WLAN Hot Spot services for the automotive and oil industries :a business analysis
Or : "Refuel the car with petrol and information, both ways at the gas station "

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Or : "Refuel the car with petrol and information , both ways at the gas station "

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1.BACKGROUND

1.1 Hotspot areas
For several reasons (e.g. range and coverage) WLAN technologies were, until recently, mainly used in private areas like offices (both large enterprise offices and SOHOs) and homes. Research and activities of leading technology firms and mobile network operators show that the interest into applying WLAN into public areas is growing. Especially the "hotspot areas" (e.g. airports, shopping centers, congress centers, etc.) are focus points. "Among network operators trialing or deploying public wireless LANs now, or considering whether to do so in the near future, are European service

providers Orange, British Telecom, Telia, , Telenor ,Deutsche Telekom , Mobilcom, as well as Korea Telecom and AT&T."[1]

1.2.Vehicles

Another aspect that forms the background for this research is the fact that more people spend time in their vehicle(s). The number of vehicles[2] per 1000 people is increasing, in the Netherlands as well as in the other European countries, although this time is stable in USA . In The Netherlands this number grew 10,33% (from 387 to 427) during the period 1993 – 1999. This is approximately the average growth in the West-European countries[3]. Related to that the traffic intensity grew enormously. In The Netherlands the traveling distance per year for passenger cars grew in the period 1987 – 1997 from 74698 million kilometers to 93081 million kilometers. This is a 24,6% growth. The largest growth was for delivery vans. This number grew from 6090 million kilometers per year in 1987 to 12639 million kilometers per year, which means an increase of 107,5%. The traveling distance for buses and truck increased with respectively 5,4% and 7,6%.[4]

1.3 Wireless access for vehicles while "on the move"

If we combine the two factors above, we can conclude , based on simple technology diffusion principles , that there will be an increasing demand for wireless services from and to vehicles while on the move.

Public voice services are already integrated into vehicles in a way satisfying safety regulations (e.g. integrated hands-free telephone sets) . Since the introduction of mobile services , the penetration has increased enormously, especially in European countries. In the Netherlands for example the number of mobile phones per 1000 people grew from 14 in 1993 to 721 in 2002[5]. This is without taking into account mobile data and mobile Internet services as enabled already via GPRS/EDGE and more so with 3G services .

The combination of the number of vehicles per 1000 people and a high penetration of mobile phone user, leads to the plausible fact that more and more drivers and passengers will use mobile services from a vehicle on the move , at the same time as safety regulations impose an integration of the access devices into the vehicles This especially impacts the deployment in the vehicles of Bluetooth technology for communication between devices in the vehicle as well as between the vehicle and its environment .

1.4 Service requirements and provisioning

Many of the wireless services have a multimodal character with a variety of requirements on communication networks such as bandwidth, asymmetry and interactivity. Besides this, users expect a cost-efficient access to their information, entertainment , technical and communication services. WLAN (IEEE 802.11 standards) meet most of these requirements ,by offering high data rates (11 Mbit/s and more) ,but at short range , and with in several countries a regulatory framework allowing value added services to be deployed locally .GPRS/EDGE and 3G services meets most of these requirements , with good coverage, with nominal data rates up to 364 kbit/s with wide coverage ,but service provisioning by public operators only . Bluetooth based Personal Area networks offer a third route, limited to a collection of devices at short range ,but with no data connectivity or management by iitself There are other concepts or standards in the broad WLAN area such as OpenAir, HiperLAN (ETSI standard) , Home RF.

1.5 Examples of uses of WLAN in vehicle environments

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[1] Total Telecom, December 2001
[2] Cars, buses and freight vehicles; no motorcycles.
[3] Centraal Bureau voor de Statistiek (CBS), 2001
[4] Centraal Bureau voor de Statistiek (CBS), 2001
[5] Centraal Bureau voor de Statistiek (CBS), 2001

In November 2001 Mercedes-Benz demonstrated a c320 sedan that had been outfitted with an IEEE 802.11a LAN. Web and media content can be radioed from roadside access point via an interface card to the sedan's onboard computer[6].
IIn 2001 , Ten Square Inc. started rolling out its point-of-sale network, called the OuterNet network, which allows drivers to do everything from downloading a coupon for a free cup of coffee from the receipt printer on the pump , to selecting MP3 and video files from the dispenser screen and downloading them wirelessly in the approximately 240 seconds that it takes the average gas tank to fill up [7].
Sensoria Corp. introduced its Telematics Environment at DEMOmobile 2001. The Sensoria Telematics Environment is a standards-based platform for delivering next-generation telematics services over conventional cellular, Bluetooth and wireless LAN connections. It should bring new voice and data applications into the vehicle[8].
Delphi Automotive Systems demonstrated automotive applications for wireless data networks at the 2002 International Consumer Electronics Show in Las Vegas. On a specially equipped vehicle, Delphi showed how licensed video files, audio files and other data seamlessly could be transmitted to and from home, office and future service-provider sources[9].
Industry analysts Frost and Sullivan projected that in North America alone, the telematics equipment market will grow from US$ 380 million in 2000 to US$ 7 billion in 2007. These numbers reflect a big push by the world's biggest automakers to roll out telematics systems. General Motors offers its OnStar navigations system in some 800000 vehicles and is investing US$ 1 billion to produce what it calls "Web cars". Ford and Volvo have an agreement with telecommunications giant Vodafone to provide in-car telematics systems[10].

1.6. Standardization and Government funded Research

Besides the above-mentioned commercial activities and initiatives, there is also research done by Standardization or Governmental Organizations. The Dedicated Short Range Communications (DSRC) Standards Writing group of the American Society for Testing and Materials (ASTM). Was sponsored by the Federal Highway Administration to test IEEE 802.11a products for telematics applications. This included vehicular public safety, electronic toll-taking, commercial vehicle operations, and information applications[11]. Since 1994, the European Union RTD activities were carried out under the Framework Programmes (FP4,FP5) ,e.g. in the DRIVE project. (acronym for Dynamic Radio for IP Services in Vehicular Environments), dealing with spectrum efficient high-quality wireless IP in a heterogeneous multi-radio environment , and with in-vehicle multimedia-services [12].There is also , under the European Road Transport Telematics Implementation Coordination Organization ,the establishment of OSGi-based in-vehicle telematics by ensuring interoperability[13].

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[6] "Mercedes-Benz shows new wireless technology at Comdex", November 2001, www.m-travel.com/11115.shtml
[7] "Pumps to deliver more than just gas", January 2001, www.nwfusion.com/news/2001/0129pumps.html
[8] "Sensoria Corp. introduces the first telematics solution to support advanced voice and data applications in vehicles", September 2001, Lexis Nexis
[9] "Delphi shows how 802.11a and 802.11b will enhance mobile entertainment, information and commerce", January 2002, Lexis Nexis
[10] Chrysler claims first with Bluetooth mobile phone system", October 2001, www.wirelessnewsfactor.com/perl/story/14420.html
[11] "Driving the Wireless Future", August 2001, www.atheros.com/news/telematics.html
[12] www.ist-drive.org
[13] http://dbs.cordis.lu/cordis-cgi/

1.7 Players

When discussing the business models for wireless services in the automotive area, an essential aspect is the identification of the players. Some of the technologies described above, such as public mobile voice service, have already been in use for some years ,and distinct players have evolved .. . The new mobile data services around WLAN will however allow new parties ,such as the oil industry , to enter the market, but will also allow incumbents to broaden their outlet area

Who are the (potential) players?

- Government and municipalities (licenses, safety, taxes, regulations)
- Oil Companies (WLAN services being offered via "their" service stations", they might start offering the service)
- WLAN Service Providers (Third party that might start offering the communication service ,but not the applications)
- Mobile Network Operators (might be threatened by WLAN or triggered to join (connection WLAN-GPRS) or become WLAN Service Providers themselves)
- Service Station owners/operators (The WLAN equipment is going to be installed on "their premises)
- Content Providers (new services and content might be needed)
- Drivers/Users/Vehicle fleet owners (= the end users)
- Client enterprises (= the intermediary between the provider and the (professional) end-user , such as vehicle maintenance or certification companies)
- Vehicle manufacturers (vehicles will carry WLAN client equipment and will be also WLAN emitter platforms)
- After-market car equipment OEMs (might be producers of the in-car WLAN equipment and application specific equipment)
- Software producers and integrators (e.g. middleware and application specific software)

Regarding all these players one can furthermore ask :

- What role and place will they have in the value added and provisioning chains ?
- Who is authorizing whom?
- What are the dependencies?
- Who is paying whom?

For the uptake of Wireless LAN services in the automotive field on commercial terms ,it is most likely that the car and automotive electronics industry will take no initiative in integrating the Wireless LAN equipment in the vehicle., unless some players are investing in the required infrastructure and service creation , assuming however some equipment price levels The infrastructure and service creation investors will ,for their account, only do so if business models and profitability can be established The users then will have to invest in after-market equipment (which already is the case for users that want to use the WLAN services in their current vehicles). This means an opportunity for producers of after-market electronic car equipment. When sound results can be presented and a number of solid parties are going to invest in WLAN services , then the car manufacturers are likely to join on a big scale in well identified service-uptake dependent areas (apart from demonstration or brand image retention reasons) .

2. RESEARCH FOCUS : REFUELING STATIONS AS WLAN HOT SPOTS

2.1 Definition, argumentation and focus players

Many problem statements can be derived from the above-mentioned issues regarding wireless services and WLAN technologies. We focus here on the sub-area where, mobility, telematics , vehicles, commerce and the possibility for upstream as well as downstream wireless data services from the vehicles come together: the gas (petrol) stations. Furthermore we focus only on two classes of players, e.g. an incumbent Mobile service operator using his infrastructure, and an Oil company interacting with gas stations in different ways described below . This choice is due to the analysis that these players in turn are the only ones who can trigger the developments in the car industry itself as explained above .

As mentioned WLAN has significantly higher data rate possibilities than cellular technologies, but on the other hand less coverage. This means that strategically located access areas have to be defined and created.. For the automotive and telematics usage , locations on or near the roadside ,including traffic signs , would be best suited., but such locations are completely government-owned and operated ,and thus do not allow for free market dynamics.

Therefore the more commercially oriented locations such as gas stations represent should be more amenable for a quick and comprehensive uptake on commercial terms . All the more so because , not only the vehicle users benefit from the new services, but there is also strategic and market potential for the gas station operator itself. It could for example, be very attractive or even critical for gas stations to start providing information needs and carrying out in-vehicle information collection . Also , in the future , hybrid or alternatively driven vehicles will enter the market as a result the market for the traditional products a gas station provides (fossil fuels) will decline .and alternative sources of revenues will be necessary. Besides the already existing alternative sources of income for gas stations, such as supermarket products , videos , car repair, rescue or rental services, the information access and collection services could be very attractive . Since the role of gas stations thereby gets broader and broader, it is more appropriate to call them "refueling stations" rather than gas stations.

Another strategic issue is about who will best operate such services, meaning either the present gas station owners/operators , public mobile operators ,or other parties And for each of those , does the provisioning of WLAN hot spot based services around refueling stations offer potential and profit levels who match or exceed those of their other major operations

2.2 Research scope

Thus our research has been addressing the following questions with full business analyses and modeling:

- How is the gas service station market structured?
- What are the market drivers and what are the inhibitions?
- What and how are the parties involved and what role are they going to play?
- What is the market potential for public automotive WLAN hot spot services?
- Where and how are the revenue streams going to be?
- What is the profit level of automotive WLAN hot spots , restricted to refueling stations, as assessed by models and analysis?
- What are the open issues, such as role and influence of players not covered in this research?

Further details than those provided ere can be found in (M.H.P. Oremus, 2002) .

2.3 Structure of gas service station market

Almost 50% of the service stations are owned by independent entrepreneurs These dealers have contracts with oil Companies which supply them and usually allow them to operate under the oil company's brand name. Most of the times the Oil Company invests in the service station equipment. The dealer is obliged to exclusively sell the Oil Company's products (fuels and lubricants). By law, such a contract can in the Netherlands be valid for a maximum of five years. Apart from the appearance and the products the dealer itself is responsible for exploitation of the service station. He is free to set a price and to optimize profit. He can also determine the product range for the shop. This model is called Dealer Owned / Dealer Operated (DoDo)

Around 20% of the service stations are owned by oil companies, but are being rented to dealers. These dealers are also independent entrepreneurs that pay a rent to the oil company.. The Oil Company does all major investments in the service station. The dealer has the obligation to exclusively sell the Oil Company's products (fuels and lubricants). For the rest the situation is exactly the same as for the above described DoDo model: The dealer can determine the price and the shop assortment. This model is called Company Owned / Dealer Operated (CoDo).

The remaining 30% of the service stations are owned by oil companies and operated by a subsidiary. The Oil Company has complete control over the exploitation of these service stations. The price and complete product range is determined by the Oil Company. This model is called Company Owned / Company Operated (CoCo).

The above structure of the service station market is based on the situation in the Dutch market. The numbers are based on Shell.

2.4 Wireless LAN configuration at a refueling station

The attached Figure 1visualizes the elements and their configuration.

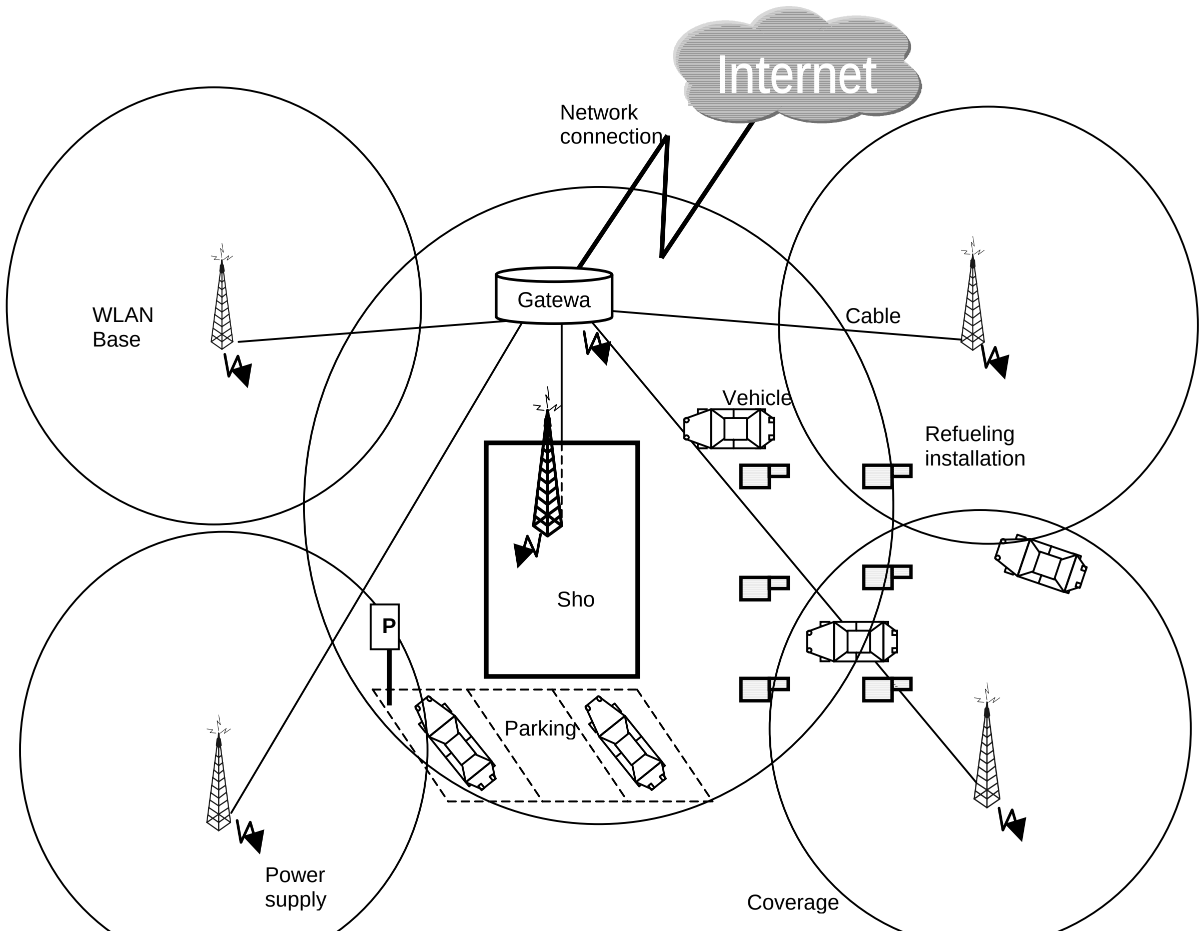
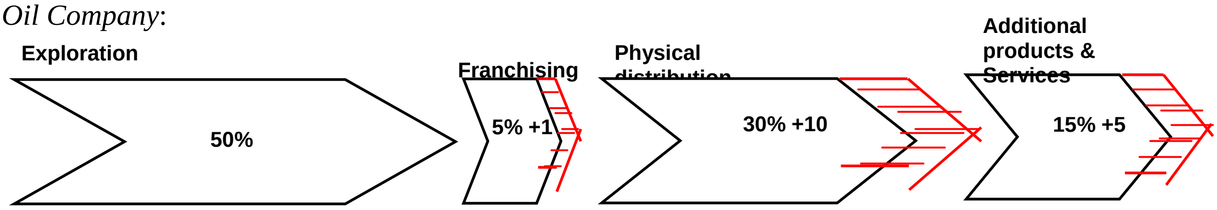


Figure 1: Wireless LAN equipment at a service station

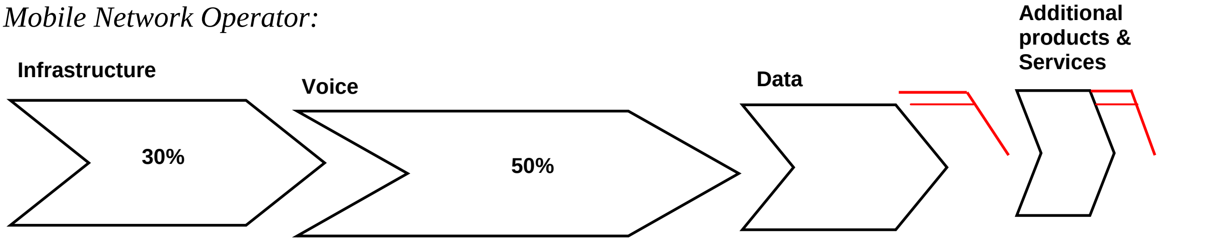
2.5 Value Chains

The estimated positive externalities linked to the introduction of WLAN services at refueling stations are depicted below :

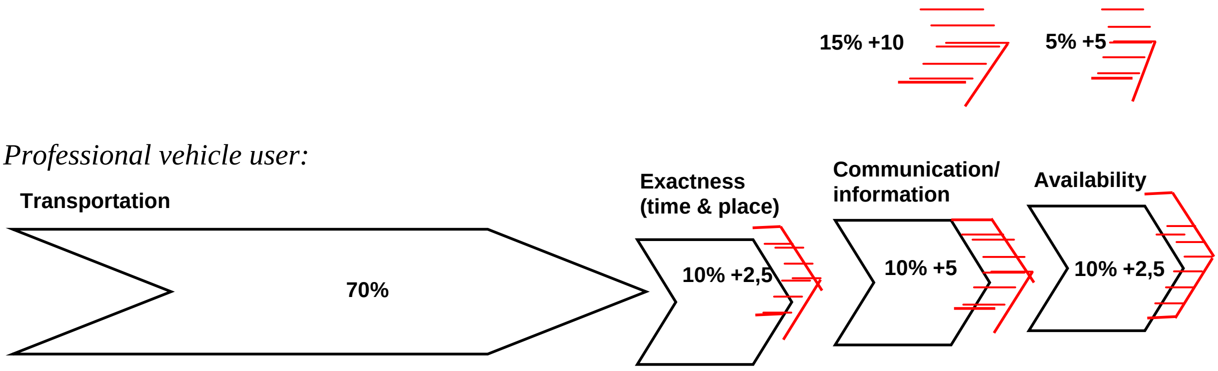
Oil Company:



Mobile Network Operator:



Professional vehicle user:



3.USER , SERVICE and PROVIDER SEGMENTATION

To get a realistic representation of Wireless LAN services in refueling stations, segmentation has to be determined, especially of users and of services

3.1 Vehicle/ user segmentation

The Tables 2,3 below give the segmentation of vehicle types and of professional vehicles. The user groups related to this vehicle category are professional, public and specialty users

Vehicle Category	**Number**[14]
Cars	6518634
Professional vehicles	970814
Motorcycles	460822
Total	7950270

Table 2: Different vehicle categories in absolute numbers for the Netherlands

Vehicle Category	**Number**[15]
Delivery van	755977
Truck	143286
Special vehicle	39599
Taxi	20578
Bus	11374
Total	970814

Table 3: distribution of the professional vehicle category in absolute numbers for the Netherlands

3.2 Service segmentation

In order to come to a segmentation of the services a number of steps have to be taken. To define the needs, vehicle stopping points and the corresponding needs are analyzed. . Table 4 shows the relevant elements for private and professional users with a refueling station as a stopping point .within WLAN coverage Table 4 differentiates between wireless and non-wireless services requiring a physical action

Service cluster	**Physical action**	**Wireless Service**	**User group**
Get/Give Information	-	Get/Give statistics (e.g. on	Professional

[14] Source: Centraal Bureau voor de Statistiek (CBS), 2001
[15] Source: Centraal Bureau voor de Statistiek (CBS), 2001

		cargo)	
	-	Notification (position)	Professional
Passenger Entertainment	Sound/Music	Sound/Music	Private
	Image/Video	Image/Video	Private
	Gaming	Gaming and -download	Private
	Reading	Reading	Private
Refuel	Get petrol	-	Both
Refreshment	Drink and Eat	-	Both
	Rest and Sleep	-	Both
Specific information	-	Services inquiry	Both
Maintenance	Replace/Fill up parts	-	Both
	-	Remote car diagnosis	Both
Infotainment	Sound/Music	Sound/Music	Both
	Image/Video	Image/Video	Both
	Gaming	Gaming and -download	Both
	Reading	Reading	Both
Get/Give Information	Route information (maps)	Route information	Both
	News (newspaper)	News	Both
	-	Traffic information	Both
Communication	Talk	Talk	Both
	Send/Receive e-mail	Send/Receive e-mail	Both
Payment	Pay at cashier	E-pay	Both

Table 4: Service needs at refueling stations

3.3 Usage segmentation

Furthermore , the Wireless LAN services are segmented according to usage categories, usually linked to Vehicle segmentation :. Common (meaning for all categories of users) , professional, private, business, public and specialty usage .

3.3.1 Private usage

The private users are in number the largest group. That implies market potential. Therefore it is useful to examine the characteristics of this user group:

- The size of the user group helps to reach critical mass (in number of users)
- The offered Wireless LAN services have to be cheap and the percentage of common service usage will be high
- Because of a high percentage of common service usage , it is hard for a WLAN service provider to distinguish his offer from competitors. A high churn rate could be the result.
- Private users are not likely to be willing to do after-market investments on Wireless LAN car equipment
- Private users are probably not the early adopters
- Every user has to be triggered and contracted individually, which entails high marketing and administrative costs

3.3.2 Professional usage

The professional user group have other characteristics than mere number to make it an interesting one.

- Because of a direct relationship to daily business (Wireless LAN services can save time and money) the professional users will are likely to be heavy users. This helps to reach critical mass (in service use)
- The offered Wireless LAN services don't have to be cheap and the percentage of specific service usage will be relatively high ; however the tariffs must be in line across competing platforms such as GPRS ,3G , low capacity WLAN ,etc ...
- Because of a relatively high percentage of specific service usage it is easier for a WLAN service provider to distinguish from competitors. A high level of customer loyalty is easier to achieve
- Professional users (i.e. their employers) are likely to be more willing to do after market investment on fleet Wireless LAN equipment
- A large group of new users can be triggered and contracted at once by contracting a single company as client

3.4 Provider segmentation and characteristics

As discussed above, we consider here only a Mobile operator service provider and an Oil company as focus providers. It should be noted however that the Mobile service provider considered here may not be a public wireless license owner but a value added WLAN service provider accessing the public license owner's infrastructure, or a mobile virtual operator running both public and WLAN services .

3.4.1 Mobile Operator Service Provider characteristics

- Site rental fee weighs heavy on OPEX
- Offering Wireless LAN services is (probably) core business at least at Division level
- A Mobile operator service provider can contract several Oil Companies and thereby obtain a large market share in terms of refueling stations.
- For a value added service provider it could be difficult to gain market share (in terms of clients), because of a non-existent brand image
- The Mobile operator service provider probably doesn't have the positive externalities the oil Company has

3.4.2 Oil Company Service provider characteristics

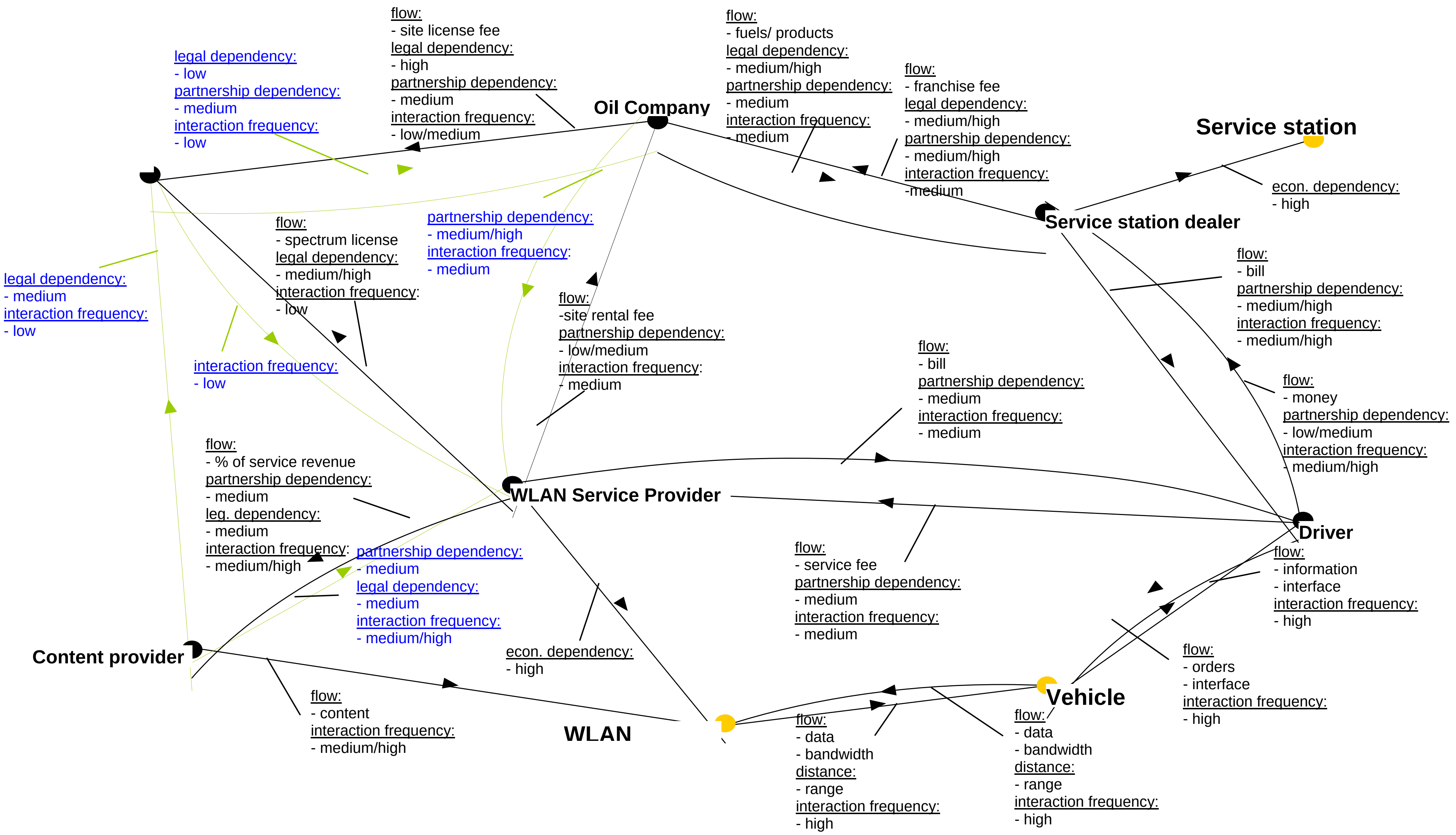
- No or low site rental fees ,and availability of on-spot support staff
- Offering Wireless LAN services probably is not core business (yet?)
- The Oil Company can quickly obtain market share in terms of equipped refueling stations, but is probably limited only to its own . In order to overcome this limit the Oil Company would have to cooperate with competitors, which is unlikely because of the fierce competition in the fuel and lubricant market
- The Oil Company can leverage its customer base and brand image to obtain market share
- The Oil Company is likely to experience positive externalities (e.g. service stations will sell more fuels, because of the Wireless LAN services)

4.QUALITATIVE MODELING

Although this article does not give enough space to elaborate , full qualitative modeling via attributed directed graphs has been made to encompass all players, all factors and identify business model bottlenecks , uncertainties or trigger conditions They also serve as a base for project planning and budgeting .The directed graphs are furthermore colored to illustrate which parts thereof are used in the quantitative relations, and switching between subgraphs due to conditional elements The graph coloring also serves to show billing/charging paths, both subscription based as well as prepaid .
As an illustration is given in Figure 5 , part of the qualitative model for private usage
The qualitative modeling also highlights :

- Complex models and a high cardinality (many mutual dependencies) in the interactions in any business model
- The role/ impact government is unclear
- The difficulty in meeting different usage business models in a way such that cost reductions (reduction in number of nodes) can be designed
- Quite many different parties have “fitting” conditions to become WLAN Service Providers by leveraging their roles as stakeholders.

Figure 5 :Graph of WLAN Service (Private User)



5. QUANTITATIVE BUSINESS MODELING

5.1 Introduction

Two quantitative calculation models , over a 5 year horizon , have been developped for the Dutch market , one for an Oil company as refuelling station WLAN service provider, and the second for a Mobile operator as refuelling station WLAN service provider . These models cover all professional users , usages and include service mix assumptions

These model allow to perform cash flow forecasts, profit or R.O.I level forecasts ,and above all to perform sensitivity analysis to identify which parameters play a role in determining the business outcomes , and how they influence each other. Thereby an insight into the structure and the working of the model and (part of) the market is provided.

The input variables include: usage (determined from stopping frequencies, WLAN service coverage, etc..) ,tariffs , service mix , service demand , CAPEX and OPEX .The outputs include : cash flows, profit/loss estimations and market shares .

By stating goal functions and constraints, optimization is carried out, to identify multipliers and thus most critical constraints and parameters .

5.2 General assumptions

For the two models, a number of general assumptions are made. These general assumptions are presented below :

- The calculation period is 5 years
- Linear growth of users is assumed over the calculation period
- The stopping frequency can be derived from the total number of kilometers driven and gas tank size for each vehicle type
- No churn is taken into account
- The market share in the Dutch market of the provider to be modeled is assumed to be stable over the calculation period
- The amortization is linear over 5 years and residual values are zero
- All installations are assumed to be finished in year 1
- All contracted service stations are assumed to be contracted and operational in year 1
- Roaming is assumed
- Roaming behavior of non-clients is similar to client’s
- User / vehicle specific services are assumed to be only available at contracted service stations
- All professional vehicles refuel in the Netherlands
- The refueling WLAN service provider contracts only one Oil Company for gas

The first step in determining the potential of the market for refueling WLAN services is taken by calculating the number of clients that have a subscription with the Service Provider (whatever party this may be). In order to come to this figure the total number of vehicles and the category of professional vehicles is taken as a starting point. This means that the number of users is calculated in number of vehicles. The user / driver of a vehicle is assumed to belong to the same category as its vehicle and one subscription is assumed to be contracted per vehicle.

As described above, the market for gas service stations isn’t homogenous. There are different types of service stations, related to ownership and operation. Since these different types of service stations are likely to have different cost structures this sensitivity is brought into the model by distinguishing explicitly the three possibilities.
For all services , a usage frequency , set-up time and access time are defined .

Regarding service demand, for professional users, a profile determines from each category base services, and additional services for that category The common service portfolio includes the plain voice access, the billing service and a number of services that the provider offers as a package without extra charges. For this package of standard services , the user is charged a flat rate fee. This means that for a fixed periodical fee the user has unlimited access to these services. On top of the standard services in the package , the provider offer additional services with a usage specific fee (Table 6)

Wireless Service	Standard / Additional
Exchange cargo-administration	Additional
E-pay (e.g. paying invoice, etc.)	Additional
Get orders	Additional
Real-time check passenger list	Additional
Real-time update passenger list	Additional
Internet access	Standard
Get/Give statistics (e.g. on cargo)	Additional
Notification (position)	Standard
Wirelessly update fleet software	Additional
Wirelessly check fleet status	Additional

Table 6: Professional vehicle/user specific services

5.3 Geographical service coverage

Assuming that the total market can be covered by the total number of service stations, we define a percentage covered by the provider, based on the total contracted service stations (e.g. 9 %) . Since the Oil Company is assumed to have contracted more service stations than a Mobile operator provider, its geographical coverage is also higher .

The geographical coverage ratio will influence the revenue. The relation is defined as an 1/X formula, which means the revenue reduction is relatively higher when the provider has less service stations contracted. Since the Oil Company has a higher geographical coverage ratio than the Mobile operator Provider , its revenue reduction ratio is lower

For one given refueling WLAN service provider to offer coverage to other stations than those he owns or licenses, a roaming fee is payable to competitors, which is charged to OPEX . Normally the Mobile operator is at an advantage here as this Provider can use his backbone to this effect.

5.4 CAPEX elements

Capital expenditure elements include both the total number of contracted service stations , spectrum license fee (if any) , all WLAN radio infrastructure elements (base stations , cables, antennas) based on service station areas and RBS coverage . Importantly, CAPEX also include related installation and configuration cost .

5.5 OPEX elements

Operational expenditure elements include : general staff costs , site rental costs based on site ownership structure , power costs , marketing costs linked mostly to number of new subscribers , customer support costs for standard package as well as additional services ,reconfiguration/update/maintenance costs linked to site numbers and usage , roaming costs payable to competitors based on station ownership distribution and roaming frequency by users,

5.6 Tariffs

The service package fee is a variable subject to optimization ,while additional service fees are set forth below, and are either common to all user types or user category specific .

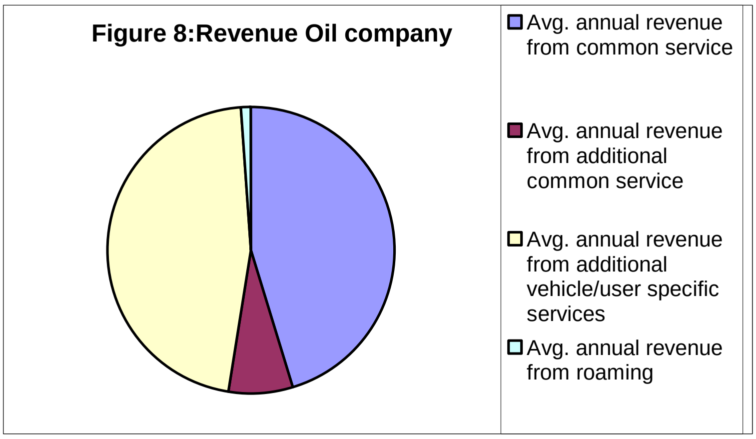
Additional common service	**Fee (per month)**
Image/Video	10
Gaming and -download	10
E-pay (e.g. parking fee, etc.)	5
Theft prevention	10
Alarm notification	10
Occupation help	5
Avg. Additional common service fee	8
Assumed additional common services (per user)	33% = 2

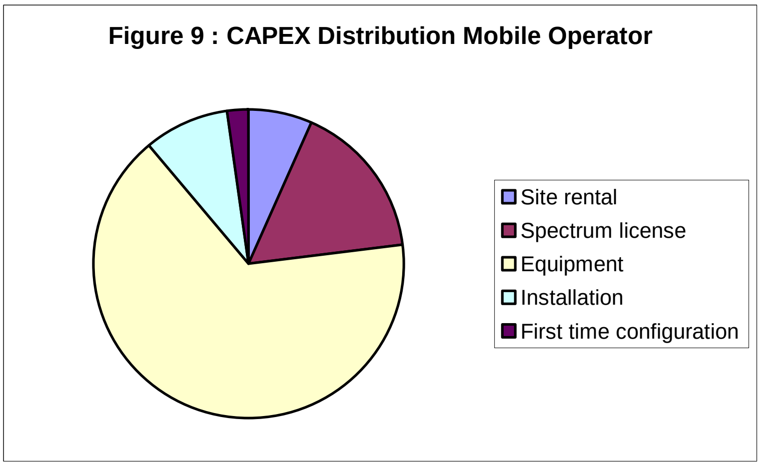
Table 7: Additional common service fee ,and vehicle/user specific service fees

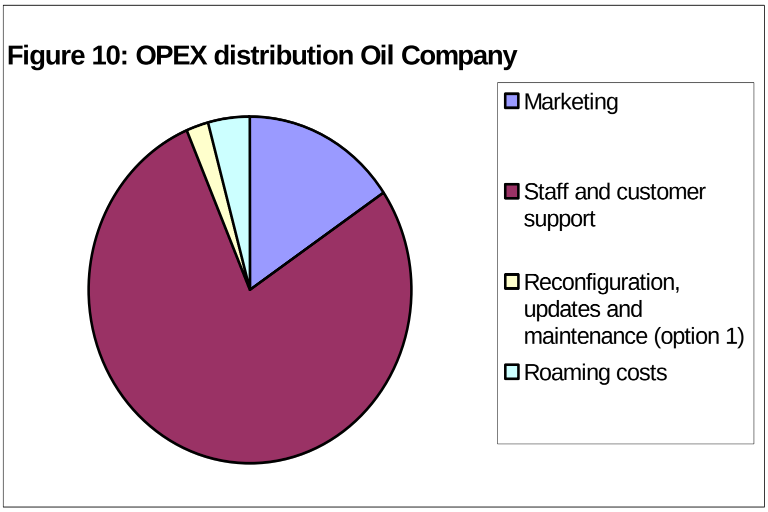
Additional vehicle/user specific service (professional user)	**Fee (per month)**
Exchange cargo-administration	20
E-pay (e.g. paying invoice, etc.)	20
Get orders	15
Real-time check passenger list	10
Real-time update passenger list	10
Get/Give statistics (e.g. on cargo)	20
Wirelessly update fleet software	25
Wirelessly check fleet status	15
Avg. Additional common service fee	17
Assumed additional common services (per user)	75% = 6

5.7 Provider CAPEX ,revenues and OPEX

With common service package fees in line with mobile operator public fees for (voice+SMS) package ,the Oil company or Mobile operator refueling station WLAN service providers have distribution sof CAPEX, revenues, and OPEX , as illustrated in a typical case in the attached Figures 8,9,10.They show that common service revenues and vehicle/user specific services are typically in balance .







5.8 Goal functions and variables for optimization

For basic sensitivity analysis, the goal function selected for the optimization , is the return-on-investment over 5 years, taken as the ratio of the net present value of the excess of operational revenues over operational expenses (OPEX) , divided by the net present value of CAPEX

In order to find the maximum of the goal function the variables that are to be iterated have to be defined as well as the related constraints ;they are typically the set jointly defined in the Table 11 below :

Table 11: Optimization variables	**Definition**
Standard service fee	Periodical fee paid by the client to the provider for unlimited use of a portfolio of standard services ; aligned with public mobile tariffs ,e.g in 18 Euro/month range (early 2003)
Common service use frequency	Frequency with which a users demands a common service as compared to his specific service demand
Contracted Company owned service stations	Percentage total number of Company owned/ Company operated (CoCo) Service stations that have an agreement with this particular provider and have Wireless LAN infrastructure installed on their territory
Contracted Dealer owned service stations	Percentage of total number of Dealer owned/ Dealer operated (DoDo) and Company owned/ Dealer operated (CoDo) service stations that have an agreement with this particular provider and have Wireless LAN infrastructure installed on their territory

Running the optimization tool for both the Oil Company and the Mobile Operator Providers models leads to different outcomes. The optimization gains are respectively ,and dependent on initial values (with all an initial standard servic fee of 10 Euros/month) , in the range 300% on the goal function for the Oil company , and 600 % for the Mobile operator ,meaning that there is room for adaptation of the optimization variables .Qualitatively the computed improvements , under the following analysis scenarios :

1. Professional user focus vs. Total users
2. Desirable service fee in view of ROI vs. Realistic in view of public services
3. Break even service fees
4. Payback times
5. Customer mix sensitivity

give the following trends :

- Higher ROI for the Oil Company
- High standard service fee in relation to constraint set
- Common service use frequency goes to the lower limit (as little common services and as much vehicle/user specific services as possible)
- Highest possible positive cash flow year 1 is 5% of total CAPEX
- Mobile Operator achieves higher cash flows
- Cash flow differences between the Oil Company and the Mobile Operator get smaller and smaller as tariffs increase
- Small percentage of service stations contracted. The Oil Company only contracts service stations that are owned by itself (no site rental costs).
- Differences mainly determined by different CAPEX levels
- In the long term the Mobile Operator achieves almost the same cash flow but with less service stations
- Large differences in ROI between the Oil company and the Mobile Operator
- Solvability is a common problem in the first 3-4 year(s)

6. CONCLUSIONS and OPEN ISSUES

6.1 Conclusions

The analysis of the business models around refueling station WLAN services for the dominant classes of vehicles, users and usage in the Netherlands , has been carried out from a context, to a qualitative, then to a quantitative level and with high modeling detail .

The complexity of the dependencies may be a hinderance when commercial principles apply .When initial values of the free variables are set at values comparable with current conditions for professional vehicles and tariffs in line with GPRS , return on investment is negative . Optimization moves towards a low percentage of contracted service stations because the cost structure of such WLAN services is still unsatisfactory . The reason for this is more in the high share of OPEX costs represented by staff expenses for different purposes due to staffing levels which the quality of service mandate for a distributed network of WLAN service delivery points .This holds true both for the Oil company as well as for a Mobile operator, even though refueling station WLAN services is a new business area for the first, and an incremental business area for the second The sensitivity analysis shows that the most critical other parameters are the subscription fee, the service mix and the percentage of contracted service stations This is also why , when shorter pay back is enforced , the Oil company achieves better profitability than the Mobile Operator as the Oil company has lower costs per service station The actual refueling station WLAN service is a very interesting business opportunity ,but only if it goes beyond the false or misleading cost advantages of WLAN technology

6.2. Open issues

The first key open issue if the modeling of externalities (see Table 12) and how they modify the previous conclusions ; the outcome is likely to be to the advantage of the Oil company However, a second open issue is the effect of the interoperability or integration between such refueling service station WLAN services with public GPRS/EDGE/3G services ,not so much because of the usual coverage argument, but because of the impact in vehicles of simultaneous access to mobile connectivity for traffic management ,etc., when the vehicles are not at hot spots .

Externalities for Oil company	Externalities for Mobile Operator
-Cross elasticity between fuel sales and information/service sales -Effects of business partnerships with vehicle maintenance and logistics sector -WLAN as a targeted usage marketing channel -Ability to build on campaigns about driver comfort and efficiency -Incremental revenues by fast enlarging scope of billing services offered by oil company -Relative advantage in getting WLAN spectrum licenses	-Cross elasticity between voice traffic at fixed refueling station sites (due to safety regulations) and mobile data/service traffic revenue from WLAN -Franchising revenues to refueling stations -Ability to build on safety campaigns -Incremental fees for handling third party content or service billing for new such parties -Relative disadvantage in getting WLAN spectrum licenses

Table 12. Some externalities

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