A social history of the mobile telephone with a view of its future

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The social history of the mobile telephone involves both the history of technological development and an account of changing social and political frameworks into which the new technological developments become integrated. The technological innovations of mobile telephony were established from the 1940s, but it was not until the 1990s that adoption took off. It has been claimed that the mobile telephone revolution can be explained by changes in the way communication happens through social networks, away from old hierarchical forms. Several unique communicative and behavioural patterns have emerged in countries with mass use of the mobile telephone, including texting (SMS) and the development of new social norms. Nevertheless there is still huge global variation in use and development, and more research needs to be conducted which responds to very local patterns of use and reuse.

1. Introduction

The history of the mobile telephone is as much about social and political developments as it is about the emergence of new technologies, standards and systems. As Jon Agar has pointed out, the mobile telephone has been:

> '... a way of rebuilding economies in eastern Europe, an instrument of unification in western Europe, a fashion statement in Finland or Japan, a mundane means of communication in the USA ... an agent of political change in the Philippines ...' [1]

Even within one culture such as that of the UK, the mobile telephone may have multiple meanings. For example, it may be linked to youth culture through texting, business activities via data services, or motherhood as it allows the notion of shifting roles between work and home. Therefore any history of the mobile telephone must take on board the links between technical features and social relations, between functionality and cultural norms.

The growing penetration of mobile telephony and mobile communications in the UK suggests that none of us can remain immune to the social and cultural consequences in our everyday lives. Non-ownership of a mobile telephone has become an identity as important as ownership. While it took the domestic telephone approximately thirty years to migrate from an instrument found most often in the hallway of the home in the 1960s, to its ubiquitous position today in the living room, kitchen, and bedroom, the mobile telephone found its way into our pockets in less than half that time. Prior to 1985, no one in Britain had a mobile telephone, now most people own, or have access to one; in 2002 the World Telecommunications Development Report stated that every sixth person in the world had a mobile telephone [2, 3]. The number of mobile subscribers around the world is likely to reach 1.4 billion this year, far more than the number of land lines (1.1 billion). Over the last decade in particular, mobile telephone use has escalated dramatically and for many people, the ability to communicate while on the move is now seen as essential to business, commerce, individual lifestyles and everyday social interaction.

A social history of the mobile telephone is not just a history of a shifting concept of mobility. In fact, the linking of mobile telephones with mobility may be premature; young people, for example may use text to communicate across very small distances, even across the room. Even if mobility is the key social concept, it is cross-cut by cultural behaviours and beliefs about intimacy, the role of public space, the changing place of women in the labour market, customisation of commodities, to name just a few. The mobile telephone has a global history in the sense that it has been developed or stalled by national politics as much as engineering challenges, exemplified by the different ways in which third generation (3G) licences were sold in the UK, France, Germany, Sweden and the USA [1]. Meanwhile there have been vast societal changes in terms of production and consumption, largely embedded in cross-national processes of globalisation. Political influences on design have been accompanied by huge social changes, such as the development of travel and the increasing car culture during the period of the mobile's early development.

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2. Invention and adoption

In the UK the first land mobile services were introduced in the 1940s and commercial mobile telephony began in the USA in 1947 when AT&T began operating a 'highway service' offering a radio-telephone service between New York and Boston. In the mid 1950s the first telephone-equipped cars took to the road in Stockholm, the first users being a doctor-on-call and a bank-on-wheels. The apparatus consisted of a receiver, a transmitter and a logic unit mounted in the boot of the car, with the dial and handset fixed to a board hanging over the back of the front seat. With all the functions of an ordinary telephone, the car telephone was powered by the car battery. Rumour has it that the equipment devoured so much power that it was only possible to make two calls — the second one to ask the garage to send a breakdown truck to tow the car with its flat battery! These first car-phones were too heavy, cumbersome, and expensive to use for more than a handful of subscribers and it was not until the mid 1960s that new equipment using transistors were brought on to the market. Weighing a lot less and drawing less power, mobile telephones now left plenty of room in the boot but were still the size of a large briefcase and still required a car to move them around (Fig 1).

Fig 1 Early car phone.

In the USA, in 1977, the Federal Communications Commission (FCC) authorised AT&T Bell Laboratories to install the first cellular telephone system. AT&T constructed and operated a prototype cellular analogue system and a year later, public trials of the new system were started. The FCC were convinced that cellular radio was practical but the sheer size of America presented problems that were not to be encountered elsewhere. Hence, although the first working examples of cellular telephony emerged in America, the Nordic countries of Denmark, Norway and Sweden and also Finland were soon to overtake their lead. In 1969 the Nordic Mobile Telephone group (NMT) had been set up to develop a cellular telephone system and by 1981, in Sweden, there were 20 000 mobile telephone users — higher than anywhere else in Europe. Cell-phones became standard kit for truckers and construction workers and by 1987 some were being sold for private use. Spain, Austria, the Netherlands and Belgium were quick to follow suit and order NMT services while Germany, France, Italy and Britain decided to design their own systems.

In 1979, the first commercial cellular telephone system began operation in Tokyo and by the mid-1980s there was a significant expansion of services offered to the general public that rapidly attracted large numbers of subscribers wherever services were available. In the UK, two companies were granted operating licences; Telecom Securicor Cellular Radio Limited (Cellnet) and Vodaphone. In January 1985, both companies launched national networks based on analogue technology and customers were able to avail themselves of the service using a mobile telephone the size of a brick (Fig 2).

Fig 2 An early analogue mobile 'brick'.

In the late 1980s there was a move to develop standards for a second generation (2G) of mobile telecommunications and digital technology; the global system for mobile telecommunications (GSM) was introduced throughout Europe in order to provide a seamless service for subscribers. Analogue technology was phased out in the UK in 2001 and digital technology (GSM) is now the operating system for 340 networks in 137 countries. Although Europe is the dominant user of GSM, it has also been accepted in other areas such as the Asia Pacific region.

Digital networks and an increase in the number of service providers to the market in the early 1990s served to further increase the number of subscribers and consumer popularity rose immensely. In 2000, 50% of the UK population owned a mobile and in 2001 almost 50% of British children aged between seven and sixteen had one. Today at least 65% of households in the UK have access to a mobile and there are approximately 47 million mobile telephones in the UK [4]. It is estimated that during the next five years the percentage of calls made from mobile telephones will increase by 25% and user numbers are expected to rise to fifty million [4].

Huge advances in technology have undoubtedly played a role in the rapid and unprecedented take-up and widespread availability of mobile communication. Agar [1] maintains that in the 1990s technical trends, particularly miniaturisation and improvements in battery technology for example, triggered our mobile world. Once batteries became powerful and portable, mobile telephones could became small and light enough to carry around. There was a leap from car-phones to hand-phones and new, lighter, more portable designs proved attractive to a new customer base. It was at this point that the mobile telephone began to move from a business tool to the pervasive communications device we see today.

Much like the landline telephone, in its early inception the mobile telephone was an elitist device mainly used for business by middle and upper class males [5]. In the UK, in 1965, an exclusive (and expensive) service called System 1 was launched in West London that was used primarily by the chauffeurs of diplomats and company chairmen [1]. By 1967, use had trickled down to 14 000 privileged and wealthy users of the System 4 mobile telephone and, by 1981, the Post Office Act meant that the telephone business left the hands of the Post Office and was renamed British Telecom. In the 1980s the marketing of mobiles was aimed at business people and it was not until the early 1990s that mobile ownership among the general public began to take off.

Since then, just as the landline was quickly adopted for more sociable purposes [6], the mobile telephone has quickly been integrated into more and more aspects of our daily lives. By the late 1990s, across the world an economic split developed between those who paid for mobile telephones on a monthly contract basis and others, mainly the young and the poor who used pre-paid services. Pre-pay customers tended to use text messaging rather than voice calls because it was cheaper, and economic differences in use are still in evidence today. Text messaging is far less popular in the more affluent USA than in poorer countries like the Philippines which is the 'texting' capital of the world, although this has as much to do with network functionality as simple economics [1].

3. Developing communication on the move

Despite the rapid technological advances since the 1940s, the technology itself did not lead to an inevitable mobile revolution. Agar [1] suggests that organisational change may yield a clue as to the rapid contemporary adoption patterns:

> '... there has been a correlation, a sympathetic alignment, between the mobile phone and the horizontal social networks that have grown the last few decades in comparison with older, more hierarchical, more centralised modes of organisation ...'

He goes on to argue that the mobile telephone activated, and was activated by, new forms of social network just as the mainframe computer of the 1950s was tied to a centralised, hierarchical, bureaucratic organisation. Central to contemporary social networks is the linking of communication to mobility. Geser has suggested that, seen within an evolutionary perspective, our ability to communicate has been shaped by two highly consistent physical constraints — geographical proximity (in order to initiate and maintain interactive relations), and a stable dwelling place (necessary for the development of more complex forms of communication and co-operation) [7]. We live in an increasingly complex world and geographical dispersion means we often need to maintain a significant proportion of our social network across distances where opportunities for face-to-face meetings are intermittent. Telephony, and in particular mobile telephony, is a key contributor to enabling us to keep track of, and successfully participate in, a set of relationships in a complex, social world. Much of the imagery and talk of the mobile telephone (particularly in early advertisements) reinforce the claim that it serves to free us from the need to be bound to a specific location (see Fig 3). Hence much of the significance and value of the mobile lies in apparently empowering human beings to engage in the fundamental activity of communication, free of the constraints of physical proximity and location specificity. Yet reading off social practices from advertisements is at best a risky activity. The fantasy of the mobile telephone, as with personal digital assistants, relies on consistently masking the 'hidden work of mobility' [8].

Fig 3 The 'freedom' of the mobile telephone.

The mobile telephone also facilitates communication that might not otherwise take place at all and hence it is

the perfect tool for increased levels of social grooming, i.e. letting someone know that you are thinking about them [9]. Text messaging (SMS) is an excellent example — messages are often low in informational value but high in terms of social grooming. Our desire to keep in constant touch is perhaps never more in evidence than in our use of text messaging, and interaction need not be within a close social network. Text messaging surged in the week that war broke out recently in Iraq [10]. The BBC World Service was inundated with thousands of text messages from mobile telephone users across the globe wanting to express their views about the war. Nigel Chapman, deputy director of the BBC World Service said:

> '... suddenly text messaging appears to have moved on from personal communication to personal statement. People have strong views about the war and are using the technology they use every day to tell us. New technologies are giving us a level of interaction with our audiences that we have never seen before ...'

Text messaging was an accidental success that took the mobile industry by surprise; there was very little promotion or mention of SMS by network operators until after it had taken off. SMS was a user triumph, particularly among young adolescents. Text messaging from the tiny keypad of the mobile telephone was and is a cumbersome exercise, but, paradoxically, because entry barriers to learning to use the service are high, or at least, higher than making a voice call, adolescents saw this as an advantage in that it enables them to exclude adults [11]. Allied to exclusivity is the fact that young people evolved a new alphabet around text messaging that makes messages virtually unintelligible to outsiders. The cost of sending a text message is also pertinent to this group in that it costs less to send a text than to make a call, and, where finite funds and the need to maintain a wide social circle are at odds, this is of consequence. It should also be noted here that text messaging is one of the few services in consumer history that has grown rapidly without a corresponding decrease in pricing. The price of SMS has remained steady and is likely to do so until networks can deal with the inevitable increase in message volume that would accompany reduced prices. Costed per character it is currently one of the most expensive ways for a user to communicate text across digital networks, suggesting that a strictly economic analysis of texting would not capture the rich social norms of the activity.

In many social situations, text messages are far less intrusive than a phone call and, while they have some of the advantages of e-mail (the recipient can choose when and whether to respond), they are far more accessible. As a result there is a very low threshold for sending messages and while the informational content is often minimal, it is highly valued as social grooming. Plant [12] also points out that texting is particularly popular with individuals and cultures who have a tendency to be reserved, because the necessary brevity of messages provides the opportunity to be direct, informal, and even cheeky. 'She' [13] reports that this is highly valued by teenagers in Bangkok and Thailand because it avoids the necessity to voice feelings and thoughts and ice can be broken without the risk of embarrassment.

4. The emergence of mobile telephone behaviour

The belief of technology companies is that successful technologies owe a large part of their success to the fact that they fulfil or enhance an existing human need, or fit well into an already well-established social context. This serves to shape the way that technology will be used. Nevertheless the uses for new technologies may be quite unexpected. For example, video was developed primarily as a tool for business but has been widely adopted as a child-minding device to entertain children while carers are busy with other tasks. As Geser [7] points out, users gradually change their habits and learn to use new technology in a variety of ways across an increasing range of situations, but it is very common for them to be unable to predict their future usage patterns accurately. For example, few would have predicted that the mobile telephone might potentially be used as an instrument for divorce but it is interesting to note that in 2001, senior Islamic figures in Singapore ruled that Muslim men cannot divorce their wives by sending a text message saying 'talaq' (Muslim men are able to divorce their wives by saying the word 'talaq' — 'I divorce you' — three times [14]). While technological innovations in general have been the focus of a wealth of research, telephony, and more specifically mobile telephony, is only just beginning to be studied in any depth. And yet, as noted by several researchers [7, 15], in a global context mobile telephony is used by a far broader stratum of the population than PCs and the Internet. As with many technologies, usage expands over time as the technology is adopted into an increasing spectrum of circumstances. For example, women who typically might have said that they needed a mobile telephone for emergencies when travelling alone at night quickly found that it served as an ideal instrument for remote mothering [16].

Given the capacity of the mobile telephone to retain significant social relationships over distance it is not surprising to find that in the UK, when children leave home for the first time to go to university, parents often supply a mobile telephone as part of the essential 'leaving home' kit. As Geser [15] describes, this helps to cushion the child from the potentially traumatic experience of living in a foreign environment by enabling them to remain tightly connected to loved ones at home; hence he describes this function of the mobile telephone as 'a pacifier for adults.'

Mobile telephones are also used to fill up 'void' spaces in time, for example when travelling, or waiting at a bus stop. Plant [12] reports that in Japan, where arriving in good time for an appointment is a very important part of social etiquette, many Japanese use their mobile telephone to while away the time they have gained by being early. As Plant points out, this means that other means of killing time such as reading books and newspapers are losing out to the preferred 'keeping in touch.' In the UK, anyone travelling on a train will be familiar with the cacophony of different voices announcing 'I'm on the train', or the rush to mobile communication if there is a delay in their journey. Indeed, the infringement on the peace and quiet of other passengers has led to the creation of 'quiet carriages' where the use of mobile telephones and personal stereos are banned. Just as netiquette was touted as a rules-based way of governing communication on the Internet, there is a development of what might be called 'm-etiquette' for mobile telephone use. Infringement of these norms has social consequences. The temptation to talk on the telephone while driving long distances is so prevalent that legislation has been introduced in many countries to curtail this practice.

Much of mobile voice call behaviour has been explained in terms of the potentially unstable or unknown sense of place between communicators. When making a call to a friend on a landline we usually know something of their environment, have knowledge of other family members who may be present, and the kind of activities that they may be engaged in at the time of the call [17]. However, in making a call to a mobile telephone this information is absent — hence the question 'where are you?' enables a communicative context to be established. As Chihara [18] points out, responses to this question may of course be intentionally false, but, nonetheless, a shared context of supposed location is still created. An increasing emphasis on the consumption of place is evident in the work of technologists seeking to develop location-based services. These both reflect and reinforce the relationship between actual geographical locations and mobile telephone behaviour.

Far from place becoming less important, these developments suggest that location will become accentuated.

5. The mobile telephone in a 'risk society'

Widespread use of a relatively new technology inevitably raises questions concerning health and mobile telephone safety has been the subject of much public debate. Conflicting reports about possible health risks of mobiles appeared in the late 1990s and are centred on emissions of radiofrequency (RF) radiation from the handset and from base-stations that receive and transmit the signals. Public concerns about possible ill effects from mobile telephones, base-stations and transmitters led to a UK Government decision in 1999 to establish an independent expert group to examine any possible adverse effects. This group used input from a wide variety of sources across the UK and abroad to produce a report in 2000 known as the Stewart Committee Report [19] and points out that:

> '... the balance of evidence does not suggest mobile phone technologies put the health of the general population of the UK at risk ...' [20]

Although this report would suggest little evidence to support the idea that carrying a mobile telephone in a trouser or jacket pocket is a health risk, in September 2002 jean manufacturer Levi Strauss launched a new line of trousers which it says protects the wearer against any radiation emitted by a handset. Although Levi say that they are not implying in any way that mobile telephones are dangerous, the company decided to launch the new range after extensive market research showed that fashion conscious consumers were also health conscious. The trousers, are fitted with pockets which have an 'anti-radiation' lining and are expected to go on sale early in 2004. The World Health Organisation has suggested that there is no need for this lining and this is supported by the mobile telephony industry who warned that the lining could stop mobile handsets from working properly. The new product has also provoked criticism suggesting that the company is playing on consumer fears. A spokesperson for Levi Strauss said that it is merely responding to consumer desire. Call volume would seem to suggest that people, fashion conscious or otherwise, do not take any supposed health risks very seriously at the point of use. However, the mobile has become part of a culture of technological risk, in which everyday practices are conducted in the context of competing scientific claims about harm and danger.

While mobile telephones have received much negative attention in the press there are also numerous reports in newspapers world-wide describing how mobiles have saved lives. According to the Cellular Telecommunications and Internet Association, over 140 000 calls are placed to the emergency services from mobile telephones every day. The prevalence of mobile telephones means that in an emergency situation the chance of someone witnessing the event having a mobile and being able to contact the emergency services is high. Examples of mobiles being used in this context are too numerous to mention but certainly they are reported across the globe — from being trapped in the rubble of an earthquake in El Salvador [21] to a car crash victim in British Columbia [22], to saving the life of a British explorer trapped near the North Pole [23]. Recently, the first case of a text message being used to locate a casualty in the UK was also reported [24].

A culture of public reporting that goes further than accidents and emergencies has also emerged; many people ring in to radio stations to report traffic hazards, congestion, and bad weather conditions. This has led to claims that mobile telephones are making a significant contribution to social capital by providing a means for people to become more active citizens by engaging in small acts of social responsibility [25].

6. The object as fashion accessory

The mobile handset has become a widely recognised consumer artefact. Particularly notable in this regard is the way in which faceplates have become circulated independently of the handset in order to enable constant customisation, for example to match a colour scheme, or to show allegiance to a football club, or a popular icon. Many advertisements in the UK for new mobile telephone upgrades play on the public's understanding of technological novelty. The idea that the mobile is on constant show and is therefore a fashion accessory has fed into an advertising rhetoric of continual upgrading to avoid being shamed.

Recently advertising has particularly focused on the youth market, both in terms of handsets and services. Although it is not obvious how this might have a positive impact on the health of the nation's teenagers, there is some evidence to suggest that a decline in teenage smoking [26] is correlated with mobile telephone ownership. There was a sharp decline in smoking among boys and girls aged 15 in the late 1990s during which time mobile telephone ownership sharply increased. The British Medical Journal [27] reported that the fall in youth smoking and the rise in ownership of mobiles among adolescents are related because the functions that smoking offers to teenagers are similar to those offered by owning a mobile telephone. Mobiles consume teenagers' available cash, particularly topping up pay-as-you-go cards. It is also argued that the mobile is an effective competitor to cigarettes in the market for products that offer teenagers adult style and adult aspiration because the marketing of mobiles is rooted in promoting self-image and identity. As ownership increases, mobiles become essential for membership of peer groups that organise their social life on the move — hence the need to own a mobile provides vigorous competition for money that might otherwise be spent on cigarettes.

The appeal of mobile telephones to teenagers goes far beyond fashion and text messaging; more than anything it provides them with a private, personal piece of technology that enables them to exclude adults from their communication circles and practices. An important issue in teenagers' lives is the process of emancipation from parents and in some respects, owning a mobile can be seen as a rite of passage. Fortunati [28] argues that as a result, the family social system is weakened because children are now managing their own communications networks and Plant [12] notes that mobile telephone use among children and teenagers in Japan enables many to lead lives that are totally opaque to their parents.

One of the dangers in approaching the mobile telephone as an artefact of mass consumption is that we can assume that the buying of the new device is when 'meaning-making' happens. However, the social relations around consumption extend out from this point of purchase, both before the sale and afterwards. This would suggest that more attention needs to be paid to research on the circulation of telephones, for example as they are bought, and sold as 'second-hand', or are passed through friendship or family networks. Furthermore it is clear through the circulation of faceplates that the mobile may not always be consumed as a whole object, but needs to be considered as an artefact which may be disaggregated. This is also evident in the way SIM cards may circulate independently of their original handsets or owners. The flip side of the conventional talk of consumption is the role of mobile telephones in supporting all kinds of illegal activities — understandably hard to research, but significant to their social history.

7. Global contrasts

One of the dangers in presenting descriptions of behaviour and consumption in a European context is that the pattern of adoption shows vast global variation, as the quotation from Agar indicated at the beginning of this paper. As noted by Townsend [15], one major impact of the mobile telephone is its capacity to include partly illiterate mass populations in less developed countries.

Mobile telephones are undoubtedly changing how, when, where, how often, to whom, and about what we communicate, but if changes in western society have been remarkable, elsewhere in the world they are even more dramatic. For example, in Britain we have long enjoyed an efficient network of public and private access to telecommunications but many other countries, particularly poorer countries, have not. Traditional state telecommunications monopolies in the former Soviet Union, for example, made people wait for months or even years to have a telephone connected and vast regions were not connected at all. Mobile telephones, and, in particular, pay-as-you-go schemes, have enabled millions of people world-wide to bypass landline-based systems that are too expensive, poorly maintained, difficult to access, or even non-existent. For example only 3% of Africans have a mobile telephone but they account for 53% of all telecommunications subscribers on the continent. In Gabon there are 37 000 land lines but mobile subscriptions exceed 250 000, and China has more mobile subscribers than the USA and Canada put together at 145 million.

In rural India, mobile telephone demand is growing rapidly, and its usage flourishes where fixed-line service is non-existent. In Kerala, for example, fishermen use mobile telephones to compare the prices they might receive for their catch at different ports. One fisherman claimed that his profit on each eight-day fishing run in his trawler had doubled because he was now able to use his telephone to compare prices at Cochin with those at Quilon, a port 85 miles away [29]. Similarly, Plant [12] describes a Somali trader in Dubai who exports small electrical goods who says that the mobile is his livelihood — 'no mobile, no business'. In Europe browsing Web pages via a mobile phone has had a very luke warm reception but among market traders in Senegal it is proving very popular. A project called Manobi [24] run by French and Senegalese entrepreneurs gathers information about the prices of food and goods being sold in Dakar and uploads them to its central database. Farmers can use their mobiles to dial in to the server via WAP and find out what the prices are at different markets so that they can get the best return for their produce. Many of the farmers using the system are illiterate but they are familiar with using calculators and treat the mobile telephone in a similar fashion. Even though the project is in its early stages it is already having an effect on the way the farmers grow crops and now many of them are only producing crops for particular markets and will only bring produce to a market where they know they will get a good price.

8. Summary

The mobile telephone appears to be a global artefact, attracting attention from technologists and policy-makers, as well as consumers. In this paper we have suggested that the multiple dimensions of social influence stem not just from the technological developments of smaller batteries and compatible standards, but from the ways in which these become integrated into social changes which are already under way and are supported by the new kinds of communicative forms which the mobile telephone permits. A measure of the mobile as a cultural icon in the UK is the role it plays in contemporary conceptual art, such as the wall of mobile telephones constructed by Thomson and Craighead [30]. In thinking about cultural importance it is crucial to look beyond traditional technical functionality of, for example, the SIM card, the network and the keypad. The handset as a symbol of status and fashion does not necessarily require connection to a network.

This paper necessarily provides only snapshots in social history. Social research on mobile telephones has only become a sustained endeavour in the last 4—5 years, and many topics, particularly in a non-Western context, remain underexamined. Among the most interesting of these is mobile use by specific local subcultures which are outside the marketers' gaze. It is likely that if a fuller social history were written we would discover even more competing accounts of the emerging role of the mobile, and richer stories about the ways in which it has been resisted or rejected.

Currently much research has been funded by industry and this has led to a strong emphasis linking telephones to consumption, and a forward-looking stress on new business offerings such as mobile picture messaging. Yet looking back to the earlier developments, particularly through previous conflicts about standards or unanticipated functions, is equally important in assessing the on-going impact not just on individual behaviour, but on the social structure of contemporary societies.

9. A view of the next decade of mobile communications

The coming decade will see rapid convergence of bio-technology, materials science (including nanotechnology), artificial intelligence, robotics, computing and tele-communications. This convergence will create whole new classes of device that we can scarcely imagine today. BT Exact is already discussing with other companies the potential for electronic devices printed on to or even into our skin. These would enable video displays and tattoos, smart make-up and perfume, medical monitors, computer interfaces and communications. It will eventually be possible to print a telephone into your wrist! We can expect technology of all kinds to become cheaper and more ubiquitous, resulting by 2010 in a smart environment bristling with sensors, processing and communication, with displays everywhere, and millimetre accurate positioning.

It is reasonable to assume that a number of high-speed wireless networks will be available that do not directly charge users for communication. This will force communications companies to move further up the value chain and charge for added value, that is value that we can add to people's lives or businesses. Fortunately, the explosion of new technologies resulting from convergence will provide us with many opportunities to do just that.

There are strong hints that we will soon have wirelessly networked credit card sized polymer displays for just a few pounds. These could be used for hundreds of new applications. Apart from being a light, portable TV, they would have extensive marketing capability, perhaps giving us the video cornflake packets illustrated in the film *Minority Report*. Devices such as that would also give us smart tickets that can guide you through an airport terminal and keep you up to date with flight progress, while acting as an advertising medium to show you special offers in the shops as you walk past. They could be used as compact notebooks, diaries, and mail terminals. They will be used for clothing and body adornment, portable games and entertainment. They are very likely to be used for social and tribal display, assisting networking in nightclubs, and marking tribal allegiance on the street.

It is the social uses of telecommunications that have traditionally been overlooked in favour of one-to-one communication. Most people exist as part of several social groups, and communications and relationships between members of these groups are a potentially large, mostly untapped, revenue source. People can already send text messages to groups of friends, but we must go much further. We should expect instant voice messaging, coherence utilities and tribal maintenance. A quick glance at a display when we are shopping should tell us if a close friend has also come to town and is within a short distance. Adding value to our lives by improving and managing social interaction opportunities will replace much of the revenue lost by the dropping of call charges.

Mobility itself will not contribute any extra volume to devices in the far future, so we should not expect mobility to have any effect on form factor. At presumed low cost, wireless connectivity will be taken for granted in any electronic gadget. Design will become increasingly important as the technology is commoditised.

We may expect that as devices become less bulky, there will be less need for integration of functionality. Furthermore, ubiquitous high-speed wireless (probably over LANs in the long term) will ensure that remote functionality is available even via modest gadgets. So people may carry a range of different devices with them for different purposes, without too much concern for their built-in function, and of course these will interwork well.

Increased connectedness makes networks more powerful. In the future, most people would be constantly accessible (when they want to be) everywhere, and 'always on.' This makes it much easier to make strong social networks. Pressure groups and ideological communities in particular will benefit, able to instantly co-ordinate the behaviour of large groups of supporters, and canvass new support. Network communities are already making good use of text messaging, but future networks will link not only the people, but all of their IT resources, seamlessly. Messaging would be instant and virtually free, so current barriers would be very much reduced. Large global pressure groups could therefore wield their increased muscle much more easily and effectively.

But having ubiquitous access to the Internet will make the Web more useful too. Today, it is still painfully difficult to access the Web on the move at any speed — only a few locations offer high-speed access, and this usually has to be bought first. As free access everywhere becomes routine, we will make much more frequent use of the Web, accelerating the virtuous circle linking the number and value of users and the quality and usefulness of applications. This of course will feed back into other areas of development. It will be seen that free access actually increases the revenue for the network providers and communication companies, who will adapt to new business models.

An area that is often overlooked is the creation of applications by users themselves. Text messaging may have been created by engineers, but its take-up was still surprising to most (a text-messaging-phone invention in 1991 was dismissed as irrelevant by senior BT managers — why would anyone want to send text when they can talk to someone?). However, we can expect that artificial intelligence and generally better software tools will enable almost anyone to create new applications with the technologies freely available. This would cause a huge increase in the range of applications, most of which would not come directly from engineers in IT companies. If we are to make the most of the potential opportunities, we must have platforms on which customers can easily do this, and more importantly, try to guess the areas of life that our customers are likely to address, and the things they are trying to solve or improve. We might be able to do something even better, even earlier. This role is perhaps more appropriate to psychologists than engineers. Furthermore, if the domain of social interaction services proves to be as lucrative as hoped, engineering might have a much more direct social focus, which might help to attract more women engineers.

References

1 Agar J: 'Constant Touch: A Global History of the Mobile Phone', Icon Books, Cambridge (2003).

2 ITU: 'World Telecommunications Development Report: reinventing telecoms', (2002).

3 ITU: 'Trends in Telecommunication Reform: effective regulation', (2002).

4 Mobile Operators Association — http://www.mobilemastinfo.com/information/history.htm

5 Roos J P: 'Sociology of cellular telephone: the Nordic model', Telecommunications Policy, 17, No 6 (August 1993).

6 Fischer C: 'America Calling: A Social History of the Telephone to 1940', University of CA Press (1992).

7 Geser H: 'Towards a sociological theory of the mobile phone', (2002) — http://www.socio.ch/mobile/t_geser1.htm

8 Churchill E and Wakeford N: 'Collaborative Work on the Move', in Brown B, Green N and Harper R (Eds): 'Wireless World', Springer Verlag (2001).

9 Haddon L: 'The Social Consequences of Mobile Telephony', Framing, Oslo (2000).

10 Guardian unlimited (28 March 2003) — http://www.guardian.co.uk/

11 Rautiainen P: 'Mobile communication of children and teenagers', Case, Finland, Tampere (1997—2000) — http://www.telenor.no/

12 Plant S: 'On the mobile: the effects of mobile telephones on social and individual life', (2000) — http:/www.motorola.com/mot/documents/0,1028,333,00pdf

13 'She' magazine — http://www.she.co.uk/

14 BBC World Service report (2001) — http://www.bbc.co.uk/worldservice/

15 Townsend A M: 'Life in real-time city: mobile telephones and urban metabolism', Journal of Urban Technology, 7, No 2, pp 85—104 (2000).

16 Ling R: 'Traditional and fixed and mobile telephony for social networking among Norwegian parents', in Elstrom L (Ed): 'Human Factors in Telecommunication', 17th International Symposium, pp 209—256 (1999).

17 Lacohée H and Anderson B: 'Interacting with the telephone', in Kraut R and Monk A (Eds): 'Home Use of Information and Communications Technology', Special Issue of the International Journal of Human-Computer Studies, 54, No 5, pp 665—699 (May 2001).

18 Chihara M: 'Lying on the go', Boston Phoenix (16 March 2000) — http://www.bostonphoenix.com/

19 Stewart Committee Report — http://www.iegmp.org.uk/

20 Sir William Stewart, Chairman IEGMP (April 2002) — http://www.iegmp.org.uk/report/announcement.htm

21 Wireless News Factor — http://www.wirelessnewsfactor.co/perl/story/7311.html

22 Wired — http://www.wired.com/news/wireless/0,1382,52363,00.html

23 vnunet — http://www.vnunet.com/News/1131965

24 BBC — http://www.news.bbc.co.uk/

25 Chapman S: 'Lifesavers and cellular samaritians: emergency use of cellular (mobile) phones in Australia' (1998) — http://www.amta.org.au/files/issues/pdfs/emergency.pdf

26 Office for National Statistics: 'Drug use, smoking and drinking among teenagers in 1999', London, ONS (2000).

27 Charlton A and Bates C: 'Decline in teenage smoking with rise in mobile phone ownership: hypothesis', British Medical Journal, 321, p 1155 (200).

28 Fortunati L: 'The mobile phone: new social categories and relations', University of Trieste (2000) — http://www.telenor.no.fou/prosjekter/Fremtidens_Brukere/seminarer/mobilpresentasjoner/

29 New York Times (4 August 2001) — http://www.nytimes.com/

30 Thomson and Craighead — http://www.thomson-craighead.net/

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