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Smart gateway

A constant eye on energy

By Jan Schulze, SYS TEC electronic GmbH

Back when electricity still came “out of the plug socket”, energy management was limited to manually switching devices on and off, and occasionally answering the door to the meter reader. Now, however, energy use is scrupulously monitored and meticulously controlled. Energy management is also playing an ever more important role away from centralised power grids.

Increased networking opens up wide-ranging opportunities for managing and controlling electrical energy. The Internet of Things (IoT) with its distributed, interconnected sensors makes it possible to precisely and continuously record the energy drawn by any given item. Handling this flood of data in a meaningful way requires tools like our smart gateway CTR-700 from the sysWORXX line.

While it is based on traditional industrial controllers, the CTR-700 is designed for use in the IoT. The device is ideal for energy management thanks to its wide variety of digital and analogue interfaces, which facilitate between 80 and 90% of connections to other devices. The CTR-700 supports fieldbuses such as CAN and CANopen, as well as Modbus and other interfaces. The smart gateway is just as flexible on the software side too. C/C++, C#.Net, Node-RED, Java and Python are among the programming languages that can be used to access and customise the stacks provided by the manufacturer for homegrown applications.

To enable wireless connectivity (e.g. via LTE), the CTR-700 can be fitted with a wireless modem from a range of manufacturers. The CTR-700 stands out from the competition due to its combination of a freely programmable edge controller and IoT gateway, as well as the possibility for internal data pre-processing. This means the collected data can be pre-analysed, weighted and processed while still in the device.

Germany's Fraunhofer Institute for Integrated Circuits (IIS) in Nuremberg has chosen the CTR-700 as a solution for its applications, and so has Israeli firm Bacsoft from Kiryat Gat. Both are using the smart gateway as the basis for their energy management applications.



Fig. 1 – Combined controller and gateway: sysWORXX CTR-700

Energy management from the cloud

Bacsoft developed its IoT platform for industrial applications and larger companies. The aim: energy management and optimisation. To that end, Bacsoft embraces the transmission of data to the cloud where it is analysed and processed. The solution is used worldwide – in water management and agriculture, for example, but also in building energy management and the industrial sector. In future, the Bacsoft IoT platform will run on the sysWORXX CTR-700 and use the device's pre-processed data, which will be transferred to the Bacsoft cloud for final analysis and management reporting. Sales Director Guy Gavish explains: “We only transmit deltas – the differences between the identified consumption values. As a result, we can guarantee highly efficient data transmission. We also get rid of ‘data noise’ – i.e. data that is not necessary for our purpose – and only pass along the datasets that are actually needed at the time.”

Bacsoft is implementing a proprietary software controller in the CTR-700.

This monitors current measurements and sends a notification to the cloud in the event of a deviation that exceeds 10% of the average value (for example). A warning is then sent from the cloud to connected smartphones or the operator's control room, depending on the configuration. Cloud access also allows those responsible to monitor their energy systems in real time.

Aside from the technical features of the CTR-700, Bacsoft was particularly impressed by the fact that we do not prioritise our own software solution for energy management and the IoT.

“They give us the freedom to implement our solutions on their devices. This lets us provide what we consider to be the perfect combination of software and hardware,” explains Guy Gavish.



Fig. 2 – IoT platform for energy management and optimisation

Local energy management

Electrical engineer Peter Heusinger describes the relationship between his research institute and the Saxony-based SME in similar terms. “We generate real added value through our partnership.” Peter Heusinger works in development in the “Networked Systems and Applications” department at Fraunhofer IIS and is involved with the “OGEMA” system, which will run on the sysWORXX controller in future. OGEMA – the Open Gateway for Energy Management – is an energy management system that was designed for local use even without cloud connectivity.

Potential uses for OGEMA are varied and include industrial applications as well as energy control in smart homes.

With OGEMA, Heusinger and his colleagues want to address a challenge that is not only ubiquitous in smart homes: the multiplicity of interfaces and protocols. “This evolved over time, and there is still a lot of diversity,” explains the engineer. He adds that combining the many different interfaces in a single platform was not a trivial matter: “If you want to link these systems in some way so that you can do something useful with the energy, then you need to work with all these interfaces.”

The result is a platform with an app-based approach. It appears that the goal is to provide a platform complete with a future app store for developers who devise particularly sophisticated algorithms for energy management.

An app for everything

Apps can be installed in OGEMA just like we are used to with smartphones. Each app has its own specific area of coverage: individual devices, perhaps, or control tasks. So one app deals with readings from inverters – how much energy is my solar system producing at this moment? Another retrieves the current weather report and the forecast for the next few days from the Internet and feeds the data to the next app, which uses the weather data to make energy management adjustments for the immediate future. Further apps take care of querying user settings, communicating with an electric car if there is one, or carrying out actions in the smart home.

But OGEMA is not another feature-oriented platform. In fact, says Peter Heusinger, the focus was more on IT security: “We thought about security right away as part of the architecture. By taking ‘Security by Design’ as our catchword, we hope to minimise external threats.” This is necessary because countless security incidents in the last few years have shown just how much potential for damage and “mischief” there is in the IoT. Alongside other steps to protect OGEMA, the Fraunhofer developers commissioned external penetration tests.



Fig. 3 – App-based energy management platform for local non-cloud use

Standard data model for efficient management

The platform works with an integrated persistent database. This is intended to ensure that the system is immediately ready for use with no loss of data even after a power cut. Incoming (sensor) data such as temperature, energy production or battery charge status is imported through interfaces. This is stored in OGEMA using standardised data types. The aim here is to allow apps to work with the data directly without the need to convert it first. Data models with a focus on energy management, such as for combined heat and power units or inverters, are included. The data models can also be expanded to show custom datasets from individual manufacturers' technical devices alongside the more usual data.

Fraunhofer IIS offers a basic OGEMA system for open-source integration. The system is licensed under GPLv3. This allows developers to use the system free of charge provided that they place their apps and adaptations under the same licence. Alternatively, OGEMA can be commercially licensed from Fraunhofer with advanced features for proprietary non-open-source adaptations. Fraunhofer itself cannot sell OGEMA as a ready-made overall system. That's why, Heusinger points out, the sysWORXX CTR-700 is so significant since it provides a basis on which to build good hardware and software prototypes: "With its wealth of interfaces and non-reliance on a specific programming language, the smart gateway is absolutely fantastic."

Very remote

Aside from industrial cloud-based uses and local energy management in smart homes or industry, another application of the CTR-700 is managing off-grid technical installations. This means equipment such as mobile phone masts which are set up far away from the electricity network.

“Field systems” of this kind are supplied with energy from renewable sources such as solar or wind power, or from fuel cells or conventional generators with a combustion motor. Systems that use renewable energy often have energy storage devices as well, to bridge any periods of low wind or sun. These batteries, like combustion motors, are subject to wear. The vital data of such remote energy sites must therefore be constantly monitored. This task is performed by sensors connected to the CTR-700. Data is transmitted pre-processed as the CTR-700 collects and processes the data. Only when threshold or expected values are found to be outside a defined range is relevant data sent to the operator.

There are two advantages to this. Firstly, it reduces transfer volumes, and secondly, it clears up the master display. However, operators can still access the system remotely at any time and retrieve the raw data.

For systems powered by fuel cells or diesel generators, it is important for fuel consumption and tank levels to be monitored. The CTR-700 sends the operating centre this data on fill levels and consumption during runtime. The operating centre can then use the data as part of supply chain management to coordinate tanker routes and ensure system availability at all times.

Simple management

Whether it's in a smart home, remotely monitored in an industrial application, or far away from a centralised power grid – our sysWORXX CTR-700 enables our partners to make energy management as easy as it was back when electricity just came out of a plug socket.