

# **Coordination of technology and diverse organizational actors during service innovation – the case of wireless data services in the United Kingdom**

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## **Abstract**

Mobile operators have made massive investments in spectrum and infrastructure to provide mobile broadband content services on ‘mobile Internet’. Faced with considerable uncertainty regarding market growth, technology options and regulatory policies, the introduction of broadband services requires the integration of multiple and diverse technologies and business models across organizations. We present a detailed theory-based study of how technologies and organizations’ interests are aligned and coordinated in order to launch 3G broadband wireless services in the United Kingdom. Actor-network theory is adopted as a theoretical lens for understanding how the relationships among the actors have been shaped by the industry’s history as well as by the possibilities created by new technologies and standards. Drawing upon 17 interviews of executives from key players in the UK mobile wireless industry including network operators, content providers, regulators and technology/service innovators we conclude that the actor-network around broadband wireless services has yet to stabilize. Wireless network operators continue to explore a range of alternative relationships with content providers and other actors while uncertainties in the environment remain unresolved. Network operators’ strategies and relationships with other business and technological actors differ considerably. We explain both the rationales behind these distinct arrangements and historical “weight” of established media and fixed telecom industries in the UK. These established industries lie behind some unique arrangements with content providers and fixed network operators that have emerged during the last years. The configuration of the emerging actor-networks in the UK are contrasted with those in the US and Korea.

*Keywords:* Wireless data services; broadband; Actor-network theory; United Kingdom; 3G

## **1. Introduction**

First generation (1G) mobile cellular systems, launched around the world in the 1980s, offered a simple telephony service integrated with the public telephone network. Conversion to digital platforms with second generation (2G) systems made data services viable and the short-message service (SMS) in particular became a commercial success.

Bringing mobile wireless services to market has always required the coordination of the technologies as well as technology providers, network operators, retailers, fixed-network

operators and national and regional regulators. Coordination of technologies was achieved with the help of a range of air-interface, networking and signaling standards. The structure of the relationships among the commercial players was shaped by competitive pressures, the cooperation required to build the systems, the nature of the technology as well as the regulatory regime's perception of how consumers' interests could be best served. Key regulatory decisions included the number of operators licensed, the spectrum made available, the support for particular air interfaces as well as numbering and billing arrangements. Of course the industry also had to coordinate with consumers by providing attractive services and pricing. For basic telephony network operators competed on price, branding, service quality, the availability of desirable handsets and, at least during rollout, service coverage. The service itself did not require much explanation – the expressions *wireless phone* or *mobile phone* covered user education. SMS was something of an afterthought in 2G systems and consumers themselves gradually figured out how to incorporate it into their lives.

The popularization of the Internet in the mid-1990s created a lot of interest in providing similar data services to mobile consumers on wireless handsets. In the UK mobile data services offerings have been built upon technological capabilities ranging from text-based services on small black-and-white screens using expensive 9.6kb/s circuit switched bearers to full-color multimedia services relying on megabit/s packet switched bearers. The coordination problems around providing 'mobile Internet' like services are considerably more complex than was the case with telephony and text messaging. There are many more technical interfaces at all layers of the stack that vary among operators and among handsets. There are a range of new backend equipment and software providers, device navigation and middleware vendors as well as application and content creation, packaging and aggregation (see Figure 1 for a high-level depiction of the main players in the wireless industry). It has also proven more difficult to coordinate with potential consumers.

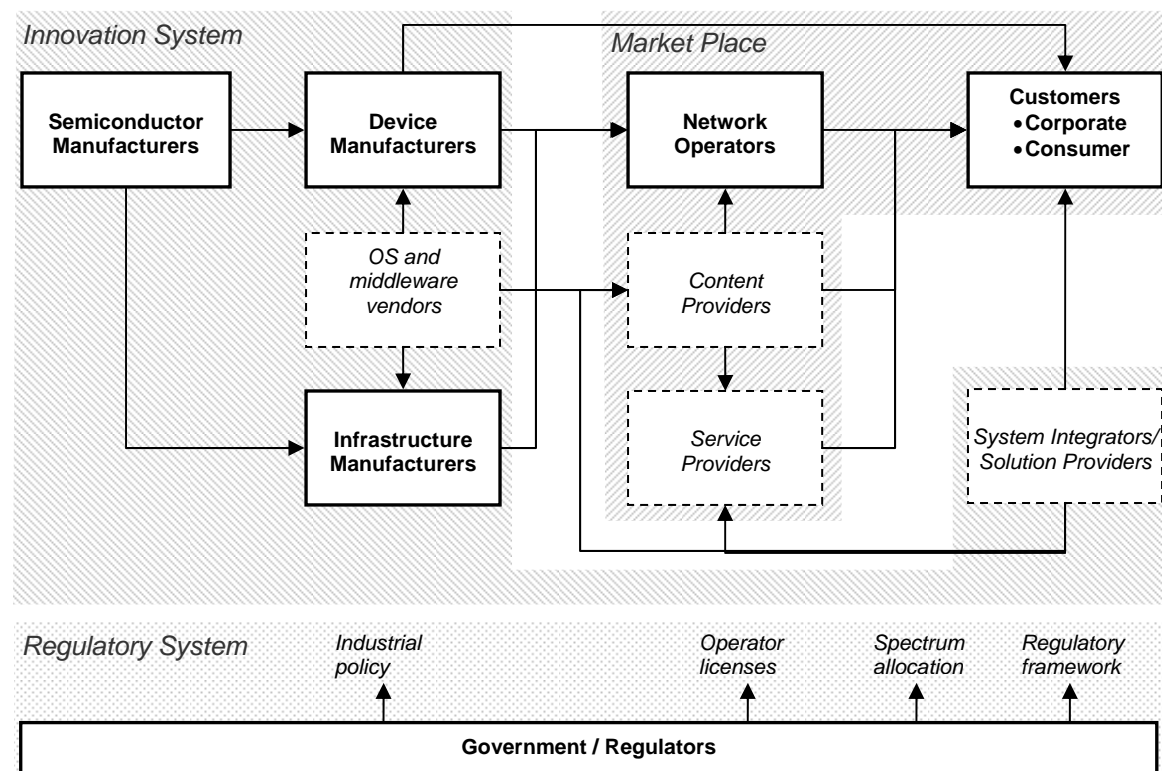


Figure 1. Major organizational actors in the wireless industry (Tilson & Lyytinen, 2005)  
(New types of actors associated with data services are shown in dashed boxes)

We adopt an actor-network based theoretical perspective to explore the question: How is the coordination of the technical components, and the coordination of customers, network operators, content providers and other essential actors playing out in the deployment of 'mobile Internet' type services in the United Kingdom? We explore the shaping and the coordination of the technologies by commercial and policy actors as well as the shaping of the relationships among these actors (i.e. industry structure) by their own strategic actions, the intentional and unintentional actions of others and the behavior of current and future technologies.

In the following sections we provide a brief overview of the actor-network perspective, the methodology adopted for the study and our findings from a series of interviews with executives from important players in the UK mobile wireless and related industries. The findings are contrasted with those from prior studies in the US and Korea (Tilson & Lyytinen, 2004; Yoo et al., 2005). In the final section we discuss the implications of the findings for commercial and public policy players as well as researchers interested in the delivery of mobile computing services.

## 2. Theoretical Perspective

We deploy actor-network theory (ANT) as a primary theoretical lens to examine the socio-technical means in which coordination is achieved during the creation of mobile Internet type services. ANT strives to avoid the technological determinism of economics and the social determinism of some sociological perspectives (Howcroft et al., 2004). It does this by removing the distinction between the social and the natural/technical – regarding them symmetrically and as “phases of the same essential action” (Latour, 1991, p129). ANT is particularly suitable for our purposes as it lends itself to the consideration of hybrids of human and non-human elements (Walsham, 1997). It provides a network-building metaphor and a vocabulary for describing the process of coordinating social and technical actors as a cascading stream of translations.

ANT views the world as networks of technical, natural and social actors (or elements) and treats them symmetrically. For Latour (1998) “there is nothing but networks.” Modern societies have a “fibrous, thread-like character” (Law, 1992) with actors being defined solely by their ties to other actors. ANT does not discriminate between macro and micro actors (i.e. individuals, groups, or organizations). Actors can also be technical artifacts ranging from the smallest component to the largest system<sup>1</sup>. The building of actor-networks is the process of overcoming the resistance of all sorts of actors and weaving them into networks with other actors (Law, 1992). The challenge is to explore how actor-networks come to generate effects like organizations, power, innovations, and industry structures.

The core of ANT analysis is the process of *translation* (Callon, 1986; Latour, 1987) where actors align the interests of others with their own. Translation follows three phases. During *problematization*, a focal actor frames the problem and defines the identities and interests of other actors to be consistent with its own interests. The focal-actor renders itself indispensable by defining an obligatory passage point (OPP) under its control that other actors must pass through to achieve their interests (Callon, 1986). The OPP is typically in the focal actor's direct path while others may have to overcome obstacles to pass through it (Callon, 1986; Sidorova & Sarker, 2000). For example, control of the Windows API (an OPP), and the resulting huge actor-network aligned with its interests, gives Microsoft considerable power.

The definition of others' interests and of the OPP are part of an actor's strategy for aligning others' interests with its own. Other elements might include creating incentives to

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<sup>1</sup> As actors can be human or non-human we purposely use the pronoun “it” rather than “him” or “her.”

encourage others to overcome obstacles to passing through the OPP. In the second translation phase, *interessement*, the focal actor executes these strategies to convince others to accept its definition of their interests. The final phase, *enrollment*, is the moment when another actor accepts the interests defined by the focal actor. Enrollment also includes the definition of roles for actors in the newly created actor-network.

During translation the focal actor assigns interests, projects, desires, strategies, reflexes and afterthoughts (Callon, 1991) to others. Enrollment implies a degree of acceptance of the assigned roles and this plays a large part in how certain relationships among human and technological actors become inscribed in technical standards and work practices. However, actors may not fully assume the assigned role and the possibility of resistance through interpretive flexibility allows for reinscription (Howcroft et al., 2004 p.346). Thus the outcomes of actor-networks building and creating inscriptions can be unpredictable.

Actor-networks with strong, stable ties can become taken for granted and used as “packages” or “resources” in the continued construction of actor-networks (Latour, 1987). These “black-boxes” can include agents, devices, texts, relatively standardized sets of organizational relations, social technologies, boundary protocols or organizational forms (Law, 1992). For example, Bowker et al. (1996) found that a classification scheme of nursing work acted as a black-boxed political actor and Boland and Schultze (1996) explained how activity-based costing became a black-box through the enrollment of allies. However, black-boxes continue to face resistance – while they are maintained by being performed and reproduced no organization or innovation is ever complete as actors can defect at any time (Callon, 1986).

Black-boxes can exhibit the property of irreversibility – “the extent to which it is subsequently impossible to go back to a point where that translation was only one amongst others; and the extent to which it shapes and determines subsequent translations.” (Callon (1991 p.150) Irreversibility not only makes it difficult to undo previous translations, but also constraints future possibilities<sup>2</sup>.

The research question presented in the introduction can now be reworded in ANT terms. The aim of this article is to explore the question: How are the actor-networks around the deployment of ‘mobile Internet’ type services in the UK being built, what obligatory passage points (OPP) are being used, and how are existing actor-network configurations influencing the process?

### 3. Methodology

We pursued our research goal by performing a cross-sectional case study of the mobile wireless and related industries in the UK. We conducted 17 in-depth interviews with key industry decision makers from a cross-section from all parts of the value-network (Fransman, 2002). Interviews are a suitable means of data collection as they provide us with an understanding of the rationales for the ways in which coordination was achieved during the deployment of Internet type mobile services. Each author had contacts in the UK mobile wireless industry and the telecommunications industry more widely. We pooled our contacts and selected potential interviewees that would give us a good cross section of the industry. The interviewees included executive level employees with three of the five UK network operators, industry regulators, device manufacturers, middleware vendors, and an industry

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<sup>2</sup> Irreversibility bears a close resemblance to what David (2000; , 1985) referred to as path dependence in which accidental or serendipitous historical choices limit subsequent economic decisions. Arthur (1989) added that the even the order of small events can have a significant effect on outcomes. One of the key conclusions from path dependency is that while one can't predict system behavior it is possible in retrospect to trace the reasons for why it behaved as it did.

consortium. The interviewees were promised anonymity and were given the chance to review this paper before publication.

Each interview explored how and why the actors participated in the deployment of mobile Internet type data services and in the wireless industry more broadly. A picture of their actor-network was built up by encouraging them to talk about how they relate to other actors, how and why they enroll in actor-networks, and how they build them. We also asked open questions about technology and services to explore how they went about problematizing and what OPPs they perceived. The interviewee's narratives are used to understand the ways in which different actors built and executed their strategies for deploying services. The interview guide (Appendix A) was based on one used in a study of the Korean and U.S. wireless industries to provide us with a basis for comparison (Tilson & Lyytinen, 2004; Yoo et al., 2005). Thirteen of the interviews were conducted face-to-face in late November/early-December 2005 and the rest by phone within a few months of this. The interviews typically lasted 90 minutes and were all recorded.

The first author, who participated in all the interviews, listened to the recordings and made detailed notes. The authors reviewed the notes to identify the main themes around the deployment of new services and coordination with technology and other organizational actors. The themes were summarized (next section) and analyzed using actor-network theory as the primary sensitizing device.

#### **4. Wireless Data Services in the UK – Themes from interviews**

In this section we present our findings about the services being offered on mobile wireless platforms, the relationships among some of the players in the industry and the role of the wireless and other technologies. We focus on three major themes. The first, around *walled gardens and Internet services*, provides a good example of where one set of actors (network operators) attempted to create an OPP (their wireless networks and walled gardens) that would shape the actor-network in their own favor, but where it actually inhibited the building of large actor-networks. This contrasts with our second theme in which a multiplicity of potential technical and business model based OPPs for *video services* is resulting in ambiguity about how a stable actor-network can be built. The third theme around *convergence with fixed services* offers an opportunity to examine how actors in the mobile wireless industry are developing differing visions of how to build actor-networks that either connect to, or compete with, strong existing actor-networks. We also present a short summary of the findings around the relationships among a sub-set of industry actors and the increasing role of brands as OPPs.

Other themes around the relationships with infrastructure and semiconductor manufacturers, the patterns of industry mergers and the role of the regulator (a very light touch at the data services level in the UK) are necessarily omitted due to a lack of space. We do not make use of ANT terminology in the remainder of this section – we leave that to the discussion section.

##### **4.1 Walled Gardens and Internet Services**

The services offered on mobile wireless platforms have diversified and used richer media as the capabilities of the devices and the bandwidths available have improved. Voice communication continues to be the 'killer app' and SMS accounts for the vast majority of the data service revenues. Network operators have offered 'walled garden' data services to customers (e.g. Vodafone Live and T-Zones) for several years. Operators looked to retain control of content and to take 50-60% of service revenues. Content typically includes news,

sports and basic entertainment services using text, graphics and more recently video clips as well as ring tones and wallpaper downloads. While ring tones have been a particular success there has been a growing realization that content creation is not really a strength of operators and that there is a role for brands more associated with quality content. News or sport branded by a network operator has not proven to be as compelling as, say, BBC News or Sky Sports. The uptake of what was thought to be a mature sports-alert service offering tripled when it was relaunched with a major content provider's branding. There has been a general retreat by operators from creating content and a willingness to let content creators do what they are good at. This of course lessens the operators' control of content.

While walled gardens can provide customers with the most popular content network operators are unable to make deals with all the content providers that their customers would like to use (e.g. preferred news sites, financial information providers or sites covering specialized interests). T-Mobile have focused this 'long tail'<sup>3</sup> of content by making the full Internet available on handsets through its "Web'n'Walk" offering. While the Internet has been available on handsets for some time the experience on the tiny screens and prohibitive tariffs have discouraged widespread use. T-Mobile claim to have solved some these problems by improving rendering on PDA sized screens and by offering more compelling pricing.

Another operator, O<sub>2</sub>, has introduced the i-mode service that has proven extremely popular in Japan. An i-mode service launched in the UK in late 2005 with about 100 sites and has adopted the more generous 90/10 revenue split in hope of better aligning the interests of the content providers. It is evident that the industry has yet to find or create a dominant actor-network configuration for data services to handsets. Operators are trying a range of configurations for delivering data services to handsets. Each operator is offering some combination of walled gardens with a variety of business models or relinquishing control of content entirely by facilitating Internet surfing on handsets.

## 4.2 Video Services

As device capabilities have improved video services have become possible. Handset based video calling made its debut in the UK with 3's launch of a 3G network in 2003. One reason that has been proposed for the slow uptake is that it is restricted to other 3 customers – a severe limitation in the early phase of network development. At the end of 2005 Vodafone and Orange started to offer video content to their subscribers. Time-critical news and sport channels are transmitted live while less time-critical content is looped. The current wireless technologies for video on handsets rely on non-scalable unicast mechanisms. It is likely that these mechanisms would be replaced if video on the move became popular. However, there is considerable uncertainty about the technologies that would eventually dominate mobile video services. While digital terrestrial television (DTT) broadcasts exists the modulation and coding schemes used for the broadcasts do not lend themselves to reception on handheld devices due to battery constraints. A standard specifically intended for broadcasting to handheld devices (DVB-H) has been successfully trialed in the UK – however there is as yet no spectrum allocated for such transmissions and a new transmission network would be required. Piggybacking on the digital audio broadcasting (DAB) network is conceivable. This has the advantage of existing spectrum allocations and transmissions networks. The downside for operators of DVB-H or DAB broadcast mechanisms is that there is no clear revenue

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<sup>3</sup> 'The Long Tail' is a reference to an article published by Chris Anderson in the October 2004 issue of Wired magazine. Anderson points out that businesses like Netflix and Amazon allow customers to access many more DVDs and books than would be economically viable with physical stores. Each DVD or book in the 'long tail' of the sales distribution represents only a tiny fraction of the sales of 'hits.' Nevertheless, the cumulative sales of the all the products in the tail is a huge revenue opportunity for business models freed from the 'tyranny of physical space.' The interviewee who mentioned this concept was drawing a parallel with the limited content that a network operator could maintain in a walled garden compared to the much wider range of content available on the wider Internet.

opportunity. A multicast enhancement to the UMTS air interface specification (MBMS) would allow operators a more efficient mechanism to deliver popular video content to its users, and to collect revenue.

Content providers are keen to provide some means for customers legitimately to access video content on-line to forestall the emergence of illegal mechanisms. This will increasingly occur via fixed broadband access to desktop PCs and laptops – the ‘second screen.’ The screen on handsets is a ‘third screen’ that can compete with, or complement, TV and PC screens. Video services on this ‘third screen’ are seen as ways of accessing an audience, particularly younger generations, that are watching less television. It also can help with customer acquisition, churn and average revenue per user – key pay-TV industry metrics.

As their customers are not tied to one mobile wireless operator major content providers are loathed to make exclusive deals with just one network operator, since doing so would alienate most of their customers. The BBC’s universal service obligation effectively prevents it from reaching exclusive content distribution deals in the UK at least for initial broadcasts as the audience has already paid for the content through the television license fee.

As with other content, brand is important for video. For example, Vodafone’s recently launched video service has been branded as “Sky Mobile TV” and is therefore easier for customers to understand than a “Vodafone TV” offering might have been.

A wireless connection is not necessary for time-shifting and location-shifting video content. The popularity of the iPod and similar products shows that, at least for music, many consumers prefer to select their content and are content to download it onto portable devices at home. Apple has started offering video for the iPod, and Google also offers video for iPod, Play Station Portable and other devices. Even without the use of a broadband connection and a PC it may well become possible for consumers to synchronize a portable device with a personal video recorder (PVR).

#### ***4.3 Convergence with fixed-services***

Wireless technology is not solely used for mobile applications. The fixed-wireless ISP ‘UK Broadband’ (a PCCW subsidiary<sup>4</sup>) uses UMTS-TDD (a ‘3G’ technology) to provide service in a limited geographical area. Most interviewees doubt that the economics of providing an alternative to DSL or cable modem based Internet access is viable – particularly since recent 50-75% reductions in the regulated price for local loop unbundling. The same would go for service providers contemplating the use of WiMAX or similar technologies.

Nevertheless network operators are cognizant of the importance of fixed broadband and see playing in this space as strategically important but their views of how to do so differ. One operator for example views wireless Internet access using 3G UMTS as a pale imitation of the experience of using fixed broadband. Even the megabit bandwidths promised by upgrading 3G networks to HSDPA in the next few years is considered unlikely to be competitive as fixed technologies will also have improved. This operator’s strategy is therefore to use DSL as their main offering in the broadband market. Another operator believes that HSDPA may well provide a viable alternative to fixed broadband in near future and has no plans to offer a fixed broadband alternative in the UK.

#### ***4.4 Relationships***

There is broad agreement that UK customers tend to first make purchasing decisions about the handset they want and then to pick a network operator. So offering a wide range of

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<sup>4</sup> PCCW is a South East Asian communications company

handsets to customers is important for operators' competitiveness. While the operators purchase the bulk of their handsets from 'tier 1' manufacturers they will also work with smaller ODMs to develop products where they see gaps in the handset market or opportunities to differentiate their device offer (e.g. O<sub>2</sub>'s X-Series and Vodafone's Simply devices). However, when it comes to offering services beyond simple voice and messaging a diversity of devices is an operational disadvantage. The application environment, browser characteristics and multimedia capabilities vary by device – even the same handset on different operators can behave differently. The wider the range of devices supported the more transcoding needs to be done and the greater the possibility of support issues. One content provider reported that they have to generate between 50 and 60 video formats to support a video service in the UK. So operators face trade-offs between offering an attractive portfolio of devices while having to support a wider range in the field. While network operators, device manufacturers and content providers all express the need for effective standards higher in the stack the industry as a whole has not been able create and implement such standards.

Tier 1 device manufacturers have very strong brands in their own right and are protective of the look and feel on their devices. Operators are generally only allowed to apply a fairly thin 'skin' to the devices' user interfaces although larger operators have had been able to drive some level of device standards to limit the number of capability profiles that it has to support in the field. For walled garden data services the operator's brand and navigation preferences usually dominate once the customer enters the browser. Thereafter both operator and content provider brands predominate.

## **5. Discussion and Conclusions**

The interviews provide a broad picture of an on-going process of coordinating technologies, services offerings and inter-organizational relationships. In addition to the organizations participating in the industry there are many technical artifacts (e.g. device characteristics, broadcast and unicast video transmission mechanisms) and more intangible actors (e.g. proposed standards, brands and business models) actively shaping and being shaped by these coordination processes. In this section we address our research question by relating the findings presented in the previous section to the actor-network theoretical perspective.

### ***5.1 Actor-network building around wireless services***

In the early days of offering content-based data services to wireless handsets network operators tried to establish themselves, their wireless networks and their walled gardens as OPPs for content and services providers. While some were certainly enrolled there was a limit to the growth of the actor-network because of the tight control network operators retained over access to their OPPs i.e. there are only so many content deals that can be made and managed. This approach to actor-network building also made it more difficult for small innovative content and service providers to enter walled gardens.

Customers however did not enroll in large numbers and network operators have been disappointed with the take-up of these early services. Operators have revised their visions of the possible actor-network configurations around data services to handsets and the configurations envisaged are more diverse than before. One vision is that content providers' incentives will be better aligned by the more generous revenues split associated with the i-mode business model. Another is that providing full Internet access on handsets allows a network operator to benefit from passively joining the strong actor-networks among customers and the immense range of existing Internet content. Yet another is allowing strong

existing content and service brands more prominence within walled gardens. Each of these options entails network operators relinquishing control of content to a greater or lesser extent. This shift in power is also reflected in the major content providers' reluctance to enter into exclusive relationships with network operators. Content providers prefer to, and are able to, strengthen their existing broadcast or web based connections with customers across most or all mobile networks. Services on mobile devices are seen as an extension of existing links between customers and content providers to just one more distribution channel.

As handset and network capabilities have improved the connections among network operators, content providers, services and customers become more complex – and provides a clear example of technological artifacts 'acting' upon human actors. The transmission and processing of video in particular has become more practical over the last few years. Video conferencing has been offered on handsets but has yet to take-off commercially – not surprising since consumers have not enrolled in large numbers to actor-networks built around fixed line videophone products or PC based videoconferencing capabilities.

Services offering television to handsets have been launched using non-scalable 3G unicast mechanisms and trials of other technologies have been carried out. The brands of established video content providers are playing a more important role in the launch of mobile video services than was the case for the initial walled garden data services. However, there remains a great deal of uncertainty about the future configuration of the actor-networks that may be built around television type services to handsets. The adoption of digital terrestrial television (DTT) as the primary transmission medium would require the enrollment of technologists and nature to solve the energy storage density constraints of existing battery technologies. The DVB-H option does not have spectrum allocations and building an actor-network around this technology would require the enrollment of regulatory actors and other spectrum users – which operators may be reticent to undertake given that it is widely perceived that at £22.5 billion the UK's five network operators overpaid for their 3G spectrum in 2000. A DMB based solution would benefit from the existing actor-network of spectrum allocations and national transmission infrastructure. However, network operators are unlikely to champion these technologies as they would be difficult to use as exclusive OPPs and there is as yet no clear business model. The UMTS based multicast mechanism (MBMS) appears to be the technology that operators would favor, giving them as it would a central role for their network infrastructure. However, the future actor-network configurations around television on handheld devices remains unclear as there are also non-wireless models for video content distribution (e.g. device synchronization with a PVR or a broadband connected PC) and innovations like the Slingbox<sup>5</sup> that can provide access to your home based video content almost anywhere you have Internet access. These technologies offer differing combinations of time and/or location shifting capabilities for broadcast video content or access to a 'long tail' of video content that might never be popular enough for broadcast. The nature of the content favored by mobile customers could be an important actor e.g. time-sensitive material would favor the enrollment of broadcast or multicast mechanisms.

Apple is leading the pack of companies striving to become the most trusted brand for accessing music content. There may be an opportunity for a non-traditional player to serve the same role for video content although there are several strong UK brands associated with video content (e.g. BBC and Sky). There is an opportunity for content providers and consumer electronic manufacturers to build a presence in portable video that would exclude mobile network operators for all but time-sensitive video content.

The inability of the industry as a whole to establish effective dominant standards for Internet type services on handsets has resulted in fragmentation of service offerings and

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<sup>5</sup> [www.slingmedia.com](http://www.slingmedia.com)

customer confusion about services (contrast with the dominant i-mode standard imposed by DoCoMo in Japan). It is unclear whether the somewhat more diverse service configurations now being offered in the UK are sufficiently differentiated or aligned with customers' interests for one to emerge as dominant. There is also significant uncertainty around what technology, if any, that will dominate the delivery of video to mobile devices. A further explosion of possible actor-network configurations around television services will make it difficult for any set of actors to build a stable actor-network. For both Internet type and video service it is clear that access to mobile data networks is not an effective OPP for actor-network building but that brands, particularly content provider brands, are increasingly important.

Operator controlled access to wireless-networks and walled gardens act as OPPs for continuing innovation in mobile data services and applications. The emergence of so-called Web 2.0 applications has taken years of experimentation on the Internet – such innovations would have been less likely if the limited attention of ISPs had to be engaged and their interests translated for experimentation to even occur. Access to a long tail of experimental Internet-type, video and other services could well be what is needed for effective and commercially viable services to emerge that fulfill customers little understood mobile requirements around time/location shifting of content or the time, location and context sensitivity of services. However, the need for mutual enrollment of network operators and (other) innovators, and particularly network operators' concerns about cannibalizing existing revenue streams reduces the service experimentation likely to take place.

## *5.2 Divergence of perspectives on network convergence*

Mobile phones have had a major impact on fixed-line telephony in terms of both fixed-line substitution and the migration of voice traffic to mobile networks. Mobile network operators differ in their visions of the relationships between fixed and mobile offerings for data services (e.g. their assessment of the viability of HSDPA as a basis for a viable broadband offer to compete with DSL or cable and the need to diversify into offering fixed services differs considerably). So operators have different visions of how they can enroll technologies and customers.

Another difficulty for mobile network operators making broadband data services at rates competitive with fixed offers is the potential for users to use VoIP to bypass traditional voice services that make up the bulk of mobile network operator revenues. Again operators appear to be taking different stances – 3 has announced its intention to support a VoIP service on its network (Skype, 2006) while there is persistent press coverage concerning other operators potentially taking action to block these services (Charny, 2006). This conflict is parallel to the wider controversy around the extent that network neutrality will be maintained by fixed network operators (Geist, 2005).

Since we conducted the interviews there has been increasing merger activity to bring about converged offerings in the UK. The main cable operator, NTL, has purchased Virgin Mobile so that it can offer the 'quadplay' of cable TV, broadband, and both fixed-line and mobile telephone services. Since Virgin Mobile is an MVNO it does not have its own wireless network (it uses T-Mobile's) NTL is buying a brand and a customer service capability (Thompson, 2006). Other players have also been making deals that extend their industry roles. British Telecom has an MVNO and is using in-home broadband access points to provide lower cost use of mobile phones at home. It also plans to offer television services via its fixed offer and longer term its 21<sup>st</sup> Century Network (21CN) promises to provide an IP based platform for multiple services. BSkyB has recently purchased an ISP and 'Carphone Warehouse' has announced that it will offer fixed broadband and telephone services. Thus

there is a considerable increase in the number of actor-network configurations being explored that include various combinations of fixed and mobile voice and data services as well as broadcast, web and mobile content. Again brand is proving an important actor.

### ***5.3 Trade-offs in actor-network building***

Attractive handsets have been an important way for network operators of establishing connections with customers. So having a wide range of handsets on offer helps network operators make and keep connections with customers. Operators sometimes believe that they have a better vision of how customer make connections with handsets and work with smaller manufacturers to produce handsets targeted at a particular set of customers. It is also interesting to note that the brands of several actors strive to establish and build ties with customers through handsets: device manufacturers, network operators and content providers.

The operators' interest in offering a wide portfolio of devices is in conflict with its operational interests of supporting fewer handsets given the diversity of capabilities that greatly complicate the offering of reliable data and video services. So actors engaging in socio-technical network building can face trade-offs. Similarly, network operators trade-off increased competition against leveraging strong MVNO brands to make indirect connections with a wider range of potential customers.

### ***5.4 Final thoughts***

The increase in the number and type of actors whose interests need to translated means that the 3G transition and the new Internet-type mobile services present a more complex coordination problem than arose with the 2G transition. New organizational actors come from the convergence of the wireless industry with the computing, contents and wider telecommunications industries. Many more technical actors are involved in the delivery of non-telephony services and the industry has not black-boxed dominant solutions for enough of the technical portions of the actor-network to reduce the tremendous ambiguity about what future configurations will be built.

The way the deployment of Internet-type and other data services has been playing out is being shaped by the strategic actions of a broad range of human (organizations and individuals) and non-human actors. Black-boxed actor-network configurations have had important roles:

- regulatory actors (e.g. local loop unbundling regulations and the BBC's charter),
- technological actors (e.g. existing DAB networks and spectrum allocations) and
- commercial actors market positions (e.g. content provider brands).

The strategic actions of organizational actors in the wireless and content industries are also being shaped by changing social norms e.g. teenagers watching less TV. These norms themselves were shaped by extensive actor-networks built around technologies like television, PCs, video gaming and mobile phones. This dynamic and complex mutual shaping of the behaviors of technical and human actors challenges the usefulness of factor models (e.g. TAM) for explaining adoption of public computing services.

In the UK the walled garden business model was dominant but the fragmentation of the industry (4 and later 5 highly competitive network operators) meant that no single operator could build a dominant actor-network with other actors. This contrasts with Japan and Korea where a dominant network operator and governmental agencies respectively were able to take true focal-actor roles.

The release of five 3G licenses in the UK shaped the current level of competition and the inability of licensees to return these spectrum allocations reduced the incentives for operators

to merge to realize synergies. In the US the transition to 3G services has largely taken place within spectrum used for 2G services creating greater incentives for mergers motivated by network upgrade synergies.

The study is of course limited by its having been confined to collecting interview data at just one point time. Further work will address this limitation by including the analysis of archival data covering a much longer period of time.

## 6. References

- Boland, R. J., & Schultze, U. (1996). From work to activity: Technology and the narrative of progress. In W. J. Orlikowski, G. Walsham, M. R. Jones & J. I. DeGross (Eds.), *Information Technology and changes in organizational work*. London: Chapman & Hall.
- Bowker, G., Timmermans, S., et al. (1996). Infrastructure and organizational transformations: Classifying nurses' work. In W. J. Orlikowski, G. Walsham, M. R. Jones & J. I. DeGross (Eds.), *Information Technology and changes in organizational work* (pp. 344-370). London: Chapman & Hall.
- Callon, M. (1986). Some elements of a sociology of translation: Domestication of the scallops and fishermen of St. Brieuc Bay. In J. Law (Ed.), *Power, action and belief: a new sociology of knowledge?* (32 ed., pp. 196-233). London: Routledge.
- Callon, M. (1991). Techno-economic networks and irreversibility. In J. Law (Ed.), *A sociology of monsters: essays on power, technology and domination* (pp. 132-161). London: Routledge.
- Charny, B. (2006, April 10). Vodafone Rolls Out Possible VOIP-Blocking Feature. Retrieved April 21, 2006, from <http://www.eweek.com/article2/0,1895,1948111,00.asp>
- Fransman, M. (2002). *Telecoms in the Internet Age: From Boom to Bust...?* (Vol. New York): Oxford University Press.
- Geist, M. (2005, December 22). Towards a two-tier internet. Retrieved April 2001, 2006, from <http://news.bbc.co.uk/1/hi/technology/4552138.stm>
- Howcroft, D., Mitev, N., et al. (2004). What we may learn from the Social Shaping of Technology Approach. In J. Mingers & L. Wilcocks (Eds.), *Social Theory and Philosophy for Information Systems* (pp. 329-371). Chichester, England: Wiley.
- Latour, B. (1987). *Science in action: how to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.
- Latour, B. (1991). Technology is society made durable. In J. Law (Ed.), *A sociology of monsters: essays on power, technology and domination* (pp. 103-131). London: Routledge.
- Latour, B. (1998). On Actor-network theory: A few clarifications. Retrieved October 24, 2003, from <http://www.nettime.org/Lists-Archives/nettime-1-9801/msg00019.html>
- Law, J. (1992). Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity. *Systems Practice*, 5, 379-393.
- Sidorova, A., & Sarker, S. (2000). *Unearthing some causes of BPR failure: An actor-network theory perspective*. Paper presented at the AMCIS 2000.
- Skype. (2006, February 14). Skype and Hutchison 3 Group Join Forces to Offer Skype on Mobile Devices. Retrieved April 21, 2006, from [http://www.skype.com/company/news/2006/skype\\_hutchison.html](http://www.skype.com/company/news/2006/skype_hutchison.html)
- Thompson, B. (2006). Will 'fourplay' be the next big thing? Retrieved April 12, 2006, from <http://news.bbc.co.uk/1/hi/technology/4896104.stm>
- Tilson, D. A., & Lyytinen, K. (2004). The 3G Transition: Changes in the U.S. Wireless Industry. *Sprouts: Working Papers on Information Environments, Systems and*

*Organizations*, 4(Summer), Article 8.

<http://weatherhead.cwru.edu/sprouts/2004/040308.pdf>.

Tilson, D. A., & Lyytinen, K. (2005, June 1-3). *An actor-network study of 3G standards making and adoption in the US wireless industry - A case study of wireless operator standardization strategies*. Paper presented at the Hong Kong Mobility Roundtable, Hong Kong.

Walsham, G. (1997). Actor-Network Theory and IS research: Current status and future prospects. In A. S. Lee, J. Liebenau & J. I. DeGross (Eds.), *Information systems and qualitative research* (pp. 466-480). London: Chapman and Hall.

Yoo, Y., Lyytinen, K., et al. (2005). The role of standards in innovation and diffusion of broadband mobile services: The case of South Korea. *Journal of Strategic Information Systems*, 14(3), 323-353.

## Appendix A: Interview Guide

### Basic individual questions

1. Basic demographic information questions (age, gender, company, rank, education background)
2. How did you get involved in the broadband wireless project in the current company? Please tell us a brief history of your own career.
3. What is your current role in the project?

### Company questions

4. Please give a brief history of your firm (or organization). What are the main product (or mission), main market, number of employees, annual budget & sales volume, and the market position?
5. How did your company get involved in the broadband wireless project? Please tell us a brief history of your company's involvement in the broadband market?
6. What are the main roles that your company is playing in the broadband space?
7. What is your firm's perspective on the broadband wireless market (on competition, market, technology, standards, and applications)?
8. What standards is your firm pursuing?
9. What role is your firm playing in the development of the standard, if any?
10. What effect has your firm had on the development of the standard?

### Identifying Actor Network

11. What actors do you interact with? Who are they? What role do they play? Key individuals of those organizations? Whom do you think we need to talk to?
12. What is your relationship with those that you just mentioned?
13. What is the role of regulatory regime and where are they moving toward?

### Strategy

14. What is your firm's strategy in the broadband wireless market in terms of product, standards, and markets?
15. What is your firm's strategy in terms of R&D, IPR, and standard?
16. What is your firm's strategy in terms of standards and market?

### Technology

17. What are other key technologies that affected (either facilitate or impede) the diffusion of broadband wireless in your country?

### National diffusion

18. Please tell us how you feel about the broadband wireless diffusion in your country?
19. Can you compare the current 2.5G and 3G to the previous wireless technology diffusion? What are the primary differences, if any?