ubiquitous tools providing a place to record telephone numbers, keep calendars, store notes while also allowing the sending and receiving of data wirelessly. But the Apple Newton was to fail in its quest to win space in the briefcases of the mobile businessperson due, in the most part, to the problem of its bulky size, its cost and its poor handwriting recognition program (McPherson,2000). However, the idea of a PDA did not go away. March 1996, saw the launch of Palm's PDA contribution the PalmPilot. The PalmPilot computing device was marketed as an aid to help people manage and organise their lives by providing instant access to a diary planner, phone numbers, to-do lists and other essential data. From the start it was viewed as an accompanying tool for the laptop, with which it would synchronise and exchange data when connected for safe-keeping. The PalmPilot was championed by the up and coming mobile professionals of the late 90's, just as the paper version of the device -the filofax - had been adopted earlier by the YUPPIE's of the 80's. With the recently arrived PalmVII, the first wireless data transfer PDA has appeared on the scene and to date new PDA's continue to arrive at electronic stores worldwide from Palm, IBM, Apple, Compaq, HP, Motorola, Casio and Sony. There has been much debate over the years about whether the PDA should take on the form of a small desktop with keyboard or, as the PC differed from the mainframe computer, take on characteristics that are more suited to the environments that it will be used in. Thus, Palm and the Pocket PC have rejected constantly fixed keyboards in favour of handwriting recognition technology and stylus device input, while Symbian's Psion, until it was discontinued recently, embraced the use of a keyboard in its incarnations and kept to a more desktop model of use. There are, to date, many problems that have surfaced with the PDA, many of which are the same as those found in the mobile telephone. The small screen, particularly in the pocket devices have dismayed many users used to more laptop friendly dimensions. The short battery life, particularly with the power hungry pocket PC, can easily lead to the loss of data if charging is not done on a regular basis. Some PDA's like the defunct Revo need a place to rest on for efficient keyboard input. Other PDA's, like the Pocket PC, have handwriting technology, which has to be learned and practised to be used effectively. As an information appliance the relationship the PDA has with the PC seems monopolistic and unnecessarily - with many files needing to go through a conversion processes on a PC before being able to be used on the device. In terms of mobility and collaboration, the key focus of our research, the challenge of the PDA lies in its complexity for connecting to a network or intranet to transmit data to other users to aid remote and distributed collaboration.

2.4 The Hybrid - putting it all together (or surfing the mobile information highway while travelling on the motorway)

Using a cellular phone with in-built modem and cable (or infra-red connection) to connect to a PDA device may at first glance seem an obvious solution to enable users to collaborate while on the move. However, the high cost, complexity and poor download times achieved by doing this can fundamentally be a curse to a fast moving executive rather than a blessing. Other attempts to connect PDA devices like the Pocket PC, include a Sierra's AirCard 300 and extension pack. However just as radio and telephones were first joined together to create the cell phone, currently PDA's and mobile telephones are being fused in the quest for the ultimate mobile information and communication appliance. This has led to the birth of two new types of devices. The first has been called the "smart-phone" a device which aims to integrate Personal Information management (PIM) functionality with a cell

phone and wireless internet access (www.Symbian.com). The second device is primarily a PDA, like the Blackberry with a constant connection for the download of email or the much hyped Andromeda from Siemens - a colour Windows CE PDA with built-in (GSM or GPRS) mobile phone capabilities. Devices like the Andromeda include richer functionality than merely a smartphone, demonstrating the ability to link with a PC, a printer and of course the Internet. But it is not just the PDA that developers have tried to integrate with the mobile phone, Motorola, among others have looked again at the walkie talkie as a resource for collaboration while on the move in a local area and tried to integrate such technology with mobile phone technology. In the United States Motorola in 1998 introduced the i1000 cellular phone/pager/two-way radio. In 2000 this device was further enhanced by the addition of wireless data capabilities in the shape of i1000plus.

However, hybrid devices are often criticised for their complexity and 'jack of all trades master of none abilities'. Are we trying to do too much with one device? People like Donald Norman in his book *The Invisible Computer* would maintain yes. Moreover, others in the literature have picked up on a resistance to the move towards new "form factors and functions" by the consumer. Richard Harper reflects on this phenomenon:

"Consider the convergence thesis...it has been argued for many years that there will be a converging of mobile communications and hand held computing. Yet in practice, if one bears in mind what we have just said, it has not yet happened. People are not buying what I call hybrids. One either buys a phone or a PDA, rarely does one buy one and the same thing. And, when it comes to the crunch one buys a phone rather than a PDA." (Harper, 2001)

2.5 Miscellaneous devices and applications to support collaboration and mobile work

Both academia and industry have attempted to design for specific kinds of mobility. For example, Symbol (www.Symbol.com) have been providing hardware support for the more factory orientated companies as well as providing in-vehicle logistical and navigational systems. We can also point to Psion's development of technologies for use in warehouse and transportation systems as another example of this (www.Psion.com). But these tools are primarily process-based and workers have had little opportunity to use them as collaborative systems (Brodie & Perry, 2001:2). In academia, the emphasis on providing resources for collaboration when mobile has been much more explicitly aimed for. The mobile system Satchel, has been developed to prototype stage to aid the business user in their management of documents on the move (Eldridge et al, 1999). Satchel supports mobile document work by allowing access to remote documents and document servers through wireless connectivity. The users of Satchel often come to believe they are carrying around their documents in a mobile device when in actual fact the mobile device used only stores references to remote documents stored on their network server. The user can also make use of various services which includes printing and scanning and exchanging of documents with other users. The Satchel system, however, suffers from inflexibility. The use of such a mobile system needs the presence of other Satchel enabled devices in the vicinity to fully utilise its functionality. Work at the Victorian Institute in Sweden has also focused on providing support for collaboration when mobile. In their paper, *Mobile Informatics*, Bo Dahlbom and Fredrik Ljunberg (forthcoming) briefly discuss two of the Institute's most recent projects. Mobiling, investigates "IT support for meetings between mobile workers". Resulting in new services such as "dynamic to do lists" appearing on users PDA's, sensitive to the proximity of other people involved in the local environment. They also discuss the IPAD project, which explores "awareable" computing. This envisioned computing device is aware of its "surroundings" and "aware of others in the surrounding". This was later prototyped as a device called a Hummingbird, utilising a Nintendo Gameboy with a transceiver and tested in a variety of mobile environments including conferences and rock festivals alerting the wearer to the presence of other hummingbird users in the vicinity. Similarly, As a tool for local collaboration, HP prototyped the Piglet - a handheld

PIM appliance which allowed, for example, people in meetings to scribble digital notes and send them to colleagues who also owned a Piglet device via a radio connection¹.

2.6 Supporting infrastructure technology for mobile devices

Much of the developments in technological infrastructure have aided the above hardware developments. At present GSM has been used to free the laptops of many mobile workers - such as telecommunications engineers - for use in non-traditional computing environments. Wireless Lan (WLAN), a new contender on the market, is also suitable for providing laptops and PDA's with wireless connectivity to cabled LAN's - thus allowing their users to roam about a small local area in a company while maintaining network connectivity. While it can be argued that WLAN beats bluetooth on bandwidth and support for PC LAN communication standards, the market is very much still open for PDA's to become dependent on bluetooth as a means for connecting the device to other appliances in the environment. The benefits being the low cost, low power consumption and support for real time applications like voice available through blue tooth. Bluetooth technology can be viewed as cable replacement technology - its proliferation being driven by both computing and telecommunications industries. Taking the form of a microchip in a device it provides a short-range radio link between enabled devices. Another new technological advancement is GPRS, which can be seen as one of the most significant step towards 3G. Eventually though, if the telecommunication industry has its way, the much hyped 3G will be deployed on a national scale to support bandwidth intensive communications such as video-conferencing and full Internet access on the move. Location based information services are also something, which has been discussed in the literature (Bergman ed., 2000) and promises the tourist, shopper or the new businessperson in an area the opportunity to get relevant information about their immediate location downloaded to their 3G mobile communication device as soon as they arrive in a location.

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