Connected Living

The Electricity Grid of the Future

Summary

In future, many homes and business will use solar panels, wind turbines and other new technologies to generate energy, as well as consume it. To efficiently manage the many sources of supply and demand, utility companies will need a network of connected sensors that provides real-time visibility and control of the electricity grid. Telekom Slovenije and its partners are demonstrating that the mobile phone networks can reliably and securely meet the communications requirements of the future electricity supply grid. As well as using its LTE network to provide cost-effective connectivity, the mobile operator is employing an innovative approach to security to provide a confidential and authenticated communication solution within a public network infrastructure.

Why electricity grids need to get smarter

Many countries around the world are looking to develop more competitive, secure and sustainable energy systems that can deliver greenhouse gas reductions and curb climate change. In the EU, for example, Member States have agreed on a framework for climate and energy, which sets the following targets and policy objectives for the period between 2020 and 2030:

- **A 40% cut in greenhouse gas emissions compared to 1990 levels**
- **Renewable energy to account for at least 27% of overall consumption**
- **Energy savings of at least 27% compared with the business-as-usual scenario**

To that end, the EU is planning to make much greater use of renewable energy, such as that generated by wind turbines and solar panels. By 2035, most homes and businesses in the EU may be generating electricity from renewable sources, contributing some of that energy into the supply grid, while also consuming electricity generated elsewhere within this grid when the sun isn't shining or the wind isn't blowing. For utility companies, a shift from

a small number of concentrated power stations to a large number of distributed sources, many of which will depend on highly variable sources of energy, is a major challenge that could result in unpredictable and unreliable generation. To prepare for this shift, utilities are looking to use telecoms connectivity to:

- **Manage and control the safe delivery of electricity**
- **Ensure resilience and safety**
- **Ensure security of supply**
- **Ensure voltage, frequency and power quality stability**
- **Identify faults**
- **Safely restore supplies**

Piloting the Future Grid

To support the utilities industry, the EU is funding a Smart Grid Project, known as SUNSEED, to develop "technological and economic models for the most efficient use of communications infrastructure in the smart grids of the future". The project is designed to explore how connected sensors can cost-effectively deliver visibility, safety and control within a so-called Future Grid.

Led by Telekom Slovenije, the project involves a consortium of nine companies from six countries, including Elektro Primorska (Ljubljana, Slovenia), Elektroservisi (Ljubljana, Slovenia), the Jozef Stefan Institute (Ljubljana, Slovenia), Aalborg University (Denmark), Gemalto (France), Gemalto M2M (Germany), the Netherlands' Organisation for Applied Scientific Research (Delft, Netherlands) and Toshiba Research Europe (Cambridge, UK).

The three year project, which should be completed in February 2017, is spending €4.8 million piloting a Future Grid in Slovenia. About €3 million of the budget is provided by the European Commission. The project employs both the public mobile communication networks owned and operated by Telecom Slovenije and the private communication network owned and operated by the grid operator Elektro Primorska to support the Future Grid.

The communication solutions being piloted in the SUNSEED project are designed to support:

- **Advanced distribution management – delivering full visibility and control across both the medium voltage and low voltage distribution networks.**
- **Demand response – enabling end-users to change their normal pattern of electricity usage in response to price incentives at times of high wholesale market prices or when system reliability is jeopardised, thereby optimising the stability of the Future Grid and minimising electricity generation costs.**
- **Outage management – to enable faults to be efficiently identified and rectified within the medium voltage and low voltage distribution networks.**

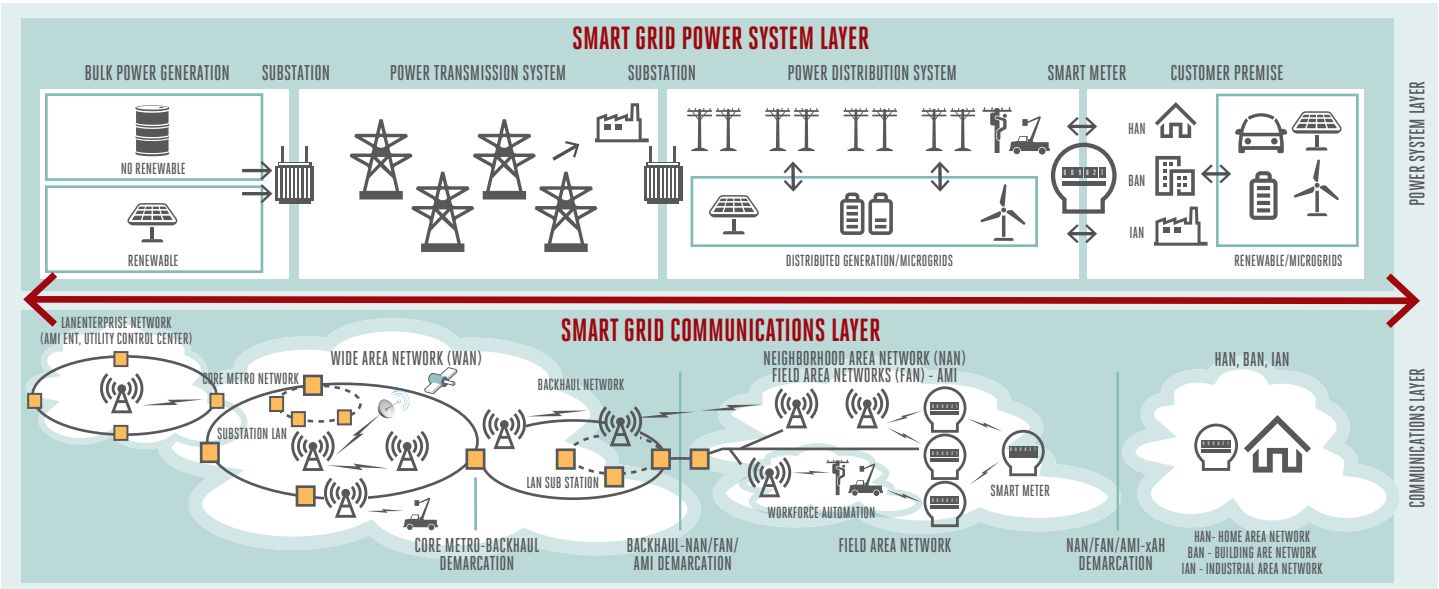
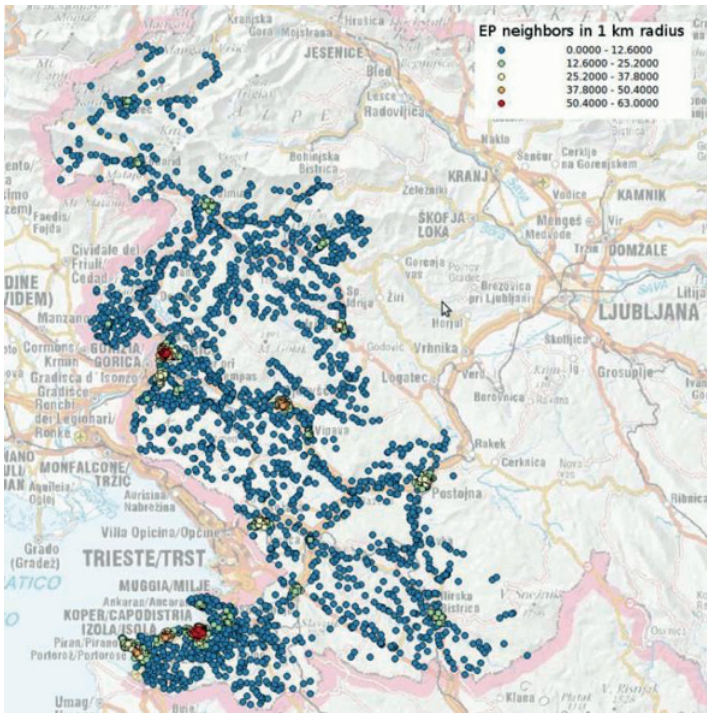


FIGURE 1: SUNSEED'S SOLVENIAN PILOT



For the SUNSEED project, Telecom Slovenije has deployed 400 wide area measurement (and control) sensor nodes across part of the existing Elektro Primorska distribution network. These nodes measure and report a variety of parameters, including time-stamped values of power, quality, voltage, harmonics and other data to enable real-time event tracking and control. Each node is equipped with a sophisticated communication module connected to Telecom Slovenije's public networks (either LTE or WiFi), which enables the delivery of encrypted data to software applications running within the utility's operational control centre.

Each connected node also has an embedded secure element designed to prevent device cloning and credential theft through a physical attack on the device. By enabling reliable authorisation and access management, this security architecture also controls which applications may interact with the sensor nodes.

In the utility's operational control centre, the software applications combine the data from the nodes with data from other monitoring and control devices to provide a holistic view of the entire electricity supply network: About 600 smart meters and 50 distribution substation monitoring devices are capturing and transmitting data across the utility's private communication network, supplementing the data collected by the nodes. These multiple sources of data can be used to enable the safe operation, protection and control of the network.

The pilot encompasses an energy network serving around 130,000 small industrial, commercial and domestic premises over a geographic area about one third of the size of Slovenia, as illustrated in Figure 1.

Mobile Networks Can Support the Future Grid

The SUNSEED project is demonstrating that Telecom Slovenije's public mobile network is able to satisfy the Future Grid's communication requirements (in terms of coverage, security, reliability, availability and latency), pointing to how a utility can cost-effectively achieve real time visibility and control of such a grid. Furthermore, a comparative study[1] of the business models of the main stakeholders in smart grid distributed energy generation shows they could all benefit economically from the use of a cloud-based service provided by a telecoms operator.

Telecom Slovenije has also demonstrated an innovative approach to security that provides a confidential and authenticated communication solution within a public network infrastructure, thereby enabling the secure near real time delivery of data on the operational performance of the electricity grid into the utility control centre. Finally, further analysis of the real time data is likely to show the potential for the development of advanced software solutions for anomaly detection, energy demand forecasting and decision support solutions.

"This project should also help Telekom Slovenije to fulfil its ambition of becoming a primary M2M (machine-to-machine communications) research and development partner for European companies involved in energy distribution."

Peter Zidar, Telecom Slovenije, Sunseed project coordinator

1 Guidelines for business models between energy and ICT sectors; Ebadge project (http://www.ebadge-fp7.eu/) Deliverable D4.3.2

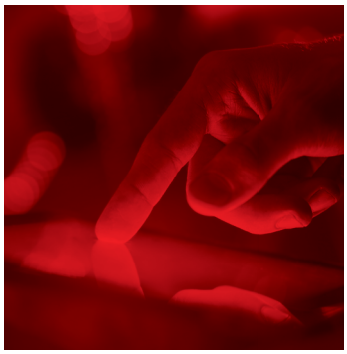
Connected Living

About the Connected Living Programme

The GSMA Connected Living programme is an initiative to help operators add value and accelerate the delivery of new connected devices and services in the M2M market. This is to be achieved by industry collaboration, appropriate regulation, optimising networks as well as developing key enablers to support the growth of M2M in the immediate future and the IoT in the longer term. For more information please visit **www.gsma.com/connectedliving**










Floor 2, The Walbrook Building
25 Walbrook, London EC4N 8AF UK
Tel: +44 (0)207 356 0600

connectedliving@gsma.com
www.gsma.com