Aalto University School of science and technology

S-72.3510 Product Development of Telecommunication Systems

Workshop
Indagon @Fokus - case

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1. Introduction

This is a document describing a concept for Indagon for their @-Fokus product. The concept has been created in Aalto University's School of Science and Technology in a course S-72.3510 Product Development of Telecommunication Systems in spring 2010.

1.1. Description

The core idea for the concept is automatic charging for parking fees using the DGPS technology based device. Parking in cities is usually chargeable, especially near city centre's. The concept we are suggesting makes parking payments easy for the customers. The device would automatically charge a correct parking fee which is designated for that certain location. The customer wouldn't have to care where is the nearest parking meter or whether the parking is paid or not correctly. There is often also a trouble with knowing what the correct fee for that zone the car is in. The device would handle that automatically. The parking fee would start automatically when you park your car and stop when you leave.

1.2. Customer needs

Customers have a need for easy parking. Parking should be as easy as possible including the payment of parking fees. The trouble of finding a working parking meter is a nuisance for everybody. There are also various different ways to pay for working and the customers have to know which ones you can use for that particular parking space. The parking payments are often paid beforehand, so you have to know, or to estimate, how long you are going stay there. This device would help in that, because the payments would be from the exact time you are in the parking space. Paying the parking fee with coins is also a nuisance, because you don't ever have the correct amount of coins in your pocket. Some people keep change in their cars just for that case. Also you wouldn't have to worry about going to add time to parking meter, if you happen to stay longer than expected.

1.3. Company

Indagon is experienced and innovative position technology and positioning Service Company. Indagon's personnel and Nokia OyJ own the company. Indagon develops, manufactures and markets precise and trustful GPS-satellite positioning based positioning terminals, –systems and -solutions.

Indagon's service clients are Finnish companies in different branches. For example Indagon has solutions in public transport, delivery, maintenance and guarding. Internationally Indagon co-operates with location service delivers. Indagons head office is in Helsinki, Finland.

All Indagon products and services base on SILTA (bridge)-solution. SILTA-solution is a flexible positioning environment with open interfaces It can be used in different terminals, positioning and radio technology.

Indagon produces basically four types of services. They have @-Focus service which is described in this report. It is based on DGPS solution and it is used to position very precisely. Flare service instead is a solution for continuous positioning. It is used for example in public transport solutions. Leader service is target to professional use in positioning in big companies. Amicarta is a huge

collective positioning service which allows user to locate friends widely. In addition to services Indagon produces also modules for their solutions.

1.4. PESTEL Analysis

Pestel analysis is an analysis of the macro environment and stands for stands for "**P**olitical, **E**conomic, **S**ocial, **T**echnological, **E**nvironmental and **L**egal analysis". It can be used for strategic management inspecting whether new products are feasible. It is often used in conjunction with SWOT analysis. This analysis is from the proposed concepts point of view.

Political -Parking fees	Parking fees, their existence, non-existences and the amount of fees are political decisions. The local government also enforces the payment of parking fees. The local government decides which kinds of systems are available.
Economic -General economic trend	The general trend can influence the customer's willingness to buy new devices and whether to invest in devices like this.
Social	If parking system works well, people learn to follow the rules of local parking. Therefore parking fees become a part of everyday life.
Technological	Technically advanced and coherent local parking system makes the system handy and flexible for users and for the parking control personnel.
Environmental	Private cars make much environmental noise. That is why parking fees should be higher in the central areas than in surrounding areas.
Legal -Parking fees	Parliament defines what is legal in the country. System that doesn't hurt human rights, virginity or laws is legal in that sense.

1.5. SWOT

Strengths Ease of use Ease of controlling	***Weaknesses*** New device have to include to car Many competing parking systems
Opportunities Save money in controlling Save user's money	***Threats*** System errors

1.6. Five forces

Michael Porter's Five Forces analysis is an industry analysis tool, which can be used to evaluate competitor threats.

The threat of the entry of new competitors	The amount of money to be put to basic infrastructure is quite high, so only big players and existing players are probably the biggest competitors.
The intensity of competitive rivalry	Aplicom, Semel are competing in the same field. The competition can be quite high.
The bargaining power of customers (buyers)	The customers have quite low bargaining power. There are only few competitors; devices are usually sold in small batches or one at a time. The customers are locked-in after they have purchased the device.
The bargaining power of suppliers	The power of suppliers is quite low. There are several suppliers of GPS and other components.
The threat of substitute products or services	Substitute threat is quite high, as the technological field is developing fast

The conclusion from the above analysis is that there is quite low threat of new competitors, but existing competitors can introduce similar devices or services using same or different technologies. Government and legislation have quite big influence how the market evolves, so focusing on it could be fruitful. One of the biggest obstacles is that the device must be installed permanently or semi-permanently to the car. That will raise the total costs of the system to the customer.

1.7. Competitor analysis

There is no standardized telecommunication solution for organizing parking payment in Finland. There are some small companies in the parking branch, but nowadays their solutions serve just small amount of people. Finnish traffic and communication office made a disquisition. There they say that are there are three ways to approach how telecommunication services and products are produced to cars in future. First way is that car industry itself produces all telecommunication related services and products. Another way is that authorities constrain car owners to use telecommunication devices in their cars. The last option is that mobile phone producers produce the products and services. Basically the edges are not that steep. For example options one and three can be somehow occur coexistently.

Nowadays there are basically five different types of telemetric bases used in car telecommunication solution in Finland. Indagon itself uses monitoring device base for their applications. Aplicom instead uses vehicle workstation base for their solution. This solution uses GPS for navigating. So it is not so precise than DGPS, which Indagon uses. Semel for their part has specialized in taxi systems. They use central processing unit (CPU) of taxi systems as a base device for their applications. Because of large relationship to taxi business, Semel's solution is not so easy transform for private parking. One telemetric base is so called PDA-devices or smart phones. In this approach smart phones are used as a base for applications. In parking payment solutions this approach is quite difficult to produce, because mobile phones are carried all the time with. And they are not leaved to cars while having things. The last telemetric base for device is PC-computer. This approach means that LCD (liquid crystal display) is used to co-operate with user. In parking solutions it is not necessarily to communicate with user. It would be much useful if user didn't have to communicate with system at all and all the information is transmitted wirelessly. The nearest competitors in Finland are Aplicom, Semel and Swarco.

2. Electronic Parking Systems

In this section we analyze already existing electronic parking systems.

2.1. Mitsubishi Electronic Parking System

Electronic Parking control system is the automated version of the manual parking control system. The system is implemented in Singapore where all vehicles are equipped with an on-board In-vehicle Unit (IU) for Electronic Road Pricing System. The system works followingly:

Access Control

This system is installed in the car park for monthly subscribers, and is used only for checking the entrance and exit of vehicles, not for charging.

(1) Operation at the Entrance

- When the vehicle presence detector (loop coil) at the entrance detects a vehicle, the antenna radiates radio frequency.

- The antenna makes communication with the IU installed in the vehicle, and reads the IU label to check whether the IU label is included in the list pre-recorded in the antenna or host computer, and if the label is found to be included in the list, the barrier opens. The vehicle can enter the car park.

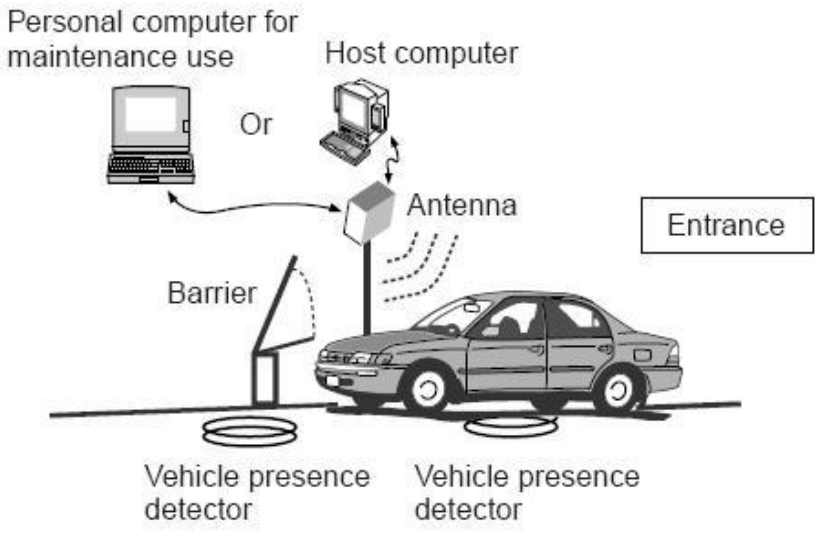

Fig 1: Access Control Electronic Parking System

(2) Operation at the exit

The exit is also equipped with a vehicle presence detector (loop coil) and a barrier. The barrier opens when the vehicle presence detector detects a vehicle. The outside vehicles cannot enter from the exit because of the barrier.

Charging the System

This system is installed in private car parks where the vehicles are charged according to the vehicle types and parking time.

(1) Operation at the entrance

- With a vehicle detected by the vehicle presence detector at the entrance, the antenna radiates radio frequency.

- The antenna reads the IU label through communication with the IU installed in the vehicle, and transmits the IU label to Charging Unit(CHU) before opening the barrier.

(2) Operation at the exit

- With a vehicle detected by the vehicle presence detector at the exit, the antenna radiates radio frequency.

- The antenna reads the IU label through communication with the IU installed in the vehicle, and transmits the label to CHU.

- The CHU (host computer, depending on the system) calculates the parking fee of each vehicle from the parking time of the vehicle on the basis of the IU label transmitted by the antenna.

- According to the calculated fee, CHU issues charging command and it is transmitted to IU through the antenna.

- On receiving the charging command, the IU deducts the parking fee from the IC card.

-The IU then informs CHU through the antenna that the parking fee has been deducted from the IC card.

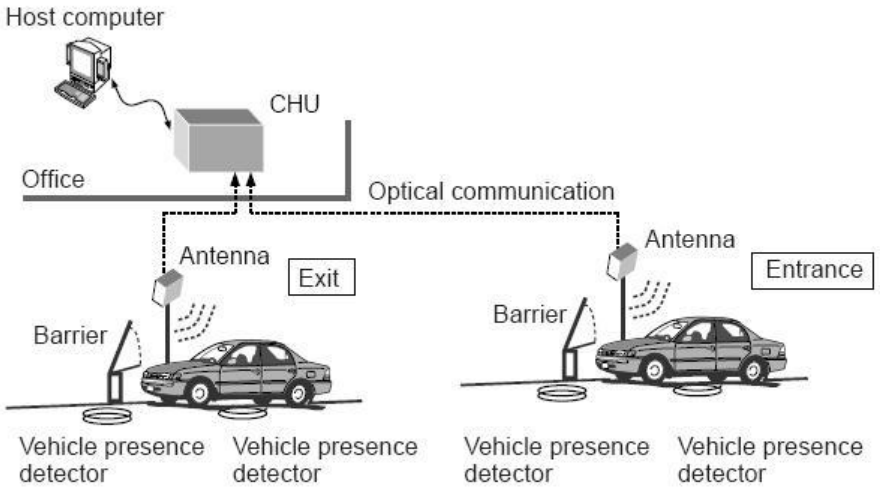

Fig 2: A charging Electronic Parking System

3. Concept

3.1. Technical feasibility

Technically the proposed concept is technically achievable. The concept is based on existing device by Indagon, which has GPS receiver, 3G transceiver and accelerometers. The correction data is received through 3G. Dead reckoning is done with accelerometers.

3.2. Description of device

The parking device would be installed in the car, for instance in the glove box compartment and powered by the cars battery, that way the device would always be active and taking care of parking fees. Modern electronic devices have a relative small power consumption, therefore the device would not endanger the cars battery charge.

The device would be programmed to the customer's credit card account, monthly billing from Indagon or account at Indagon, which the customer can posit money into. This way you would ensure the atomization of the payments. The parking areas would have to be programmed into the device, before retailing it, so it would be aware of when and where you are parked and when you are just standing in traffic lights. One solution is that the parking fees would only be charged from the account when the car has been stationary for five minutes, the keys removed from the ignition slot and only when the car is located in a preprogrammed parking area. The updates of the internal map can be downloaded to the device via 3G.

We also thought about a small optional handheld device that would inform the customer of the parking fee in that particular area where he is located at, the customer's account balance and additional information.

A replacing solution could be software on the customer's mobile phone. The parking device would send information via Bluetooth to the customer's mobile phone, informing him with parking information. We see this software as an additional free feature to the Indagon's device, but this could also be bought from Indagon separately.

The Indagon device would also take of road tolls and automatically charge the customer's account based on waypoints preprogrammed onto the Indagon parking device.

3.3. Description of service

The main sales argument would be that the customer would get 20% off the parking fees, where ever he or she parks. This would save the customer money in the long run and make the Indagon parking device more attractive on the market. Regardless of the parking fee discount, the city would have a much more constant cash flow from the customers and could even increase profits, compared to parking meters.

There could also be a solution where the parking fee would be charged for example doubled or tripled when the customer exceeds the longest time he is allowed to park in that specific area or spot. This means that when a customer is breaking the parking rules, he would automatically pay extra for it, resulting in additional profit for the city, also because they could reduce the amount of traffic wardens, there for increasing profit by saving. Or in a parking area where there is free parking for a limited amount of time, the parking device would start charging the customer, when he or she exceeds the allowed time for parking.

One problem that we encountered was the issue with traffic wardens, how would they know that the customer is paying for the parking space? It would be necessary to have some kind of

indicator in the customer's car that he or she is using the Indagons parking device. One fancy solution would be an RF ID tag, but then the traffic wardens would need a recognition device for the RF ID tag, which again would raise the costs of the whole system. A more primitive solution would be a small LED installed under the car's windshield and complemented with a Indagon sticker, informing the traffic warden. A lot of cars already have small LED lights installed in them, burglar alarms etc. therefore the sticker would be necessary.

3.4. Immaterial rights

Protecting company's immaterial rights are a good way to reduce competition. There are two ways to protect this concept, patenting and utility model. Both of them would give Indagon competitive advantage.

3.5. Patenting

Patenting for the concept could be possible. A short survey from Espacenet, which is a public database of patents, provided by National Board of Patents and Registration of Finland, didn't reveal any patents in this particular topic. We didn't find any patents which combine DGPS and parking systems, so it could be useful to patent the concept. This would require a lot more time to investigate thoroughly.

3.6. Utility model

If patent is not obtained, a utility model could be thought of. This would protect the Indagon's business model and reduce competition in this particular field.

3.7. Pricing

Indagon's device cost approximately 200 Euros. It is quite a big amount of money, but customer could get 20% off the parking fees, if he or she used Indagon's device. The money used to buy the device would be paid back to customer sooner or later and it would be enough valuable to get that device. Also including other additional features to the device makes it more compelling to the customers. Trying to get volume customers could lower the production costs, which would probably increase the market size.

3.8. Risks

Information shared with application have to be secure and trusty. The biggest risk for this concept is that all secure information is leaked away from users to the third party. Data security must be high, so that information leak probabilities are low.

The device have to work in every time in every place. Heat, cold, battery duration and wet conditions have to take into account when introduced this kind of concept.

3.9. Estimated life cycle

Indagon is now searching use for the module device at end of its life cycle. According to Indagon, estimate life cycle for this product is four to five years. If this product-service combination is a success, it would be beneficial for Indagon to lengthen the product life cycle.

3.10. Variants of the product

Many other applications can be also added to this product-service combination. The customer can itself decide which kind of variants they need in their use.

4. Added value services / features

The proposed concept requires specific hardware, which is similar to existing device Indagon currently holds. The same device could provide additional features to end users. Most of these are software updates and they can be added later on with software updates to the same hardware.

4.1. Navigation

Normal navigation features are quite easy to add to the device. It can be an additional feature for extra price. Some customers would probably be willing to pay something for it.

4.2. Road Tolling Systems

Road tolls are probably coming to Helsinki metropolitan area with current increasing rate of traffic congestion. There is currently no defined system yet, how they are going to be implemented. The device we are suggesting in this document can also include an application for payments of road tolls.

4.3. Insurance

Some insurance companies provide customers a pay-per-drive -feature, which is a insurance payment based on how much you drive, where you drive and how you drive. All these data is already gathered by the device, so it could be an added value to customers, if they can lower their insurance costs by using the device.

4.4. Emergency help

It would be easy to include an emergency situation application to the device. It could have an emergency button as well as some automatic inspection of emergency situation. An example of automatic detection is if accelerometers show that deceleration is more than what can be achieved by brakes is an indication of a crash. Also if the accelerometers show that the car has flipped over, it is an indication that help is needed.

4.5. Statistics

Statistics of driving habits, times and habits could be provided to interested parties. The data is already tracked and Indagon's database holds the data, so they could be sold to companies who need these kinds of data.

4.6. Speeding warning

If the car is moving faster than the speed limit, it could provide a warning sound. This can be useful in some areas, where the driver is not always aware of the speed limit.

4.7. Tracking down stolen car

If the car is reported as stolen, the device can give the location of the vehicle to the police, who can then return the vehicle to it's current owner.

5. Different types of Road Tolling

In this section we investigate what type of road tolling already exists.

5.1. Corridor Tolling

A driver pays a fee to use a specific stretch of roadway or a congested bridge. This tolling system is used to repay the cost of building a road infrastructure. The system is as easy as stopping and paying at entry.

5.2. Cordon Tolling

A fee is charged for entering a specific area. Its primary objective is to reduce traffic congestion in that area. All entry points to the area will implement the scheme. The public transportation system must be made very efficient to make this program effective.

5.3. Area Wide Mileage Tolling

This is a mechanism whereby vehicles are charged based on vehicle-miles-traveled (VMT). An example of this system is the German truck toll, in which all trucks are required to pay tolls based on the distance traveled inside Germany. In our project for Indagon, we can use this measurement for Insurance companies.

5.4. Integrated System Management

In this visionary concept, demand for transportation would be managed through information: users would have a choice of modes and routes and an array of ways to pay for a trip. The charge would incentivize the most efficient transport choice and the market would drive the provision of capacity. Highly complex systems, such as roadside-vehicle-traveler communications would be required, but system usage is expected to be highly efficient. Required conditions include market flexibility and access to information.

5.5. Components of Electronic Road Toll Collection (ETC)

5.5.1. In-road sensors

Sensor systems may be subsurface, roadside or overhead. Inductive sensors embedded in the road surface can determine the presence of a vehicle. Treadles register a count of the number of axles a a vehicle passes over them. One example of an in-road sensor system is Traffic Reporting and Control (TRAC), which combines state-of-the-art inductive loop detection with advanced signal processing (Smith, ITS Decision, 2002). The TRAC system can perform pre-classification in both manned and unmanned toll lanes. It can also be used for post-classification for toll enforcement. The whole classification process takes 0.1 seconds.

The TRAC system is packaged within a standard inductive loop detector, which:

- Identifies vehicles in classes
- Accurately detects single-loop speeds
- Measures vehicle length and number of axles
- Provides point, toll segment, and toll regional view of traffic flow
- Provides web access to all data

5.5.2. Overhead Cameras (Video Tolling)

Video tolling is done by means of license plate identification/recognition (LPI/R). As a vehicle passes through, cameras on overhead gantries take a picture of the plate. Optical Character Recognition (OCR) software is used to read the picture of a plate, and it is checked against a

database to find the owner. The challenges associated with Video tolling are poor imaging (blurry, poor light, obstruction) or different plate styles and reflective plates. However, video tolling could be used with other systems for tolling enforcement.

5.5.3. Vehicle to Roadside Communication

Transponders with RFID chip embedded in a unit or sticker, called an electronic tag, are used. As the tag passes under the gantry with a mounted transmitter, it responds to the radio signals. Based on programmability Electronic tags can be classified in the following types:

Type I – with no processing capabilities, read only information

Type II – with updatable area which can be used to encode information at entry points.

Type III – 'Smart tags' with microprocessor. They can communicate detail information about account balance, driver and vehicle information to a road side or overhead sensors.

Electronic tags may be Passive, Semi-passive or Active according to the power source.

5.6. Successful Road Tolling Systems

The following road tolling systems have been successful.

5.6.1. The Toronto 407ETR in Canada

It is one of the most sophisticated toll roads using electronic tags. It uses transponders with video enforcement. Vehicles with gross weight over 5 tons are obliged to use (a different type of) transponders while it's a choice for regular vehicles. Transponders are properties of 407ETR and leased $2.15 per month or $21/year.

If the traveler is not from the area or simply chooses not to lease a transponder, trips are logged by plate number recognition system (Automatic Vehicle Identification). The toll charge is then added to Video Toll Charge per trip.

5.6.2. London Cordon Tolling

It uses Video tolling, with cameras deployed at edges of the congestion areas. The payment is done on daily basis and vehicles are segmented for fair charges, exemptions and discounts(for residents in the area).

5.6.3. Singapore Electronic Road Pricing

Singapore uses road pricing to decrease traffic congestion. The system uses In-vehicle Units (IUs), an on board equipment in vehicles. The ERP system uses a dedicated short-range radio communication system to deduct ERP charges from CashCards. These are inserted in the In-vehicle Units (IUs) of vehicles before each journey.

As the vehicles are making a trip through the selected route, a payment will be made at each gantry. Not paying is subject to legal penalty of $10, which could be paid online using SingTel network - with a discount.

6. Marketing

The main sales argument would be that the customer would get 20% off the parking fees, where ever he or she parks. This would save the customer money in the long run and make the Indagon parking device more attractive to the market. To the city officials, the incentive is that when parking payments are automated, the probability of not paying for the parking is reduced. In the long run, if the devices are in wide use, the need for traffic warden is reduced, thus saving money. Also, the incomes from parking payments could be higher, because there would be less cars who haven't paid.

6.1. Marketing plan

Marketing should first begin to city officials. To get their approval for the concept is crucial. Later the end user marketing should start. To get customer interest, it should focus on cost savings to end users and easiness of parking payments.

6.2. Channels

Marketing the concept to city officials is best done by direct contact to them. End user marketing should consist of wide marketing communication, like newspaper ads, internet marketing and maybe also ads in parking lots.

6.3. Segmentation

End user segmentation and targeting will produce better results with marketing. Segmentation should be done by thinking which end user groups are most likely to purchase such a device. In this case the segmentation could be done by economic class and location. Middle class and the wealthier part are more likely to purchase such a device. Also people who frequently use parking services are more likely to obtain the device.

6.4. Geographical Areas

The most promising areas for the system are big cities. Helsinki and the metropolitan area is the most beneficial area, but also other big cities in Finland could be potential. There is also potential for marketing the system for internationally, for example to big cities in Europe.

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