Present and Future Organisational Models For Wireless Networks

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1. Introduction

Wireless networks are becoming more and more ubiquitous. Every day, networks are being deployed all over the world by a variety of organisations. Some of these are public and some are private; some are subscription based, while others are freely accessible. Networks that were previously thought to be unrelated are suddenly becoming closely linked, with their actions/behaviour affecting those around them. It is important for organisational structure(s) to emerge to guide the development of these wireless networks. Wireless networks cooperating with one another would provide a powerful connectivity service. Also, a large number of un-co-operating wireless networks in an area may negatively affect one another. This topic bears relevance to HEA funded project M-Zones, which is concerned with the behaviour and management of multiple Smart Space domains. Organisational models are of particular importance to the research theme "Intra and Inter Domain Management of Smart Space Environments" for numerous reasons. In order for inter-domain network management to exist, inter-organisational business structures must first be in place. At present, there is very little crossover between the various mobile telecommunications operators and WiFi vendors and operators. Business models that capitalise on cross-network usage also need to be researched. A large-scale real-world implementation of inter-operating Smart Spaces will only be achieved if network providers can generate revenues from roaming users.

The paper examines organisational structures that are used across networks and proposes some potential future organisational structures that may help guide the deployment of large-scale wireless networks. The following structure is used. Firstly, the current state of Wireless networks is surveyed with respect to GPRS [1], WLAN [2], and UMTS [3]. Next, a brief historical look at telecommunications organisational structures is taken. After this, some possible future strategies are explored, first in the near future and then more long-term prospects. The value of content and services and their effect on networks is then discussed. Next, some sample scenarios are described. Finally, conclusions are drawn.

2. Current Models

The most relevant organisational models are those from the world of telecommunications, due to the fact that they have well defined structures, revenue streams and processes. GPRS is the most widespread implementation of a wireless data network. Industry experts currently regard WAP [4] as a failure [5] due to the fact that uptake and usage patterns have been extremely low[1]. Many telecommunications network operators have deployed GPRS data networks and hoped the charging per usage rather than as per time spent online would entice customers to begin using WAP or mobile Internet services. The introduction of the Multimedia Messaging Service (MMS) has encouraged the general public to use the GPRS networks. At present, MMS is still a very young technology and it is difficult to predict whether it will be as successful as SMS. However, one of the great accomplishments that the network operators have made is that most users are unaware of the GPRS network – that is to say it has disappeared from the user's perspective. The average user is uninterested in the technological

[1] However, the Mobile Data Association (MDA) announced UK Mobile Internet WAP usage has increased as of late, showing an 18% for the last quarter of 2002. http://www.mda-mobiledata.org/resource/releases/prwapjan03.asp

nature of the network that they are using. Generally, they are concerned with the services available to them and the costs incurred. The technology driving the network is irrelevant for their perspective. A major factor impeding the widespread use of GPRS networks is the huge tariffs network charge for information exchange. O2 Ireland currently charge approx. €2.42 per MB downloaded[2]. A stream of 56kbps MP3 [6] quality audio would roughly use 0.5 MB/second. Using O2's pricing structure, five minutes of audio at this quality would incur a charge of €12. An hour would cost €144. As can be imagined, any service attempting to use the GPRS would find itself severely hampered by huge costs.

Concurrent to this is the emergence of WLAN networks or WiFi 'hotspots'. At present, many businesses offer WiFi access to their customers. Some are charging for this service[3], while others are offering it free of charge and generating revenue from indirect sources[4]. The problem with these models is that they counteract one another - why would someone pay for wireless access in one café when it is available free of charge next door? A key aspect to consider is that a wireless network is in essence an "edge-network" technology. That is to say wireless networks are access points into a backbone wired network. The wired network operators will not tolerate organisations offering third parties access to their proprietary networks, without the wired operators incurring some financial gain. It is possible that the wired network operators will introduce a new type of charging scheme that takes this extra usage into consideration. If this were the case, in an attempt to recoup these new costs, some businesses may charge the customer directly for wireless access. However, others may continue to offer the service free and pass on the increased cost indirectly. E.g. increasing the price of beverages. Another interesting development in the world of WiFi has been the emergence of public wireless networks, as in the case of Hamburg, Germany. These networks are owned and operated by local government, but bandwidth is leased out to third parties requiring operator-level connectivity[5].

UMTS or 3G networks are the next generation of telecommunications network. These networks have a much more rigidly organised approach than WiFi. A lot of research has been carried out to develop sustainable business and charging models[6]. The high cost of the spectrum licenses is leaving the operators with huge bills and start up costs, which they must recoup through higher charging schemes. In order to utilise 3G networks, consumers must upgrade their current handsets and as of yet no "killer application" has emerged to entice customers to do so. It appears that at the moment, 3G is pricing itself beyond the reach of the average consumer[7]. Ultimately, customers view their mobile phones as a communications device and not an "information services" delivery system. In order for UMTS networks to achieve success, network operators need to modify peoples' attitudes towards the core function of mobile phones.

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[2] Figures based on O2 pricing schemes. For more information see http://www1.o2.ie/products_services/mobile_internet/gprs/price_plans

[3] The coffee house, Starbucks has been offering WiFi access supplied by T-Mobile, to customers for a fee. http://www.theregister.co.uk/content/archive/26747.html

[4] Some public houses in the UK are offering free WiFi access to customers. The management believe that the cost of installing and maintaining the WLAN is absorbed by increased sales of food and drink. http://www.theregister.co.uk/content/archive/28381.html

[5] The German cities Hamburg, Munich, Frankfurt and Berlin have deployed WiFi networks, offering free Internet access. http://www.hamburg-hotspot.de/

[6] Much of the research carried out in the field of business models for 3G networks is publicly unavailable. However, a lot of effort has been expended in this area. http://www.wirelessnewsfactor.com/perl/story/19533.html

[7] The House of Commons Public Accounts Committee in the UK have warned that 3G Network Operators passing on their high costs to customer could "slow the successful development of the industry and limiting the extent of competition". http://www.silicon.com/news/500018/1/1032956.html

The main organisational difference that can be observed between 3G, GPRS and WiFi is that 3G and GPRS adopt a top-down, centralised approach, where the telecommunications operator owns and operates the infrastructure and users are (generally) subscribers. However, with WiFi there is a more ad-hoc approach, with third parties generally owning and operating the infrastructure. At present, most users are not subscribers and most services are free. When compared with mobile networks, this depicts a contrasting bottom-up decentralised structure [7].

3. Historic Models

When describing future organisational structures of networks, it is worth taking a brief historical perspective on things. The evolution of networks and network providers presents an interesting trend. In the early days of telecommunications, monolithic, government-owned telecommunications companies supplied services to customers. After many years, governments began to privatise their telecommunications arms. However, the resulting private companies were in monopolistic positions and to combat this, many of them were split up into separate smaller business units and left to compete with one another (Private Fixed Line Telecommunications Operators - PT) [8]. In the 1980s, the mobile operators (MO) entered the fray. Often these were extensions of fixed-line telecommunications operators, but from the perspective of the consumer, they were another network provider vying for their attention. As the Internet gained popular momentum, Internet Service Providers (ISPs) appeared. Often subsidiaries of fixed line telecommunications operators, they also added another expense to consumers. This cycle has been graphed in Figure 1:

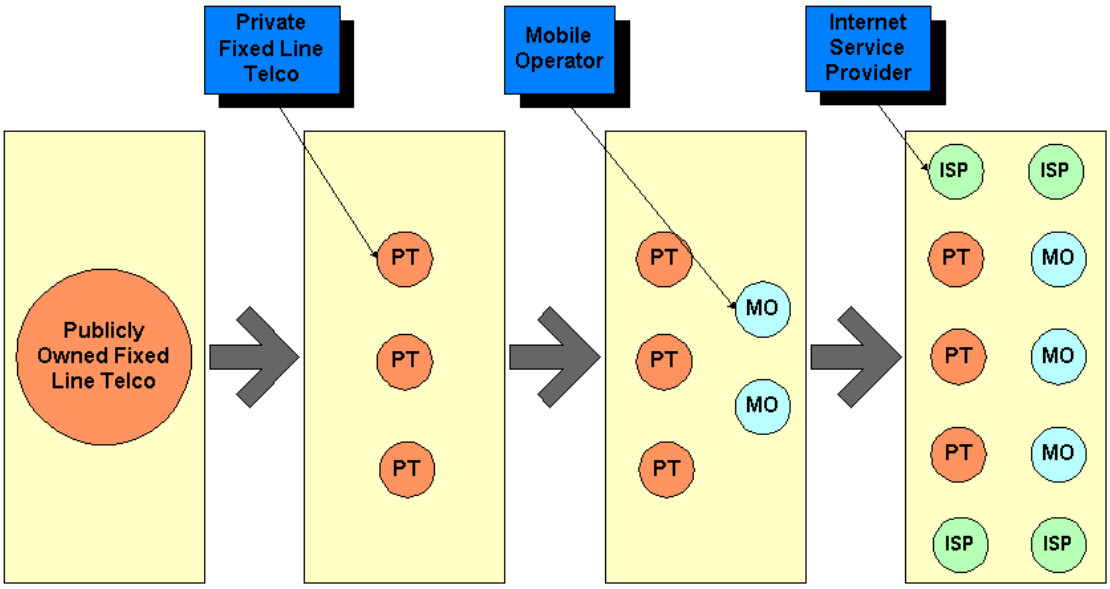

Figure 1 shows the increasing amount of network operators in the marketplace

A trend depicting an increasing number of operators in the marketplace can be clearly observed.

4. Future Structures

Immediate Future

The most immediate new organisational model that has emerged is the creation of third party WiFi operators (Wireless ISP – WISP). These operators install and maintain WiFi networks

in various locations[8]. WLANs have so far been very ad-hoc in the nature of their deployment. Generally, "hotspots" have been deployed by WiFi enthusiasts and the corresponding geographical coverage patterns have been sporadic in nature. The arrival of dedicated WiFi operators demonstrates a level of maturity in this field and also the beginnings of a top-down organisational structure. Many of these have not been successful. MobilStar and Metricom, two organisations offering free WiFi access to consumers, filed for bankruptcy in 2001[9]. This highlights the need for a charging scheme. It is unlikely that consumers will pay subscription fees for network connectivity alone. Hence the need for the development of value-added services such as music downloads, which may boost subscription levels. WiFi operators also have a revenue source from organisations wishing to provide WiFi access [7].

Long-Term Future

Two of biggest questions facing 3G network operators are:

1. How will they recoup the huge investments made acquiring the spectrum licence and deploying the network infrastructure?
2. Will consumers upgrade to 3G networks and handsets?

Recently, Transnat and Gemplus unveiled a billing scheme for roaming between GPRS and WiFi networks on a single device[10]. This presents an interesting development as it shows willingness from both WiFi and telecommunications operators to do business together. It also represents an acknowledgement of WiFi on the part of mobile operators. Based on this development, scenarios can be extrapolated and possible future alliances between various network operators will be described.

In an attempt to promote 3G uptake, mobile network operators may form alliances with these 3rd party WiFi vendors offering package deals to customers. E.g. Using devices that are both 3G and WLAN enabled, users may roam freely between WiFi hotspots and the greater UMTS network. Data services intelligently select the cheapest network, depending on availability. For a flat rate monthly fee, customers receive unlimited WiFi access and a certain amount of UMTS access (E.g. 3GB/month). All UMTS usage above the allocated figure is charged directly to the mobile operator. Such a scheme would seem ideal for all parties involved. It would appeal to telecommunications operators as consumers would upgrade to 3G networks. It would be attractive to WiFi operators as they would have a direct source of revenue from their proportion of the flat-rate schemes. The business locations that are WiFi-enabled could offer WLAN access as a benefit-in-kind to their customers and thus generate more revenue for themselves by selling more of their direct product/service. And most importantly, the consumers themselves would be happy because WiFi and 3G working in tandem offers them a more attractive service than each on their own as customers are more in control of the cost and by combining the operators, multiple bills are consolidated into one.

Applying these alliances to the historical models described in Section 3, produces an interesting development. The number of operators that the consumer has to deal with is reduced. While many network operators still exist, they are grouped together into the various public-facing consortia. There is a many-to-few directional trend.

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[8] Three of the world's largest technology firms IBM, Intel, AT&T plan to deploy WiFi 'hotspots' in 20,000 locations across the US. http://www.theregister.co.uk/content/archive/28454.html

[9] In 2001, WLAN operator MobileStar filed for bankruptcy. Its WiFi assets were later bought by T-Mobile, who are now one of the largest WiFi operators in the world. http://www.isp-planet.com/news/2001/voicestream_mobilestar.html

[10] Two companies Transnat and Gemstar have announced a universal system for roaming between GSM/GPRS and WLAN networks. http://www.transat-tech.com

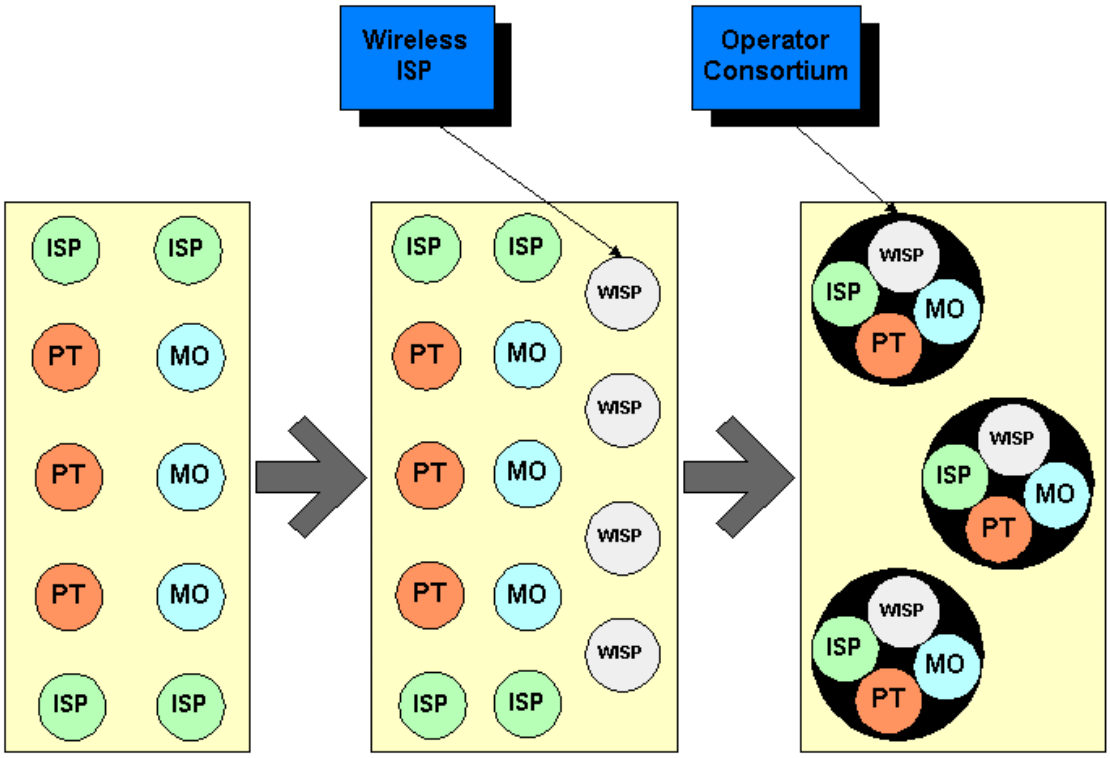

Figure 2 shows the emergence of operator consortia

As these organisational relationships mature, the individual relationships will "disappear". That is to say they will still exist, but their public profile will diminish. As a technology becomes more ubiquitous, its visibility diminishes. As stated by Mark Weiser in the seminal article 'The Computer For The 21st Century': "*The most profound technologies are those that disappear*" [9]. For example, roads have largely disappeared from public perception. They are taken for granted – people pay taxes and expect good roads in exchange. Consumers are going to pay the network operators in exchange for good services that are delivered to them on the basis of a disappearing communications infrastructure.

5. Content and Services

A network is only as good as the content and services it delivers. Many network operators have realised this and see themselves as both network operators and content providers (as in the case of AOL and T-Online). They host portal sites that offer free quality content to consumers. However, many also offer premium content and services to consumers for a fee. The services and content is usually of an exclusive nature, but has a certain degree of quality associated with it[11]. By applying this trend to the operator consortia described in Section 4, an interesting step is taken. To entice consumers to utilise these high-bandwidth wireless networks, the operators have established links with content providers so as to offer basic content-based services to their customers. To generate more revenue, the consortia might offer premium fee-based services that are not available at the basic level. Wireless operators could make a lot of money from these fee-based services.

Examples are video-on-demand, multimedia instant messaging systems and VoIP[12]. All successful services of this type will have to bear one certain characteristic - usefulness! At the heart of them all will be genuine usability factors. Organisations need to develop these

[11] For example, in February 2003 AOL announced it was to launch a subscription-based music download premium service for its members. http://www.theregister.co.uk/content/6/29486.html
[12] Voice over IP

services based on identified customer needs and the marketplace situation (competitors). Consumers are not going to pay for services that do not fulfil their basic criteria. E.g. WAP was heralded by mobile operators as a new Internet service for customers. However, it can now be seen that WAP's actual usefulness is quite limited. From the customer's point of view, the service is overpriced. Most content available is not made for the WAP service. The majority of content is based on web pages designed for desktop displays and not today's smaller mobile phone screens. Navigation through WAP content on a mobile phone is a severely hampering factor as the amount of effort required does not justify the quantity of information received. Hence, WAP usage levels were/are low[1].

Ultimately, the speed and bandwidth of the physical (or ethereal) network means little to most people – they are generally interested in the services that are available i.e. what they can do with it. A powerful network will only provide a mechanism for delivering more useful services; it isn't a service in itself. Consumers are not interested in a powerful network. They wish to use a service. However, a powerful network is required to facilitate the service.

6. Example Scenarios

Sean is an Investment Banker working for a large multinational bank in the city centre. Sean's job requires that he be in constant communication with business sources so that he can receive up to the financial information to his PDA and make decisions based on that information. Sean also has a mobile phone with which he makes all his voice calls, but this device is not WiFi enabled. During normal working hours when Sean is in the city, he is under the coverage of a variety of WiFi networks. However, Sean's home in the suburbs has no WiFi connectivity so his PDA receives data via the 3G mobile-phone network. Sean's job can often be time-sensitive and he cannot experience intermittent network connections or bandwidth problems. Thus, Sean has taken out the Gold Quality of Service option with his network operator NetCon. NetCon provide Sean with blanket 3G coverage, but also allow him to connect to any of the WiFi networks with which they have an agreement. Sean's bill is calculated on the amount of traffic he generates across the various networks.

Lisa is studying psychology at the City University and lives in a nearby student apartment block. Lisa owns a PDA that also doubles as a mobile phone through the use of headset device. She primarily uses it for making phone calls and exchanging instant messages with her friends. However, her PDA also helps her with her studies, using it to access lecture notes and academic papers. The entire university is covered by a WiFi network, which also extends to the apartment block in which she lives. Access to this network is free for students. The University has an agreement with NetCon such that NetCon agree to carry student traffic over their WiFi and 3G networks with the student being charged accordingly. Lisa has a strong interest in music and avails of NetCon's MusicNow service, from which she can download music in mp3 format at €1 per track.

NetCon is a conglomerate company that represents many different companies offering network communications connectivity. The main partners in the conglomerate are mobile phone operators and the large-scale WiFi service providers. NetCon also represents businesses and individuals who wish to offer WiFi connectivity to others and avail of their charging scheme. NetCon bill the people and organisations that use the networks they are responsible for and share the revenues among the appropriate entities. NetCon have a variety of options available to customers, including WiFi-only deals, WiFi and 3G packages, prepaid options and various billing schemes. NetCon also have links with content and service creators, offering branded services to their customers, such as the MusicNow service.

6. Conclusions

Data networks are becoming more and more pervasive. Networks of different types are being deployed at very high frequencies. The networks offer different levels ofconnectivity, speed and bandwidth to consumers. However, the core factor that they all have in common is that they are in place as information delivery systems. By co-operating with one another, the individual networks will be able to offer the best levels of service to their customers.

At present, UMTS network operators are exploring many ways to recoup the huge costs associated with deploying a 3G mobile phone network. By using business models inherited from GPRS networks, 3G would price itself out of reach of the general public. Providing a cheaper service in tandem with widespread WiFi networks may assist them to entice consumers to become customers. Through the co-operative use of networks, operators will be able to provide more cost-effective usage patterns. 3G network operators and 3G service providers must identify customer needs in order to provide "killer applications".

As networks become more ubiquitous, their visibility will disappear. In much the same way as other successful technologies have done, wireless networks will disappear into the background. However, this is dependent on the availability of quality content and genuinely useful services. The combination of quality content and useful services is the key to the widespread use of wireless networks.

7. References

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