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PlanGridEV

Deliverable 3.3

New ICT developments and services for EV integration in electricity distribution networks

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Abstract / summary

D3.3 New ICT developments and services for EV integration in electricity distribution networks

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 in operation processes. In this framework, the involvement of ICT systems is critical to allow high penetration of EVs in the system through network services provision.

Four categories of smart grid strategies have been considered for network planning and ICTs are present in all of them:

- **Distribution automation:** it deals with network devices and strategies linked to network operation, e.g. network reconfiguration and topologies, voltage control strategies, network monitoring, etc.
- **Advanced metering infrastructure (AMI) and automatic meter reading (AMR)**: smart meter related features and technologies.
- **Distributed energy resources (DER) integration:** distributed generation, storage and demand management resources (including EVs) for distribution network operation.
- **Customer empowering:** devices and strategies that can induce customers to change their energy consumption habits.

During the smart grid project planning phase, the operation strategies maximizing technical features and minimizing investments and operation and management (O&M) costs have to be selected. The minimum number of interventions providing the expected results have to be considered, e.g. number of feeders refurbished with remotely controlled switches or the number of automated secondary substations. Therefore, a **smart grid project assessment** must be performed, both economically and technically, to compare the results provided by different planning strategies, in order to choose the best solution among them.

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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. The **services** that could most suitably be provided by EVs and other DER systems to the network have been analysed through use case descriptions:

- Frequency regulation.
- Load balancing.
- Voltage regulation / reactive power provision.
- Peak shaving.
- Load profile flattening.
- RES integration.

A general **ICT network architecture** is proposed considering all services listed above. The architecture is comprehensive, so it can be taken as general reference for use case development. In consequence, it has to be particularized for each specific deployment, considering the mapping between actors and roles in the regulatory framework, the service requirements and the market and business model characteristics. The proposed architecture is shown in the next scheme.

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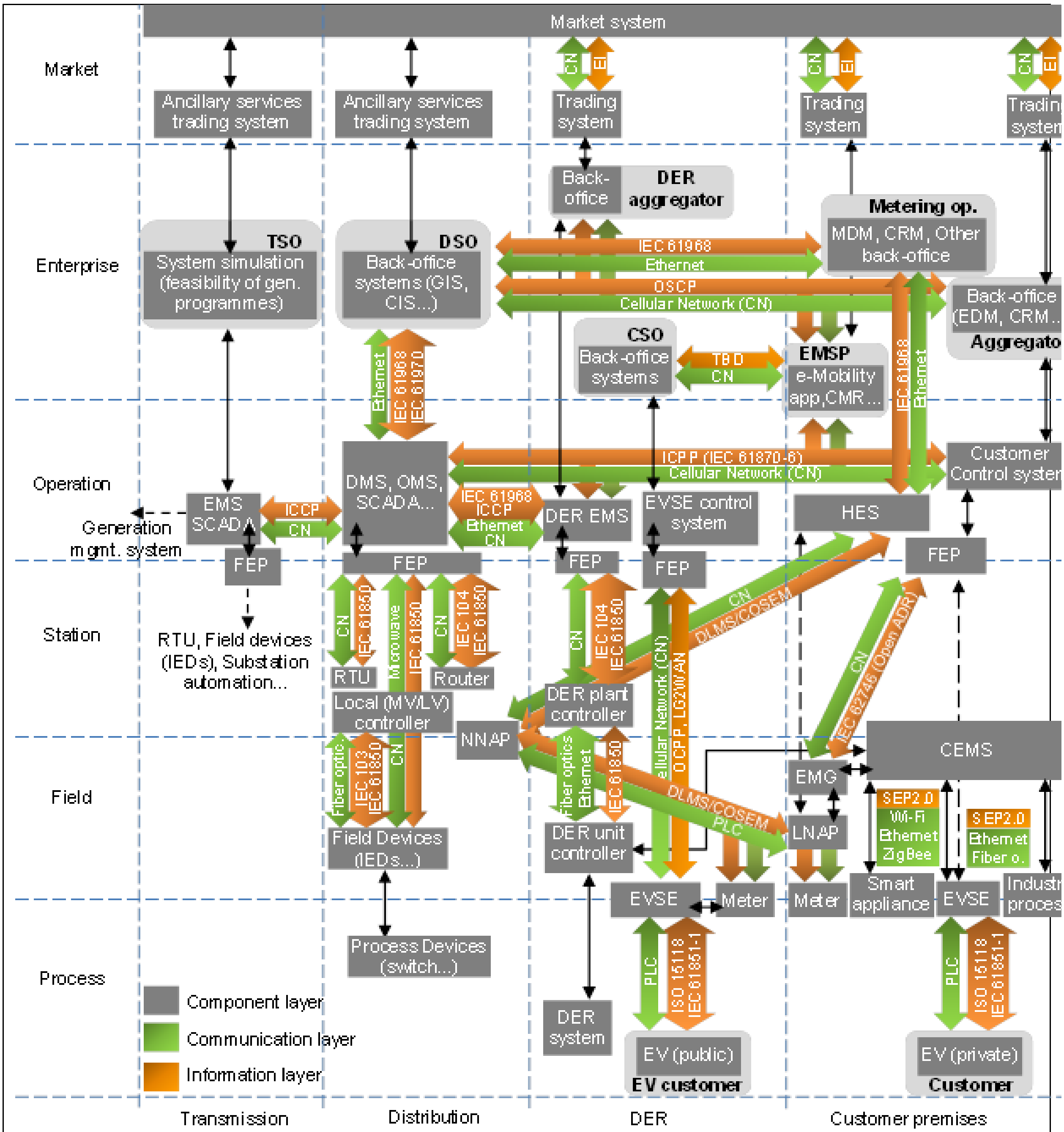

Figure 1 Comprehensive ICT architecture proposal

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Most utilities use currently more than one communication mean, depending on the functionality and service they need to cover through network operation. This will still be the case in smart grid environments, even if the complexity of ICT systems will increase significantly. DSOs will require a distribution automation network, an AMI network and a DER control network, but these can be shared up to some extent. The following **solution** is proposed:

- **One common ICT infrastructure for AMI, non-critical distribution automation, DER control and customer empowering:** the final solution should be scalable, built upon standard solutions when available, hierarchical according to the above presented architecture and considering security and reliability aspects from the design phase. Public networks could be used for less critical information exchange and Service Level Agreement options could be chosen for communications requiring intermediate resiliency.
- **Critical distribution automation ICT infrastructure:** These networks are normally local area networks in charge of connecting control systems with intelligent field devices through fast and reliable technologies such as fiber optics. Security risks should be carefully assessed and managed, and reliability improvement strategies should be deployed to minimize disturbances associated to network operation. Private networks are recommended.

PGEV project **test beds** are a step towards future smart grids and, as consequence, their architectures fit to the one proposed in the present document. The following figure shows graphically the mapping of the main functionalities of PGEV test bed architectures to that of the proposed scheme.

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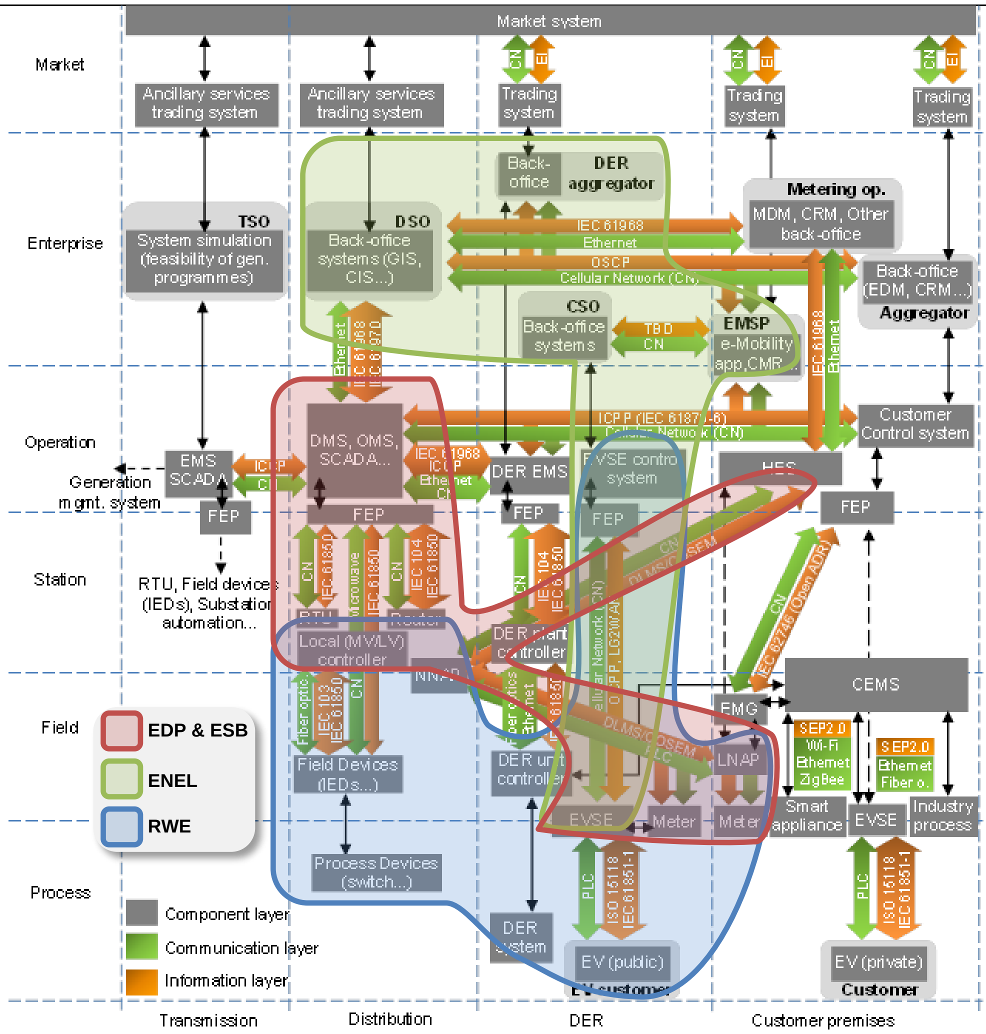

Figure 2 Mapping between test beds' and proposed ICT system architectures

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. Apart from the interaction between actors, most smart grid strategies will depend on ICT systems, e.g. remote control, automated actions, monitoring, etc.

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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, for example: interoperability of solutions, coordination with legacy systems, inclusion of security in ICT solution design and assessment of ICT reliability on smart grids performance.

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 deployment of ICT based strategies. This deployment should be based on the optimum solution implementation, targeting always sustainability. Therefore, apart from technical and cost aspects, socio-economic impacts should also be taken into account in the global assessment of solutions.