

## INNOVATION REPORT

# Reliable, consistent and efficient electrical power distribution for industry, services and consumers



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*Reliability and consistency of electricity supply is critical to many industrial and service activities: when the power quality is inadequate, business suffers. To operate the power network in a more efficient manner, it is necessary to exploit data from a huge number of electronic devices involved in the control and protection of power systems in a systematic and standardised way. With issues such as smart metering and real-time monitoring becoming crucial, the ITEA 2 IMPONET project addressed the modelling, design and implementation of a comprehensive, flexible and configurable information system to meet the most complex and advanced requirements in electrical energy management.*

### Smart grids and smart solutions

The electricity business has changed dramatically with the integration of renewable generation, which is distributed and non-programmable. The development of intelligent networks (Smart Grids) is essential to efficient management and sustainable energy. The introduction of smart meters and Advanced Metering Management (AMM) systems signal the first step towards the implementation of Smart Grids, from distributed generation to demand management, whereby the information flow is integrated into a real-time platform for the operation and monitoring of the network.

The involvement of key actors in the energy sector enables the European energy ICT industry to be more competitive in European and international markets. The complementarities of the partners from four countries and the high level of each partner's commitment demonstrate the relevance of the needs for a solution such as IMPONET for the energy sector and the impact that the technological results will have on their business models.

### Challenges and opportunities

IMPONET investigated the business challenges and opportunities in the electrical distribution domain, identifying and describing the requirements for advanced metering and power quality monitoring. The system architecture was elaborated focusing



on the ability to process massive amounts of information in real-time while maintaining bi-directional communications through the use of several communication technologies and common standards, such as IEC 61850 and CIM.

Initially, a prototype concentrator and meter device were developed, using ZigBee radio for local communications and GPRS with IP for communications with the control centre. Subsequently, the development of a high processing power, storage capable concentrator enabled the hosting of a middleware for bi-directional communications in real-time.

Significant research was carried out on methods and technologies for collecting, storing and processing residential meter data, with a special focus on extreme-processing middlewares and large, non-SQL storage architectures. Extensive use of the storage and processing architecture for handling massive amounts of information was made in implementing several advanced metering use cases while several platforms were developed for the visualisation of customer energy data according to the needs of different stakeholders.

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Power Quality (PQ) concepts and use cases were defined geared to short duration disturbances in four main sub-areas (processing, modelling, management and reporting) and the corresponding methods and tools for power quality monitoring in the electrical distribution domain were developed further. Integration of the IMPONET eco-system of services and devices for data acquisition and processing aimed to deliver an advanced metering platform for residential customers on the one hand and a powerful framework for power quality monitoring on the other.

### State-of-the-art

The state-of-the-art has been enhanced with the production of top-quality SotA documents on communication components and protocols and a comprehensive competition analysis, including R&D projects. With the benchmarking of meter data management (MDM) solutions, IMPONET has pushed the envelope. Furthermore, the project has defined a clear standardisation strategy whereby active participation in standardisation committees and working groups in communication, billing, quality monitoring, smart grids and smart metering along with strong involvement in IEC 61850 consolidated the project's impact.

The main innovation generated by the IMPONET project lies in the advanced real-time architecture that contains a dual model of publish/subscribe and request/response in which data access allows interoperability between the different data models for big data. Ultimately, therefore, the key value of IMPONET can be regarded as managing the unpredictability of energy sources as well as smart metering to reduce our consumption footprint and boost the efficiency of energy distribution, in line with the targets for local energy consumption and supply.

A brief review of the project's results reveals a huge amount of integrated products and a lot of experiments aimed at assessing the best combination of technologies:

- A concentrator and a meter design whose processing capabilities could prompt even more innovation possibilities
- Impressive detailed advanced system architecture
- Dual architecture mechanism (publish/subscribe and request/response)
- Data platform based on SQL and non-SQL databases, Hadoop and Oracle engines, among others
- Reduced processing time from 24 hours to 1 hour for the billing process of 200,000 customers
- Web portal for customer, distributor and retailer
- Forecasting energy consumption to within 2% precision
- Geo-Portal for power quality monitoring
- Impressive integration management tool

The unique selling points of these innovations translated into business value are the extension of energy management applications to the consumer and the enabling of network monitoring through the development of advanced algorithms for prediction and simulations. In addition, real-time data processing and discrimination do not compromise the independence of equipment and extensive use of several communication technologies.

### Impact

The rich and expressive IMPONET demonstrations (fifteen in all) revealed the actual integration of the global architecture developed within the project in a controlled workbench environment that covered several available scenarios of an electricity network. The IMPONET results are set to be demonstrated in the near future in several technology pilot projects, particularly in the LINTER testing laboratory at the Union Fenosa Distribution premises and also for the ENDESA distribution company. Consortium members have actively promoted the standards that are relevant to the IMPONET project through the appropriate bodies. In addition, the dissemination activities included conference papers, journal and magazine articles, the chapter of a book and three PhD theses as well as incorporation in academic courses and websites.

This business-driven technology project has resulted in a huge amount of deliverables and an impressive architecture to master a complex system. The market potential – impact on the market and market exploitation – is significant and there is already considerable interest in commercial development, from Serbia, Spain and Malaysia:

- **EPS (Serbia):** Prequalification for modernising the electricity infrastructure in Serbia. Supply and installation of electricity meters, MV/LV internal control metering and related software as well as overall system integration.
- **UFD (Spain):** Unión Fenosa Distribución is requesting a brand new MDM platform that can cope with the massive amounts of information coming from T5 smart meters (residential customers).
- **Tenaga (Malasia):** Development of an advanced MDM platform, capable of processing the large amount of information coming from the residential smart meters, and making use of state-of-the-art storage technologies (Non SQL) to store and process these data.
- **Endesa (Spain):** a Customer Data Processing & Web Portal Pilot to cope with the massive amounts of information coming from residential customers.

Smart grids are the key element to ensuring the efficient management of energy in a new, advanced, reliable and sustainable energy model. IMPONET provides the essential

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cornerstones to achieving a comprehensive, flexible and configurable information system to support the most complex and advanced requirements in energy management. This will bring important economic and environmental benefits and have a significant social impact. The involvement of end consumers in the active management of electricity demand should also bring a new, more responsible model of energy use, resulting not only in more efficient energy generation but also in significant

savings in energy consumption. IMPONET will also closely follow the findings of the 'Future Internet' and, in particular, the Internet of Services and Software, the Internet of Things, the Internet of Users and the Network of the Future.

**More information:**

[www.innovationenergy.org/imponet/](http://www.innovationenergy.org/imponet/)