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Assessment of ICT-based Architectures for the integration of EVs in Smart Grids

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Short abstract

Distributed Energy Resources (DERs) involvement in network operation processes is one of the main tools for flexibility enhancement in smart grids and this can be achieved through ICTs deployment.

The final objective in this paper is to describe how electricity grid planning and operation can leverage advanced ICT solutions to allow Electric Vehicle (EV) management for the provision of network services (by contrast, network planning *business as usual case* relies upon grid extension strategies).

Keywords: Electro-mobility, Smart Grid, Network services, ICT

Full abstract

The evolution of distribution networks towards smart grids pursues lower environmental impact through optimized processes (higher efficiency) and the deployment of cleaner energy production technologies. To achieve this, the system must transit from a passive to an active network, requiring remote and automated control systems, and the integration of distributed energy resources (DER) in operation processes, including electric vehicles (EVs).

In this framework, the involvement of ICT systems is critical. The use of ICTs in the electrical system is already a fact, mainly in the transmission system but also at energy distribution level. It is expected that this dependency will increase with the evolution towards smart grids and, among other functionalities, it will help integrate demand into network operation.

DER system involvement in network operation processes is one of the main tools for flexibility enhancement in smart grids and the principal scope of this study [1]. The **services** that could most suitably be provided by EVs to the network have been analysed through use case descriptions in accordance with [2]:

- Frequency regulation.
- Load balancing.
- Voltage regulation / reactive power provision.
- Peak shaving.

- Load profile flattening.
- RES integration.

ICT architectures have been proposed in accordance with the SGAM examples in [3], including communication technologies and information protocols, for the exchange of data between actors and components. The next figure shows, as an example, the proposed ICT architecture for the voltage regulation service.

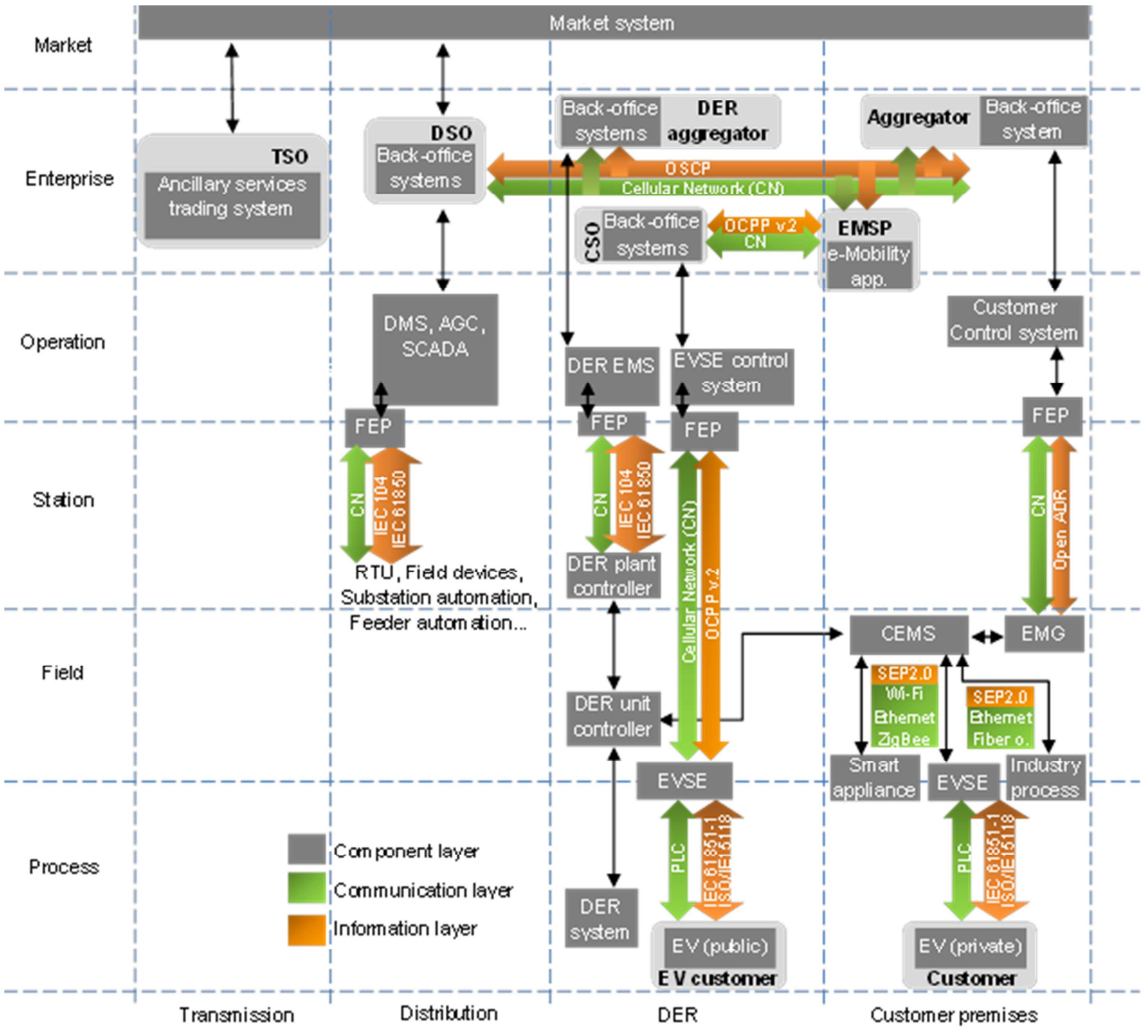

Figure 1 ICT architecture for the voltage regulation service

As one of the main results of the study a general **ICT network architecture** is proposed for the provision of advanced network services by EVs and other demand resources in smart grid environments.

Some of the **conclusions** of the study regarding EV integration in smart grids through ICTs are the following:

- **Technical** solutions already exist to overcome the new challenges. The communication means are ever faster and able to transmit higher amounts of data; information protocols permit an intelligent communication with demand and network assets; data

mining processes allow a better management of big amounts of data; etc. However, still certain improvements are required to enhance the efficiency of ICT deployment in smart grids.

- **Market** layer aspects are also relevant. The involvement of end-users in voluntary network service provision is linked to the existence of compensation schemes, normally related to economic aspects, e.g. energy cost reduction, additional incomes, etc. In order to provide such incentives, system operators, should also get a benefit from the utilization of this type of resource. Today, big size generators and consumers are eligible for wholesale and ancillary services market participation. The inclusion of lower size customers in these markets would increase the flexibility availability for system operators and, therefore, it might have a positive impact on system operation costs.
- **Regulation** has a lot to say in this context. The regulatory framework can impulse or put barriers to this new distribution system concept. Attention should be paid to the following aspects: distribution system remuneration schemes, participation of DER in energy markets, remuneration schemes for service providers and overall competitiveness in energy markets.

All three aspects, i.e. technical, market and regulatory, are critical to permit the use of new resources, such as those provided by EVs, in network operation processes.

The **final objective** in this paper is to describe how electricity grid planning and operation can leverage advanced ICT solutions to allow EV management, and demand management in general, for the provision of network services. By contrast, the network planning business as usual case relies upon grid extension strategies. This research work results from the work carried out in the PlanGridEV EU funded project [4].

References

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