3rd Electric Road Systems Conference 2019
Frankfurt am Main, Germany, 7th to 8th of May 2019

Revenue Management for Electric Road Systems

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Summary

Electric Road Systems (ERS) deployed in commercial operation will need to charge for the use of infrastructure, electric energy and potentially other services, regardless of choice of technology for the energy transfer. An ERS revenue management solution need to handle use cases with multiple actors, roles and commercial relationships. In addition, the future revenue management solutions should be interoperable and independent of business models in order to flexibly meet the needs of new situations for emerging ERS.

1 Introduction

There are ongoing studies and development on Electric Road Systems (ERS) around the world in order to explore different technologies, as well as various user and business perspectives [1, 2, 3, 4]. A straight forward conclusion from these efforts is that future electric road systems will need some form of revenue management for billing the use of infrastructure, electric energy and potentially other services. How such revenue management shall be designed has not been determined, let alone investigated before the presented study [5].

No matter what technology solution for energy transfer chosen for future ERS there will be a business ecosystem with several actors as illustrated in Figure 1, and commercial relationships between different roles such as goods owners (industries), haulage contractors, road operators, electric power distributors etc. Although a single actor may take care of more than one role, it will likely be a complex situation where multiple actors shall get paid. Since it is presently not known to what extent ERS will be used and which business models that will be used, ERS revenue management shall have an open and scalable architecture that enables interoperability and different business models.

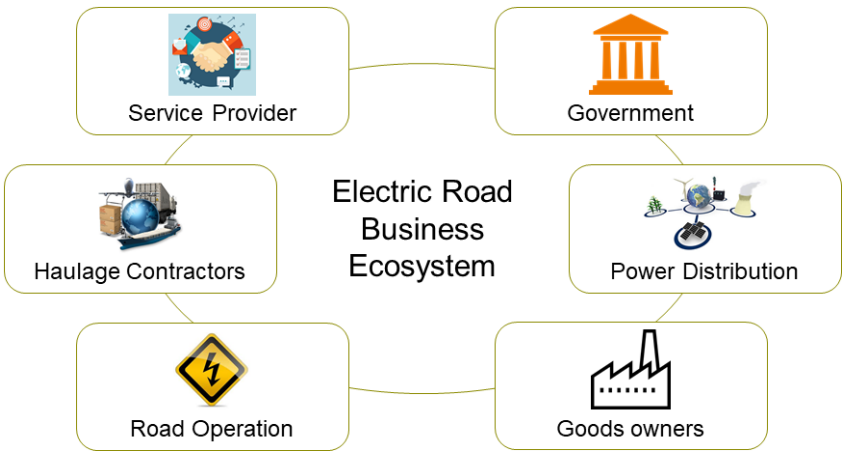

Figure 1: Business ecosystem for electric road systems with several actors and roles.

2 Revenue Management

Rate of development, competition and especially the need to adapt to different business models has caused revenue management systems used by communication service providers to often be flexible and configurable in order to cope with changing commercial situations with multiple actors and roles, which corresponds with what the revenue management for ERS need to handle. Trading of electricity for railway transport affects fewer roles than what is expected to be the case for ERS and its revenue management system is therefore not deemed possible to reuse directly for ERS, but it is highly relevant to note the trend to calculate energy consumption based on distance reading of power consumption.

When designing ERS, it is important to understand and define the various actors in commercial terms in order to ensure that the revenue management will support a variety of possible business models. With clearly defined and committed entities in the ERS structure, there is great opportunity to avoid a situation where different competitors position themselves with proprietary systems, but instead take advantage of a situation where the actors share a given framework. The latter type of competition leads to diversity and encourage innovation.

Architecture for ERS

A proposed revenue management system architecture for ERS was described in a previous Swedish report [5] and is illustrated in Figure 2. This proposal is developed with inspiration from business support systems from the telecom industry and with the idea that energy calculation shall be based on the distance reading of power meters or sensors in vehicles. The architecture is meant to be open, modular, scalable and enable interoperability as well as different business models.

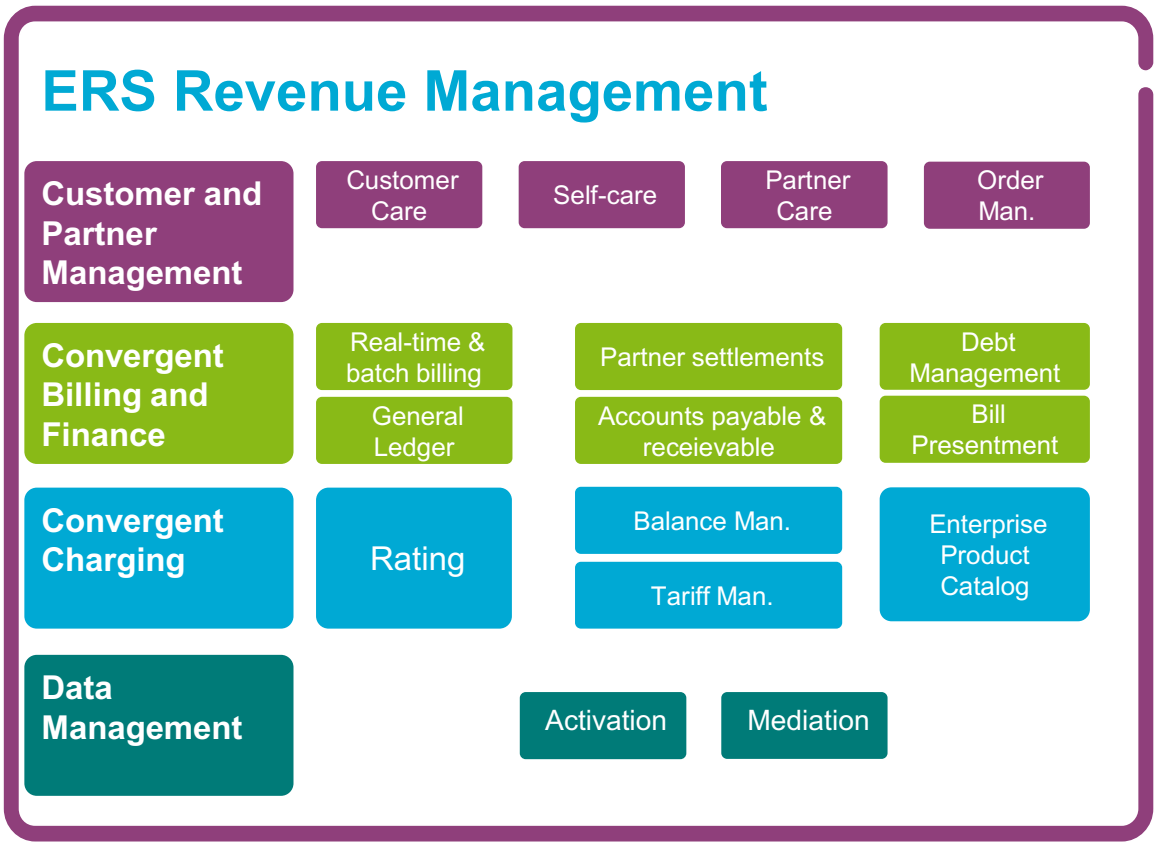

Figure 2: Revenue management system architecture for electric road systems.

The revenue management system consists of four parts:

- Customer and Partner Management
- Convergent Billing and Finance
- Convergent Charging

- Data Management

These four parts each have a number of modules with different functions:

- *Customer Care:* Manages the customer service interface.
- *Self-Care:* Manages the internet portal where the customer can make settings and changes.
- *Partner Care:* Registration and management of partners.
- *Order Management:* Manages all customer orders and the ordering process.
- *Real-Time & Batch Billing:* Generation and updates of invoices.
- *General Ledger:* Maintains the ledger in the financial system.
- *Partner Settlement:* Calculation of partner balance.
- *Accounts Payable and Receivable:* Management of income and outgoing payments.
- *Debt Management:* Retains any debt in the system.
- *Bill Presentment:* The interface that presents invoices and communicates with the printer or third party that sends invoices.
- *Rating:* Sets the price of each record according to the current price list.
- *Balance Management:* Maintains the balance of each customer's account.
- *Tariff Management:* Configuration of price models, discount structures and price levels.
- *Enterprise Product Catalogue:* The complete product register with allowed customers, prices to apply and when a product can be offered etc.
- *Activation:* Communication with the electricity meter and the control system in the energy transfer infrastructure.
- *Mediation:* Responsible for extracting, transforming and normalizing all data sources in and out of the system.

These modules are meant to be integrated with each other and not always possible to remove without affecting the entire system, i.e. the revenue management system will not be fully modularized in order to achieve the best system efficiency.

Information and data exchange

ERS opens new needs and opportunities where information and data exchange between vehicles and infrastructure is essential for the usage. Information and data exchange can be viewed as three layers where the first is the basic for the ERS function that currently is covered by energy transfer technology. The second layer is what needs to be added to create data for the revenue management and the third may be traffic information. This means that data on energy, position, time (and thus indirectly also speed) will be connected to the vehicle and possibly to person. There is thus a need to study relevant privacy issues concerning revenue management and traffic information for ERS. Lessons can probably be drawn from existing systems such as toll roads and congestion pricing.

3 Conclusions

Regardless of the choice of technology for the energy transfer, ERS deployed in commercial operation will need revenue management for billing the use of infrastructure and energy. The revenue management need to handle complex use cases with multiple actors, roles and commercial relationships. In addition, the future revenue management systems should be interoperable and independent of business models in order to flexibly meet the needs of new situations.

It is important to develop business models for electric road systems and to consider what should be the role and responsibility of the road operators. In this context, one should consider what should be the role and responsibility of the road operators. A possible solution might be certified service providers who will be responsible for procuring electricity, billing the use of infrastructure and energy, and offering of new innovative services. With help of anticipated communication systems part of the vehicle/road/infrastructure and sensors in the vehicle/road system, added value could be created by third-party developers who access or buy some of the information. It is only the imagination that limits the amount and types of new innovative services.

There is also a need to identify what impact electrification of the major highways will have on future needs and expectations of traffic and operating information through forthcoming research studies and interviews with relevant stakeholders.

There are pre-developed management systems that are able to handle very complex revenue streams. Interviews with several suppliers indicate that it would take approximately six months to configure and deploy a system to be used for ERS and that can be expanded with services as they occur. Future adjustment of the revenue management should be possible by changing the configuration.

Acknowledgments

This work was conducted as a part of the Swedish Research and Innovation Platform for Electric Roads funded by the Swedish Program for Strategic Vehicle Research and Innovation (FFI) and the Swedish Transport Administration.

The authors would like to thank colleagues at RISE and Ericsson for stimulating and helpful discussions.

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