MegaChips

SWITZERLAND DEPLOYS ADVANCED SMART METER NETWORK WITH HD-PLC BROADBAND POWERLINE (BPL)

To meet the demands of Switzerland's Energy Strategy 2050, EVUlution AG empowered its smart meter network with fast, robust, secure broadband powerline (BPL) technology from MegaChips.

Building a smart meter network for the future

EVUlution AG offers utility companies a wide range of new digital and future-oriented solutions. With their market expertise and technology know-how, EVUlution developed the advanced smart grid solutions SMARTPOWER to support Switzerland's ambitious Energy Strategy 2050. The SMARTPOWER System is a comprehensive solution for smart metering and future-oriented energy management.

In the wake of the Fukushima disaster in 2011, Switzerland made the commitment to permanently transition from the use of nuclear energy. To do this, Switzerland is building faster, more capable smart meter networks to support the ongoing decentralization of power generation, flatten demand peaks, and increase total energy efficiency. Switzerland's Energy Strategy 2050 provides a roadmap for restructuring the nation's energy policy to achieve these goals and enable a nuclear-free energy sector.

As a first step towards meeting these challenges, EVUlution is working to install new smart meters across Switzerland and Liechtenstein before 2027. This new smart meter network will go far beyond advanced meter reading (AMR), bringing new capabilities to electric utilities and consumers alike.

Addressing the challenge of smart meter communications

Historically, one of the biggest challenges facing smart grid architects is selecting the right communications technology. While there is no shortage of available technologies for wired (Meters and More, G3-PLC, PRIME, etc.) and wireless communications (Wi-SUN, LTE, GSM/GPRS, etc.), system architects still struggle to meet speed, distance and reliability requirements while managing installation, operation, and maintenance costs. Typically, these costs far exceed the costs of the smart meter devices themselves. So, selecting the right communications technology is key to making the most of smart grid infrastructure investments.

With its goal of bringing smart meters to every household EVUlution understood the importance of choosing the right communications technology. The company partnered with CORESIGHT AG, an innovative engineering services provider headquartered in Liechtenstein, to build the new smart meter device (aka, Smart Manager) and evaluate communication technologies.

EVUlution had high expectations for the new Smart Manager. "EVUlution wanted to go beyond automatic meter reading (AMR)," explained Roger Caviezel, Head of SMARTPOWER. "The Smart Manager needed to be able to
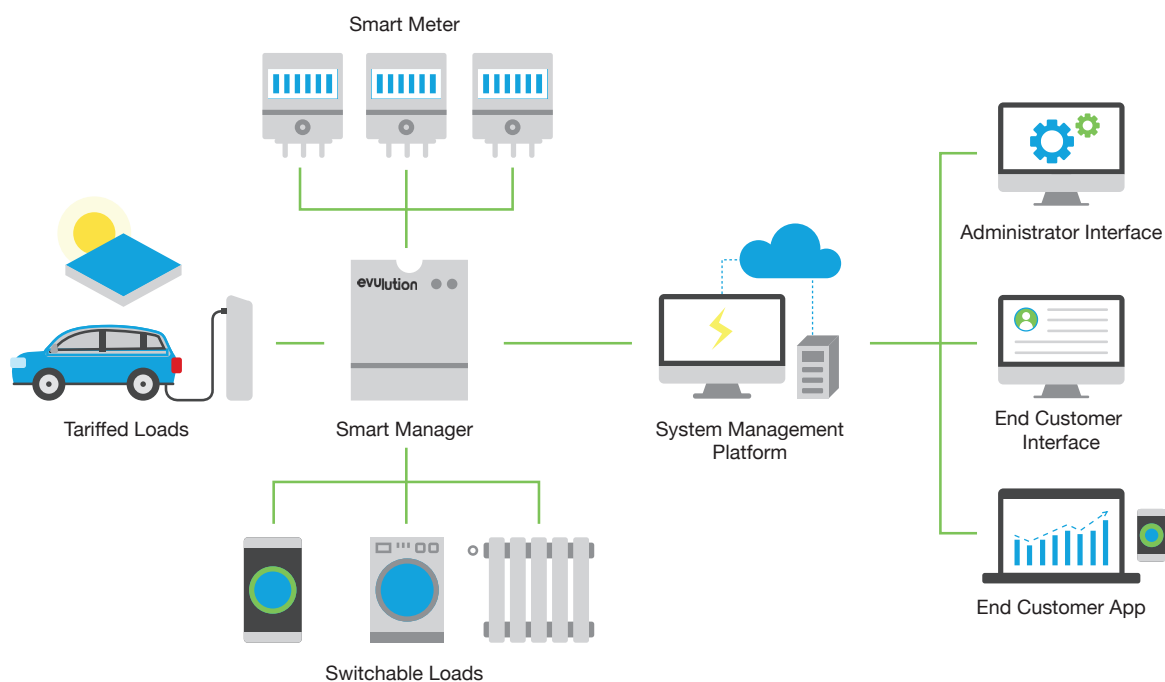
EVUlution's SMARTPOWER Architecture: Smart Managers provide a universal gateway that connects a mix of metering devices to the cloud, giving consumer real-time visibility into their power consumption, while also giving utilities the ability to manage switchable loads during peak usage.

send real-time, live values to the cloud, where customers can view their power consumption via a web interface. The goal is to promote energy efficiency, avoid peaks, and enable utility companies to get the most out of their energy infrastructure."

The Smart Manager is a universal gateway that provides an all-in-one metering solution for electricity, heat, water, and gas meters. The Smart Manager needed to include multiple interfaces for these meters, along with the ability to provide remote firmware updates. Additionally, it needed the ability to turn off switchable loads like boilers, electric heating and electric vehicle charging stations to better manage peak loads.

Given the popularity of narrowband powerline solutions in Europe, EVUlution and CORESIGHT initially conducted tests with G3-PLC/PRIME and others. As a powerline technology, narrowband PLC offers the promise of reducing installation costs by transmitting data on the same lines used to deliver power. However, its limited throughput (<32kbps, max) fell far short of the application requirements, causing issues with device accessibility and firmware updates.

"It was clear that narrowband PLC was not going to work for real-time demand," Rupp explained. "That's why we decided to evaluate broadband powerline."

Rising above communication challenges with broadband powerline

CORESIGHT began by evaluating broadband powerline technologies in a test installation under real-world conditions in the field.

The development team immediately discovered the advantages of HD-PLC broadband powerline technology. For starters, HD-PLC required much lower power consumption than other technologies under evaluation. Furthermore the architecture is less complex and requires less memory to run. More memory means more cost, and more power consumption – missing EVUlution's most important requirements.

In contrast, the HD-PLC solution from MegaChips was highly integrated, considerably lower in power consumption, and designed for Industrial applications. Most importantly, the support provided by MegaChips and its network of partners ensured a successful design and evaluation process.

HD-PLC: Setting a new standard for powerline performance

Originally developed for high-speed multimedia applications, HD-PLC has since been enhanced with multiple robustness mechanisms to meet the needs of industrial applications. Today, HD-PLC is an international standard—based on IEEE 1901-2010 and ITU-T G.9905—for high-speed, long-range, IP-based communications. Supported by the HD-PLC Alliance and its members, HD-PLC continues to advance. The new IEEE1901-2020 was ratified in late 2019 adding a flexible-channel Wavelet-OFDM architecture to the PHY/MAC for the diverse needs of IoT applications.

IEEE1901-2010 operates over a high frequency range (2MHz to 28MHz), while IEEE1901-2020 operates between the accepted 2MHz to 100MHz frequency band. HD-PLC leverages the Centralized Metric based Source Routing (CMSR) scheme defined in ITU G.9905 to implement an innovative multi-hop functionality that dramatically increases network range, robustness, and speed.
Multi-hop technology takes the guesswork out of network planning and design by enabling any node to act as a repeater. With this technology, the nodes in the network dynamically calculate route cost and select the best route based on link quality. This eliminates bottlenecks and improves robustness, since the network will automatically reroute traffic if any given node fails.

Offering PHY speeds up to 1Gbps, IEEE1901-2020 enables transmission ranges up to several kilometers. HD-PLC is perfectly suited for modern smart meter networks and other high-speed industrial-IOT applications.

Megachips' solution offers a set of predefined channels of operation optimized for various wired communication applications, topologies, and noise environments. It provides on-chip programmability to select the best frequency bands with predefined carrier spacing to build the most robust industrial networks.

Putting HD-PLC to a real-world test drive

Every smart meter deployment has unique constraints that are difficult to anticipate. Old fuses and overvoltage protectors, different types of rails, unusual network topologies— real-world environments pose all kinds of challenges.

So, after CORESIGHT successfully evaluated HD-PLC in EVUlution's controlled environment, it was time to put it to the test in a larger pilot project. The team deployed Smart Manager in Landquart, Switzerland. This case study presents the results for just one installation comprising one transformer station, seven distribution cabinets, and around 100 terminals.

The key to any successful deployment is good network design. Real-world installations commonly pose challenges for PLC technology. PLC must be seen as a widely distributed communication bus with hundreds of branches, each of which may cause signal attenuation range and throughput.

This is where the HD-PLC's multi-hop capability shines. The development team learned that the repeating devices must be placed at specific locations within the power distribution network to achieve optimum range and throughput. "As each Smart Manager device estimates the channel to its communication partner, it is crucial to consider the location of the repeaters at the planning phase of the system rollout," explained Rupp. As the number of branches of each power distribution increases, the greater the signal attenuation caused by the branches of each power string. Placing additional PLC repeaters increased the number of hops and ensured that the connection remained stable and reliable.

Each PLC repeater had to withstand temperature and environmental conditions, so CORESIGHT developed a HD-PLC repeating device that is waterproof, temperature resistant and, of course, provides exceptional connection capabilities. "We learned that the key for maximum HD-PLC performance is to reduce conducted emissions by the device's power supply as much as possible," stated Rupp.

The EVUlution PLC repeater's unbeatable performance, fast deployment and robust design were clearly established. "The EVUlution PLC repeater is without a doubt reliable, safe and satisfies the need for our customer,' stated Roger Caviezel.

Because HD-PLC technology provides a transparent Ethernet bridge, special care must be taken when it comes to the planning of the network topology. Each utility company has strategies for servicing their transformer stations, in which case energy can be rerouted from other transformers to supply the grid.

As each HD-PLC network demands a Master device to keep track of each connected Terminal, a mechanism had to be established to perform switching of the Master device in case of power re-routing.

PLC repeater

HD-PLC thrives in real-world environments
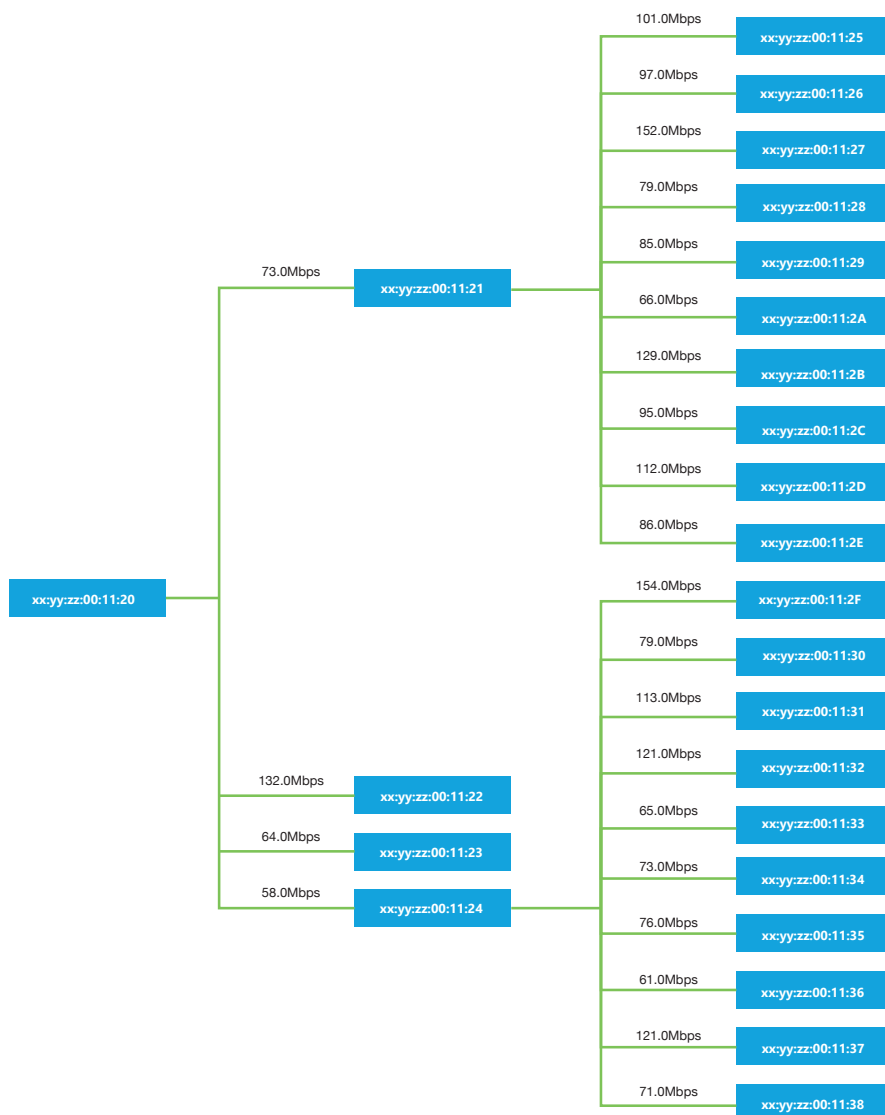
This picture shows the HD-PLC throughput measurements on a pilot customer site. This site contains one transformer station and two distribution cabinets with several houses connected.

This picture shows the HD-PLC throughput measurements on another pilot customer site. This site contains one transformer and several distribution cabinets with several houses connected.

Smart manager metering device

Ready for a smarter energy future

As utilities around the world prepare to meet the energy challenges of tomorrow, broadband powerline (BPL) solutions like HD-PLC with Multi-hop promise to provide the bandwidth, range, and security needed to go beyond simple AMR.

By making the transition from kilobit to megabit data rates, companies like EVUlution have the power to enable real-time visibility into energy consumption and future-proof smart meter networks through remote firmware updates. HD-PLC provides a smarter communications solution, for a world that constantly demands new levels of intelligence and innovation.

The team has been impressed with the results. "I was pretty amazed at what it could do in terms of range and throughput considering all the nodes and branches that the signal is being laid on," stated Rupp. "HD-PLC is much more robust than anything I've ever seen."

This PLC installation covered 342m from transformer station to distribution cabinet. Throughput over this connection is about 20Mbps.

MegaChips

Enabling everyday life through innovation, MegaChips is a semiconductor leader whose technology transforms the world we live in by helping each one of us achieve healthier, safer and more fulfilling lives. Leveraging decades of technology excellence, partnerships and acquisitions, we are shaping the next wave of the digital revolution, adding significant value for businesses and consumers in the areas of Internet of Things, displays, enterprise, and mobile computing all around the world.

www.megachips.com

CORESIGHT

CORESIGHT specializes in the development of industrial electronics, firmware, software and programmable logic for demanding industrial products. Besides the development of the smart metering device itself, CORESIGHT supports EVUlution with its broadband powerline measurement skills.

www.coresight.li

evulution

In 2020, seven energy supply companies from Switzerland and Liechtenstein entered into a cooperation under the name EVUlution. Together, they provide future-oriented solutions with innovative products and services that are driving the energy transition and preparing for the complex requirements of future energy supply.

www.evulution.com