SOLUTION BRIEF

Intel IoT
Energy Industry

Transforming Utility Grid Operations with the Internet of Things

Challenging Times

It's not an easy time for utility companies as they face falling revenues, rising infrastructure costs, and increasing risk of outages caused by inconsistent energy production from renewable sources. Less money is coming in as more people and organizations take steps to curb their energy use. Utilities are paying more to maintain and build infrastructure due to increasing complexity, resulting from the rising number of intermittent and variable renewable energy sources connected in the distribution grid. A growing dependency on static energy sources (renewable with inverters) makes it harder to plan contingencies compared to traditional dynamic energy sources with rotating electric generators.

Improving Grid Infrastructure

These factors, and others, are disruptive forces on the operation of the grid and long-established utility business models, as depicted in Figure 1. Addressing the escalating grid complexity with traditional "copper" solutions (more electrical equipment, concrete walls, etc.) is not sufficient, because many of the operational problems are rooted in a lack of information. For example, grid stability could be enhanced with a data-driven transformation of key processes, such as real-time monitoring, predictive maintenance, and knowledge management.

Utilities would also benefit from improved situational awareness pertaining to distributed energy production, flexible consumption, and infrastructure health, allowing them to operate closer to the margin, and anticipate and react to network faults. Such steps would enable utilities to "do more with less," thereby avoiding new infrastructure investment.

Solution for 21st Century Energy Infrastructure

A new approach is required for operational technology. It is based on the Internet of Things (IoT), which enables an operational system that provides accurate and useful information to support real-time decision-making. The IoT connects field sensors, devices, equipment, and field workers (the "things") to the enterprise environment in a flexible, secure, and cost-effective manner. To accelerate the adoption of IoT in various industries, such as electric power, Intel is working with manufacturers and systems integrators who are uniquely qualified to enable IoT solutions. From edge devices to cloud-based applications, their solutions collect both operational and nonoperational data into a big data architecture that serves the needs of grid operators, utility planners, and asset managers.

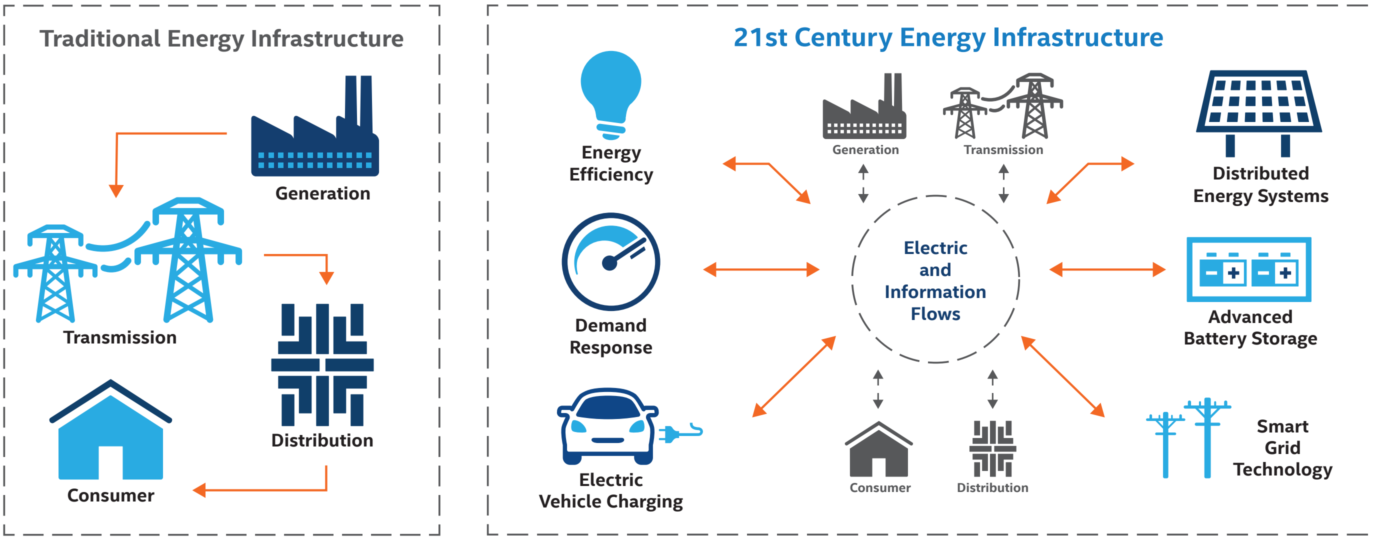

Figure 1. The transformed power grid is far more complex than the traditional grid.[1]

Putting Data to Work

IoT solutions take full advantage of IT standards for scalability and security while providing the data needed to increase the efficiency and predictability of the grid. They enable utilities to collect and make use of different types of data, including:

Electrical Data
Ensure grid and equipment are operating at peak efficiency.

Consumption Data
Improve energy balancing with a very granular understanding of peak energy usage, even as consumption per household is no longer uniform.

The growing popularity of electric cars, solar panels, demand response, etc., makes it imperative to measure time-of-day usage per home.

Nonoperational Data
Respond preemptively to changing conditions: weather, equipment temperature, dissolved gas, vibration, etc.

Transforming Energy Infrastructure

The higher level of connectedness and data-driven operations enabled by IoT solutions delivers benefits in a number of areas, including:

Reduced CapEx/OpEx
IoT technologies allow utilities to increase the ROI of their grid infrastructure through efficiencies gained from increased situation awareness, higher levels of data-driven decision-making, scalability at a lower cost than supervisory control and data acquisition (SCADA), and interoperability with existing technology investments.

- Monitor the condition and performance of assets in real time.
- Avoid building new capacity through better use of existing capacity.

Improved Worker Safety and Productivity
Wearable technologies help ensure field workers have the information they need at their fingertips to make them safer and more efficient. Remote offices can also directly monitor and observe activities, allowing them to offer better support and more constructive advice.

- Keep workers safe in remote and potentially more dangerous work sites.
- Use video technology to allow onsite workers and remote experts to work side-by-side.

New Revenue Opportunities
IoT solution collaboration can simplify and speed up the design and deployment of new revenue-generating applications and services that improve the utility's bottom line.

- Offer new types of services, such as HVAC operation comparisons, SLAs for industrial/commercial customers, and energy efficiency services.
- Bundle offerings with other service providers (e.g., home security companies).

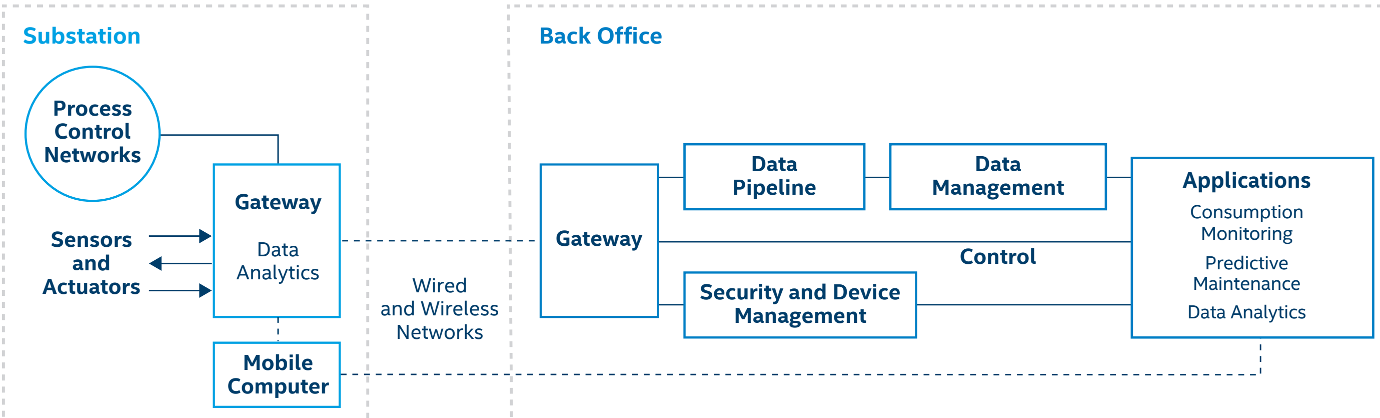

Figure 2. Real-time grid monitoring and control

Solution Overview

IoT solutions for the utility grid will typically contain the elements shown in Figure 2. The substation contains equipment that can be monitored by sensors and controlled by actuators. In order to have these sensors and actuators communicate with back-office systems, they can connect to a gateway that performs a variety of functions, including:

Protocol Translation
Enables inter-network communications (e.g., between Modbus* and TCP/IP).

Device Management
Configures and manages grid edge devices.

Data Aggregation
Combines and filters data from multiple sensors.

Data Analytics
Run close to the edge, facilitating quick, intelligent, closed-loop control.

The gateway can also work in collaboration with mobile computers or process-control networks. Data is transmitted between substations and the back office over wired or wireless networks. In the back office, a second gateway is the conduit to the applications, such as consumption monitoring, predictive maintenance, and data analytics running on servers in the datacenter.

Roles of IoT and SCADA

Grid operators typically use a supervisory control center to visualize the status of the grid. With the increasing amount of distributed assets connected to the grid, including distributed energy resources that are not part of the utility assets, maintaining complex grid systems is becoming cost prohibitive and error prone. This is because the number of connection points often exceeds the scalability of the existing SCADA database, triggering an expensive upgrade. Moreover, as asset changes (e.g., addition, removal, and connection) grow more frequent, it is much more difficult to maintain the SCADA network model used by the operational system and guarantee it accurately represents the physical reality.

Utilities expanding their legacy operational technology to address this changing environment may find the cost of scaling proprietary communication technology and protecting proprietary systems against cybersecurity threats a high-risk, high-cost proposition. Utilities need real-time infrastructure monitoring to achieve situational awareness for 21st century energy infrastructure, which IoT enables at a much lower cost than most solutions based on SCADA. Upgrades to operational capabilities using IoT technologies complement, but do not replace, existing SCADA solutions.

Intel Tenets of IoT Solutions

By 2020, it is expected that more than 50 billion devices will be connected to the cloud and each other using IoT.[2] Before this can become a reality, solution providers must recognize and tackle the complexity of IoT solutions to ensure secure and reliable IoT deployments. Along these lines, Intel, working with its ecosystem partners, defined a system architecture specification (SAS) for connecting nearly any type of device to the cloud. SAS helps solution providers design IoT solutions in keeping with five key tenets:

Services to monetize IoT infrastructure
Data management from edge to cloud

Analytics infrastructure to provide value for utilities
Real-time, insightful, and secure data analytics

Seamless data ingestion and device control to improve interoperability
Broad protocol normalization support and closed-loop control systems

Automated discovery and provisioning of edge devices to ease deployment
Device setup from box to cloud in minutes

World-class security to deliver the requisite data and device protection
Robust hardware- and software-level protection

IoT-Based Solutions for Energy Infrastructure

In support of IoT solutions for energy infrastructure, Intel offers capabilities that fall into several categories:

Hardware and Software for Smart Grid Edge Devices

Utilities are deploying Intel® computing and communications technology across the power grid and in datacenters to increase the utilization of existing electrical capacity and optimize the use of alternative energy sources. Distributed intelligence, based on Intel® Xeon®, Intel® Core™, and Intel® Atom™ processors, decentralizes control and improves energy efficiency. A wide range of operating systems, development tools, and security solutions are available to assist application developers.

Intel IoT Solution for Active Grid Management

This end-to-end IoT solution for the energy industry provides a data management platform to transform the operation, planning, engineering, and system analysis for the distribution grid that is facing increasing penetration of distributed energy resources (DER), such as solar, microgrids, and battery systems. It enables transparency in the operation of thousands of secondary substations, allowing them to be monitored by a remote operations center.

The solution also enables the integration of nongrid assets (e.g., DER) into the operation of the grid. For example, it can connect, install, and configure sensors in the field to a gateway that interfaces to a data management platform. After sensors are installed, field engineers never have to go back to the substation, unless sensors need to be physically replaced. End–to-end security features protect data (at rest and in motion), the gateway, and user IDs. The solution also manages edge devices and provides connectivity through a machine-to-machine (M2M) layer.

Trusted Analytics Platform (TAP)

Intel is a key contributor to the open source, Hadoop*-based platform that provides a layer to manage data coming into the analytics system. As a result, data scientists can spend more time working on analytics algorithms and less time configuring the system.

Collaborating on 21st Century Energy Infrastructure

Intel has developed an entire ecosystem around IoT solutions for the power grid, enabling utility companies to pull together all the necessary developers, systems integrators, and OEM/ODMs needed to construct a solution. This includes the Intel® Internet of Things Solutions Alliance, whose members provide the hardware, software, firmware, tools, and systems integration that developers need to take a leading role in IoT. Contact your Intel field sales representative to learn how Intel and its IoT ecosystem can help develop a pilot to better understand how IoT technologies can help improve profitability.

Resources

Intel® Internet of Things Solutions Alliance

Members of the Intel® Internet of Things Solutions Alliance provide the hardware, software, firmware, tools, and systems integration that developers need to take a leading role in IoT.

Intel® IoT Gateway Development Kits

Intel® IoT Gateway development kits enable solution providers to quickly develop, prototype, and deploy intelligent gateways. Available for purchase from several vendors, the kits also maintain interoperability between new intelligent infrastructure and legacy systems, including sensors and datacenter servers.

To learn more about Intel solutions for the energy industry, visit intel.com/energy.

1. Bay Area Council Economic Institute, "21st Century Infrastructure: Keeping California Connected, Powered, and Competitive," www.bayareaeconomy.org/media/files/pdf/21stCenturyInfrastructure.pdf.

2.IDC, Intel forecast.

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