EXPLOITATION OF PUBLIC AND PRIVATE WIFI COVERAGE FOR NEW BUSINESS MODELS

Thomas Lindner, Lothar Fritsch, Kilian Plank and Kai Rannenberg
Chair for Mobile Commerce & Multilateral Security, Johann Wolfgang Goethe University.
{ThomasLindner\Lothar.Fritsch\Kilian.Plank\Kai.Rannenberg@M-Lehrstuhl.de}
Gräfstraße 78, D-60054 Frankfurt am Main, Germany

Abstract: The expected boom in wireless networking and the rapidly increasing number of private and public access points prepare the ground for additional – initially unintended – usage possibilities of this fast growing infrastructure.

A first example is 'Location Based Services'. Since access points constantly broadcast unique, identifiable information like the MAC address, this data could be exploited for additional services. Because of the narrow broadcasting range of a WLAN (Wireless Local Area Network) cell, precise location information can be obtained at low cost. This could be used i.e. as a basis for LBS (push), or navigational services (pull).

Since WLAN chips are integrated into more and more devices like PDAs (Personal Digital Assistant) and mobile telephones, WLANs could be used for access to simple classic internet services like WWW or email as well as more sophisticated services like VoIP (Voice over Internet Protocol).

This paper describes four exemplary possibilities of exploiting the WLAN infrastructure for additional services, provided that WLAN is almost ubiquitous in a coherent area.

Key words: WLAN, WiFi, Business Model, LBS, UMTS, VOIP

1. INTRODUCTION

WLAN is an intensely discussed topic not only at professional trade conferences (it was the main theme of the 2003 Cebit computer fair), in trade journals, and even in mass media from television to newspapers. A rapidly increasing number of access points can be observed. For example, the largest German mobile network operator T-Mobile recently announced plans to operate 10,000 hotspots worldwide by the end of the year (T-Mobile 2004). In the same way, the equipment of all Intel notebook CPUs with WLAN functionality fuels the diffusion of this network access technology. This accelerating wireless network spread already led to the speculative question whether WLAN is a competitor or even the undertaker of UMTS (Universal Mobile Telecommunication System).

At present the WLAN infrastructure is based on three columns:

- private (non-consenting, possibly consenting in future)
- corporate (non-consenting)
- commercial (consenting and non-consenting)

The notion "consenting" denotes the hotspot operator's consent to use his infrastructure within a business model. Today, WLAN technology is just used as (internet) network access technology with the advantage of no need for wires.

The existing business models of commercial hotspots providing wireless internet access are insufficient from a financial perspective as they have to compete in terms of price with the comparatively inexpensive wire based internet access the customers are used to. Today's target group of commercial hotspots, offering the business traveler mobile access to corporate mail and network is rather limited. Nevertheless, comparing capacity with actual usage reveals an obvious lack. This lack seems to offer opportunities in economic terms for both providers as well as customers.
Further business possibilities for premium services could be i.e.:

- inner city navigation
- promotional and/or informational messaging
- synergistic business models by mobile operators
- private bandwidth sharing

Since WLAN has been unconsidered in economics research so far, there are hardly any empirical examinations. Hence, this paper tries a tentative approach in this direction. Since wide coverage is a precondition for further exploitation, we examine in a first step the WLAN coverage in a large German city representative for other congestion areas. In a second step, we pre-

sent four exemplary business models trying to reveal the particularities of decentralized mobile network infrastructures. The application of a business model ontology is to provide for structure and comparability. Finally, we discuss our findings and give advice for successive research steps.

2. EMPIRICAL EXAMINATION

We evaluated the WLAN infrastructure in Frankfurt am Main / Germany selecting business and residential districts to investigate the coverage in a representative urban area.

Using the following hard- and software we drove through the selected districts and located and mapped existing WLANs:

Hardware	Software
• Sony Vaio notebook PCG-GR214EP • D-Link WLAN adapter DWL-650+ • Garmin Etrex GPS personal navigator	• Winows XP Version 2002 Service Pack 1 • NetStumbler Version 0.3.30 • StumbVerier MapPoint 2002 Edition Version 1.0.0 Beta 5 • Microsoft MapPoint Europe 2002

Windows XP was necessary for the usage of the D-Link DWL-650+ in order for it to work with NetStumbler. Using NetStumbler on the drive we detected the available WLANs and mapped them with the exact positioning coordinates downloaded via NMEA protocol from the Garmin Etrex. A summary of the log-file created by NetStumbler was plotted on MapPoint Europe 2002 maps using StumbVerter.

3. RESULTS

A screenshot of NetStumbler is presented in figure 1.

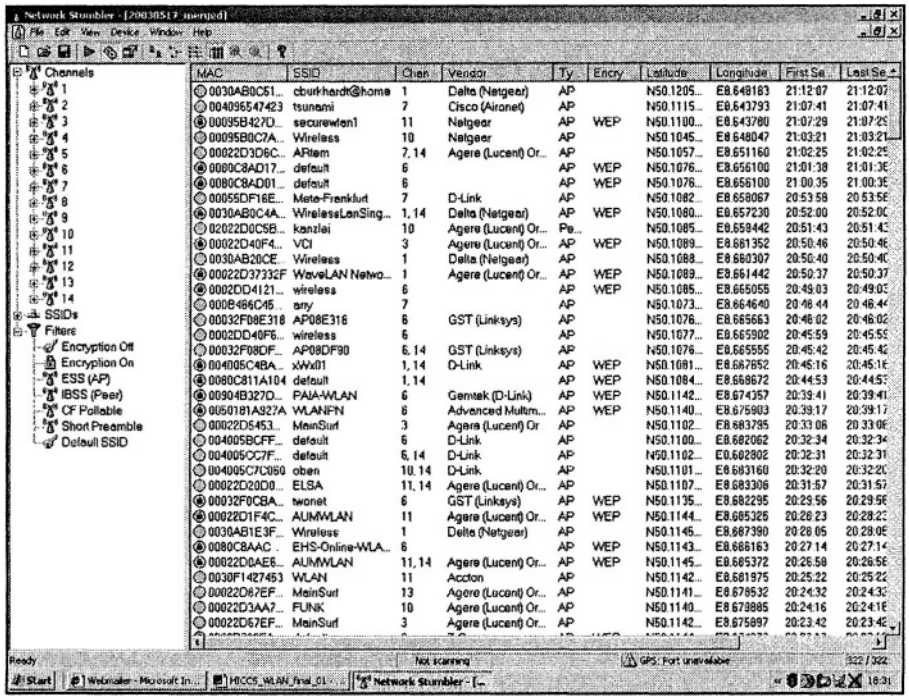

Figure 1. NetStumbler screenshot of log-file data

The collected information was then transferred into a graphical presentation using StumbVerter and Microsoft MapPoint as shown in the following pictures.

Figure 2 demonstrates an overview of the studied Frankfurt city area in a large scale.

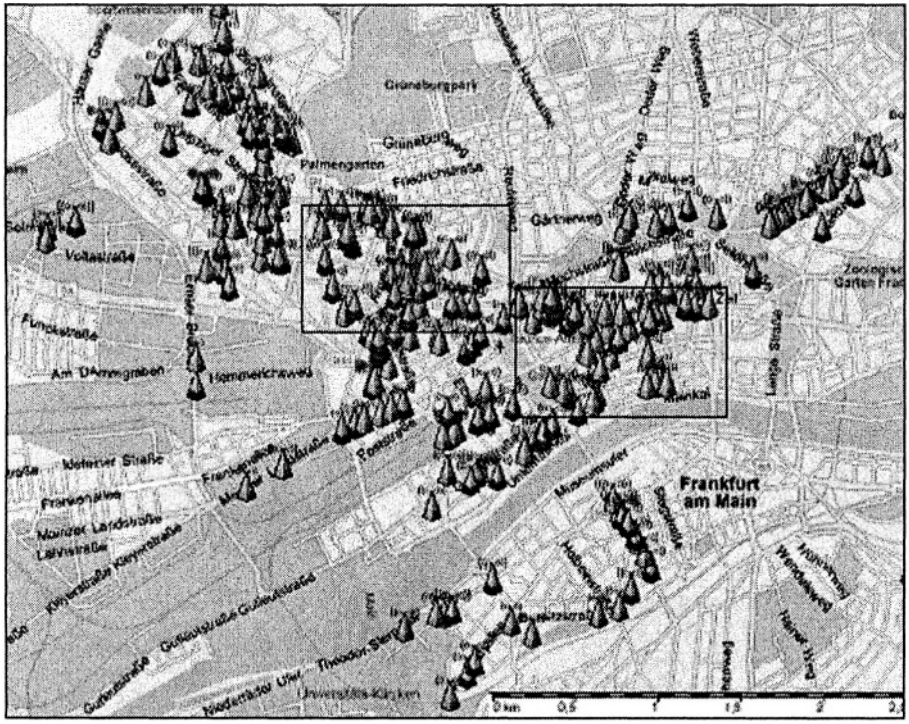

Figure 2. Overview of evaluated areas of Frankfurt

In Figures 3 (residential area – left box) and 4 (commercial area – right box) selected residential and commercial districts are shown in smaller scales in order to give a better impression of the WLAN availability in specific areas.

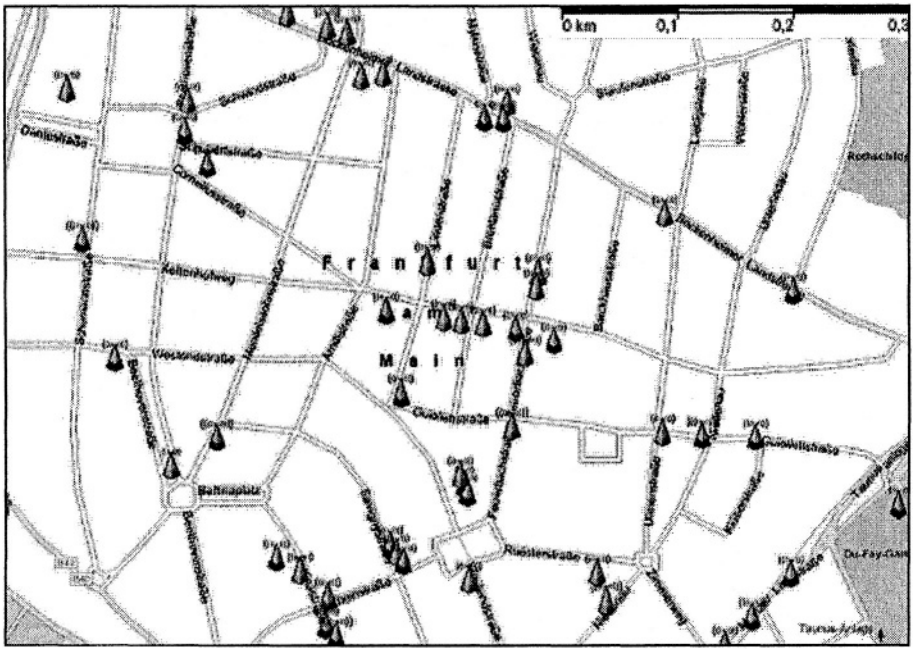

Figure 3. A selected residential area (Westend)

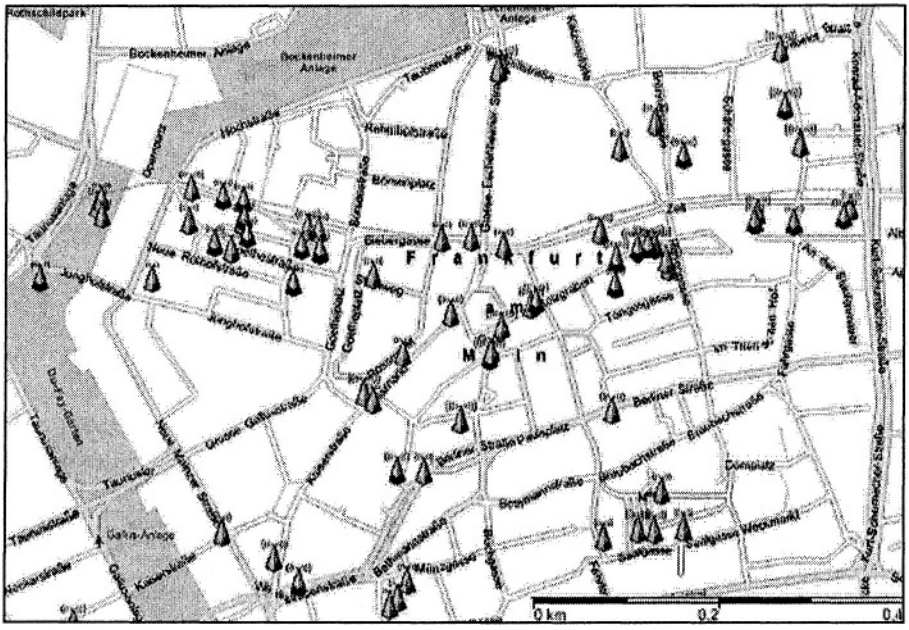

Figure 4. A selected commercial area (Zeil – Fressgass – Römer)

A total of 322 WLANs were detected and mapped in the researched areas. With only 139 (43.17%) access points being protected through web equivalent encryption (WEP) the majority of 56.83% (183) was not protected using WEP. While 39 access points did not broadcast an SSID, 40 access points sent the manufacturer's default SSID. 9 WLAN access points could be identified as being commercial hotspots.

4. BUSINESS MODELS

We will analyze four possible business models making use of WLAN access points. These models are either in consent with the respective access point provider or non-consenting. For comparative purposes we summarized the key elements of each business model according to the business model ontology suggested by (Pigneur 2002) at the end of each paragraph.

4.1 Business Model 1 – Inner City Navigation by Non-Consenting Use of Broadcasted Access Point Signals

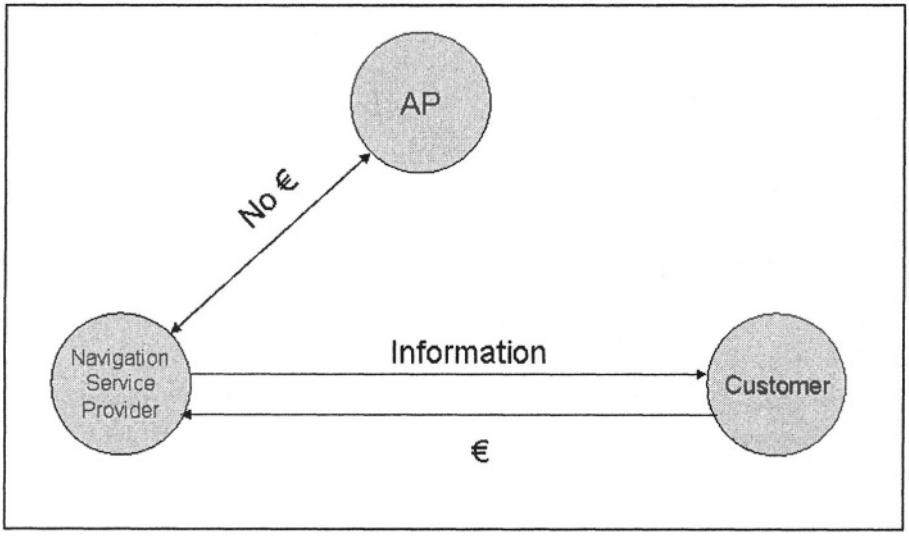

Figure 5. Non-consenting business model – inner city navigation

Today geographical location systems using GPS are limited in their accuracy in inner city areas due to their dependence on at least 4 visible satellites to triangulate the exact position. In cities this is not always achievable as buildings sometimes block the line of sight. As a consequence, information

cannot always be accurate. This deficit is overcome by mobile navigation systems in automobiles by incorporating driving distance and directional changes of the car into the geographical location information calculating the position in reference to the last known triangulation point. For non-motorized users of GPS based navigation systems these supplementary and additional calculatory procedures are not available. Aggravating the situation for the non-mobile customer is the fact that GPS devices require constant energy supply.

A mobile device using the information as broadcasted by WLANs could overcome these shortfalls. Since the energy requirements a far less WLAN based location devices could be incorporated into existing mobile communication devices i.e. mobile phones, handhelds, notebooks etc. Available on today's market is the PDA Compaq iPaq 5400 which is equipped with WLAN technology including antenna and could therefore make use of the broadcasted signals without further hardware investment.

In this non-consenting business model it will be the obligation of the provider of the geographical information services to locate the available access points and map them to their geographical location. These data of access points and their geographical positioning have to be maintained on a regular basis and could be sold as a product allowing geographical location determination for motorized and non-motorized customers as well.

The product to be sold could be only the program to access the database – software solution - or comprise hardware and software as well.

Potential customers for these services could be either ad-hoc customers like business travelers or tourists coming into cities renting the hard- and software for a limited period of time to be able to navigate in the unknown environment, or customers who could be on a regular program update scheme receiving periodically updated information. Further interested customers could be tourist boards of the cities offering visitors the possibility to discover the points of interest in a city via a guided, WLAN supported tours, receiving additional information on selected points of interest in their own language.

In this model consent exists only between the database provider and their customers. The supplier of the basic information – WLAN hotspot – is not a part of the active business process and will therefore have no particular interest in assuring continuity and accuracy of the broadcasted data. One possibility of involvement for the access point provider could be that the database provider enters into a business relationship with the owners of the access points thereby ensuring accuracy of the database and revenue possibilities to the information provider (WLAN access point). This however might be a next step into a consenting model but at present using the WLAN data

is to be regarded as non-consenting since a business relationship would only exist between location device users and database provider.

Value Proposition	- service provider takes advantage of a low-cost infrastructure, probably leading to lower prices for customers
	- WLAN enabled device is cheaper for customers than GPS equipped device
Infrastructure	- relies on high urban density of WLAN hotspots
	- requires accurate maintenance of hotspot location database
	- can provide navigation on-board or off-board dependant on the availability of mobile communications
Financials	- less infrastructure investment for the provider of the navigation service
Customer Relationship Management	- customers must be acquired and serviced by the service provider

4.2 Business Model 2 – Consenting, Target Group Oriented, and Situation Based Use of Information

The flow of information and the users of such become ever more mobile. The internet has opened the possibilities of companies addressing their customers independently of time and location – anytime, anywhere, always. One could say that the interaction between company and potential customer is always "one click away". This "click" is often farther away than one might think. Additionally it is very difficult for the information provider to specifically address their potential customers' needs due to the anonymity of the internet. This has led to the consequence of unwanted and annoying pop up ads, spam mails etc.. WebSite owners thought in the past that they finance their businesses by selling advertising space to companies on the basis of costs per thousand appearances. A possible shortfall of these models might have been that the information was distributed indiscriminately and only reached few potential customers. Decreasing click-through rates led to a change of the concepts by the advertising companies. The new business model of the advertising industry is to honor only qualified contacts. WLAN

offers, due to its narrow broadcasting range, a possibility from the "one click away" in the internet to a "one step away" in real-time and real space.

This consent-type business model combines the advantages of electronic communication with the geographical accessibility. It is suggested that access point providers offer their users at the moment of connection to the platform information about services and products in the near vicinity (one step away). This platform could a be a 3rd party logon portal which supplies general interest information as well as specific, customer oriented information about nearby services i.e. theater, restaurants and of retailers with special offers. To enable the advertiser to pinpoint their offered services or products to very narrowly selected target groups will require that the customers, in using the access portal, allow an interest profiling. This profiling could be portal driven, resulting in the storage of the submitted data in a centrally located database, which could be accessed from various geographically diverse access points offering the possibility for the customer to use the personalized WLAN driven services not only at his original point of profiling but in other areas as well. The access point providers could either be a cooperation of locally active service providers or one provider with a multitude of national or even international access points.

A further possibility to store profiling data is using identity management where the profile is device driven and stored in the device itself as a standard part of the initial mobile device personalization. This identity management profiling will assure security and protection of personal information, avoiding possible conflicts with internationally different laws for personal data storage. This would require however a world wide accepted standard for multi-purpose profile data structure and transmission to enable global WLAN services usage.

The range of customer specific offers could be as widespread as from offering culturally interested persons sitting in a cafe close to the opera information about still available tickets for today's event to a nearby book seller informing a book lover next table about the latest arrivals. These examples base on an informational push model. Further on information could be offered on a pull basis as well in which a customer can access information on available services through a portal specific search engine. This pull-on-demand information can range from available activities like cinema schedules, nearby restaurants, special events, and special offers on selected products to public transportation departure times at the nearest station.

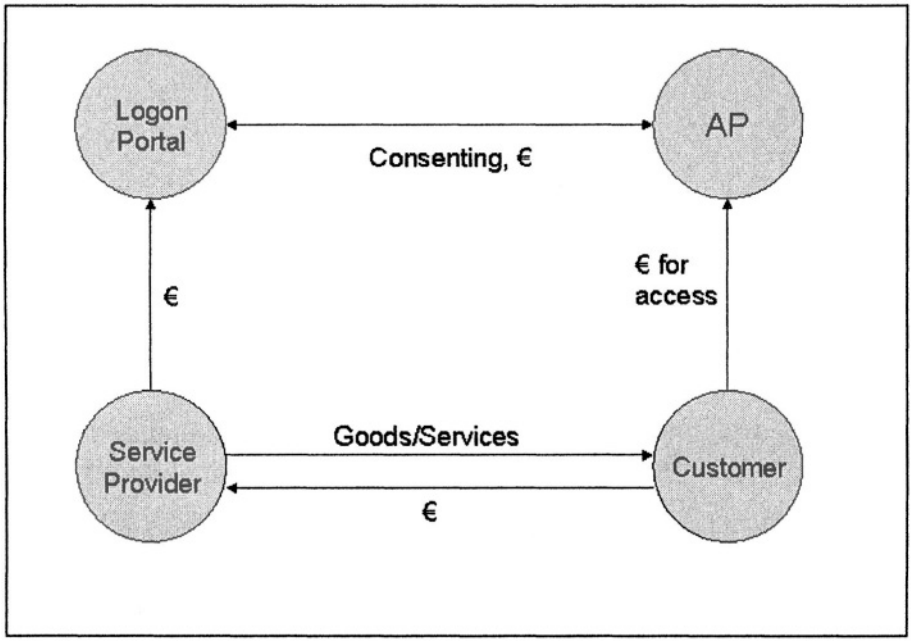

Figure 6. Consenting business model – logon portal

The narrow broadcasting range of a WLAN access point offers the possibility that the advertised offer is always just one step away. The use of modern content management systems enables the portal provider to adapt the submitted content to a wide variety of mobile communication devices i.e. smart phones, handhelds, notebooks and thereby to multiple display sizes.

Once the customer profile is consentingly stored in a database the specifically directed information messages are not limited to one geographical area or city but can be applied on a broad geographical range. In the example of a business traveler sitting on a business trip in different cities and connecting through WLAN access points offering the logon portal, will receive messages from interested parties in a reachable vicinity of the new site.

Value Proposition

- service provider can use WLAN location as an input to create localized information portal content

- customer receives localized information for the exact hot-spot's environment he is in

- cost of distribution channel is low compared to GSM/UMTS

Infrastructure	- requires hotspot operation in large scale or many contracts with small hotspot networks
	- a payment solution for access billing needs to be developed
	- customers can use standard WiFi enabled terminals
Financials	- additional costs result from administrative work and content acquisition
	- service provider receives payment either explicitly or by way of the hotspot operator
Customer Relationship Management	- customers are acquired by hotspot operators and/or service providers
	- customer's portal usage can be analyzed for better customer care

4.3 Business Model 3 – Synergetic Use of WLAN by a Telco

As mentioned in the introduction WLAN technology might be competing against UMTS, predicting even that WLAN could make the substantial investments in the licenses and start up costs for installing the UMTS network in Europe obsolete. We suggest that the combined use of WLAN and UMTS could lead to a better return on investment for the Telcos and by the same token offer an added value benefit for customers. In the first step of building up the UMTS networks, where upfront investments are high and the available bandwidth will be limited, WLAN could supplement these networks. From the expected standard bandwidth of 2Mbit/s only 384Kbit/s will be available in the initial phase making this a bottleneck for UMTS customers. The installation of WLAN access points in strategic locations, like airport lounges, railway stations, hotels etc. could alleviate this potential stumbling block. Telcos could offer their UMTS customers free or low cost internet access for their computers via WLAN, thereby leaving bandwidth free for multimedia mobile phone based applications. (Spinney 2003) suggests a similar symbiotic approach including a location based service with cellular-to-WiFi-handoff whenever high bandwidth is required.

In the competition amongst the telcos for UMTS customers a well positioned and well built up WLAN infrastructure could amount to a competitive

advantage. Figure 7 depicts the relationships between the various actors. A UMTS or GSM customer can connect to an access point whenever possible and necessary. He is not billed separately for this services. Rather all access technologies like GSM, GPRS, UMTS and WLAN are covered by one product.

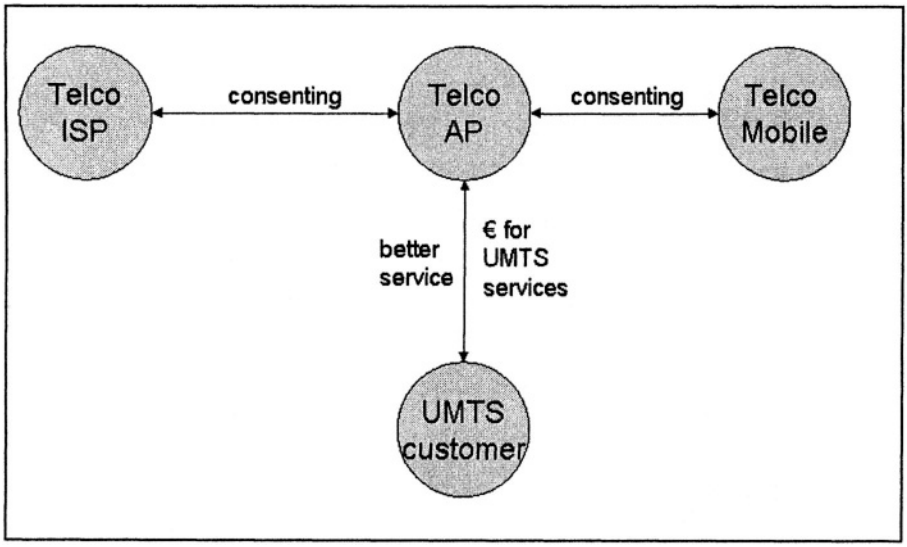

Figure 7. Consenting business model – synergistic use of WLAN and UMTS

Research has to be conducted in the areas of adoption and diffusion. Thus, empirical evidence has to be gathered regarding the effects of more product and price simplicity as well as technology and network integration on adoption and usage. Furthermore, possible implications on diffusion theory have to be considered.

Value Proposition	- customer automatically connects with the most appropriate access technology according to the situation
	- more simplicity, e.g. of configuration
Infrastructure	- infrastructure consists of UMTS, GSM and WLAN cells and the corresponding client technologies at the customer's side
Financials	- less infrastructure investments
Customer Relationship Management	- customer acquisition, retention and service by the service provider

4.4 Business Model 4 – Private Access Point Provision

Besides the hybrid business model 3, in which coexistence between UMTS and WLAN is suggested, an exclusive WLAN model is also imaginable. In this scenario a full coverage of wireless LANs is available in congested areas. These WLANs are to be used by any mobile device, like mobile telephones, PDAs, notebooks, etc., for any service that is also accessible on the internet, like www, email or VoIP. The main advantages in comparison with classic cellular broadband telecommunication networks are among other things lesser start up and running costs, higher user acceptance and most likely faster time to market. In case of VoIP via mobile (also called "Voice over WLAN") the announcements of many mobile device manufacturers regarding market ready WLAN enabled mobile phones in the course of 2004 underlines the increasing convergence of IT and telecommunications. However, it has to be admitted that these mobile phone manufacturers chiefly focus on indoor usage scenarios for the WLAN part of their devices. In order to build a network of WLANs there are several options. One possibility is to build a completely separate own network of wireless access points that covers a whole area (e.g. a city). This way, the whole infrastructure remains under the service provider's control. The other possibility is to include the existing infrastructure of privately owned access points and add own ones in areas with lacking coverage. However, this requires a broadband connection of the private access points to the internet or the service provider's network respectively. Currently, the most widespread broadband internet access technology in Germany is DSL, which offers a minimum download speed of 768 kbit/s. Furthermore, private persons have to be convinced and enticed to share a part of their bandwidth with others. In order to further reduce the own investments and additionally enforce the spread of broadband internet access DSL could be bundled with WLAN technology and subsidized in sale, possibly in connection with a multilevel marketing model. Furthermore, private persons could be refunded or rewarded according to the shared bandwidth.

Still, there are several major problems that have to be resolved. First, there are questions of security, trust and availability. Current research in the area of peer to peer networks and reputation systems could offer helpful approaches here. Availability is also achievable by provision of technical redundancy with the access provider and also by a network structure that constantly provides for two alternative wireless access points within reach for each customer device. Furthermore, contracts with private access point providers should include penalties in case of unavailability.

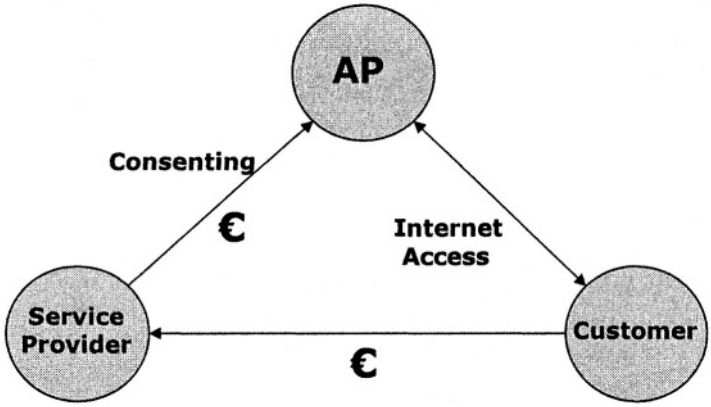

Figure 8. Consenting business model – private bandwidth sharing

Furthermore, the above described field tests have to be supplemented by further empirical examinations. Currently, we are planning studies on the evolvement of the private and public WLAN densities in major German cities. Additionally, we examine the bandwidth of associated (internet) network connections. Several field tests have to be carried out regarding necessary minimum coverage, network capacity, quality of services, performance and quality of WIFI enabled mobile phones as well as roaming. Finally, administration and management systems (e.g. billing systems, user registry) which allow for the particularities of an only partially owned infrastructure have to be developed.

Figure 8 depicts the various participants and their relationships in business model 4. The access point provider offers wireless internet access to the customer. The customer is equipped with a WLAN enabled device. He is charged by the service provider who himself rewards the access point provider.

Value Proposition	- customer simultaneously business partner
	- ubiquitous broadband voice and data services
	- better utilization of the WLAN infrastructure leads to lower costs and consequently to lower prices
	- less capital requirements for initial investments lowers market entry barriers and increases competition that in turn results in lower prices
Infrastructure	- parts of the infrastructure are provided by indi-

	viduals (wireless access point and broadband core network access)
	- parts of the infrastructure are provided by the provider (network access in areas that are not covered by private access points, (virtual) core network, network and user management, billing systems).
Financials	- less initial infrastructure investments
	- lower operator margins
Customer Relationship Management	- incentives for private access point operators to become customers

5. DISCUSSION

In this paper, we have presented various business models which aim at exploiting currently evolving private and public WLAN infrastructures for new purposes. As is often the case, many applications emerge only after some period of usage and experience.

In the navigational model, the use of broadcasted signals does not require consent with the access point operator, whereas models two, three and four require consent. Models 1 and 2 benefit from the narrow broadcasting range of the WLAN cell ranging from geographical location information to the closeness of information sender and receiver (seller and customer).

The relative density of WLAN access points as shown in figure 2 would suggest that the presented models could be easily implemented. However when analyzing the data in detail one sees that the WLAN access point density, as shown in figures 3 and 4 of residential and commercial areas is as yet insufficient. We intend to follow the development of WLAN access point availability in further studies.

Even if at first impression the existing scarcity of accessibility is perceived as contradictory to our suggested business models, it could be regarded as an advantage for commercial hotspot providers. The inexpensive installation of WLAN hotspots in commercially interesting areas requires, especially in comparison to UMTS, little investment for complete coverage, making up-front investment minimal. As a consequence the cost of the offered services could be held at a lower level and thereby assuring easier market penetration and market acceptance and lowering business risks.

The presented model one, the inner city satellite independent WLAN navigational system, should not only be regarded as a stand-alone application but could be seen as a complementary product to the automobile based GPS navigational system, enabling continuation of geographical information independently of the car. The customer parking the car, not yet having reached the final destination, could be guided via mobile WLAN based device to the end point of the journey.

The idea behind the second, portal driven, consenting model is the use of the narrow broadcasting range of the WLAN access points to bring customer and merchant together (one step away). We presented the model predominantly as an informational push model where the customer, logging on to an access point, will receive either general information or information tailored to a possibly existing profile. This geographically narrow communication concept could be offered on a pull basis as well, enabling a customer to specifically search for information. We predict that a pull model, with an active search capability, would even increase the acceptance of WLAN services and the usage of modern mobile communication devices. Identity management using the device for storage of personal data as part of the mobile communication flow will be a protective shield for the customers assuring anonymity resulting in higher acceptance rates.

The third model presented the synergistic potential of UMTS and WLAN enabling telcos to offer added services to increase the usage value of their UMTS investment. Especially in the initial introduction phase this might protect the still narrow UMTS bandwidth by transmitting larger amounts of mainly internet based data on a parallel WLAN, reserving the UMTS bandwidth primarily for multimedia smart phone based application traffic. For the customer the parallel use of UMTS and WLAN connection capability could be a decisive factor in selecting their UMTS provider. For telcos the installation of a network of WLAN hotspots could support the UMTS license and infrastructure investments by acquiring new customers and offering additional services resulting in a win-win situation.

The individually presented business models could and should not only be regarded as independent products but as supportive and possibly integrated services, making better use of the required investment in the WLAN infrastructure for the provider, and enabling the customers to seamlessly use more and better adapted services.

6. CONCLUSION AND OUTLOOK

Based on the present brisk expansion of the WLAN infrastructure the presented visions and business models might come to the market a lot faster

than expected as of today. Consent between access point provider and service provider is imperative to drive the development of the commercial exploitation of the WLAN infrastructure. Only commercially viable, consent driven business models will assure a uniform and world wide accessible WLAN infrastructure.

As stated in the introduction, this paper is just a first step towards an economic analysis of decentralized and partly client owned networks. There are a lot of future research topics. First, several empirical examinations have to be conducted, in order to validate the premises, such as model-specific density requirements, access point provider acceptance or technical feasibility. Second, there are questions from a marketing point of view, e.g. pricing models and prosumer aspects. Another area of research is the examination of emerging value networks. These peer-to-peer reminiscent networks include so-called prosumers, that is customers who also act as producers or rather service providers. This leads to a couple of strategic questions for the incumbent service providers and operators. Finally, all the aforementioned phenomena are to be analyzed by microeconomics regarding possible implications or consequences.

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