TOWARDS A TRULY SMART GRID —

THE CASE FOR BROADBAND OVER POWER LINE —

SUMMARY

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The Case for Broadband over Power Line

Summary

Power grids around the world are undergoing a process of profound change, driven by some of the most fundamental forces that are changing society as a whole:

- **Electrification**: Higher proportions of final energy use will take the form of electric power (e.g., due to the move to electric vehicles).
- **Decarbonization**: The addition of renewable power sources and battery storage to the power grid drastically reduces the carbon intensity of power generation.
- **Decentralization**: The proliferation of decentralized energy sources and the emergence of prosumers represent a true change of paradigm with serious consequences for the grid's stability.
- **Security**: As the complexity of grids grows, both the information required to manage the grid and the physical infrastructure must remain secure.

Broadband over Power Line (BPL) could economically contribute to handling the vast amounts of information required to manage the smart grid. The need to monitor and control an ever-increasing number of devices implies a need to transmit and manage massive pools of data. To handle the data and manage their networks, utilities have choices including both wired and wireless communication. BPL, a form of power line communications (PLC), provides utilities with a good balance of technical capabilities (e.g., low latency, high availability, high bandwidth), coverage, security, and cost, as this technology uses existing power line wiring to transmit data signals.

The PRIME (PoweRline Intelligent Metering Evolution) Alliance commissioned IDC to conduct a study on broadband over power line and its use in smart grid applications. IDC surveyed 17 utilities and 14 vendors in the study. This work is being done within the strategic framework of the PRIME Alliance, whose aim is to propose and provide real interoperable solutions for telecommunications in smart grids. Corinex, member of the PRIME Alliance and leader of the BPL Task Force, established to develop an interoperable specification, provided its proven expertise in the deployment of this technology, in support of this study. Its solution is the only one used in all analyzed industry use cases; however, the new solution and vendors bringing it to the market are also covered in the study.

Key findings of the study include:

1. Smart grid communication is in transition from narrow to broadband and the industry is at an inflection point in the adoption of BPL technology. Four utilities are using BPL today, and a majority are testing or planning to deploy BPL soon.
2. Key use cases have been tested in the field by utilities (discussed below).
3. The performance of various BPL technologies varies significantly. The three utilities that have used BPL in mass rollout have used the UPA Standard, and in each case the

same product and semiconductor vendors were used. A multivendor ecosystem based on a common standard would speed up a comprehensive rollout of BPL in the markets.

4. The PRIME Alliance recently designated the G.hn technology developed by the ITU as the standard for BPL applications. G.hn is the natural successor to the UPA technology employed in recent rollouts of BPL by European utilities.
5. The business case for BPL is improving significantly as both lower costs and higher data throughput reduce the cost per transaction.
6. Large utilities are already working with vendors to develop complex solutions with software platforms and mature technology that they can efficiently deploy themselves.

Benefits of BPL

BPL technology enables utilities to collect data on voltage levels, phase angles, harmonics, and temperature while providing connectivity for other applications. In addition, by using existing infrastructure and enabling end-to-end control of grid communications, **BPL helps DSOs operate independently of third-party communication service providers**.

BPL can be deployed in parts of the network and interoperate with existing narrowband technologies that use IP protocols consistent with the UPA or G.hn standards endorsed by the PRIME Alliance. **In this way, utilities can benefit from the power of BPL on an incremental installation basis.**

Proven Use Cases

In December 2018, the PRIME Alliance standardized four use cases and set performance requirements for each of them. Several European utilities have implemented field trials of these use cases.

Use Case #1: BPL Smart Meters with BPL Concentrator, enabling a full BPL metering chain, including a BPL smart meter as end point and a data concentrator as controller. The meter can be used for edge computing applications. **ČEZ Distribuce, a major European DSO**, combined BPL with machine learning algorithms to predict residential loads and production of solar power. As a result, peak energy outputs and inputs were reduced.

Use Case #2: The coexistence of BPL and NB-PLC, a use case similar to number 1, enabling grid operators to use broader-band LV BPL concentrators and gateways with their installed base of NB-PLC smart meters. **A major Spanish utility is testing BPL** on the LV part of the network and moving narrowband concentrators into the buildings.

Use Case #3: BPL smart meter gateway, including voltage sensing. Voltage sensing can detect problems in the grid, reduce investments in equipment, enable better quality of service, and reduce the system's overall CO_2 footprint. **For the field trial, E.ON** considered several communication options, piloted several BPL vendors, and **chose Corinex** for the first rollout wave, which started in late 2019. **This is the industry's first full implementation of a BPL**

network of over 100,000 network elements with high-availability element management software. **E.ON plans to expand its BPL infrastructure in the near future based on ITU-T G.hn** and considers BPL technology as an important key communication technology for its future smart grid and smart metering rollout, establishing interoperability among different vendor products as a basic requirement.

Use Case #4: BPL on medium voltage lines, enabling grid operators to backhaul traffic using MV lines as an alternative to optic fiber or wireless networks. The feasibility of demand response and vehicle-to-grid applications greatly depends on the MV grid's capacity to ensure reliable connectivity for millions of IoT devices in real time. **Iberdrola** deployed over 25,000 BPL MV devices.

Implementing BPL in the Low-Voltage Grid: An Inflection Point for the Industry

Mass rollouts of BPL started at the MV level, where there was a need for more bandwidth. This need is now extending to the LV level of the grid with significant demand for a full BPL smart metering (and more general smart grid) chain. **Most utilities participating in the study expect to deploy BPL in LV projects. This represents the inflection point for the BPL industry**, as metering infrastructure is the number one volume driver for technology providers.

Conclusion: What Comes Next for Smart Grids?

The pace of change has accelerated significantly, and grids using narrowband technology might not be capable of facing the challenges that lie ahead.

BPL offers a good tradeoff between latency, throughput, and quality of service for many DSOs looking to make a critical step towards a smarter grid. **Products based on the ITU-T G.hn standard are being tested in the field** by utilities and in laboratories. Field results obtained so far demonstrate that these products can reach **physical data rates in the range of 150 to 250 Mbps**, depending on the channel characteristics. **It is evident that network speed will be critical for utilities to provide flexibility and microgrid services in the future.**

Recommendations for Utilities

Think ahead of your future needs: Large-scale infrastructure deployments require careful planning. Benefits often come from scale. Based on current trends, **the cost per transaction using BPL communication will be significantly lower than that of many competing technologies**.

Make use case-driven connectivity choices: Pilot studies have validated that the most compelling use of BPL technology is in smart metering and AMI applications, enabling utilities to provide new services.

Select partners, not simply technology vendors: Vendors must have strong R&D capabilities and a proven track record of long-term collaboration with utilities to adapt solutions to their specific needs.

Talk to your peers, but keep in mind you are unique: Unbundled grid operators own and operate natural monopolies that do not compete directly with each other. Therefore, learning from those that have taken decisive steps forward should be uncomplicated. Still, no two grids are the same and the same is true for their operators.

About the Analyst

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Jean-François Segalotto is the Associate Research Director for IDC Energy Insights in Europe. He is responsible for conducting region-focused research providing full coverage of the utilities industry value chain. Segalotto leads the European Utility IT and Operational Technologies Strategies advisory service, which provides full coverage of the utility industry value chain. In his role, Segalotto covers a wide range of industry-specific themes, including smart grids, mobility, Internet of Things, connectivity and networks, and business systems supporting smart customer operations and digital transformation.

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