



In
partnership
with



Intelligent energy distribution with 5G

Exploring the power
network of the future

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All SOGNO partners shown on the final page

Rethinking the traditional

Traditionally, utility companies built one-way networks, beginning with production in a power plant followed by power distribution directly to homes and businesses.

Today, utility companies produce energy from increasingly varied sources, including renewables such as solar and wind. Renewable energy also comes from private individuals and companies, who feed self-generated power into the network from the edges. Alongside this, new patterns of energy consumption are emerging as the number and type of energy-consuming technologies, such as electric vehicles, increase.

For many years, energy consumption had been dropping due to the move toward energy-saving technologies. Today, the shift in the opposite direction poses utility companies the challenge of keeping networks stable, as they were not designed with these needs in mind. Higher levels of consumption and new patterns of energy flow mean a greater need for visibility and identification of bottlenecks to maximize service performance. Therefore, utility companies must modernize and digitalize in line with the changing market for greater stability and resilience through monitoring and automation.

EU initiative field trials

Leading utility companies — ESB Networks in Ireland and CEZ Group in Romania — are exploring how digitalization can enhance operations and improve services for customers. They were approached to join the EU's Service Oriented Grid for the Network of the Future (SOGNO) initiative, which saw them take part in field trials of new automation services for the distribution grid.

The two companies started with similar aims; they both wanted to minimize customer outages due to storms and other events damaging overhead power lines, which can result in financial penalties for lost customer service minutes.



The SOGNO initiative was launched to explore the power network of the future

To achieve this, they were keen to explore how technology can help find faults more precisely and in near real time, and then reconfigure the network to restore services automatically. They also sought to increase network monitoring and visibility to improve power network stability and resilience through remotely optimized operations.

Finally, ESB Networks and CEZ wanted to explore adding even more renewable energy sources into their power networks. These goals were explored through the SOGNO initiative.

"SOGNO's field trials and experiments sought to demonstrate that power distribution automation services can be virtualized, placed in the cloud and function well with 4G and 5G communications."

Dr Fiona Williams,
Research Director, Ericsson

Establishing collaboration continent-wide

We launched and led the organization of the SOGNO initiative to respond to the needs of power network modernization.

The initiative was established to address the growing need for distribution system operators (DSOs) to have real-time insights into network operation, as well as to remotely optimize their processes for a cost-efficient, seamless and secure power supply for customers. SOGNO is part of the EU's Horizon 2020 research and innovation program.¹

Ericsson led the initiative, and knowing that it would take a lot of experience and specialist knowledge to achieve the goals, we united 13 partners, including industry representatives, academia, and small- and medium-sized enterprises, from more than 7 European countries.

We jointly developed a scalable, cost-efficient automation solution, enabling data-driven monitoring and control of power infrastructure, proven as a turnkey service. The solution harnesses 5G to help virtualize automation services and locate them in the 5G Edge infrastructure. Combined with innovative sensors, data analysis techniques and 5G-based ICT, it provides support to DSOs with real-time control and decision-making in planning.

Five advanced services

SOGNO's approach included developing and implementing five advanced power management services, using deep learning-based AI techniques. Their functionality was then validated by field trials in DSO power networks as well as laboratories at RWTH Aachen University in Germany, led by Professor Antonello Monti, Technical Manager of the SOGNO initiative.

"Future grids will be customer-centric infrastructures: end users, now prosumers, will interact with grid operations. We have defined how the technical interaction should happen and how to ensure this is secure, where the goal is to create a flexible and secure system ready for a carbon-free society."

Prof Antonello Monti,
Technical Manager of the SOGNO initiative, RWTH Aachen University

System awareness services

- State estimation for monitoring the grid in real time
- Power quality evaluation to monitor particular parameters and evaluate the grid's health
- Power control solutions to manage distributed generation for a larger penetration of renewable energy (laboratory-tested for safety reasons)
- Load and generation forecasting to predict power consumption or generation in advance of possible contingencies, as well as timely identification of operating conditions approaching the boundaries

Autonomous self-healing services

- Fault location, isolation and service restoration; an automated solution that manages emergency conditions triggered by a fault, identifies its location, isolates the faulty grid section and restores the power supply in non-faulty segments

Innovative solutions

We provided 5G infrastructure to drive the initiative. 5G enabled low-latency and high-reliability communications for measurement and control devices used in near real-time virtualized applications, which were hosted in the Ericsson 5G Edge solution.

The 5G radio network was optimized for the services, further reducing latency to less than 5ms on average and achieving next-generation communication performance. Our solution supports low-cost sensors and measurement devices to make new services more affordable. The advanced SOGNO services radically reduce the need for measurement devices while creating a highly accurate picture of the state of the power network.



The power network of the future will include even more renewable energy sources

¹ The SOGNO initiative received funding from the EU's Horizon 2020 research and innovation program, under grant agreement No. 774613

Promising field and laboratory trials

SOGNO ran large-scale field trials in live power networks in Ireland and Romania, as well as 5G tests in the Ericsson laboratory.

Investigations in Ireland

ESB Networks had 2 test sites covering over 530km of medium voltage power lines. A crucial motivation was to provide more automation in the power network for homes and businesses.

The trials showed that increasing network monitoring can identify faults faster and crew could be sent to the precise location of downed lines. This is an example of actionable intelligence for operational improvement. The trials only needed a handful of measurement devices to monitor network segments containing hundreds of kilometers of power lines and over 100 nodes.

The field trials proved that efficient state estimation, power quality, and fault location, isolation and service restoration were all possible for ESB Networks.

5G-supported cloud services and self-healing networks could offer ESB Networks the chance to improve services and adapt its network to changing climate conditions and consumer preferences.

“Innovative solutions like SOGNO are needed to give insight into how power networks of the future will perform. Our consumers will require ever more robust and dependable electricity networks to support their electrified lifestyles, as we continue to decarbonize our world.”

Emma Silke, Electrification & Innovation Delivery Manager, ESB Networks

“SOGNO services were added to our already set path towards digitalization and complete the progress we have made so far in collecting data about the grid. The results obtained by implementing SOGNO will contribute to a faster mapping of the location of grid incidents, a restriction of the affected area, optimizing the grid load, avoiding congestion and decreasing losses.”

Doina Vornicu, COO and Member of the Management Board, CEZ Romania

Research in Romania

CEZ Group in Romania undertook the SOGNO trial to identify outages in real time, as well as to improve system restoration, state estimation, load and generation forecasting, and the quality evolution of the KPIs for the distribution service. The trial focused on household and business customers.

CEZ realized the pilot projects for enhancing the observability of its grids through the implementation of next-generation monitoring services in medium and low voltage networks, substations and secondary substations.

Fourteen sets of current and voltage sensors were installed (6 sets in medium voltage networks and 8 sets in low voltage networks), to which 14 Power Measurement Units were attached. The sensors transmit the characteristic electrical measurements of the grid at one-minute intervals. Through the implemented SOGNO services, CEZ obtained the estimated characteristic measurements for the entire adjacent areas. In this way, we can talk about having full control of the network in real time.



An example of some of the technology deployed in ESB Networks' power network in Ireland

Telekom Romania supported the general studies and provided network connectivity for key remote equipment and information, as well as delivering a valuable communications service provider perspective about the importance of data configuration.

Top-level benefits of the SOGNO solution

SOGNO has shown that, with 3GPP technology, utility companies can optimize operations to provide customers with cost-effective, seamless and secure power.

The field trials confirmed that the SOGNO services and devices are able to offer system awareness and self-healing features, improving operational efficiency, reliability and planning of power networks. More efficient renewable energy source integration and faster recovery from system outages were also proven, contributing to greater customer satisfaction.

The results showed that 5G and LTE can provide easy-to-deploy, upgradable, secure and reliable communication solutions and Edge hosting of automation services. The deployment and remote upgrading of these services are simplified as a result.

By moving smartness to the cloud, automation can be virtualized and offered as a turnkey service, with service provider support. This reduces utility capital investment and the need for specialized, in-house ICT competence.

Finally, integrating deep-learning techniques into the SOGNO services enables utility companies to implement a data-driven approach to grid management, while requiring the deployment of only a few new measurement devices in the field.

The benefits of 5G as part of SOGNO

The initiative verified that 5G networks can more than meet the ICT requirements for operating full-scale power network monitoring. Further to this, testing in a live environment provides an opportunity to explore how a 5G network can be configured to meet the real needs of utility companies.

The 5G radio network was tested and optimized to provide low latency, high reliability and a secure connection to run the services. It also offered wide-area communications for network devices and seamless personnel integration with 4G network-based power services where 5G is not yet available.

5G Edge infrastructure capabilities can support local hosting of SOGNO distribution network automation services, increasing power network resilience and minimizing the communications latency, if desired.

For utility companies that have a public 5G network setup, network slicing enables them to directly control the reliability and security parameters of their communications networks.

The operational benefits

LTE and 5G wireless communications enable swift deployment and remote updating of smart grid services, which can be supported by external experts if desired, and avoid vendor lock-in.

The SOGNO platform architecture facilitates flexible software and hardware component integration from multiple vendors, data exchange, parallel operation, seamless integration with utility legacy systems and rapid deployment of new services.

The services support utility companies' internal competence development, enabling a trial-and-error learning approach and tailoring of services to specific requirements, thus decreasing reliance on external vendors.

The initiative also offers the choice between remotely hosted (cloud-based and open) and self-hosted service platforms in the utility ICT infrastructure, providing flexibility to suit each organization's setup.

The financial benefits

The initiative showed that testing and procuring new services using a software-as-a-service approach carries a low investment risk and requires no upfront capital costs.

Finally, automation services reduce penalties for lost minutes of customer service through faster reconnection of customers affected by outages, as well as increased rewards for continuity of power supply.

"SOGNO has proven that 5G can support near real-time power distribution automation services."

Dr Fiona Williams,
Research Director, Ericsson

ESB Networks

ESB Networks DAC is the licensed Distribution Operator in the Republic of Ireland. The Irish Distribution Electricity System includes all distribution stations, overhead electricity wires, poles and underground cables that are used to bring power to Ireland's 2.3 million domestic, commercial and industrial customers. ESB Networks has a key role in leading the transition to a secure and affordable low-carbon future for Ireland, using clean electricity to drive carbon out of heat and transport, and the economy. It is actively improving network reliability through its Smart Network and increasing renewable portfolio.

CEZ

CEZ Group has been present in the Romanian market since 2005 and provides electricity in seven counties: Argeş, Dolj, Gorj, Mehedinţi, Olt, Vâlcea and Teleorman (via the Group's energy distribution company). CEZ Group's business in Romania is represented by nine companies, including a portfolio of energy and natural gas supply, energy distribution and energy production from renewable sources. In Romania, CEZ also owns Europe's largest onshore wind farm, as well as a hydropower system.

The SOGNO team

Industry partners

- Ericsson GmbH, Germany (Project Coordinator)
- Altea BV, The Netherlands
- CEZ Romania SA, Romania
- Ericsson Eesti AS, Estonia
- Elektrilevi OÜ, Estonia
- ESB Networks, Ireland
- Telekom Romania Mobile Communications SA, Romania

Small- and medium-sized enterprises

- B.A.U.M. Consult GmbH, Germany
- Centrul Roman al Energiei, Romania
- Gridhound UG, Germany
- The National Microelectronics Applications Centre Ltd., Ireland

Academia

- RWTH Aachen University, Germany (Technical Coordinator)
- University of Bologna, Italy
- Waterford Institute of Technology, Ireland

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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