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Title:

Business models and business role interaction for wireless broadband access services provided by non-telecom actors and mobile network operators

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1. Introduction

The usage of Internet is currently changing from mainly being a service consumed in fixed and known locations like your home or at your work to be a service used at any location. This "public" wireless broadband access can either be based on extension of broadband systems using WLAN for the local area or be wide area cellular systems with high data rate capability.

Mobile network operators have started to offer very competitive flat rate subscriptions for wireless broadband based on 3G / HSDPA. In the Nordic countries this type of subscription has increased more than 400% in less than a year. The monthly flat rate fee is 10 – 20 Euros which is the same amount of money that can be charged per hour in a traditional hot spot that targets business users. These "business" WLAN hot spot are also challenged by wireless access offered for free (or very cheap) at cafés, a restaurant, hotels, buses etc. The main driver to provide wireless access for free is to support the core business rather than to get revenues from an access provisioning business.

A large increase in wireless broadband usage is expected. We can expect more or less the same penetration as for mobile telephony. At the same time there will be a migration from fixed to wireless or even mobile networks. Mobile networks promise anytime everywhere services. This is a very strong quality guarantee. It is important to realize that in using Internet access at fixed and "known" locations people have been used to get a more or less guaranteed data rate and availability. A wide scale migration from fixed networks to wireless network is likely to result in the same kind of requirements.

The paper will look at the consequences of such kind of quality guarantee from capacity, cost and availability point of view. Since quite large capacities are needed it is vital to study how those capacities can be provided in a cost efficient way and also to study options for new types of business models.

For fixed and mobile telephony and for broadband connections the business model has been the same for many years. End-users have a subscription with an operator that provides the service. For wireless access provided at public places there already today exists a number of different business concepts. A number of submarkets can be identified. The involved market actors are; Mobile Network Operators and Internet Service Providers but also Municipality Network Operators and Facility owners. As mentioned above, other types of actors outside the telecom sector have started to offer wireless access services.

In this paper we will describe and analyze these submarkets with different sets of actors and different ways to cooperate and to organize the value network. The description of these submarkets also includes type of markets segment, the value proposition, cost structure and profit potential.

We claim that new strategies for cooperation are needed in order to be able to offer public Internet access with high quality and capacity at low cost. This includes both "technical" cooperation between wide area and local area network and, more importantly, cooperation in the business domain between different market actors.

2. Submarkets for wireless broadband access

For the provisioning of public Internet access services we have identified a number of submarkets satisfying more or less similar types of customer needs. In this paper we will focus the analysis on the first four submarkets. Submarket five, communities, is not analyzed and submarket six is discussed in sections on business drivers and future work.

1. *Mobile Broadband Access* services where the Mobile Network operators provide nation wide coverage using cellular systems. Monthly flat rate subscriptions are dominating.

2. *Wireless cities* where local authorities and/or the metropolitan area network provider offers access in a city or town. More common in the US only a few cases exist in Sweden. The usage can be based on monthly subscriptions or on fees for short term usage

3. *Business hot spots* where wireless access is provided at airports, railway stations, hotels, conference centers and on trains to customers that are willing to pay quite high fees. It can also be an add-on service for those that have mobile or fixed broad band subscriptions.

4. *Consumer hot spots* where the wireless access is provided for free or at very low cost at fast food restaurants, cafés, hotels, at buses and any public place. The key market actor can be the hotel owner, etc but also operators that want to provide added value to own customers.

5. User or commercial *communities* where FON is the most known example. FON users share there own wireless access with other FON users using common login and security procedures provided by FON. The compensation can be free usage of other FON enabled networks or monetary compensation where the money originates from non-FON users.

6. *Private office hot spots* using high capacity WLAN or femtocell (cellular) solutions where the access mainly is for internal (own) users but in principle public access is possible. Some operators see femtocell solutions as a major tool for cost-reduction since it off-loads traffic from Macro base stations and reduces the need for expensive network build out.

3. Research area and questions

The research area includes topics and research questions related to the differences between wireless services and offers provided by "Mobile Network Operators" and by "other types of providers"

1. Can any specific types of pricing models and types of subscriptions be identified?
2. What options exist for cost-efficient deployment of high capacity wireless networks?
3. What kind of business drivers can be identified, are they different for different actors?
4. What different ways to cooperate and organize the value network can be identified?

4. Methodology

For the modeling of capacity demand, the network design and the cost structure break down we can use either the methodology proposed and used by Johansson (2007) or an alternative methodology described below. One key element for the first method is that the demand is expressed as average user data rate during the "busy hours".

For both approaches the starting point is the demand expressed as the total amount of data (Gbytes) per user and month and secondly that the parameter used to dimension the network is the required amount of deployed capacity per area unit (Mbps per square kilometer).

In the alternative approach (to be used below) the users are assumed to use the whole amount of data for services that require a certain data rate say 1 Mbit/s. If they cannot obtain that data rate this is regarded as blocking. The selected user data rates are used during a fraction of the "busy hours". By using this approach we can use the standard tables used for telephony traffic calculations. The "data calls" can in the same way as for voice telephony be regarded to be Poission distributed both regarding arrival times and the length of the call. Using the Poisson distribution may give an optimistic picture since the introduction of "flat rate" charging will encourage longer holding times. One of the advantages by using this latter methodology is that quality aspects such as used data rates and probability of blocking more easily can be introduced

For the business modeling and analysis we will use the business model definitions and framework proposed by Chesbrough & Rosenbloom (2002) including the following parts:

- ***Value proposition.*** The added value for end-users of the specific service.
- ***Market segment.*** Who are the primary customers? What is the estimated willingness to pay? What charging/payment model will be used?
- ***Firm organization and value chain.*** What additional assets and functions will the firm need in order to provide the service?
- ***Cost structure and profit potential*** What is the cost structure and profit potential of producing the service offer given the chosen type of value chain, segment and price?
- ***Firm in value network.*** How the firm is positioned in the network of other players?
- ***Competitive Strategy.*** How is the company position in relation to other competitors?

The organization of the value chain is discussed using a network model with actors, resources and activities (Håkansson, 1987). This network model is modified using *Business roles*. A business role controls a set of resources and performs certain activities in order to implement certain functionalities. In this network model *Relations* between actors and business roles are added and together with *Actors* and *Business roles* they are the three cornerstones in the used analysis framework (Blomgren et al, 2007)(Markendahl, 2007)

In the analysis of the submarkets in section 6 we will describe cases where market actors like ISP´s, mobile or urban network operators, operation and maintenance companies, credit card companies and different types of "site owners" (hotels, cafés, bus and train companies) takes different business roles. Hence, we will illustrate different ways to configure the value chain or network. The following business roles will be used: Provisioning of backbone capacity, Network operation & maintenance (O&M) combined with Access control, Customer acquisition and relations management (CRM), User identification and finally Payment support (Charging & end-user billing).

5. Cost and capacity aspects

In this section we will study the implications on required capacity when quality aspects such as guaranteed speed and access probability are introduced.

5.1 Number of potential users and demand.

The average population density for the major cities in Sweden is in the range of 1000 – 4000 persons per square kilometer. For downtown Stockholm it is 10 times more ~ 30 000 and in office areas it can be around 10000 persons per square kilometer. With estimated user requirements in the order 100 Kbit/s - 1.0 Mbit/s the result is a capacity requirement around or well over 100 Mbit/s per sqkm. To meet this demand a number of base stations each with a capacity of 1 – 10 Mbit/s are needed. To avoid trunking losses they have to be fully accessible by all users over a substantial part of the service area. From traffic point of view a requirement of 100 Mbit/s is not met by 10 base stations with 10 Mbit/s each unless they are fully accessible by all users within the service area and thus be regarded as one “big” base station. The above means that when different systems operated by different operators are engaged they have to act as one single system.

5.2 Capacity and dimensioning

One figure often used for the amount of data transferred per month per user is 3 GB. Below such a user is named standard user. We assume that the broadband users require a certain data rate (e.g 1 Mbit/s, 256 Kbit/s or 100 Kbit/s). A standard user is then using the transmission link in average 800, 3125 or 8000 seconds per day respectively. Let us further more assume that the traffic is spread over a few (3) busy hours. The average traffic load per user during such a 3 hour period can be derived dividing the average transmission time by the number of seconds in 3 hours which results in 0,074 E (Erlangs), 0,289 E or 0,74 E respectively.

Before we can calculate the fully accessible capacities that are needed we have to assume an acceptable call denial rate (blocking rate). In voice telephony 2% is often used. The necessary capacity for a base station to serve 10 and 100 average users under the assumption that busy hours coincide will be the case for a substantial part of the users. The total offered traffic load for the three data rates is 0,74 E, 2,89 E and 7,4 E respectively. By using Erlang B tables we find that the capacity need for the base station is > 3, 1,8 and 1,3 Mbit/s respectively for the three data rates. With 2 % blocking the carried traffic is 0,98 times the offered traffic. Now the carried traffic expressed in amount of data can be derived by multiplying the carried traffic in Erlangs by the respective data rate. For all three cases we achieve 0,72Mbit/s. The necessary capacities for each rate a figure for the throughput efficiency are < 0,24, 0,4 and 0,57 respectively. The figures for 10 and 100 standard users are shown in tables 1 and 2.

Data rate	1 Mbit/s	256 Kbit/s	100 Kbit/s
Total traffic	0,74 E	2,89 E	7,4 E
Necessary capacity	>3 Mbit/s	1,8 Mbit/s	1,3 Mbit/s
Carried traffic	0,72 Mbit/s	0,72 Mbit/s	0,72 Mbit/s
Throughput efficiency	< 0,24	0,4	0,57

Table 1 Capacity of a base station and throughput efficiency for different data rates - 10 average users.

Data rate	1 Mbit/s	256 Kbit/s	100 Kbit/s
Total traffic	7,4 E	28,9 E	74 E
Necessary capacity	13 Mbit/s	9,7 Mbit/s	8,6 Mbit/s
Carried traffic	7,2 Mbit/s	7,2 Mbit/s	7,2 Mbit/s
Throughput efficiency	0,55	0,74	0,83

Table 2. Capacity of a base station and throughput efficiency for different data rates - 100 average users.

From the table we can draw some quite interesting conclusions. The necessary capacity to serve 10 standard users is higher than 1 Mbit/s. This is about the capacity one HSPA carrier can provide in average over the base stations service area (about 1 sq km). The number of users an 1 –2 Mbit/s base station can serve for different user data rates is shown in table 3 . The probability of blocking on such a base station in the 10 user case is shown in table 4.

The necessary capacity is more than 2,3 times higher in the 10 user case caused by lower trunking efficiency when the user data rate is 1 Mbit/s compared with 100 Kbit/s for the same amount of data and the same quality of service. This causes a cost penalty when higher data rates are used in addition to the penalty for higher data rates arising from the link budget. It is thus better from cost point of view to use increased capacity to add more users than to offer the users a higher data rate. On the other hand new services may require higher user data rates and that is what mobile broadband is about. To serve 100 users about 10 Mbit/s is required. Several HSPA carriers are needed. In this case about 1,5 times higher capacity is needed when 1 Mbit/s as user data rate is used compared with 100 Kbit/s.

Average base station capacity	1Mbit/s	2 Mbit/s	5 Mbit/s	10 Mbit/s
User data rate 100 Kbit/s	6,7	17	55	120
User data rate 256 Kbit/s	1,4	5	17	42
User data rate 1 Mbit/s			2,3	6,7

Table 3 Number of users served at different data rates

Average base station capacity	1Mbit/s	2 Mbit/s	5 Mbit/s
User data rate 100 Kbit/s	0,1		
User data rate 256 Kbit/s	0,19	0,002	
User data rate 1 Mbit/s	0,40	0,14	0,001

Table 4 Probability of blocking for the 10 user case

The “average throughput” approach can be used in order to make rough estimates. But in order to get useful estimates for dimensioning with some kind of guarantees for the service quality the “alternative” method described above should be used. Hence, we can conclude that in order to experience “real broad band” services during busy hours the capacity requirements and number of base stations are quite high already for a fairly limited number of users. This leads to quite high costs to be covered by these users. It is not likely that they are willing to spend much more than at present.

In the next sections we will look at the possibilities to view the total market as a number of submarkets with different characteristics. The existence of such submarkets is likely to provide capacity that can reduce the requirements on wide area networks and also cover some costs.

6. Description of sub markets

6.1 Mobile Broadband subscriptions

General description

Technically the solution is based on 3G /HSDPA radio access technology and modems for laptops. The service provides anywhere-anytime connectivity and is not related to any specific location. The actors providing the service are typically Mobile Network Operators

Value proposition

One major user value is the anytime-anywhere connectivity enabling high degree of availability provided that the network is not overloaded. Another perceived benefit by some users is the ease of use “switch on – login – start to use”. There is no need to handle multiple user names and passwords or to handle payment as for hot spot services.
Another aspect is the competitive flat rate subscriptions that in addition to low price also provide cost control (unless you use the service abroad).

Market segments

We can identify two dimensions when user segments are discussed: one dimension deals with consumer or business usage and the other dimension consider if the mobile broadband is a “complement to” or a “substitute for” fixed broadband, hence four sub-segments exist.

Consumers can be characterized by either being focused on low cost or being a substitute user with higher requirements and higher willingness to pay. Business users most likely use the service as a complement to fixed broadband but with high requirements on availability, reliability and no restrictions of usage, hence the willingness to pay is high.

This is also reflected in the terms and conditions of existing service offers

- Low cost service (- 10 €) with restrictions on data rate and/or amount of data
- Premium service (20-30€) with higher data rates (Mbps), no restriction on usage

All Swedish Mobile Network operators (Glocalnet, Telenor, Telia, Tele2 and “3”, have this mix of subscription models.

Firm organization and value chain, Firm in value network

The Mobile Network Operator (MNO) takes all business roles using a business model with the traditional vertically integrated value chain typical for telecom operators, see figure 2.

Cost structure and profit potential

From the cost perspective we can identify two types user environment; “rural & suburban” and “urban & hot spots”. In regions where most people live in rural and suburban areas there is no capacity problem when wireless networks are deployed. For low to medium levels of demand the cellular systems provide a cost efficient solution. In urban & hot spot areas with high user demand (Mbps per area unit) it may be very costly to support a large number of users with medium or high data rates, see section 5. The flat rate fees imply that network build out due to increased usage will result in higher costs but no additional revenues.

Competitive Strategy

The offers from different MNO´s are very similar concerning prices and data rates, some differences can be identified when it comes to limitations in montly usage. The MNO´s can not compete on coverage; compare voice services, since the operators share 3G networks using two joint-ventures for network deployment and operation. However, the operator “3” did offer higher data rates for some period of time, when HSDPA was deployed in some parts of the “own” network. Temporarily, 3 attracted customers but the other operators soon offered the same kind of service at the same price level.

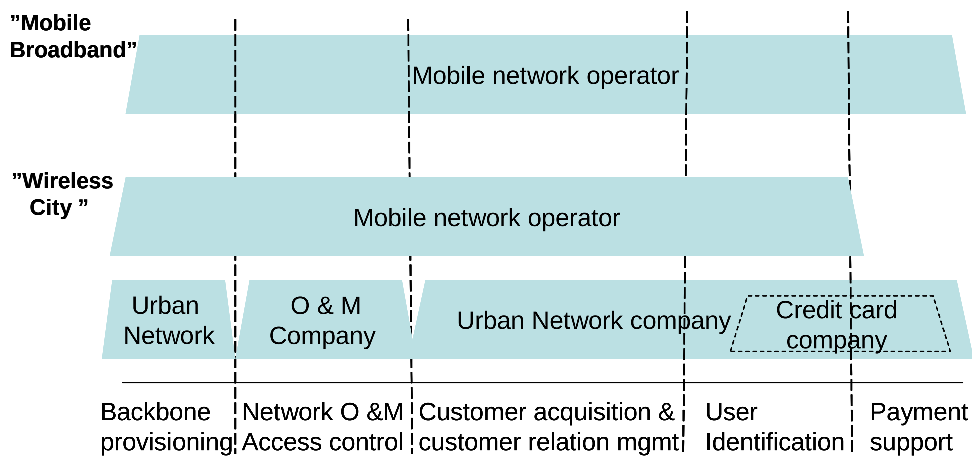

Figure 2 Configuration of business roles for “Mobile broad band” and “Wireless cities”

6.2 Wireless cities

General description

In this case the wireless access is provided to citizens, visitors or to employees in a city or a town. The service can be provided for free, as a public utility, or for a monthly or short term fee. WLAN hot spots or hot zones are dominating. A number of wireless city initiatives by the local authorities have been announced. In Sweden a few cases exist, the deployed networks in some areas of the Swedish towns Karlskrona and Linköping and the network to be deployed in Gothenburg. Typically, the main actor is the operator of the metropolitan area network.

Another kind of public access is also provided by mobile network or broad band operators. Examples are Telia Surfzones and Glocalzone, but they can also be characterized as consumer hot spots, see the next subsection.

Value proposition

The service is available in some areas of the city or town, usually for a monthly or short term fee. It is not known if the wireless access is bundled with the fixed broadband access.

Market segment

No specific user segment can be identified; the offer is for local users in the city or town. Examples of prices are: 5€ for one hour, 10€ for 24 hours and 30€ for one month.

Firm organization and value chain, Firm in value network

In the Swedish towns Karlskrona, Linköping and Gothenburg the wireless network is deployed and operated by a specialized “O&M company” the Cloud. In this case the Cloud cooperates with the authorities and/or the metropolitan area network operator that is responsible for the backbone network and for customer acquisitions, customer care and billing for monthly subscriptions. For one-time subscriptions (one hour, 24 hours or one month) the cloud offers “pay as you go” services using credit card or SMS through mobile phone subscriptions, see figure 2.

The wireless city services provided by operators are “added value” to existing customers. Hence no payment for the usage is involved but the users need username and password in order to be able access the network. All business roles are taken by the operator, see figure 2.

Cost structure and profit potential

The overall cost would be low since existing backbone is used. There would be a potential to provide an attractive offer for the local market, although other solutions are very competitive, see the next paragraph.

Competitive Strategy

With the pricing scheme presented above there will be strong competition from both “mobile broadband” (cheaper and provided “everywhere” and from “consumer hot spots” ((usage “for free” or very cheap). It is not evident how the competitive strategy looks like. The authors would recommend wireless cities to exploit the local presence, possibly by providing bundled offers with fixed broad band access. However, discussions with representatives of metropolitan area networks indicate that this opportunity has not been considered or identified.

6.3. Business hot spots

General description

Typical locations for “business hot spots” are hotels, conference centers, airports, railway stations and long distance trains. Examples of actors are Mobile network operators, local network operators and actors that manages (owns) hotels, airport, railway stations, etc.

Value proposition

The access service is available “here & now” with an expected high level of reliability and with high data rates and there are no limits on used amounts of data.

Market segment

The customers are typically people on the move with medium to high level of willingness to pay. The usage and payment options may include: one time usage using credit cards, one time usage using SMS voucher issued by other operator or long term subscriptions with hot spot operator or mobile network operator. Prices are similar as for the case of a wireless city, typically up to 10€ for one hour, 20€ for 24 hours and 50€ for a month.

Firm organization and value chain, Firm in value network

For the business hot spots we can identify many different ways to configure the value network, In Figure 3 we provide some examples where the actors can be: ISPs, Mobile Network Operator, local network operators, network O&M companies, Site owners and actors that can handle payments, e.g. a credit card company.

One case is when one actor, e.g. a telecom operator takes (almost) all business roles, one example is Telia Homerun. Another possibility is when a MNO "out sources" network operation to an "O & M company", one example is the Telenor cooperation with the Cloud. Yet another type of configuration is when the site owner takes most of the business roles. "Internet on trains" is one example where the Swedish railroad company SJ makes use of a multi-operator solution including cellular and satellite systems to provide the backbone capacity. Payment can be handled by SJ or a credit card company. Finally, the value network can be configured with the site owner taking care of the customer related business roles and an O&M company (the Cloud) is operating the network.

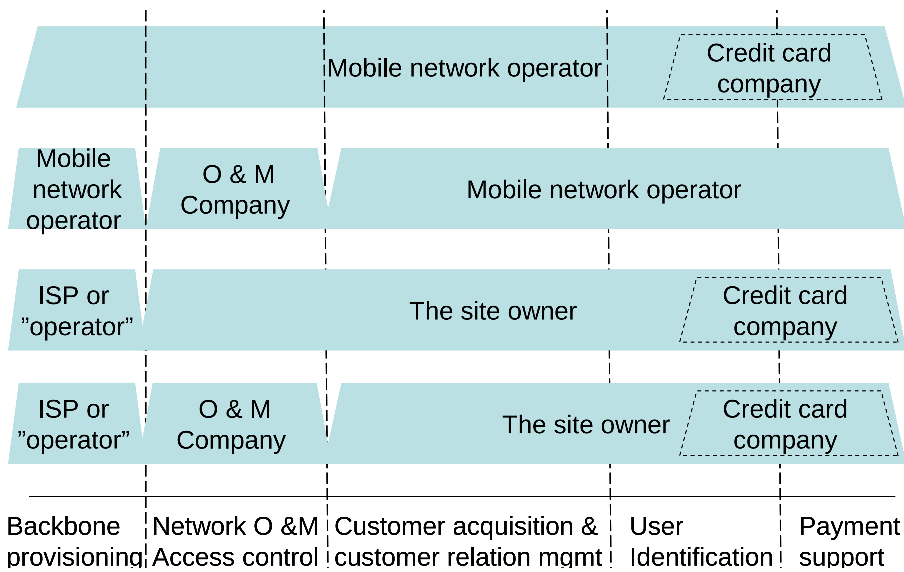

Figure 3 Different types of configuration of business roles for "Business hot spots"

Cost structure and profit potential

The profit potential in this case would be high. The networks are deployed in areas (sites) with a clear demand. The cost would be low since the customer acquisition and the payment is already taken care of as part of the core business of the site owner. The price is high and the users within the segment have a high willingness to pay.

Competitive Strategy

Historically business hot spots have been associated with very high usage fees, e.g. 100-200€ per month or 0,2$ per minute and quite a limited number of users. Now the fees are lower but still one hour may cost as much a one month of mobile broad band. No response has been observed to meet the competition from flat rate mobile broadband subscriptions or from the very cheap consumer hotspots.

6.4 Consumer hot spots

General description

We can identify two types of main actors; 1) non-telecom companies like hotels, cafés, fast food restaurants and transportation companies and 2) broadband providers (e.g. Telia and Glocalnet) that offer wireless access as an added value to the own subscribers.

Value proposition

The wireless access offer is bundled with some other service, e.g, a cup of coffe, a hamburger, a bus trip, a stay at a hotel. It is "something extra" offered to the own customers. The wireless service is cheap, for free or included in some other type of service.

Market segment

No specific user group or user need can be identified. The typical customer usually has a low willingness to pay for the service but may have high expectations on availability.

Firm organization and value chain, Firm in value network

We have identified a number of ways to configure the value network, see Figure 4. The simplest type is when a site owner (e.g. a café) offers the service for free to anyone. There is no need to buy a cup of coffee or a hamburger, hence no user identification or payment support is needed. ISPs that offer the wireless access as add-on take all business roles; user identification is needed but no payment support since the service "is included".

When compensation from the customer is needed, either as a usage fee or included "in the hamburger", the site owner needs to handle payments in some way. The access network can be operated by the ISP or by an O&M company. The cooperation between MacDonald's and the Cloud is illustrated by the configuration at the bottom in Figure 4.

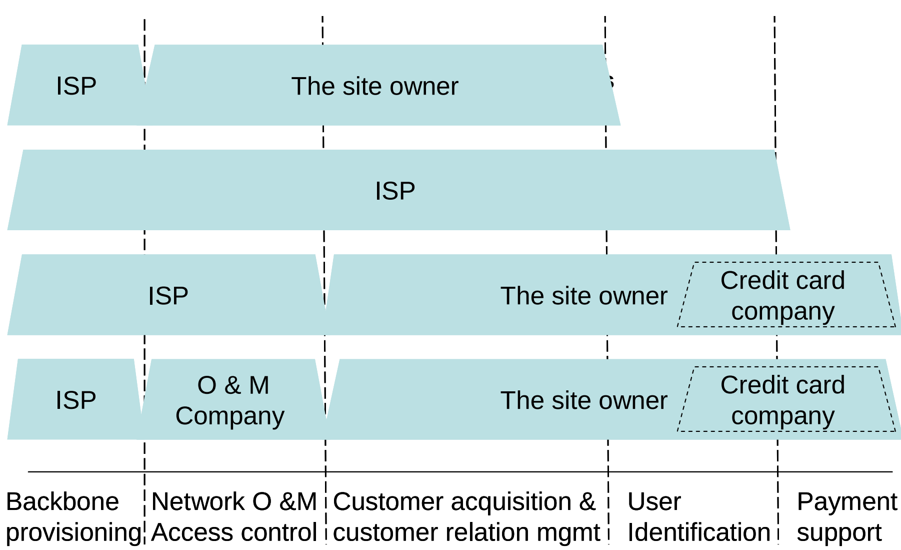

Figure 4 Different types of configuration of business roles for "Consumer hot spots"

Cost structure and profit potential

In general the cost for the network would be low since the capacity is deployed in a limited area and since existing fixed broadband can be used. If substantial increase in usage can be expected cost efficient build-out of additional backbone capacity may be a challenge. Costs for customer acquisition and payment support are already taken care of. Alternatively, the access service itself can be seen as a part of the customer acquisition.

The profit potential is hard to estimate since the wireless access is supporting the core business. The value for the market actor that offers the access service must be expressed in “other terms” like increased sales, customer satisfaction or loyalty.

Competitive Strategy

In this submarket the wireless access is part of the competitive strategy itself. It is a way attract customers, (a way to get the customer into the café) or to reward loyal customers. One trend is that the wireless access more or less it is seen as a commodity. It is “expected” to be available for free at many locations. If there is no free WLAN at the café the potential customers will go to another place.

7. Analysis

7.1 Summary of observations

Some common themes and patterns can be identified from the different submarkets.

Value proposition

The key characteristic of the wireless broadband services is that it enables the user to access the Internet at other places than in the home or at the office. The use of Internet services is moved also to public places. The value proposition is about “the possibility” to use Internet “here & now”. For some people it is of importance if the access service is cheap or for free. Other aspects are “ease of use” and the ability to access the service without cumbersome procedures for login and/or search for access points.

In addition to “site owners” the most active market actors are the mobile network operators. However no bundled offers with mobile telephony have been observed. Fixed broadband providers like ISPs and metropolitan area network operators seem to be less interested in public access services. The focus seems to be fixed broad band to homes and offices. No bundling with mobile and fixed broad band access has been identified anywhere.

Market segments

No traditional user segmentation models (e.g. early adopters, teenagers, families) are found to be representative for the wireless broadband access. Of course, differences can be identified for business and consumer users when it comes to usage patterns and willingness to pay. However, currently the most useful classification of user groups would be

- The complement users, that have broadband access at home and/or at work, and use the wireless broad band at public places and when on the move.
- The substitute users that replace the fixed broadband at home with a mobile broadband subscription and always use the wireless solution

Firm organization and value chain, Firm in value network

A general observation is that wireless access services are delivered using a multitude of different ways to configure the value network. Mobile network operators still make use of the vertically integrated value chain, both for wide area and hot spot services. At the Swedish market four different ways to deliver services are identified for the mobile network operators:

- mobile broadband using own cellular network (used by all mobile operators)
- own WLAN network (Telia and Glocalnet)
- WLAN network operated by a third party (Telenor and the Cloud)
- Integrated solution for own 2G, 3G and WLAN access (Telia)

It can also be observed that the “network O&M company” the Cloud is present at three of the submarkets and that they cooperate with all other market actors; mobile network operators, metropolitan area network operators, payment providers and site owners (both in business and consumer hot spots).

Cost structure and profit potential

The most dominating trend the last year has been the very large increase in the number of mobile broad band subscriptions. State of the art can be said to be a flat rate subscription with a monthly fee of 10 – 20€. Some operators have upper limits on the amounts of data that can be used every month. However, other operators acting at the same market offers “all you can eat” type of subscriptions at the very same price. The revenues will increase when new customers start to use the services. However, the increasing usage will provide challenges for the operators to produce the access service at a lower cost.

Competitive Strategy

The traditional business hot spots are challenges both by the flat rate mobile broadband subscriptions and the consumer hot spots that offer services very cheap or “for free”. It is questionable if the business hot spots can survive with the current pricing. Charging one hour of usage in a local environment with the same amount as one month of mobile broad band access (that can be used “everywhere”) is not a viable business model. In addition 3G and HSPA modems for laptops become very common. If people get used to the 3G type of systems it is not obvious that WLAN access, with potentially better performance, will be used although it may be available.

7.2 Business drivers and opportunities – the current market

A number of different business drivers can be identified on the analyzed submarkets

- To make money on the access service is the motivation for the actors that offer mobile broad band and WLAN access in business hot spots
- To support the core business rather than to get revenues from the access provisioning. This is most evident for the consumer submarket. Both ISPs and non-telecom actors (e.g. fast food restaurants and bus companies) use this strategy.
- Wireless access is seen as a commodity similar to electric power, hot water and air conditioning. Hotels “must have” wireless access, possibly for free, otherwise another hotels is chosen by the customer. In this group we can also include wireless cities where the access service is seen as a public utility.

7.3 Business drivers and opportunities – future markets

Other business opportunities to investigate are to bundle fixed and wireless broad band and to exploit customer and business relations in order to offer “roaming” possibilities.

We also expect that the ability to provide wireless access at low cost will be a major issue in the future. The cellular macro base station solutions must be complemented by other types of solutions. It is interesting to note the Vodafone motivation to consider use of femtocells:

- “to reduce the need for capacity in macro network” and “ to reduce the cost of wide area network rollout”
- “to offload heavy data users from the wide area network in dense urban areas resulting in RAN CAPEX where deployed”

8. Conclusions and further research

We will conclude by providing comments related to the research questions (RQs) described in section 3 including implications that also outline areas of future work.

8.1 Comments on the research questions

RQ1. Can any specific types of pricing models or types of subscriptions be identified?

Two trends can be observed when it comes to pricing and charging for wireless access;

- “Cheap” flat rate subscriptions did make mobile broad band to take off
- WLAN access for free is offered at many locations and is often taken for granted

This is what actually is happening now and it challenges the traditional usage based charging used in the telecommunication sector. Fixed and mobile telephony has traditionally been charged per minute and at a traditional WLAN hot spot you “buy hours”. Common for both the trends above is that an increased usage does not result in more revenues. We can see two implications of this adoption of flat rate and access “for free”

- The traditional business hot spot need to change the pricing away from”10€ per hour”
- Since the revenues are fixed (for a specific penetration rate) an increased usage must be match by even more efficient ways to produce the access service at very low cost

RQ2. What options exist for cost-efficient deployment of high capacity wireless networks?

A widespread adoption of public Internet access and related increased demand will mean that much more wireless capacity need to be deployed. Compared to the amount of data that is used for voice services we need to deploy 100 – 1000 more capacity the coming years. This means that the production cost per bit must be decreased dramatically.

For a given radio access technology and a given amount of allocated spectrum the capacity can be increased by adding new base station sites or by adding sectors to existing sites. Part of the needed improvement can be provided by increased efficiency. The current improvements of existing or new radio access technologies (HSDPA and LTE) are truly impressive, without these achievements the success of mobile broadband would not have been possible. However, these improvements are not enough; we need to combine a multitude of strategies in order to achieve the cost reduction of several orders of magnitude.

In order to increase capacity we need to deploy more sites. However, to add more macro and micro base stations is not entirely a feasible solution if we want to decrease the cost per bit with 100 or 1000 times. Even if the radio equipment was for free the non-telecom related costs for site deployment (towers, masts and installation) and the running costs (O&M and site leases) will lead to too high production costs for the delivery of the wireless capacity.

Hence, we need to combine high capacity radio solutions with low cost deployment strategies. We argue that the use of high capacity local network and cooperation between different market actors is a feasible way forward in order to achieve decreased network costs.

RQ3.What kind of business drivers can be identified, are they different for different actors?

For mobile operators and hot spot operators the business driver is to get revenues from the usage of the wireless access. Another driver is to support some other kind of business, in or study we have observed that the following types of actors has used this strategy; broadband operators, train and bus companies, hotels, cafés and fast food restaurants. The access service can also be provided because it is seen as a public utility that should be available to citizens.

However, none of the market actors use the public wireless access service in the local environment as a way to off-load traffic from wide area networks and hence save costs.

RQ4.What different ways to cooperate and organize the value network can be identified?

For provisioning of mobile broadband access the mobile network operators control all business roles using vertically integrated value chain. For the other submarkets a multitude of ways to configure the value network can be identified and where different types of actors may have the main customer relation.

8.2 Conclusions

It is important to view the whole broadband market as one virtual entity where the users are served in several submarkets. Desirable properties would be unified ways to manage customer relations and seamless roaming. None of the submarkets is self-sufficient and can compete favorably on all other submarkets. If the actors on different submarkets cooperate then all actors would benefit from such cooperation. They can give better service to their customers at a lower price.

Expensive wide area networks can be offloaded which reduces network investments. Here the local networks can play an important role. However, in order to exploit the benefits with cooperation between wide area and local networks new forms of business relations and cooperative strategies are needed. Actors do cooperate already today, see examples of value networks, it is place in most submarkets but it is not motivated by cost reasons (yet!)

8.3 Future work

Future research needs to estimate how much of the total traffic that can be provided in the various submarkets and how the providers of capacity (and services) at the same time can compete and cooperate with each other. Here new business models and new types of business role interaction that offer win-win situations are necessary.

Cost efficient deployment using cooperation and femtocell concepts should include all types of radio access technologies, (WLAN, HSDPA, LTE etc). There is no reason to exclude some type of technology, frequency band or strategy for resource management.

The femtocell concept should be developed further taking into account the possibilities in the business domain. Operators have a possibility to build and run high capacity local networks which can serve internal users as well as guests and public users. Operator also has the possibility to form joint ventures with other actors in the same neighborhood.

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