Cisco Edge-to-Enterprise IoT Analytics for Electric Utilities

Comprehensive analytics infrastructure platform for the Internet of Things for Electric Utilities with the Cisco Unified Computing System

Advances in technology now enable virtually anything to be connected to the Internet. This Internet of Things (IoT) represents one of the most profound technology innovations in history. We are in the midst of a transformative time when simply enormous numbers of devices are being connected to the global network. Cisco estimates there will be 50 billion IoT devices by 2020, and ten times that number, 500 billion, by 2030.

Highlights

- Meet increasing demand, integrate renewable power sources, and dynamically balance supply and demand with a fully connected smart grid based on analytics built on the Cisco® IoT Analytics Infrastructure powered by the Cisco Unified Computing System™ (Cisco UCS®) and Connected Grid Routers
- Reduce risk and accelerate your implementation with world-class Cisco security products
- Turn Internet of Things data into actionable insight all the way from the edge of the network to the enterprise
- Take advantage of edge-driven analytics to implement predictive asset management, avoiding catastrophic failures, reducing maintenance cost, and improving overall availability
- Glean accurate insights on power quality, supply, and demand
- Create the next-generation, fully connected smart grid by dynamically adapting supply and demand in an automated manner

It is this exponential increase in connections that transforms the Internet of Things into the Internet of Everything (IoE), creating both significant challenges and unprecedented opportunities for organizations around the world. The IoE will transform nearly every industry, locally and globally, and the energy and utilities sectors are no exception. The smart, connected devices that make up the IoE generate data that analytic applications need to be able to collect, aggregate, and analyze to deliver informed, actionable insights. The challenge is to build the right digital infrastructure and enable the right set of applications to harness this data and draw insights.

Electric utilities

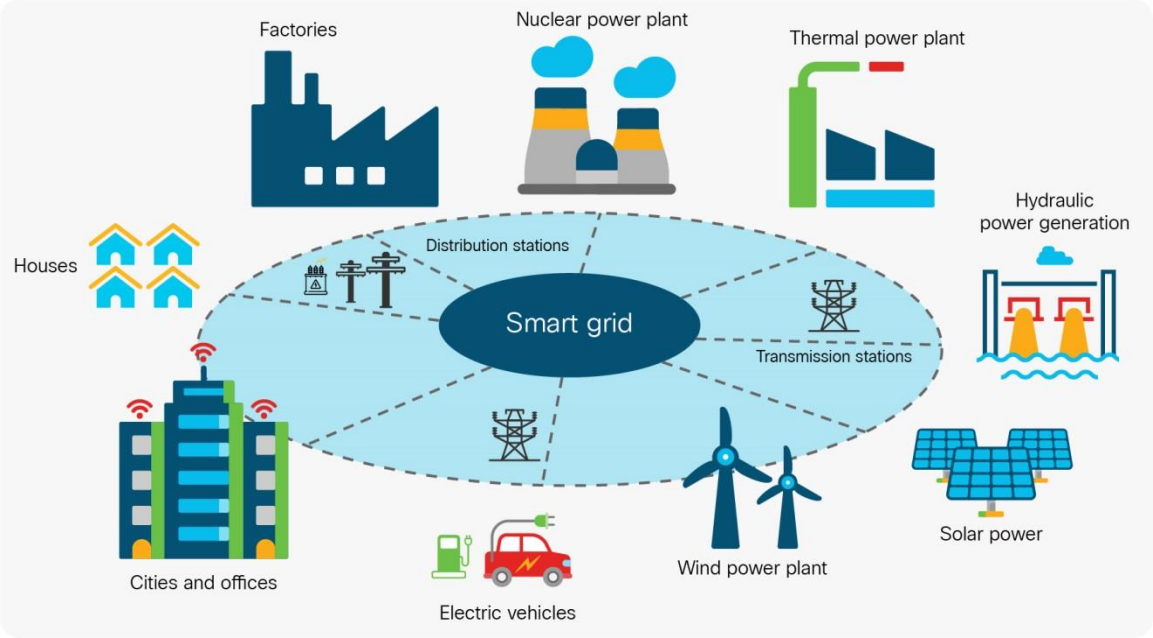
Today's electric utilities are increasingly focused on grid modernization. Steadily increasing demand, integration of new sources of electricity in the form of wind and solar power, and the need to dynamically balance supply and demand are all driving the industry to embrace a fully connected world fueled by real-time insight from data generated and analyzed throughout the grid—from out at the edge of the network to the inner core of the enterprise data center.

With the entire landscape shifting, utilities are turning to technology to help them create cost-competitive business models for reliable power delivery. Analytics powered by IoT-generated data enables utility companies to:

- Implement predictive asset management, improving the overall availability and operational performance of assets while reducing their total cost of ownership. Edge-driven analytics enable organizations to move from scheduled maintenance models to predictive ones, giving them dynamic control over their equipment and maintenance resources. These capabilities help avoid catastrophic failures by identifying critical issues that occur inside the normal scheduled maintenance window, lower costs by eliminating unnecessary maintenance tasks, and make more effective use of scarce and expensive human and capital resources. This strategy is essential for large industrial organizations.
- Expand the smart grid into a true next-generation power grid, using a two-way flow of electricity and information to create a widely distributed and automated energy delivery network. The smart grid provides advanced information about electricity generation, communication, and infrastructure by capturing sensor information. This information helps organizations understand delivery patterns and consumption patterns by analyzing the data collected by the system.
- Integrate renewable resources more efficiently onto the grid with edge algorithms that smooth the transition between power resources while maintaining grid stability.
- Provide more accurate insight on power quality. Streaming analytics applied to data collected from transmission and distribution lines gives real-time insight into grid events as they unfold, improving the ability to predict future requirements.
- Restore power faster after an outage by optimizing resources that minimize the duration of customer interruptions and increase restoration efficiency.
- Create personalized energy services for each customer, becoming the company of choice, not just for power but also for other home services.

A high-level overview of a “smart grid” is depicted in Figure 1. Power producers, including power plants and distributed energy resources, generate electricity, which is transmitted across the grid, passes through a variety of different substations before reaching consumers: industrial facilities, commercial buildings, and domestic households. Each step in the process involves complex machinery with very high availability requirements. Power plants are relatively few in number but have thousands of sensors. Substations have fewer sensors than power plants but there are a great deal more of them. Distributed energy resources, such as solar power generators and wind farms, have their own sets of sensors as well as specialized substations that allow power to flow into the electric grid from a different vector than the main power plants. Finally, power consumers have just a few sensors, primarily a smart meter, but there are millions of consumers.

Figure 1. High-level view of electrical grid



Each node in this interdependent network of producers and consumers produces data that needs to be collected, filtered, aggregated, transmitted, and stored. The goal of the Internet of Things is actionable insight enabling positive outcomes. For power producers, this means higher uptime and lower costs through the efficient management of assets, as well as improved troubleshooting and advance notice of power outages. For consumers, this means a better understanding of power usage and lower costs through the intelligent use of power-hungry equipment during periods of lower demand. All participants benefit from a two-way flow of information dynamically matching demand and supply, resulting in lower costs and fewer outages.

Edge-to-enterprise

To make such a network viable, you need infrastructure and analytics. The infrastructure collects and transmit the data and provides the execution platform for the analytics systems. The Internet of Things presents a significant architectural challenge, because the IoT devices generate enormous amounts of data—on the order of hundreds of terabytes per day. IoT devices also produce many different types of data. The data is often very “noisy” and is produced continuously. Also, many applications require real-time analysis and response. A final consideration is the often-harsh environment the computing equipment must contend with out in the field.

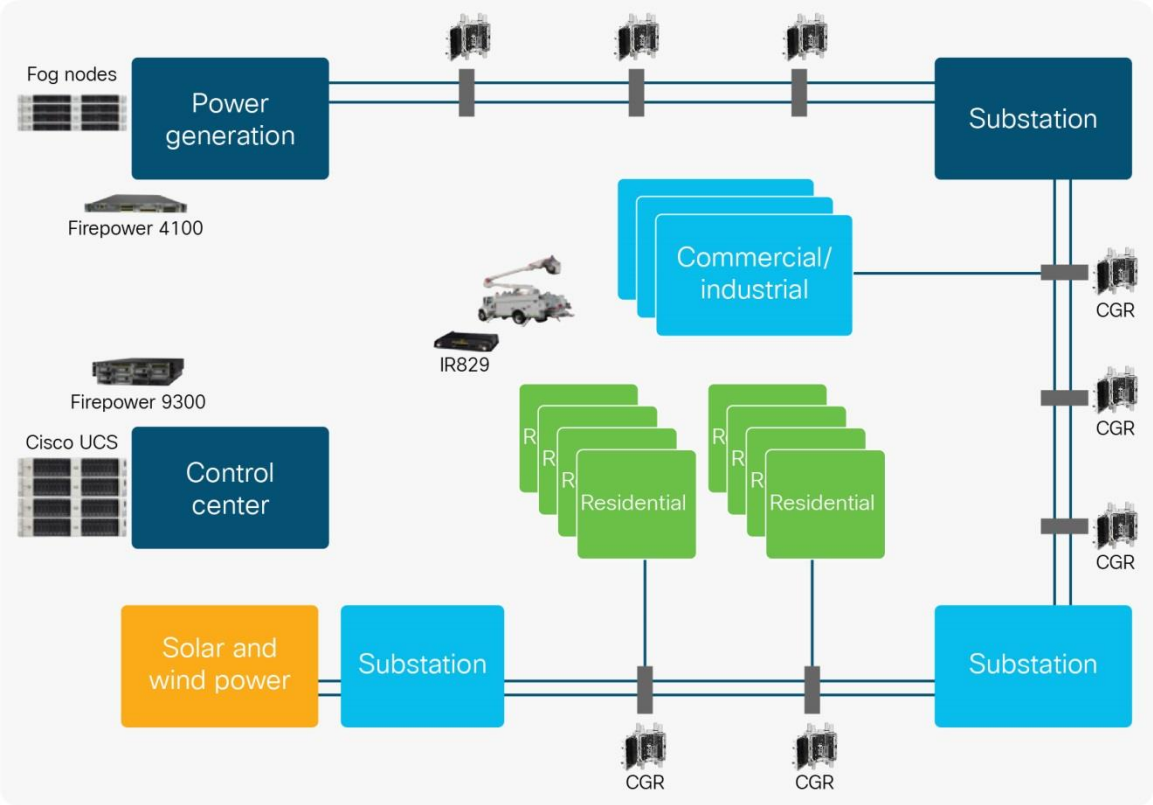
Traditional computing models send the data to the enterprise data center for analysis. However, this approach is impractical in many scenarios, because of the volume of data being produced and the need for real-time analysis and response times, often measured in milliseconds.

Simply collecting data from connected sensors, systems, or products is not enough. To benefit from the promise of IoT data, businesses need to be able to expand the way their analytics processes are run, from traditional enterprise data centers out to devices on the edge. The challenges arise from the complexity—and risks—inherent in capturing and analyzing the huge volumes and varieties of data flowing from the ever-increasing numbers of things.

As a result, a new model for analyzing IoT data at the edge of the network has emerged. This model moves the analysis and response close to the devices that generate the data, reducing latency and reducing the load on the network and the enterprise data center.

Figure 2 shows an architecture for analysis of IoT data, including real-time analysis and response at the edge of the network, as well as historical analysis, operational control, and model development in the enterprise data center.

Figure 2. Architecture for Cisco UCS edge-to-enterprise IoT infrastructure



Enterprise Components

Cisco Unified Computing System

Both in the enterprise and at the edge, Cisco Unified Computing System™ (Cisco UCS®) rack mount servers are recommended. Cisco UCS C-Series Rack Servers and S-Series Storage Servers deliver unified computing in an industry-standard form factor to reduce Total Cost of Ownership (TCO) and increase agility. Each server addresses varying workload challenges through a balance of processing, memory, I/O, and internal storage resources.

Edge Components

Cisco CGR Connected Grid Routers

The Cisco® 1000 Series Connected Grid Routers are versatile communications platforms built to meet the communication infrastructure needs of industrial verticals such as utilities, energy, and smart cities. These routers allow utilities to integrate multiple applications, such as advanced metering infrastructure, distribution automation, integration of distributed energy resources, and remote workforce automation onto a single platform. The CGR 1000 Series supports outdoor wired and wireless sensor networks, enabling applications such as street lighting, smart parking, and other smart-city applications.

Cisco 829 Industrial Integrated Services Router

The Cisco 829 Industrial Integrated Services Router is a ruggedized integrated services router designed for deployment in harsh industrial environments. The router has a compact form factor, an integrated 9V to 32V DC power input, and multimode third-generation (3G) and fourth-generation (4G) Long-Term Evolution (LTE) wireless WAN and WLAN connections.

Cisco Fog Director

Cisco Fog Director provides the capability to manage large-scale production deployments of IOx-enabled fog applications at the edge. Fog Director is essential in deploying and managing application software to be executed at the edge of the network.

Cisco 3000 Series Industrial Security Appliance

The Cisco 3000 Series Industrial Security Appliance (ISA) provides the industry's widest range of specific access control, threat detection, and application visibility for the harshest and most demanding of environments. ISA works in harsh environments (with a temperature range of −40° to 60°C) and is hardened for vibration, shock, surge, and electrical noise immunity. It offers four high-performance Ethernet data links in a rail- or rack-mount form factor.

Cisco Firepower firewall

Cisco Firepower appliances are fully integrated, threat-focused Next-Generation Firewalls (NGFW) with unified management. They uniquely provide advanced threat protection before, during, and after attacks, while providing better security, faster speeds, and a smaller footprint.

Conclusion

The comprehensive Cisco Edge-to-Enterprise IoT Analytics infrastructure for Electric Utilities delivers industry-leading performance, scalability, and cost of ownership. This platform enables organizations to develop and deploy Cisco UCS at the enterprise and Cisco CGR and Cisco ISR at the edge, and related infrastructure to support powerful IoT and analytics processing.

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For more information

Cisco big data portal: https://www.cisco.com/go/bigdata

Cisco UCS Integrated Infrastructure for Big Data: https://blogs.cisco.com/datacenter/cpav4/

Cisco Connected Grid Routers: https://www.cisco.com/c/en/us/products/routers/1000-series-connected-grid-routers/index.html

Cisco 829 Industrial Integrated Services Routers: https://www.cisco.com/c/en/us/products/collateral/routers/829-industrial-router/datasheet-c78-734981.html

Cisco 3000 Series Industrial Security Appliances: https://www.cisco.com/c/en/us/products/security/industrial-security-appliance-isa/index.html

Cisco Firepower 4100 Series: https://www.cisco.com/c/en/us/products/security/firepower-4100-series/index.html

Cisco Firepower 9000 Series: https://www.cisco.com/c/en/us/products/security/firepower-9000-series/index.html

Cisco and SAS Edge-to-Enterprise IoT Analytics Platform Cisco Validated Design: https://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/UCS_CVDs/Cisco_SAS_Edge_to_Enterprise_IoT_Analytics_Platform.html

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