Development of charging station data services for new user groups

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Abstract

Our goal has been to examine the possibility of using charging station data to new user groups in the professional market. Opportunities have been identified through in-depth interviews with large public and private fleet owners, car distributors, utility transport providers, operators of charging infrastructure and developers of digital maps.

As a result of the survey, the selected main focus has been to find solutions for large public and private fleet owners developing a communicative charging infrastructure, leasing companies to acquire control of mileage for electric cars, a cost efficient system for all stakeholders to develop interoperability and universal access to a commercial charging infrastructure, and integration of in-car charging station data for car importers and distributors.

We have identified a number of needs and systematically assessed and proposed solutions with the support of charging station data, both to meet present needs and identify more visionary possibilities, without adding to high overhead costs.

charging station data, fleets, charging infrastructure

1 Introduction

The main objective has been, based on charging station data, to explore and develop new, customized services for EV-users in the professional market. This may include goods transport, fleet owners, taxis, car rental / leasing/ sharing, car importers, infrastructure builders and suppliers of digital maps. We have also included to investigate a simple and cost efficient solution for easy access and interoperability for all the users of the charging infrastructure. This has been identified as a common challenge among all the stakeholders. The real cost of electricity is relatively low, and overhead costs connected to development, transmission of data and installation of equipment, must not become too high.

We have accomplished an investigative pilot project to identify needs, opportunities and benefits through dialogue with stakeholders. The project has been exciting to work with, receiving great response, found interesting discoveries and practical solutions. We are early movers in an early stage of introduction of EVs among professional users. As Norway has a functional EV-market more than a testlab, we think this can be useful and unique knowledge to share, based on input from relatively experienced EV-users and a flourishing EV-business.

2 Methodology

Challenges and opportunities, both practical and strategic, are obtained through in-depth interviews with players in the different target groups. Overall the response has been good, the players have been open-minded and acknowledged the need for new solutions. We made a number of findings which we defined as a series of issues.

Sketches for conceptual solutions have been developed based on our own knowledge and experience, and through investigations in the market. Because we are early movers in a new field, we have had limited sources and references to support our work. Mainly we have tried to use well-known technology data and communication technology into a new sector of business activities.

The project has in size been limited to describe solutions for the most relevant issues that emerged. Among the eight defined findings of possible needs, we concentrated to investigate four of them.. Prioritization was based on common challenges, the effect of finding solutions and the possibility for duplications for other users.

The investigating pilot project had not implementation of solutions as a goal. The next step for the project owner will be to move forward in partnership with stakeholders in the various sectors, to realize the proposed solutions. In Norway we are waiting for a greater penetration of more intelligent and communicative infrastructure to support the solutions we are proposing.

Examples of user groups, key findings and solutions are listed above in separate chapters.

3 Large public and private fleet owners

3.1 Main challenge

Large public and private fleet owners will need to develop a dedicated charging infrastructure with the quality the users will need. Including real time data with warnings of charging stop, availability, reservation, ID-control and optimal utilization of the infrastructure.

3.2 Critical factors

Large Norwegian fleet owners are ready to step into a massive implementation of electric cars. In Norway until now primitive, but cheap, charging poles have been used. The knowledge about more advanced charging options has been limited, and it is a lack of information about equipment, technologies and the possibility of communication between car, connector and user.

The fleet owners should start a process to investigate where charging stations have to be located and what kind of equipment should be used. The key is to identify for which kind of applications the use of the electric cars are most vulnerable and need to have maximum reliability. The resources should be allocated to solve these challenges. Based on the dialogue following view points and decisions are considered:

- For these functions establish charging mode 3 with monitoring, which enables communication vehicle, charging point and control/back-end system.
- Control system must be alerted for unintended charging stops, either it is failures in the car, grid, vandalism etc.
- It is expressed a desire for availability information of charging points and reservation option.
- For the main part of the fleets (except unpredictable goods transport, taxis etc.) fast charging options do not look to be necessary for daily operations.
- Access to fast charging services will mainly be a back-up solution as a consequence of unintended charging stops or other reasons for critical low battery status.

3.3 Recommended solution

The project's proposal is to develop a mobile application for the users which includes:
- Map presentation of available charging infra-structure, both dedicated and public
- Information about charging status for each electric car
- Charging stop alerts for all the cars, making it possible to avoid unwanted problems
- Real time availability info for the charging stations in the network
- Internal booking options
- Direct assistance contact to a service center
- Information about available public fast chargers

- ID-control to the charging point integrated in the application
- Educational information for new electric vehicle users.

The application can be a "white label" product with common core technology, with a function slightly adjusted to the different customers' needs. The combination of not over-investing in an expensive, advanced charging infrastructure for electric cars without vulnerable use, and an application technology which can be shared by several fleet owners, make this as a cost-efficient solution.

4   Leasing companies

4.1   Main challenge

Leasing companies have normally collected mileage of the cars to their administration systems when the users are manually reporting through using dedicated cards when filling petrol. This is necessary for securing service intervals, insurance agreements, cost control etc. For electric cars which can charge from everywhere in the grid, this control function will not work. The need of mileage information has to be solved through other methods of reporting.

4.2   Several options

Based on our dialogue with the companies, we have defined four possibilities:

4.2.1. "Charging card"
A "charging card" can replace the gasoline card, and mileage has to be entered by the user before charging. This has been considered unrealistic because such services are normally not on the charging points. Besides this, charging can also take place from all kind of electric outlets, not only dedicated charging points.

4.2.2. Automatically from the charging station
Information from special-equipped, connected charging stations can be automatically sent to the administration system based on detection of the car-ID and readings of its IT system. This is challenging to accomplish because there are a lot of different technologies to synchronize, both on the car and infrastructure side.

4.2.3. Automatically from the car
Mileage is in the car's computer system and newer cars can communicate over the mobile and wireless network. A sensible solution in the long term, but requires that the leasing companies choose models from car suppliers that support and provides the collection of data.

4.2.4. Manually reporting
At requests in regular intervals the car user reports mileage via mobile or web interface, as it is for electricity meters today in Norway. Easy and inexpensive to implement, and a procedure we are used to.

4.3   Recommended solutions

Summarized we consider option 4.2.4. as most promising as it is easily doable, and a solution which is independent of different car models and charging stations. The EV value chain has a challenging lack of standardization, and we have to expect to live with this problem several more years.

The solution can be incorporated into mobile applications which the leasing companies should offer their customers. This app can also get other useful electric vehicle related information (see large fleet owners 3.3). Through an app with more functions, the demand for manual reporting will be integrated in a package/setting which increases the added value for the customer.

Most forward-thinking will be option 4.2.3. where the car reports automatically. Both of principle and practically reasons, this should be a responsibility of the car management system, not the charging point or the user. We recommend leasing companies over time to prefer cars with this functionality available, and today start to request it from the car manufacturers and distributors.

5   "Charging card" for interoperability for the infrastructure

5.1   Main challenge

Fleet owners, EV-users and infrastructure owners aim to have an easy and universal access to the commercial charging infrastructure, with an interoperability enabling future settlement of payments between the operators. We have been looking to a cost-efficient, scalable solution.

5.2 Critical factors

There are several purposes to be fulfilled:

- Promote the fast charging infrastructure and develop a common customer base
- Create understanding for payment for charging, which has not been usual in Norway – everything has been for free
- Provide EV-users with easy access to the complete network
- The operators prefer subscription to secure a stable income, but have to have "pay-as-you-go" solutions to acquire public funding
- Establish identification of the users to prepare roaming and distribution of the revenues
- Ensure free competition to stimulate development of the most user-friendly services, and keep it open for new operators
- In the next few years the customer base will be too low to justice high investments, the project aims to start with a simple and cheap solution which will be scalable

5.3 Recommended solutions

Our proposal to solution:

- Establish a common "charging card" (RFID-tag) in a joint standard, which gives access to the complete network of charging stations
- Wide distribution through the Norwegian Electric Vehicle Association's "welcome pack" to all new EV-users
- Simple user registration through internet to establish contact with charging providers
- It is enough to establish a relationship to one operator, the operators exchange a white list with RFID-tags through the database to open all chargers for a client
- All sensitive customer data will be owned and protected by each operator
- Nobody should be forced to be a subscriber, "pay-as-you-go" solutions have to be offered, but the price structure can be used to stimulate the user to be a regular financial contributor through subscription
- Free competition is secured by keeping all business transactions by each operator
- Through the national database NOBIL all Norwegian charging points have a unique international ID
- When the volume of transactions is high enough, and it is economical sensible, roaming can be introduced and invested in
- The system has a low initial cost, is modular and it is easy to create add-on functions
- This is an open system which make it easy for new operators to participate in the common network and client base
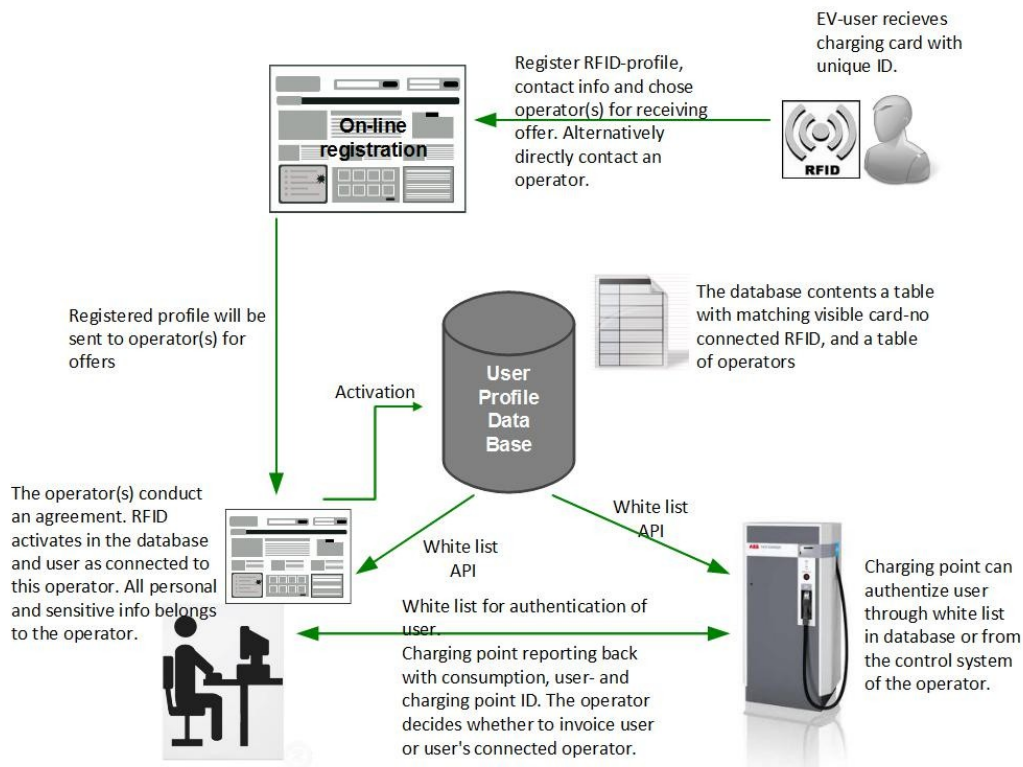- The database of IDs and white lists should be kept by an independent third party

Figure1: Flow chart

6 Car importers and distributors

6.1 Main challenge

Car importers and distributors aim to have charging station information as integrated as possible in their electric cars, to provide a high service level for new EV-users. We have looked to solutions which is immediately easy to carry out, and future innovative solutions which can create a competitive advantage.

6.2 Critical factors

The electric cars have widely different opportunities based on the installed navigation instruments and the communication ability with the surroundings. We have solutions that address the breadth of this.

6.3. A set of solutions under different conditions

6.3.1. Electric cars with standard navigation equipment, but even with lack of continuous updating of static data

With use of data from the Norwegian charging station database NOBIL, we have developed a module that provides a plug-and-play solution for different car models. The filtering can be adapted to type of charging stations which can be used of the different car models, and the navigation technology they have installed. Example: http://www.ladestasjoner.no/nedlasting/gpsfiler.

A module as this can be implemented at the car distributors communication platform or be available at general web pages for charging station info.

6.3.2. Electric cars with better integrated mapping solutions for charging station data, but not having continuously updates of static data or real-time data

The project is in discussions with suppliers of digital maps to assist in technical solutions which can update the cars continuously. In Norway Nissan LEAF is equipped with charging station data from NOBIL (www.nobil.no), but until recently only updated in quarterly intervals.

Technically it is not demanding to implement solutions for this. But there are bottlenecks in a complex value chain from different charging stations databases (for example NOBIL) and the communication all the way to the electric vehicles, with different players involved from mapping and car business. The challenge is more about business politics than technical solutions. We aim to lead the way by putting the EV-user in focus, and demonstrate solutions which the business can implement when they are ready.

6.3.3. New electric cars will arrive to the market, with advanced telematics to be constantly online to handle all kind of ITS data

This allows for continuous updates in the car's navigation:
- Static data about charging stations (many databases have daily changes)
- Real time data about availability: operational / out of service, occupied / free
- Booking options

The data can in different ways be communicated to the car and the user:
- From the car manufacturer's servers through the mobile network.
- By using the emerging DAB network for radio. In Norway this will in few years cover the whole country and replace the FM-network. The interesting aspect with DAB is the add-on function TPEG (Transport Protocol Export Group) which can communicate real time data in a more advanced way than the old FM TMC/RDS system.

Compared with the mobile network, the DAB network under development appears to be more efficient and affordable for transport of data from the charging station servers out to the cars. We expect the car manufacturer to take advantages of this and develop possibilities to include charging station data. As an example, Toyota is using the DAB-technology in the new Prius [1]:
"Toyota Touch Pro also incorporates DAB/DAB+/DMB digital radio as standard, making it compatible with a new advanced Transport Protocol Export Group (TPEG) traffic information service. Based on a digital communication channel, TPEG represents a significant improvement over existing, RDS-TMC analogue systems because it can carry far more information.
Not only will its pin-point accuracy enable better navigation routing, but it will also supplement a basic traffic event and flow service with information on parking availability and fuel prices, adding additional information including speed

limits and weather thereafter."

Toyota does not mention the possibility of using real time charging station info, but this has been presented as an idea from others [2]:

"This paper addresses the availability of digital multimedia broadcasting to provide better charging services to electric vehicles. Through the advertisement framework which has been implemented by an extended TPEG frame and is capable of updating current waiting time in each charging station within a few second, the broadcast can eliminate multiple information retrieval requests from a lot of vehicles. The in-vehicle application first selects the candidate stations based on remaining battery and its current location. The uplink channel can be connected by either the cellular network or WiFi interface, if necessary. Then, the charging time estimation and time overhead for detour is evaluated to select the best one. Due to the delay in information posting, there can be inconsistency between the posted and the actual waiting time. The experiment shows that the inconsistency ratio is not so significant if charging stations are sufficiently available."

The project has studied this possibility thoroughly and will initiate a consortium with the most advanced actors among the car manufacturers, together with the national broadcasting in Norway. Norway is in front with a modern public non-commercial broadcasting, solid charging station database and the world's highest density of EVs. We can take an advantage of this through testing the opportunities, and share the results with the world.

6.3.4. There are EVs without navigation in the vehicle

Here we rely on developing mobile applications which includes excellent filtering capabilities to establish user profiles, based on the attributes of the different electric vehicles and the charging points they can benefit from.

References

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