



Research Report

EXECUTIVE SUMMARY:

Smart Grid Networking and Communications

WAN, NAN, and HAN Communications for
Substation Automation, Distribution Automation,
Smart Meters, and the Smart Energy Home

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Section 1

EXECUTIVE SUMMARY

The smart grid can be described as the merging of two networks:

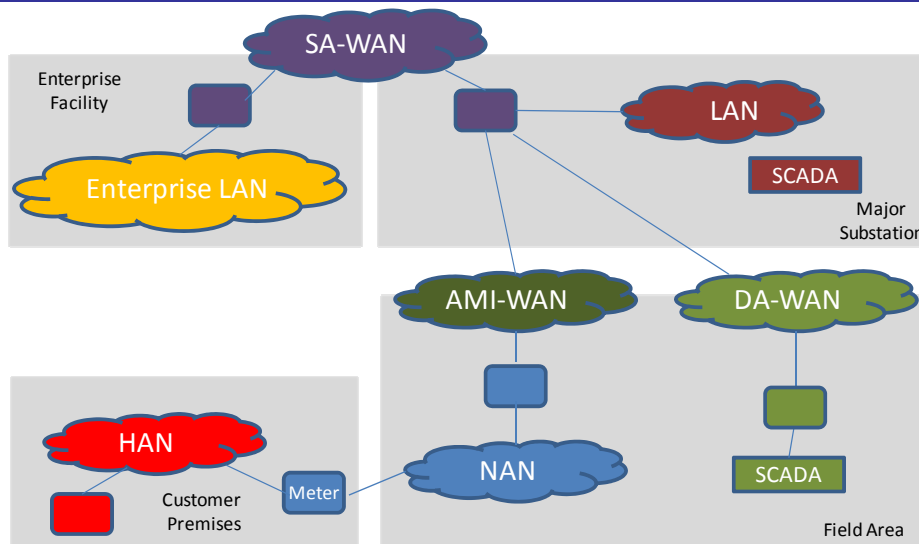
- The “power network,” which consists of the generation, transmission, and distribution grid that is considered the engineering wonder of the 20th century
- The modern “communications network,” which is considered the Internet marvel of the 21st century

Although this may represent an overly simplistic and romantic view, it does capture the importance of the communications and networking technologies within the smart grid, which is the presumed solution to many pressing world problems.

The convergence of several imperative and large-scale issues has injected a dramatic sense of urgency into a relatively sleepy industry. An insatiable demand for energy by the developed and developing world, growing economic and personal dependence on electricity, a carbon-intensive energy supply chain threatening the world’s climate, and economically and politically unstable energy sources are just four of the issues driving a fundamental transformation of the world’s electrical infrastructure. This change involves both sides of the electricity equation: “smarter” demand that is responsive to supply elasticity, and generation that includes renewable, distributed, and less deterministic generation sources. Ultimately, such a transformation requires the creation of an automated, distributed, and secure control system of an unforeseen scale that is enabled by reliable, flexible, and cost-effective communications.

The first step is to understand the smart grid communications network as a true integrated network rather than as parts of separate, vertically integrated application silos. This parallels the evolution of enterprise and telecommunications networks over the last 20 or 30 years into a single, integrated voice/video/data network. Figure 1.1 illustrates a simple reference model for articulating the requirements for different grid communications applications, technologies, and devices.

Figure 1.1 Simplified Smart Grid Communications Architecture



(Source: Pike Research)

The smart grid communications architecture covers a broad waterfront of applications, ranging from large utility data centers and high-speed and geographically diverse substation backbones to the connection of small microcontroller-based home appliances. These can be categorized into five fundamental application groups:

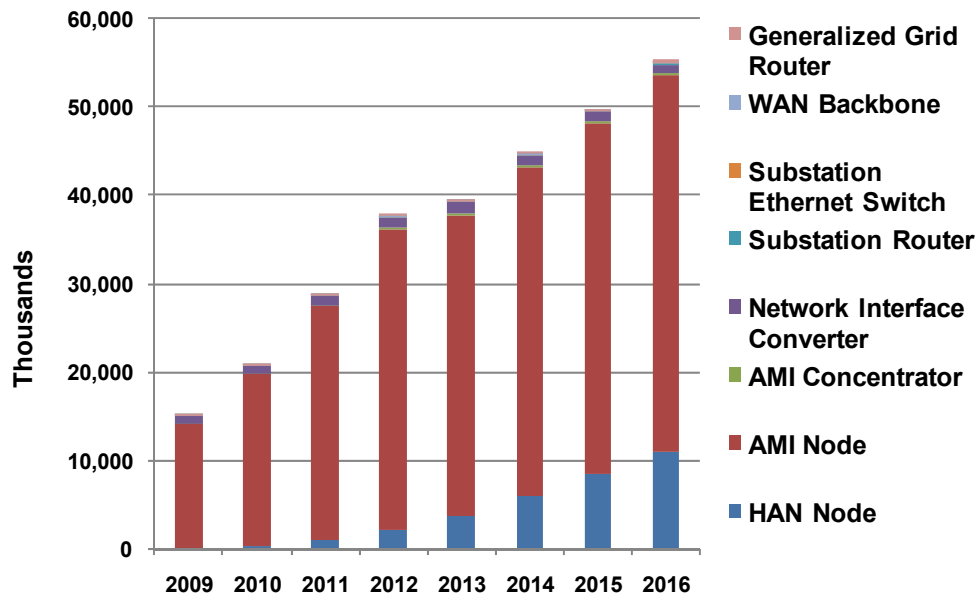
- Enterprise network
- Substation automation (SA)
- Distribution automation (DA)
- Advanced Metering Infrastructure (AMI)
- Home Area Network (HAN)

This report examines the requirements, technologies, and devices associated with the last four of these five groups (the enterprise network resembles that of any corporate enterprise and hence is not specific to the “smart grid”).

Most grid communications today are part of specialized – and often proprietary – systems. The need for standardization has been long understood. Recently, however, government initiatives (and funding) around the world have energized standards efforts, resulting in unprecedented activity and cooperation among many stakeholders. In the United States, the National Institute of Standards and Technology (NIST) has created a framework for evaluating and effectively blessing specific standards for use in the smart grid. It has also identified gaps where appropriate standards do not yet exist and has effectively marshaled the industry to address these gaps in a timely manner. Similar initiatives are occurring within the EU and Asia, including China, Korea, and Japan.

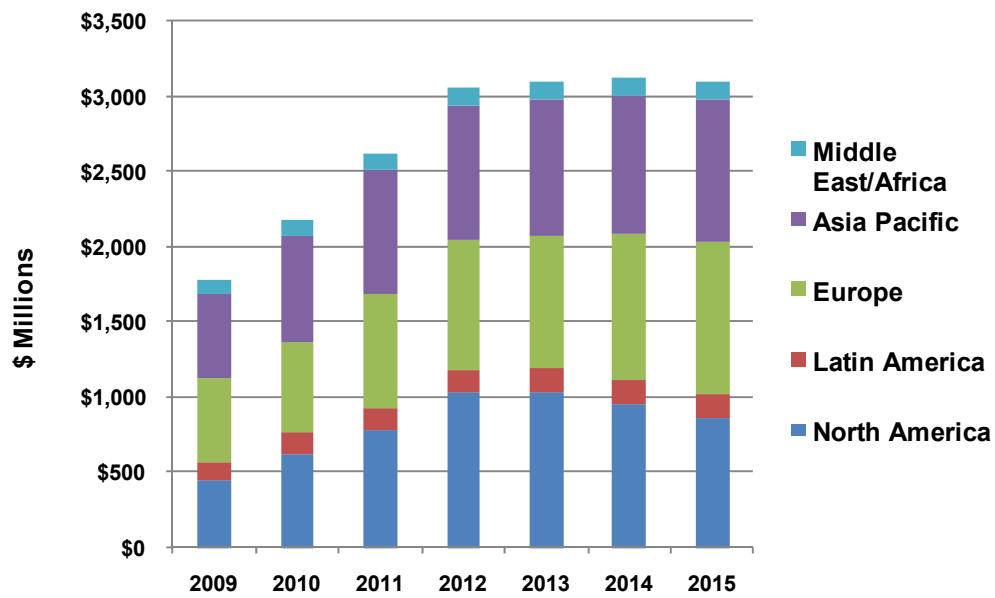
The scope of smart grid communications efforts has created some “gold rush” characteristics in the market, as traditional communications and IT companies now see the electric utility industry as a potentially high-growth adjacent market. Indeed, the opportunity is real. Pike Research forecasts that the number of communications node shipments associated with the smart grid will grow from 15 million in 2009 to over 55 million in 2016 (Chart 1.1) at a compound annual growth rate (CAGR) of over 20%. Associated revenue will grow from \$1.7 billion in 2009 to \$3 billion in 2012. It will stay at this level for the remainder of the forecast period (Chart 1.2) for a CAGR of just over 8% (2009-2016).

Chart 1.1 Communications Device Forecast, Units, World Markets: 2009-2016



(Source: Pike Research)

Chart 1.2 Communications Device Revenue Forecast by Region, World Markets: 2009-2016



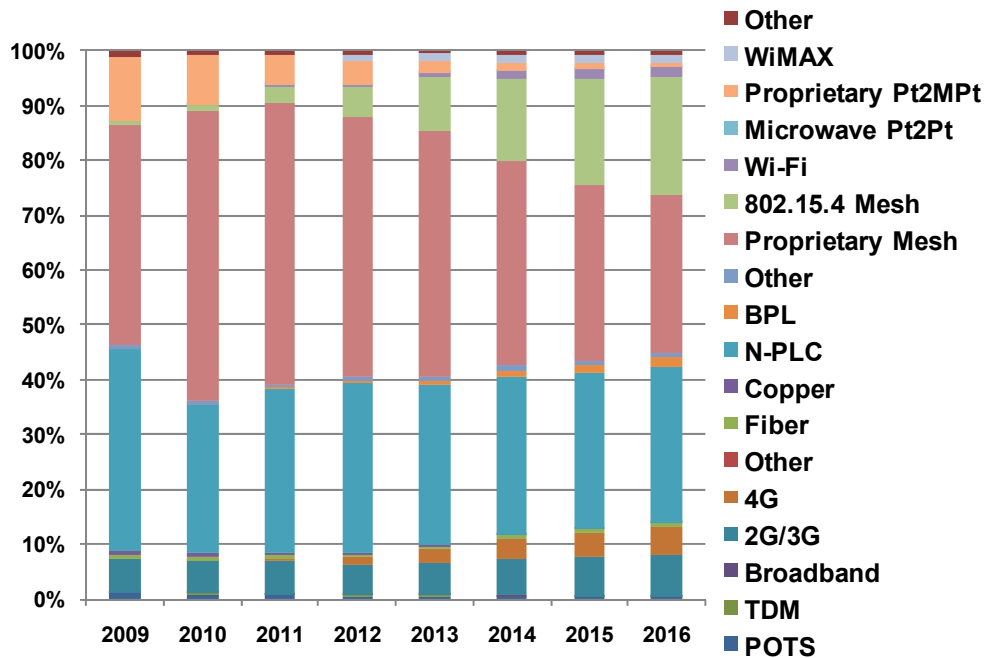
(Source: Pike Research)

However, there are many regional, application, and technology subtleties within this large opportunity. Some aspects and devices within the smart grid are denominated in “per home” units. Others are classified as “per substation” or “per distribution feeder,” and may not represent the volumes that newcomers, conditioned by consumer or enterprise “per person” unit volume, may expect.

The range of communications technologies used in the smart grid is very diverse, with an eclectic mix of public and private, wired and wireless, standard and proprietary networking products (Chart 1.3). This mix is poised to change, sometimes dramatically, within the forecast period, depending on the technical, regulatory, and standards-setting factors within each region. In the United States, private wireless networking technologies that can support emerging standards are forecast to win out, while PLC-based and public network technologies will hold greater sway in Europe and Asia.

This report examines and forecasts the devices and technologies associated with smart grid communications by application and by region.

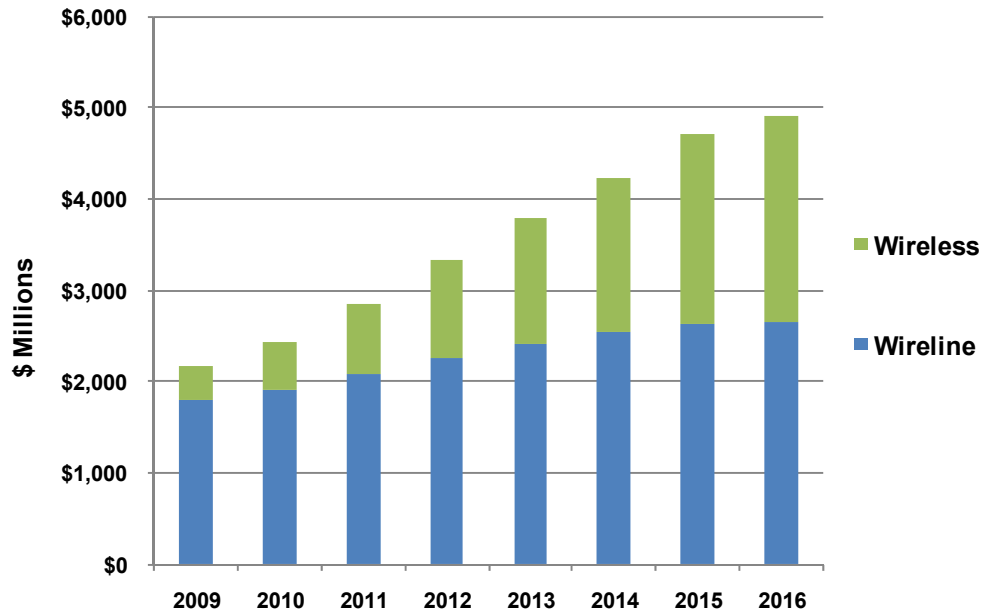
Chart 1.3 *Communications Node Technology Distribution, Units, World Markets: 2009-2016*



(Source: Pike Research)

In addition to smart grid equipment revenue, the significant use of public network infrastructure, especially outside North America, will provide a large and growing market for public carriers. Chart 1.4 illustrates the forecast for worldwide service provider revenue associated with the use of the smart grid communications technologies described in this report. Note that despite the industry hype around wireless carrier opportunities, traditional wireline revenue is forecast to remain the larger portion, even in the midst of robust wireless growth.

Chart 1.4 Public Service Provider Revenue, Wireless vs. Wireline, World Markets: 2009-2016



(Source: Pike Research)

There are significant risks inherent in the evolution of smart grid communications. For example, the highly regulated nature of the electric utility business makes it susceptible to policy and political influence at both the local (i.e., consumer acceptance) and geopolitical (i.e., energy price shock) levels. In addition, the technical complexities associated with widespread renewable distributed energy generation (RDEG) and plug-in hybrid electric vehicles (PHEVs) are not yet fully understood. Finally, the security concerns associated with a distributed control system on the scale of a fully interconnected continental smart grid are not fully appreciated by either policy makers or technologists.

As such, building, securing, evolving, and managing the communications network portion of the smart grid represents one of the great challenges and opportunities of today.

Section 10

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Section 12

SCOPE OF STUDY

Pike Research has prepared this report to provide participants in the smart grid markets, including vendors (grid equipment, meters, communications equipment, in-home consumer devices, and IT hardware and software), telecommunications services providers, component suppliers, electrical utilities (power generators, retailers, and distributors), regulators, investors, and other interested organizations with a study of the market for smart grid communications equipment and technology. The major objective is to identify and evaluate the challenges and opportunities for communications and networking technology given emerging smart grid application requirements and standards. This includes a forecast of likely growth for a wide range of communications device types and wired and wireless technologies. The report also provides a review of major demand drivers, technical developments and standards, as well as selected key industry players within the competitive landscape. While technical overviews are provided, this is not meant as an exhaustive technical assessment of the technologies and markets covered, but rather a strategic examination from an overall business perspective. Pike Research strives to identify and examine new market segments to aid readers in the development of their business models. All major global regions are included. The forecast period extends through 2016.

SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike Research's analysis is primary research gained from phone and in-person interviews with industry leaders, including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Pike Research's analysts and the firm's staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Pike Research's reports. Great care is taken in making sure that all analysis is well supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

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NOTES

CAGR refers to compound average annual growth rate, using the formula:

$$\text{CAGR} = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2010 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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