SIEMENS

Anders Betalen Voor Mobiliteit

Phase 2 Market Consultation

Total Cost of System and Organization for KMP

Siemens response

Management Overview

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1. INTRODUCTION

Based on the Anders Betalen voor Mobiliteit (ABvM) requirements, Siemens proposes its satellite-based road user charging solution which is ready to introduce Road User Charging for all vehicles on all roads. This solution is able to differentiate location, time and vehicle properties as required by the Ministry of Transport. Additionally, the solution is the platform for next generation value added traffic services.

This report demonstrates that the relevant technologies needed to commence a nationwide road user charging scheme of this magnitude and complexity are available and can be deployed within the pre-calculated ABvM budget and within a timeframe of 2 years.

Siemens is able to integrate all major components of the solution, based on its in-house expertise of all building blocks for Electronic Tolling (see figure 1):

- On Board Equipment (OBE)
- Electronic Toll System
- Enforcement solution
- Central System

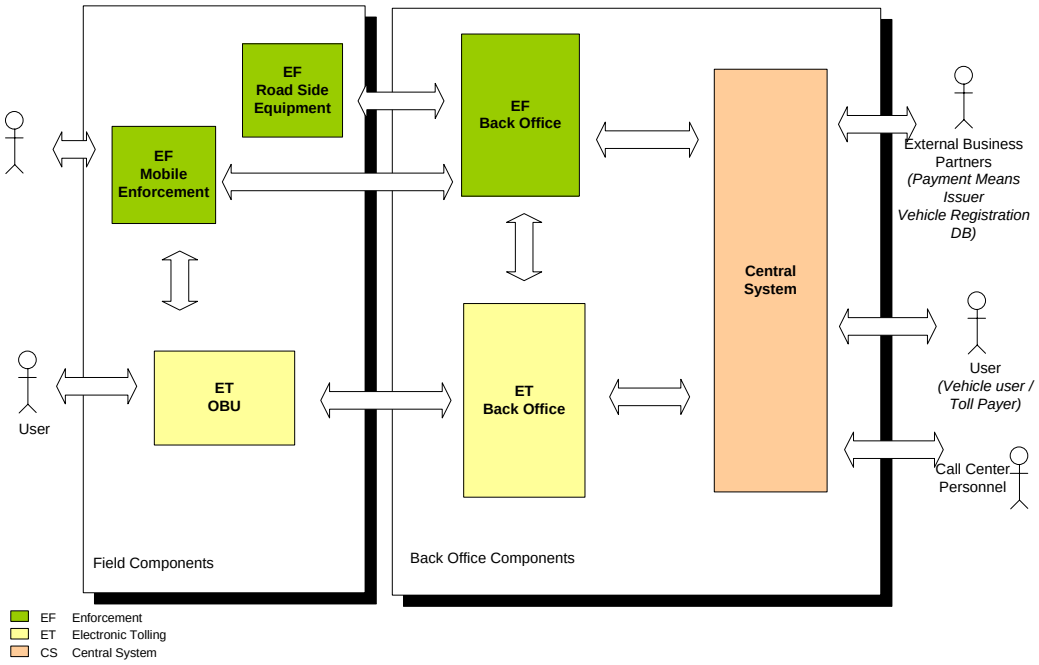

Figure 1: Subsystems of the toll system

The solution has proven its reliability and feasibility around the world, being deployed in projects for the UK, Australia, Germany, the USA.and elsewhere. It is highly scalable, beyond 20 million users, and supports both “thin” and “fat” client scenarios. The Siemens solution thus provides the Dutch ministry with the flexibility to implement what it considers the most suitable dividing line for collecting data and calculating the road user charging fees between the field components (OBU), and the back-end (central server). In the ABvM situation, Siemens recommends a thin client OBU scenario due to its high level of flexibility and efficiency with respect to operational costs.

The proposed System is based on GNSS technology (Global Navigation Satellite System, based either on the existing GPS system or on the European GALILEO system currently being implemented) in combination with Cellular Network communication technology. Vehicles will be equipped with an On Board Unit, meeting the requirements described in the EC directive EC 52/2004.

This report has been compiled with contributions of LogicaCMG.

2. IMPLEMENTATION SCHEDULE

Implementation of the scheme is scheduled within a period of 2 years and consists of a number of major steps. Compared to the implementation of already installed schemes, a period of 2 years is challenging but realistic. The Austrian tolling scheme for trucks, which deployed an elaborate infrastructure, was implemented within 17 months from contact signature. The German tolling scheme for trucks - after suffering considerable delays due to a revision of the program once it became clear that the initial planning of 15 month was impossible to obtain - was eventually realised within a period slightly over 2 years.

The following major steps in the implementation can be identified:

- Preparation and design
- Implementation of the enforcement system
- Implementation of the Back Offices
- Development of the OBU
- Production of the OBU
- Distribution and installation of the OBU
- Integration and test

Of these steps, the most critical tasks are related to the roll out of the OBUs for which very thorough planning is needed. However, when tasks are realised in parallel, the 2 year period is feasible.

Based on these major steps, the following implementation schedule can be envisioned, assuming a contract start date of 1st of January, 2010:

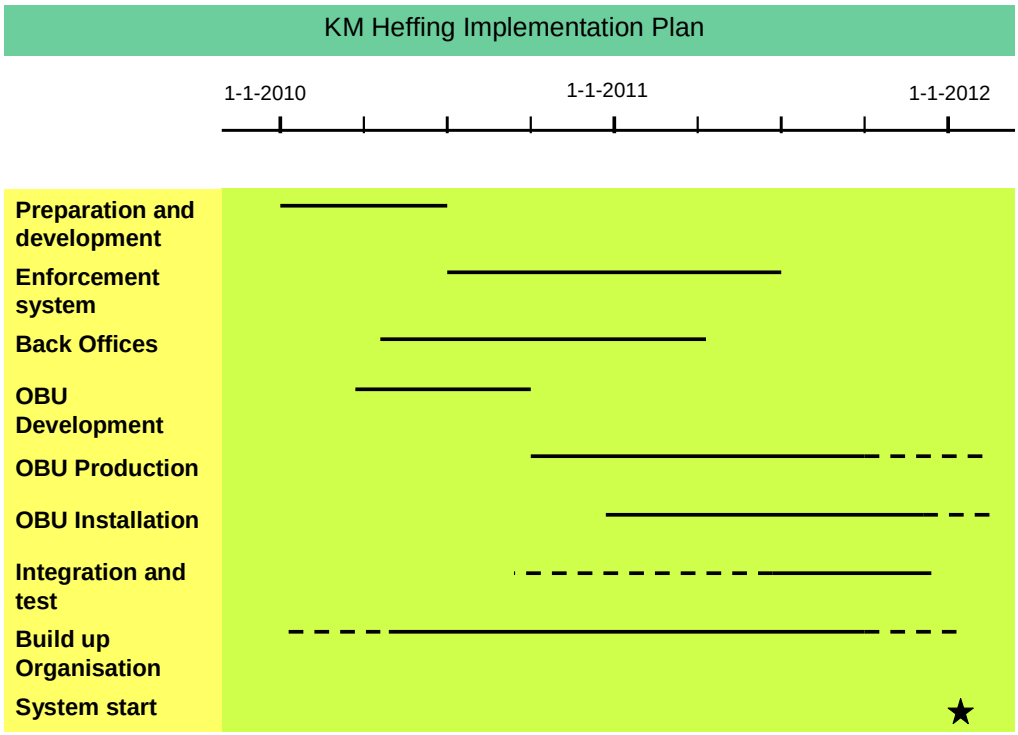

Figure 2: Overall project planning

Some remarks to the above schedule:

- Enforcement system: The total number of fixed enforcement stations is limited to 107, which is less than the 800 tolling gantries installed in Austria within one year. The only potential time-critical issue may be the need to acquire building permits. In this approach, it is assumed that the Ministry of Transport will take responsibility for this task.
- Back Offices: Development within this timeframe is possible, there are no constraints.
- OBU Development and Production: This task needs to be started early since production tooling can have significant lead times. Manufacturing 8 million OBUs in 52 weeks equals an output capacity of 150,000 OBUs per week, and should thus be distributed over multiple manufacturing sources accompanied by meticulous planning and quality control.
- OBU Installation: The production of OBUs leads the installation by approximately 3 months, but then continues in parallel. Based on the assumption that installation of an OBU can be accomplished in less than 1 hour, for the proper installation of OBUs in 12 month, approximately 4000 installation centres are needed and 8000 staff need to be trained (4.000 are needed to perform the task, 8.000 are trained for redundancy purposes). It can be envisioned that many different facilities could perform this task, but assuming it would be executed by members of the Bovag organisation, there were 6.300 stations having a total of 58.000 employees in 2005. Thus, the installation of OBUs would increase the number for these businesses by approximately 10%.
- Integration and Test: This task is implicit to the program, but important is the overall system integration and end-to-end test. Since OBUs are delivered and installed already 1 year before going the program goes live, end to end tests can commence as soon as the OBUs are deployed, enabling early error detection and correction. In addition, relevant parts of the organisation can start training on the operation of the system.
- Organisation build up: The organisation is gradually implemented during the implementation phase and should reach its full strength approximately 3 month before going live of the program.

3. BASIC SYSTEM CHARACTERISTICS

Siemens has developed a system concept by defining a business architecture based on the given requirements. The resulting architecture is the basis with which the business processes have been developed which are necessary for managing the enterprise and to ensure the correct and efficient system operation. The business architecture defines the structure of the operational business of the road user charging scheme with respect to customers, markets, distribution and services channels, partners and suppliers. A system design has been outlined which best reflects the business processes.

3.1 Operational Environment

The Operator of the road user charging scheme needs to perform the following major tasks:

- provide easy access for all eligible users to the scheme
- capture the distances driven by all eligible users
- calculate charges according to the rules provided by the Authority
- produce invoices for all users of the scheme
- provide an enforcement solution that minimises non-compliant behaviour and fraud
- ensure reliable and robust operation

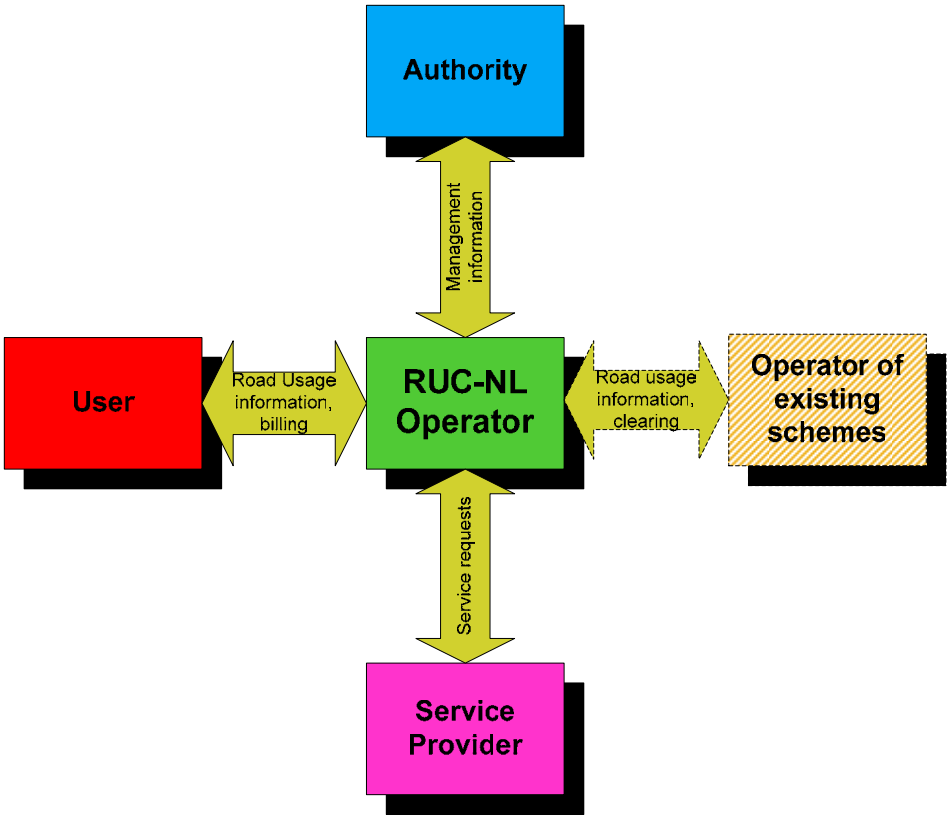

Figure 3: Operational Environment

3.2 Business Processes

The primary processes of the system consist of measuring and recording of road usage, determining the costs, and billing and accounting. Secondary processes include the enabling (e.g. providing OBU) and terminating user participation, providing user service and support, enforcing the correct use of the scheme, and tariff administration. Depending on the amount of outsourced services, management of business partners also plays a significant role.

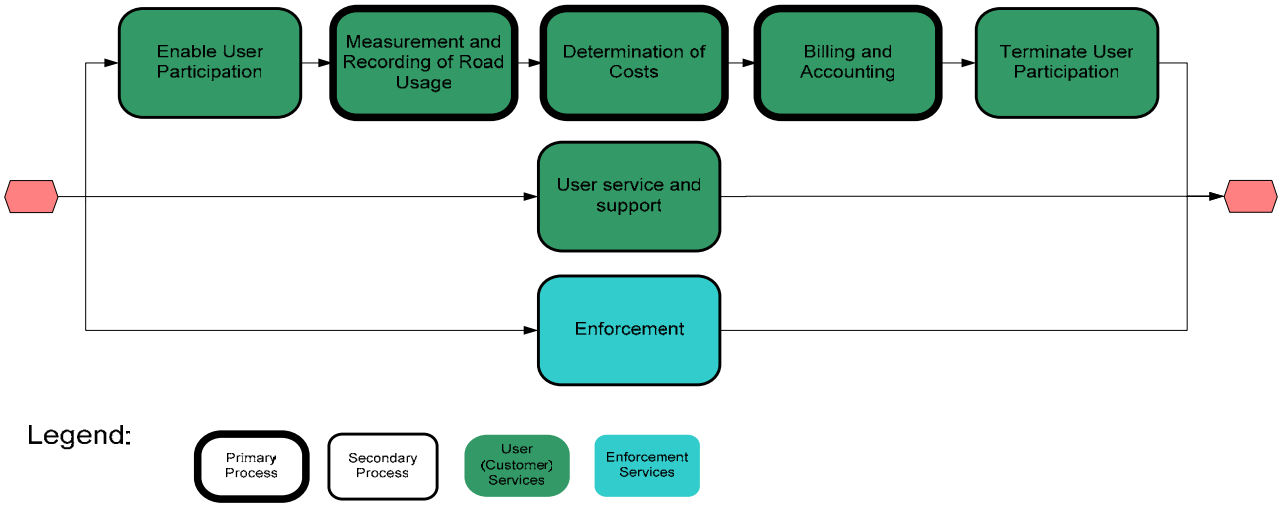

Figure 4: Business Processes

3.3 User Access to the Scheme

Considering the operational business processes, Siemens proposes two basic sub-schemes:

1. The Main Scheme, intended for all regular vehicles of domestic users and foreign users frequently travelling in the Netherlands, consists of an On Board Unit (OBU) which is permanently mounted to a vehicle during its entire lifetime, except for foreign vehicles or vehicles exported from the Netherlands
2. The Occasional Scheme, intended for foreign users and domestic users with special vehicles, such as “old-timers” and motorcycles. The occasional scheme consists of two parts:
   - Low Use On Board Unit (LOBU), which is self-installable and provided on the basis of a refundable deposit, either on a pre-paid basis or post-paid contract basis.
   - Virtual Vignette, offering a flat rate charge for the usage of the road network for restricted time period, for vehicles (e.g. motorcycles) in which a LOBU cannot be mounted, or for very occasional users.

The Main Scheme OBU is made available upon successfully validated registration, and can be installed in an authorised installation stations (such as APK stations). The LOBU for the Occasional Scheme can be obtained in any shop of the distribution network. The user can remain anonymous in

the case of prepayment. It is also available to domestic users for non-regular vehicles under the same conditions as the main scheme.

The Vignette is tied to a specific vehicle (license plate based) and supports a flat rate model, calculated such that it is more expensive than a dedicated toll payment based on on-board equipment. The License Plate information needs to be registered whilst subscribing for the vignette. Since all user data is placed in the central user registry, there is no need to actually distribute physical stickers for the vehicles.

4. SYSTEM CONCEPT

4.1 System Overview

The road user charging system consists of three major building blocks (see figure 4. below):

- Electronic Tolling
- Enforcement
- Central System

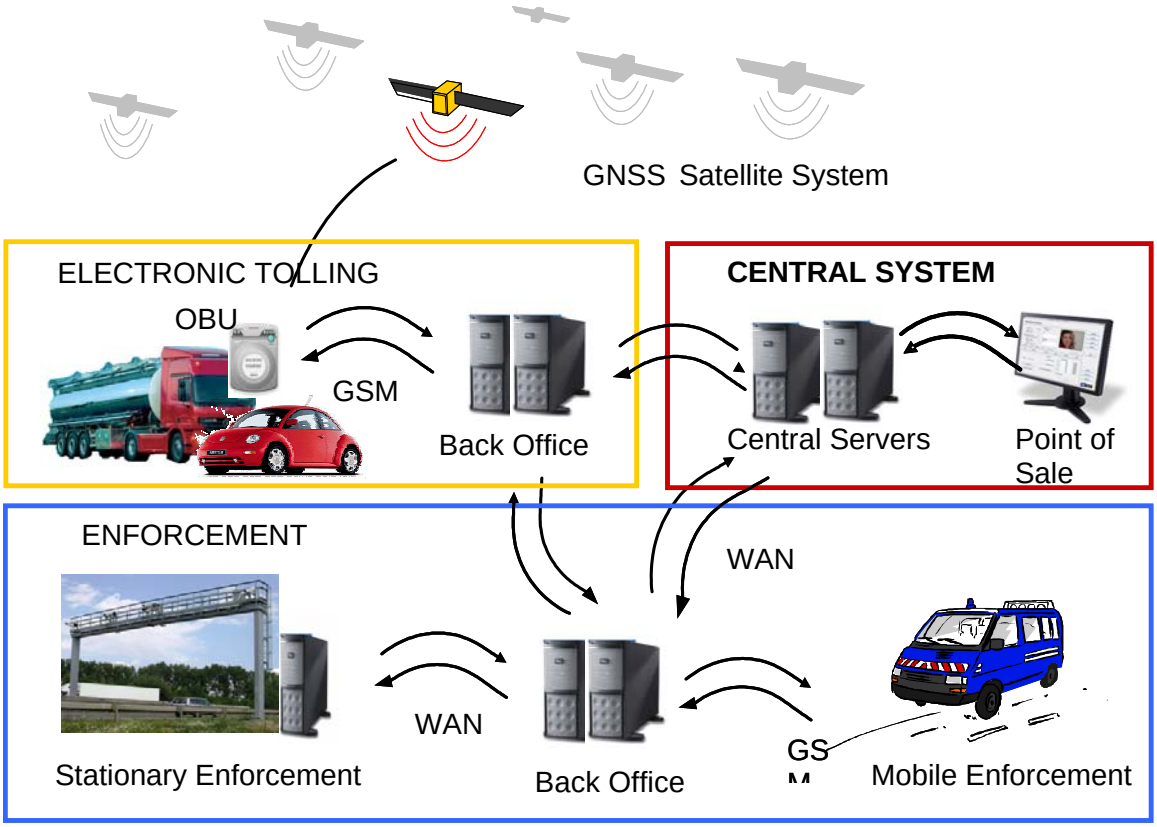

Figure 5: System Overview

4.2 Electronic Tolling

The electronic tolling (ET) subsystem collects vehicle road usage information, with which charges are calculated and applied (depending on daytime, date, location, and vehicle category). The Electronic Tolling subsystem consist of the building blocks illustrated below:

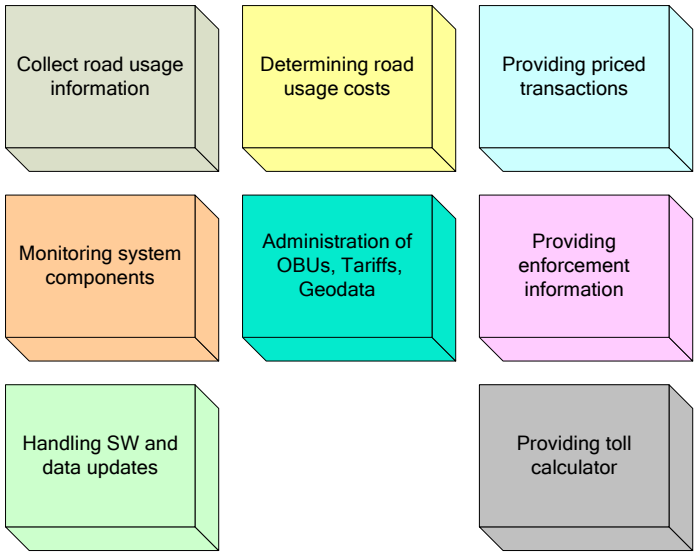

Figure 6: Main Responsibilities Electronic Tolling

The proposed system is based on Global Navigation Satellite System (GNSS) technology in combination with Cellular Network (CN) communication technology, such as the GSM mobile phone network. Every vehicle is equipped with an On Board Unit, fulfilling the demands described in the EC directive EC 52/2004. While vehicle location data is collected based on GNSS, an algorithm is applied to identify the presence of a vehicle on a road or in an area subject to road user charging. The collected data is stored durably in the OBU and transmitted to the ET Back Office at regular intervals via CN.

GNSS and CN technologies provide a number of advantages for a nationwide road toll solution:

- **Flexibility and expandability:** Changes and extensions of the tolled road network are easily possible, even on short notice.
- **Minimum roadside infrastructure:** Collecting road usage information doesn't require any roadside infrastructure and does not disturb any road maintenance activities.
- **Ease of use especially for occasional users:** LOBUs are based on the "Plug and pay" approach: request LOBU, mount LOBU and go. If the account is running low, top up the account by call or via internet.
- **Easily adaptable:** The costs for adding road user charging areas is minimal, both section-based and distance-based road user charging objects can be defined.
- **Enabling telematica services:** Traffic control, traffic analysis, improvement of road safety, and vehicle tracking are easily possible with the deployment of OBE in all vehicles.

- **Future-oriented solution:** Compliant with the EC directive EC/52/2004 for interoperability, the GNSS/CN approach is the basis of future automatic toll solutions, and enables interoperability with other (e.g. foreign) road user charging schemes.

The processes within the Electronic Tolling subsystem include several steps, which are illustrated below:

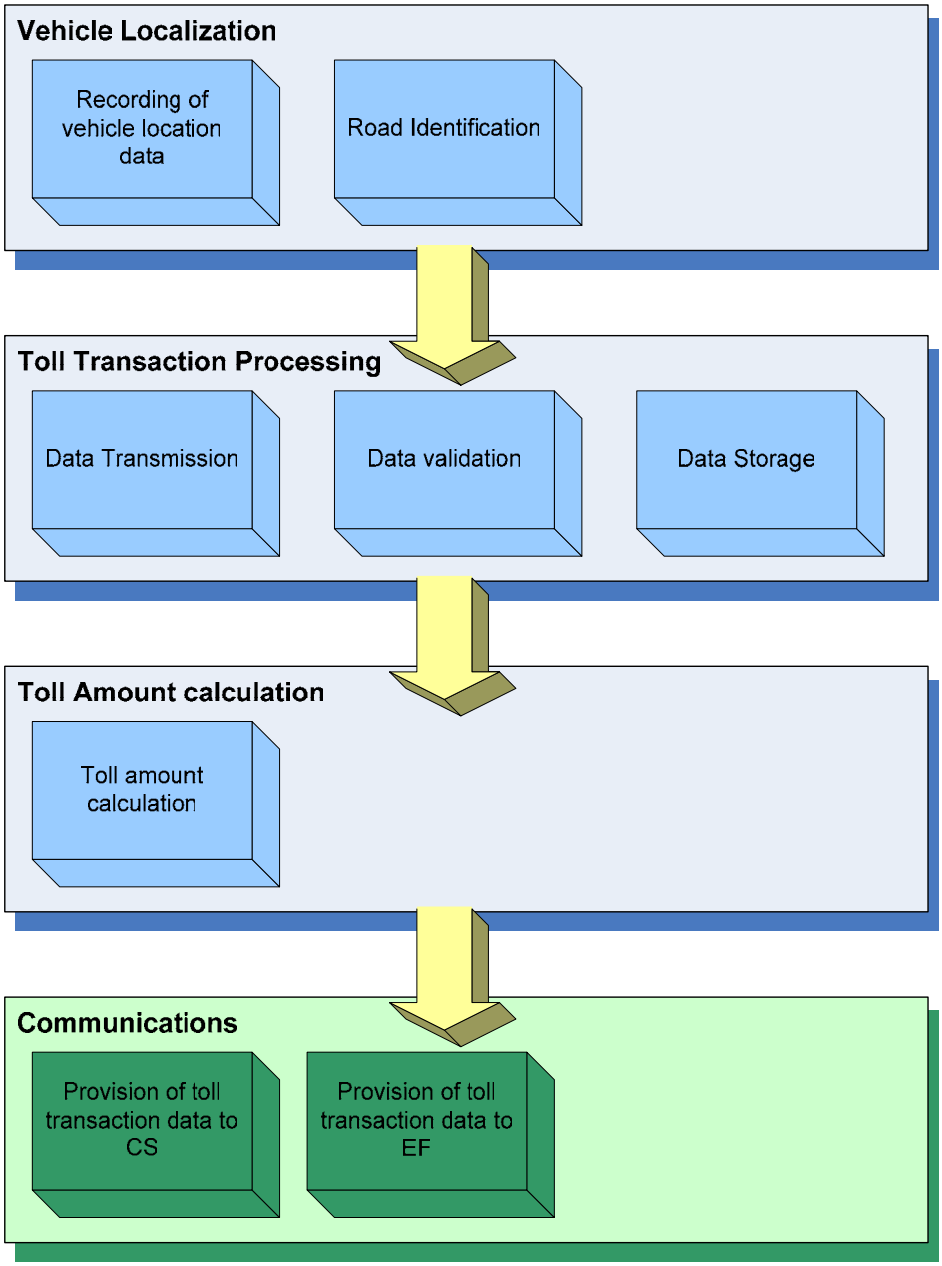

Figure 7: Charge Data Handling

4.3 Enforcement

Enforcement is used in order to detect fraud or non-compliant behaviour of users. There are several elements that contribute to an effective enforcement, the main ones being:

- Automatic Enforcement, which consists of
  - Stationary Enforcement - located at specifically designated points, eligible vehicles are automatically checked using electronic equipment
  - Transportable Enforcement - checking the most significant parameters in order to determine compliant behaviour, based on Automatic Number Plate Recognition.
- Mobile Enforcement - Control vehicles containing electronic enforcement equipment can conduct random or systematic checks at arbitrary points of the road network

The strategy of enforcement shall enable the operator to achieve certain coverage of control over the chargeable network. Road users should realise that their behaviour is checked and non compliant behaviour is penalised. In addition to the standard enforcement methods, some plausibility and functionality checks can also be added, e.g. recording the distance provided by the Odometer and checks of the OBU during the annual inspection of vehicles.

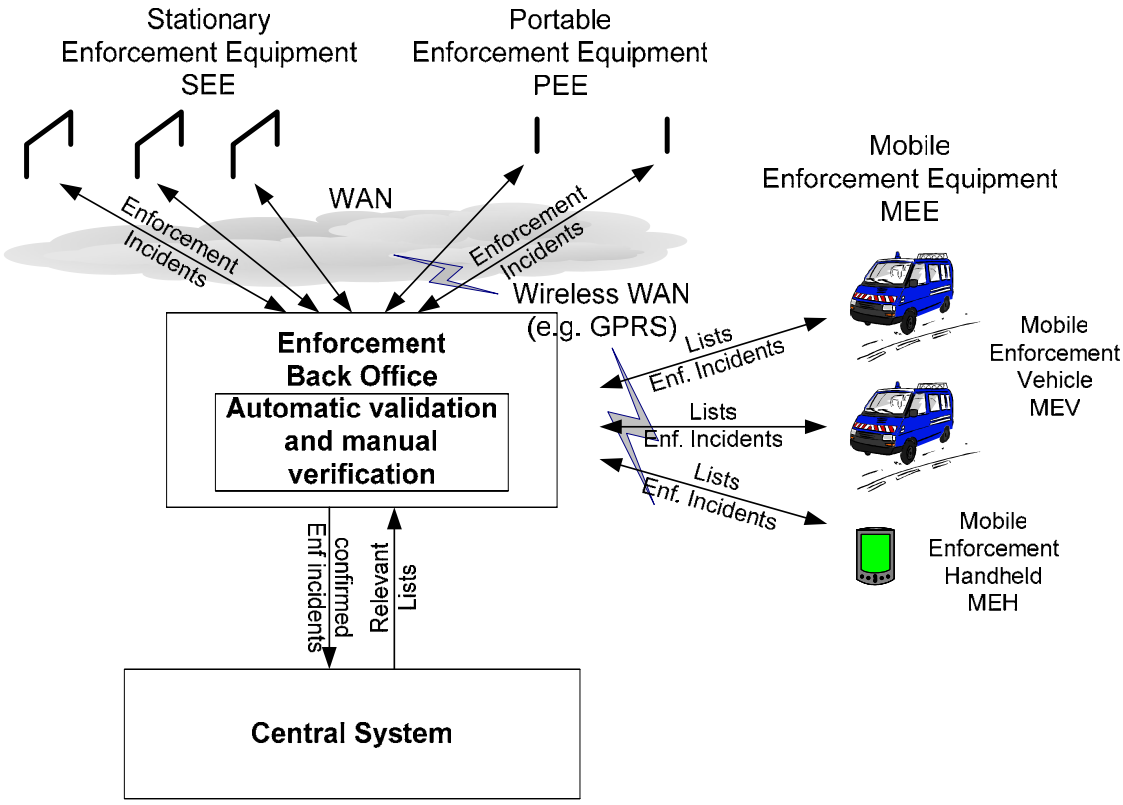

Figure 8: Overview of the enforcement system

Toll violations in form of enforcement records are transferred from the roadside unit to the enforcement back office where violation processing takes place. Preparation of evidence records is done and the responsible Authority has to be informed about toll violations. A manual verification of enforcement records in the back office minimises wrong accusation and maximises the enforcement

level. Verified toll violations (evidence records) are forwarded to a unit for execution of penalties (violation processing).

A central database provides information about faults and alarms of equipment and devices, system performance, and statistic data. The central monitoring unit automatically obtains status and event information for all critical hardware and software components. Information is filtered according preferences, and is displayed in real time to the staff. A report generation capability allows historical and statistic data to be summarised for subsequent analysis. Detailed historical logs are maintained for all components.

4.4 Central System

The Central System (CS) handles all back office processing. Whereas usage data and enforcement data flow into the system, the CS produces invoices and fines, and provides means for customer interaction to the system. A Management Information System provides the necessary data to account for its performance.
The customer relationship management (CRM) module is an integral part of CS. Vehicle data can be verified through an interface to the vehicle registration database. The customer registration includes the type road usage charging (use of OBU, LOBU or Vignette).
The financial data includes the payment channel that the customer wants to utilise to pay the invoices. The CS provides the billing engine that aggregates usage data into periodic invoices. In addition to road usage invoices the billing engine sends out fines for violators of the road usage charging.

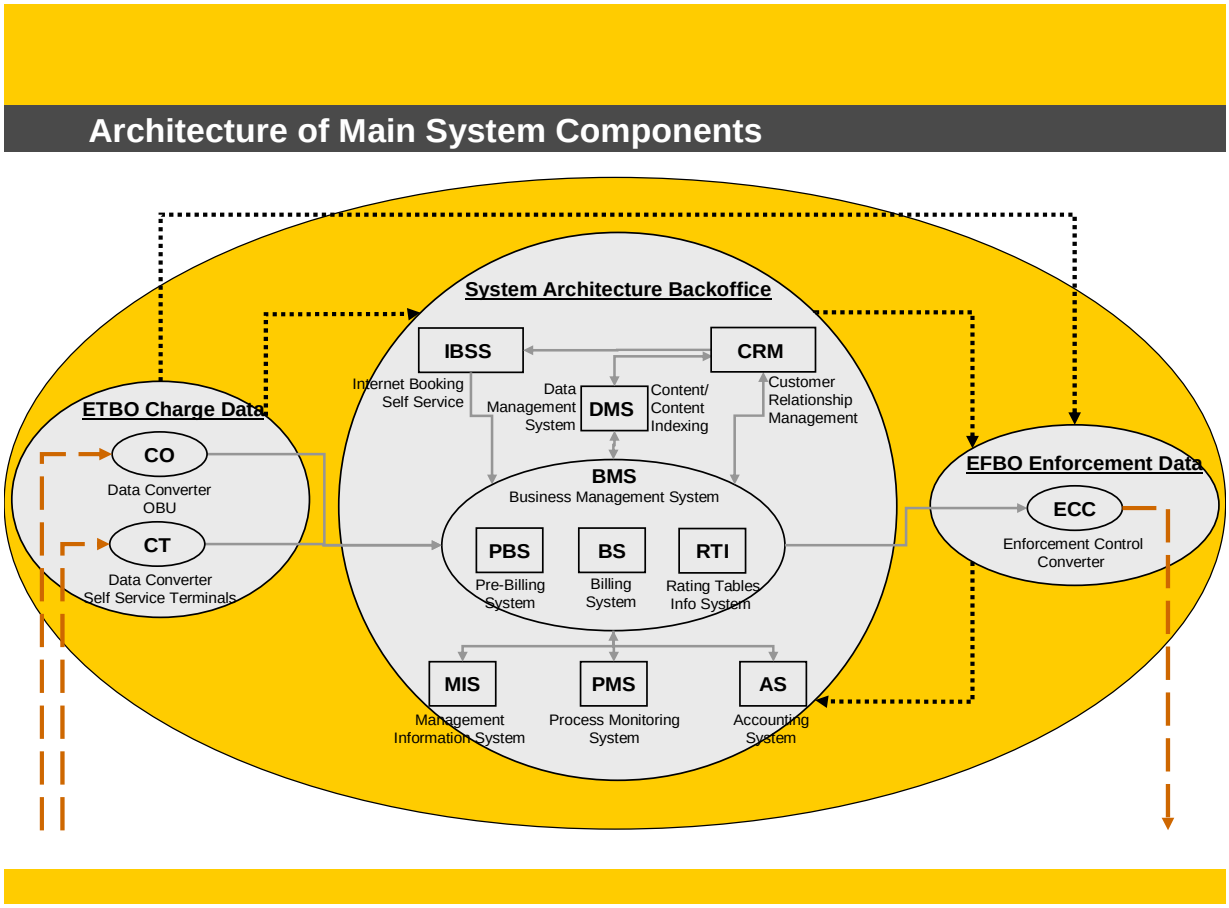

Figure 9: Overview of the Central System

The usage data is fed into the Central System from the electronic tolling back office (ETBO) which aggregates the usage data into Charge Coded Data. Thus, the ETBO shields the privacy sensitive road usage data from the CS which only exists to facilitate the administrative processes. The enforcement back office (EFBO) feeds violation data into the CS.

The CRM system also provides an interface to the users for obtaining information from the system, such as viewing invoices via the web interface. Also, the CRM system supports complaint handling and exemption approval. An integral part of the CS's interfaces are automatic contact channels: web interface, voice response, SMS, points of sale.

The picture above sketches the overall architecture of Central Services. For the sake of redundancy, the Back Office including the ETBO and the EFBO can be hosted in 2 locations remote from each other where the data in both locations is kept up to date. Thus in case of a malfunction in one of the locations, the other will immediately take over and perform all functions. Consequently a very high availability of close to 100% is obtained

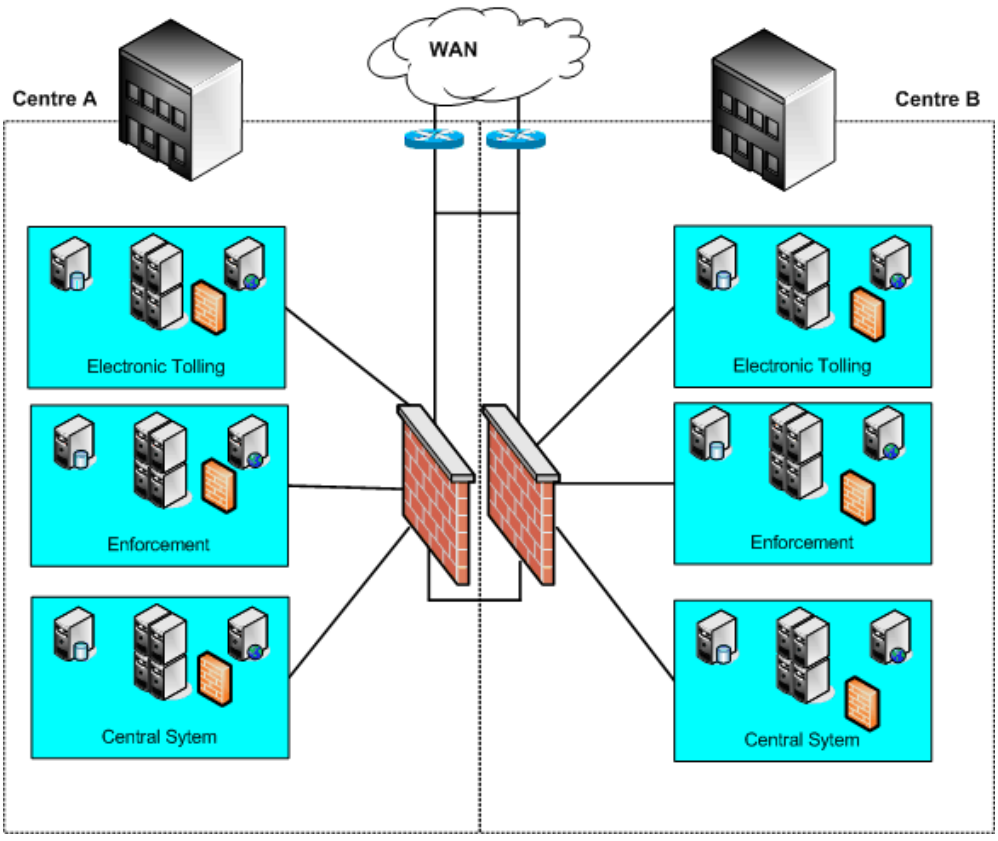

Figure 10: Back Office in "Hot Standby" hosted in 2 locations

4.5 Distribution Network

The distribution network consists of all required elements that are necessary to provide users with access to the scheme. This includes the logistic part of the system, the distribution locations as well as the stock management and the refurbishing procedure. In order to provide these types of equipment (OBUs and Vignettes) to the users the following facilities are established:

- Points of Sales (e.g. gas stations)
- Contact points (post offices)
- Installation centres (e.g. APK stations)

4.6 Thin vs. Fat client approach

The electronic tolling subsystem is the operational core of the toll solution. Its main task is to collect vehicle road usage information from the distributed On Board Equipment (OBUs and LOBUs). From the collected road usage information, the charges are calculated and applied, using a flexible tariff model which is capable of handling different tariffs dependent on location, date/time, vehicle categories and toll section. The accumulated charge information is provided to the Central System.
The road usage information is collected by use of GNSS (GPS) location information and geographical data (geo data). These data contain information about specific road sections, borders and other road usage relevant position data.

In general, there are two approaches for the processing and distribution of data between the OBUs and the Back-Office. There is a so-called Fat Client approach, consisting of an intelligent On Board Unit which contains the latest version of all necessary information (road user charging trajectories, road categories, tariffs, etc) and processing power to calculate the tariff per trip. The Back-Office takes care of the regular processes. Alternatively, in the so-called Thin Client approach, the OBU does perform a minimum of processing and does not contain any geographical (map) information. It basically registers the trip data and transmits this (in an encrypted format) to the Back-Office. There, the information about tariffs, road categories etc. is available and applied to calculate the trip costs.

The main advantages and disadvantages of both approaches are summarised below:

	Thin Client	**Fat Client**
Operational Cost	Relative low, since OBUs (8 million) are “dumb” devices. Lower failure rates and associated cost expected, higher acceptance of road user charging.	Relatively high, since OBUs (8 million) are intelligent. Higher failure rate and associated cost (help desk, reinstallation) and lower acceptance of road user charging.
Updates of tariffs, roads, schemes	Not necessary, since all data is kept centrally	Lower, since all OBUs need to be updated for every change in scenario.
Privacy	High, encrypted trip data is transferred; Trusted Third Party required to ensure privacy	High, only charge data is transferred to Back-Office
Flexibility in road user charging scenarios	High, since all intelligence is maintained centrally	Lower, since all 8 million OBUs need to be updated for every change in scenario, which may take several months.

Interoperability with other road user charging schemes	High	Lower
Value added services	Traffic information can be easily deducted and generated in the ETBO	Generation of traffic data is more cumbersome
Evolution of charging algorithms	Charging and map matching are in the Back Office, easily accessible and therefore can be more easily evaluated and improved	Map matching algorithms are in the OBU, hence difficult to access, evaluate and improve.
Price of OBU	Lower	Higher

4.6.1 Information Security

The system architecture must support the implementation of appropriate levels of information security such as:

- Confidentiality – to protect against unauthorised access of data
- Integrity – to assure the completeness and correctness of information and the functions that process them (to prevent malicious or accidental alteration of data)
- Availability – to assure unrestricted access to data by authorised personnel

Security is implemented on the system, subsystem, and component levels for all communication channels. Flexibility is needed since actual security requirements are defined through an ongoing risk analysis process in which new threats can be detected and handled appropriately..
Functionality which must be addressed in the architecture includes:

- Authentication and authorisation, including identity management
- Access control
- Auditing
- Encryption
- Digital signatures
- Approaches to ensure transactional integrity in a distributed environment (ACID)
- Approaches to ensure non-repudiation (e.g. based on digital signatures)
- Protection against malicious software and denial of service attacks

The necessary functionality must be provided with the required level of security (e.g. strong, certified components in critical areas). Further, it must be possible to enhance the level of security in the future if requirements increase (e.g. length of used keys).
The architecture supports the use of hardware security modules for several reasons (e.g. use of digital signatures in OBEs) which offer strong security and are certified according to ITSEC (at least at level E3).

4.6.2 Data Protection

The thin client solution requires trip data processing in a centralised system to determine charging data. The privacy aspect requires special attention for this solution. In order to guarantee a sufficient level of privacy of the road users additional organisational and technical measures are taken. A dedicated entity, called ETBO, is foreseen to collect all trip data from road users and to transform this into the charging data (Charge Coded Data).
The ETBO is fully isolated from the other subsystems and its operation is controlled by a Trusted Third Party, which provides regulation and assessment of all data handling.
Based upon the Dutch privacy (WBPR) regulation, the following principles are applied:

- Only information is collected, which is required to calculate the Charge Coded Data, such as the OBU ID, date, time, and position data as well as the corresponding License Plate Number for enforcement purposes. Within the ETBO, no information about the OBU keeper or vehicle owner is known.
- Information is not stored any longer than necessary.
- Collected information is used exclusively to calculate the Charge Coded Data.
- Road users are informed about which information is stored and what it is required for.
- OBU owners shall be provided access to the data stored about themselves. This can be combined with a service to give the OBU owners access to their trip data and check their invoices (whereby sufficient security measures are deployed).

Since the Charge Coded Data do not contain privacy-sensitive information, it can be used within the Central System without additional measures.
The OBU trip data, without OBU ID and therefore anonymous, may be used as a basis for statistical section trip time calculation. Such data may be be provided as statistical non-identifiable data to support Traffic Information Services.
All OBU data is subject to data mining processing in the ETBO for detecting weak points within the GNSS network.. Data mining processing can also detect malicious or suspicious behaviour of a certain OBU. When malicious behaviour is detected, all data of the concerned OBU are reported to the enforcement entity.

4.6.3 Interoperability

Within the timeframe for implementation of this system, it is expected that developments for achieving interoperability between European electronic fee collection (EFC) systems will have progressed considerably. Today interoperability is implemented only on a bilateral basis between operators, while in the next five years the European Electronic Toll System (EETS) is scheduled to be operational at least for heavy goods vehicles.
The solutions as proposed by Siemens in this report are prepared for interoperability scenarios on several levels because of several independent strategies and measures:

1. The system and business architecture we propose is designed to offer a maximum degree of flexibility. The system is modular; the interfaces are well defined and can easily be made transparent to partners outside the system. The processes are also defined and designed in a way to ease accommodation of changes and integration of external partners.
2. Siemens monitors developments and participates actively in standardisation and in the definition of the EETS. Therefore, Siemens is well at the forefront of all developments and participates in the decision-making process to ensure that newly-defined standards effectively cover the needs of technical and procedural interoperability.

3. Extensive research and development efforts insures Siemens' technical leadership and innovation in the field of electronic road user charging. Our flexible system and process design makes it easy to integrate new developments and solutions. Therefore, we can deliver the best value for money, covering all emerging needs. This is especially true for interoperability issues.
4. Siemens is not in the same position as an operator of a single system. We are open to all kinds of solutions without any bias. We are in a position to deliver the optimum solution for any given environment and can provide interoperable solutions on an impartial basis, without being motivated to protect earlier investments in a particular solution.

5. COST ESTIMATION

The costs used as a basis for the financial calculation have taken the development of market prices and the evolution of technology into consideration. Since the introduction of the scheme is anticipated in 2012, the assumption has been made that technological improvements and reduced cost of major system components have a positive impact on the overall price relative to today's levels.

The initial overhead for rollout at the introduction of the scheme (i.e. the transition phase during the first year of operation) has been regarded on a more global level. Thus, additional costs for system ramp-up have been calculated within the investment costs.

The operational expenses for the scheme are based on anticipated price levels at 2012, when the scheme is actually introduced. Therefore, it is assumed that evolving operational efficiency and technological improvements will allow the costs of operation to decrease over time after introduction of the "Kilometerprijs-KMP" Road user charging Scheme.

Based on current cost calculations, Siemens estimates the total project costs are:

	CAPEX (€)	**OPEX (annual)**	**Depreciation (annual)**
OBUs:	1.800M	158M	40M
Declaration & Customer Care:	5M	106M	4M
Payment & Billing:	81M	106M	2M
Enforcement:	114M	11M	9M
Miscellaneous:	193M	18M	6M
Total:	**2.192M**	**398M**	**60 M**

(all figures rounded off)

6. MIGRATION SCENARIOS

The start of operation of a system with the required dimension needs to be phased in - doing it in a smooth and defined manner. Different scenarios are possible in order to get the required result - with different cost-implications.

Siemens has identified 5 different major scenarios, called Big Bang, Smooth Migration, Vignette, Big Smooth and Open Market Approach. Siemens recommendation would be to start introduction of Electronic Road user charging based on the so-called Big Smooth approach.

The Big Smooth approach is a combination of a smooth migration scenario with randomly selected vehicle owners and the Big Bang scenario. In this case, vehicle owners are randomly selected to mandatory have their vehicles equipped with an OBU in a period up to 1 year before the system is completely life. Once OBU's are installed they start to collect and transmit data to the back office. Users receive virtual invoices enabling them to get used to the financial effects of the system. In a short period of less than 4 months before the system is completely in operation, equipped users are again randomly selected to actually migrate to the system. For them existing taxes are terminated as soon as the vehicle owner starts to be charged for road usage. The proposed 12 to 16 months implementation period could be used for the proof of concept and a reliable continuous roll-out to assure the system starts on time. The political message, that the scheme is not merely an additional tax burden, could be easily underlined since drivers can directly compare the virtual KM-price with the taxes they are actually paying. From a technological point of view, a steady increase on the system load is guaranteed and supports a smooth ramp-up and testing phase. In addition because of the random nature of selecting the "to be equipped" and "to be migrated" customers, the gradual system start up will not be perceived as being unfair or rendering undue (dis-) advantages for larger groups of users.

7. RISK ANALYSIS

Siemens has conducted a risk analysis which has delivered the following main risks:

- Negative public attitude

Lack of social acceptance for ABvM will make the set-up of the system more riskful, especially when the system is boycotted on a large scale. Prevention through execution of a joint powerful communication strategy of public authorities and private parties is essential to mitigate this risk.

- Insufficient penetration of installed OBUs at start of operation

Delay of system start will occur if not all (eligible) vehicles have its OBU installed. Risk can be mitigated by a well planned and structured roll-out scenario, in combination with a sensible migration strategy and incentives for early installation.

- Risk related to insufficient specifications

Insufficient specifications, especially related to interfaces towards other operators, may lead to changes in design (e.g. of the OBU), which may cause delay in the start of operations. Risk can be mitigated through definition of clear responsibilities and management of interfaces between participating parties, establishment of overall project lead for integration and ramp up.

- Time period between contract award and Start of Operation less than 2 years

Too little time for implementation will lead to low or late availability of equipment (esp. OBUs), applications that are not tested fully, and loss of income. Risk can be mitigated through agreement on realistic timelines design, development, integration and testing. A pilot phase with a representative number of users will reduce risks as well.

- Insufficient preparation of installation centres and distribution points (training of staff, installation and testing of equipment)

Insufficient preparation will lead to insuffucuent installation capacity and delay in the introduction of ABvM. Risk can be mitigated through thorough training planning, use of various training channels and early involvements of the Points of Sale of the OBUs. A user friendly OBU design and installation methodology is needed to achieve lowest risk probability

8. COMMENTS ON REQUIREMENT SPECIFICATIONS

As required by the Ministry of Transport (MoT), Siemens has reviewed the requirement specifications of the MoT. In this chapter, the most relevant feedback is summarised.

- Requirement [1]: *"Road user charging scheme is based on the distance travelled with by vehicles in the Netherlands."*

Through years of experience in testing and evaluating distance measurement, Siemens has concluded that distance based data derived from GPS system delivers results by far superior over those provided by tachographs (odometers). GPS location information can be processed in different ways in order to determine distances driven. Siemens already thoroughly investigated the method of interpolation of location stamps and of map matching of location stamps. For specific scenarios, an intelligent combination of both methods can be considered.

- Requirement [2]: *"Road user charging shall be differentiated on the basis of time."*

Time differentiation for charging is related to the complexity of the tariff table within the Central System. Siemens has already implemented rather complex tables (vehicle classes, time of day, date etc.) - in principle there is no issue about differentiation assuming that the timing information about the road usage (provided by the OBU) is available.

- Requirement [3]: *""Road user charging shall be differentiated on the basis of the location of the vehicle."*

A GNSS based toll solution as proposed by Siemens offers the utmost flexibility to fulfil this requirement without the need for installing road side infrastructure.

- Requirement [5]: *"Road user charging shall be introduced on all roads in the Netherlands."*

A GNSS based toll solution as proposed by Siemens offers the utmost flexibility to fulfil this requirement without installation of road side infrastructure. There are no restrictions in the definition of specific roads (i.e. roads that have to be charged individually or excluded from charging).

- Requirement [7]: *"The road pricing system shall be 'free-flow'."*

Assuming that the performance of the technology chosen is appropriate, Siemens does not expect any implications to free flow traffic from the road user charging scheme.
There are several technologies in place, with or without OBUs, supporting an electronic toll collection system with Multilane Free Flow capability

- Requirement [15]: *"The actual costs for driving (road charge) shall be visible in the vehicle."*

Due to the nature of toll technologies, this requirement increases the complexity of the solution. Either certain intelligence must be outsourced to the OBE or system components have to be designed according to the resulting real-time requirements which increase risks and costs. However, pre-pay users as defined within the solution proposed by Siemens are warned when there account gets low, whereby the expected number of users using this service is low.

9. CONCLUSION

Siemens is highly committed to contribute to the success of Anders Betalen voor Mobiliteit. Hence, we are pleased to conclude that the Anders Betalen voor Mobiliteit goals of the Dutch ministry of Transport in our view can be realised within cost budget and time frame as postulated by the Ministry, by deployment of Siemens' Electronic Tolling solution. Our advise is based on our in-house expertise, proven technology and the global system integration power of Siemens.

Highlights of the Solution for ABvM as proposed by Siemens:

- It fulfils the needs of "Anders Betalen voor Mobiliteit" by providing a usage-based charging scheme which is secure, efficient, and reliable.
- Flexibility in the introduction of the scheme allows for the Dutch government to choose Road User Charging scenarios which will be most effective and most accepted by the public.
- High flexibility in road user charging scenarios enabled by a centralised solution
- Cost-effective coverage of all roads without requiring expensive roadside installations for road user charging
- Other schemes, such as Congestion charging and "versnellingsprijs" can be easily introduced
- Reduced risk and operational market introduction within 2 years, due to key in-house expertise and the ability to easily integrate third party components
- State-of-the-Art technologies will be deployed to guarantee system accuracy and prepare interoperability with other road user charging schemes (both domestic and foreign)
- Easy integration of all user types enlarges acceptance of new system
- User-friendly system, making it easy for all citizens to participate in the scheme and providing the opportunity to provide new services for all users (for example, to reduced congestion or to improve traffic safety)
- Guaranteed availability by separation of Central Office building blocks and Trusted Third Parties