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Semantic web promises a smarter electricity grid

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(PhysOrg.com) -- Dispersed wind farms and solar panels on people's homes are posing new challenges for managing power grids that were designed when all electricity was generated in centralised plants. A new semantic web technology promises a solution.

Managing increasingly dispersed energy resources - from far-flung wind farms on remote mountaintops to racks of solar panels on suburban homes - is crucial if the electricity they produce is to be used as efficiently as possible.

Today, wind farms, solar and other renewable resources generate around 7 percent of the European Union's electricity, a figure that is set to rise to 20 percent by 2020. But unlike conventional fossil-fuel burning or nuclear power plants, few of these dispersed energy generators feed information into grid management systems.

So grid operators can't be sure what generators are connected, whether they are in operation and, if so, how much power they are producing. This could become a bigger problem, once these power sources start to account for a larger portion of Europe's energy supply.

"Grid management systems were designed around a large number of clients and a few suppliers, but now there are increasing numbers of suppliers. This requires a new level of communication and management system," explains Bernhard Schowe-von der Brelie, a researcher at the FGH research institute in Mannheim, Germany.

Schowe-von der Brelie led a team of researchers who have made considerable progress towards developing a solution, not only for managing distributed resources in an electricity grid, but also for communicating with autonomous systems, devices and sensors across any network.

Self-describing network

Working in the EU-funded S-TEN project, the team developed a generic framework for novel ICT architectures and applied semantic web technologies to make networks 'self-describing' so that each component - be it a volt meter on a wind turbine or a thermometer on a weather station - autonomously publishes information about what it is, where it is, and what it does.

Because semantic data can be understood by machines as well as humans, the approach should lead to more efficient automated grid management and better decision-support for human operators. Smart power grids, efficiently supplying a town or city from locally generated electricity and then feeding it into a wider supply network, could therefore be more easily and cost-effectively set up.

"Instead of storing information in a centralised database, the S-TEN approach is for each node, each sensor or device connected to the network, to have its own intelligence," Schowe-von der Brelie says.

"The network, which can be accessed through a web interface, shows its current status - i.e. which objects are part of it and what they are currently doing. As well as providing monitoring and control of the network, this architecture can enable preventive maintenance strategies," he notes.

The semantic web interface is built around the OWL (Ontology Web

Language) W3C standard, which allows applications to interpret the meaning of information.

World first OWL-STEP converter

In addition, the team developed the world's first converter between OWL and STEP (STandard for the Exchange of Product data), a common format for expressing the design and functional aspects of a device.

"Our work on standards is a fundamental part of the project, and will help ensure a future for the technology in different fields," the project coordinator says.

Managing distributed energy resources - the focus of two of four demonstrator applications developed by the project - is just one potential use for the technology, Schowe-von der Brelie notes.

Industrial equipment, embedded with sensors and chips storing and exchanging data, could alert technicians when they are due for maintenance checks or when a part needs to be replaced, thereby ensuring that factory downtime is kept to a minimum and safety risks are greatly reduced.

As highlighted in one of the S-TEN demonstrators, the machine itself could even provide the technician with updated maintenance guidelines extracted from information stored on the network.

Another demonstrator showed how the networked sensors and devices could be used to improve building standards - another essential means of improving energy use. By monitoring the power and heat consumption of homes, factories and offices, and correlating that data with information from nearby weather stations it would be possible to gain a clear understanding of the energy efficiency of different buildings.

It is likely that at least some of the project demonstrators will lead to commercial applications over the coming years, Schowe-von der Brelie says. Meanwhile, several of the project partners are looking to further their research through a new initiative under the European Commission's recent call for novel ICT solutions for smart electricity distribution networks.

S-TEN project: www.s-ten.eu/

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