New Services and Products Share Real-Time Distributed Data Across the Grid

WHITE PAPER

OSIsoft®

Ensure the Successful Integration of Renewable Resources while Maintaining Stability and Optimizing Grid Management

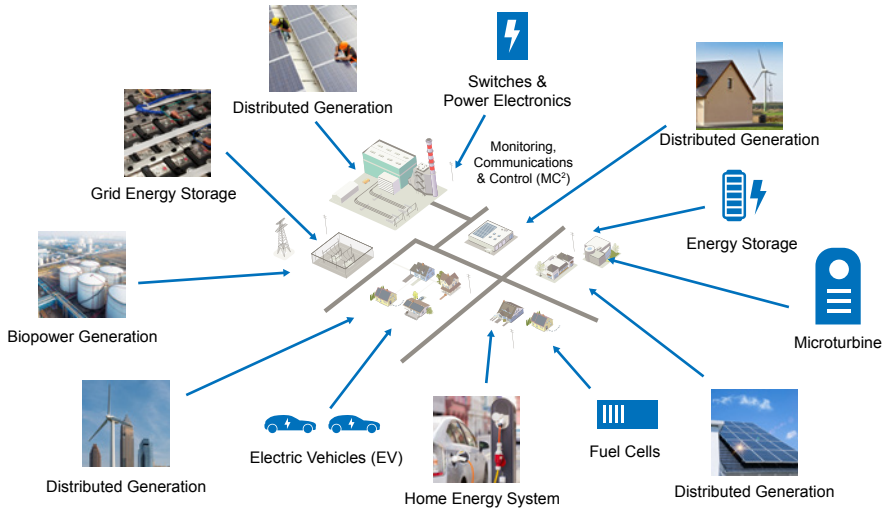
The growing use of renewable energy is providing new opportunities for energy users to reduce carbon footprint and energy costs. However, the unpredictability of solar, wind, and other renewables makes it difficult to maintain stability and optimize grid management.

The key to ensuring the successful integration of renewable resources may lie in the availability of real-time series data collected from distributed data points, often described as the Internet of Things (IoT). But the huge amount of data collected from these data points operating at the edge of the grid must be processed, and a number of different formats in use must be smoothly integrated; the lack of data granularity and existing data silos presents additional challenges.

To address these edge-of-the-grid issues a new community of energy suppliers, service providers, storage vendors, software suppliers, and electric vehicle (EV) charging platforms are offering distributed real-time data using an IoT model that can help utilities, independent system operators (ISOs),and large commercial and industrial energy users to work together to optimize web operations.

OSIsoft's PI System is used by many utilities to collect, manage, and analyze data for transmission and distribution groups. Through Connected Service agreements, OSIsoft has made it possible for innovators to also use the PI System as an IoT platform that collects, stores, analyzes, and visualizes real-time sensor-based data from the grid edge, which can be used by the centralized grid to optimize the uninterrupted availability of energy resources. The following are three examples of the PI System being put to work in innovative, edge-of-the-grid applications.

Figure 1



Grid operators can use real-time data to integrate distributed energy resources

Itochu Provides Weather Forecasting Data

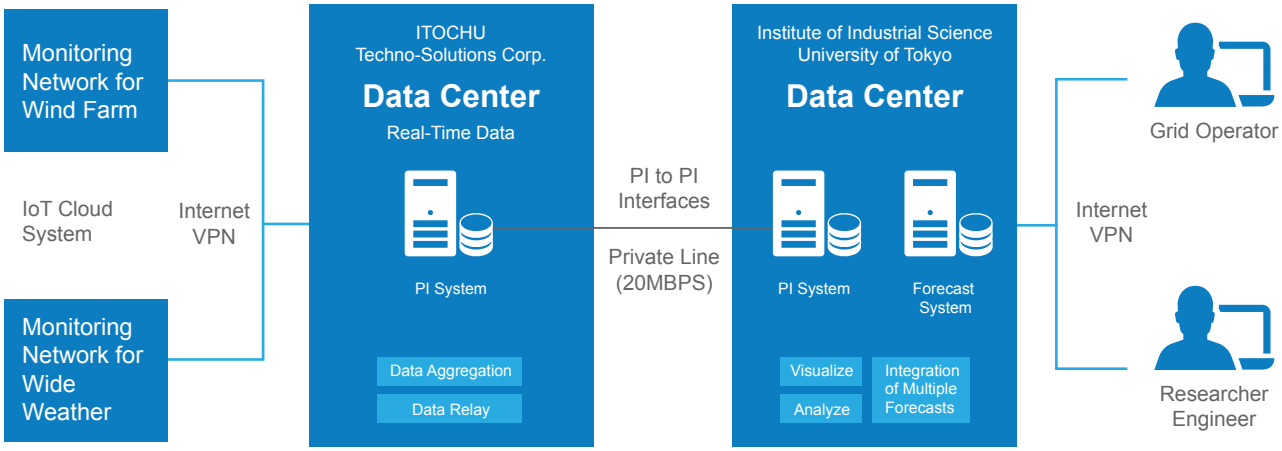
Following the Fukushima Daiichi nuclear disaster, the government of Japan promoted renewable power generation. To address a concern that rapid increases in variable energy may affect grid stability, Itochu, a system integrator and service provider, created a monitoring system to forecast wind power output generation to improve integration of renewable energy sources in eastern Japan.

Working with NEDO, the national R&D agency, Itochu created a wide area network consisting of more than 40 wind farms, 114 weather data stations and the Japan Meteorological Society's 400 surface weather station sites. OSIsoft's PI System acts as an IoT platform to collect renewable energy data, such as power output, along with weather data, including wind speed, wind direction, pressure, and temperature, to contribute to wind power output forecasts in eastern Japan. This data improves the ability to forecast variable renewable energy (VRE) to manage the integration of wind energy into grid operations.

Itochu uses the PI System® to collect massive amounts of IoT data that help researchers increase the accuracy of wind power forecasts in eastern Japan. It stores VRE data such as wind, PV power output, SCADA, and wide area weather data such as wind speed direction, temperature, pressure, and humidity, to develop VRE forecasts in order to optimize the demand supply and frequency adjustment.

Working with its partners, Itochu has been able to improve the overall accuracy of its wind power forecasts with the exception of wind ramps caused by low pressure weather systems. In the future, Itochu will continue to expand its IoT system and further develop forecasting techniques. The goal is to improve control of power output fluctuations with a combination of storage and operation of large-scale generators and batteries to optimize power system operation.

Figure 2



Real-time data from wind farm and wide area weather stations contribute to wind power forecasts.

Itochu Solution

Itochu uses a PI Interface™ to stream the power and weather data using a unified file format into the PI System, with these PI System components:

- Asset Framework (AF): Organizes the past, real-time, and future data in an easy-to-navigate hierarchal format to manage data, perform roll-up analysis, and develop templates that describe each turbine
- Notifications: Sends alerts of high wind ramps that can affect the grid
- PI ProcessBook®: Enables the creation of charts and displays to visual critical data
- PI Coresight™: Provides the ability for engineers and analysts to visualize and access VRE and weather data from desktop displays, laptops, or other mobile displays
- PI DataLink® to analyze data in Microsoft Excel

Enphase Energy: Shares PV Data

While the rollout of solar photovoltaic (PV) capacity can help diversify US power sources, utilities need to smoothly integrate solar energy from highly distributed residential rooftops and small commercial sources. How can utilities achieve accurate, highly granular, and near–real-time visibility?

Enphase Energy, a manufacturer of microinverters, AC battery storage, and smart PV technologies, deploys the PI System, via Connected Services, to collect site-level data such as secondary voltage and PV production. This data is made available to help utilities integrate PV energy from Enphase customer installations.

Enphase gathers information collected from smart microinverters and aggregates site data. The result is a low-cost solution for utilities that does not require additional screens or new software. Using PI System's Asset Framework (AF), utilities combine Enphase site data with SCADA or meteorological data to perform analytics that simplify the integration of solar resources into the grid.

To support its utility customers, Enphase needed to organize its data into a format that is relevant to the utility. Enphase collects data microinverters from homes solar panel, moves it to the Envoy gateway, and then disseminates the data to utilities. Enphase takes advantage of the flexibility of the AF templates to make the data relevant to utilities. For example, the utility may be interested in data for a zone that represents a group of houses, or may want to know if the houses in a specific geographic area belong to the same segment of a distribution circuit.

As PV generation penetrates the grid, utilities are increasingly attentive to voltage regulation and the ability to link voltage data with photovoltaic production. The voltage data utilities currently collect takes about 24 hours to percolate through the system; Enphase systems can collect that data faster, and at a finer resolution.

Faced with growing PV capacity, utilities increasingly need timely and detailed data about PV generation capability and performance. Since many utilities use the PI System, data can be presented in a format that is both familiar and useful to utility operators. By partnering with developers of the PI System, PV developers can offer utility energy management solutions that address their needs in the evolving PV market.

Figure 3

Enphase Energy aggregates data from smart microinverters and send PV generation data to utilities to simplify solar integration.

Enphase Energy Solution

As utilities integrate more data from outside providers such as meteorologists, Enphase is using OSIsoft's PI Cloud Connect services to securely acquire that data. The company can also use PI Integrator for Esri ArcGIS to display asset data at distributed locations. Finally, Enphase uses Notifications to allow utility operators to set alar ms when data reaches pre-determined critical levels.

Enphase will can use Event Frames to perform analysis on voltage trends. By using Events Frames, operators can calculate statistics on frequency and duration of voltage spikes that fall outside the optimal range that the utility is trying to achieve.

eMotorWerks: Controlling Volatility in Demand Management

Widespread adoption of electric vehicles (EVs) has faced two large hurdles. One is convincing the consumer that electric cars are convenient, reliable, and easy to operate. That hurdle was partly addressed by the emergence of the Level 2 EV charger, which provides faster charging time. The second hurdle is the question of whether the existing energy grid can support the increasing demand a successful electric car market would generate.

The growing market is already affecting demand: EV charging creates large electrical loads that are concentrated both in time and location, resulting in high energy costs due to peak usage and the need to add energy sources in response to demand that can't be met by renewable sources that are affected by weather and time of day. The addition of dirty energy generation defeats the intent of electric cars and strains electricity distribution, threatening overall stability and reliability.

eMotorWerks is addressing the demand issue with a smart network, called JuiceNet®, of Level 2 EV charging stations, called JuiceBox® stations that incorporate grid sensing and response. The chargers also use smart phone and computer interfaces that enable users to manage, time, and monitor charging and electrical source information. For the consumer, the result is faster, cheaper EV charging controlled from a smart phone: the user can set a time to charge and a charge rate, for example, based on cost or available source. For energy suppliers, such as independent service operators (ISOs) and regional transmission operators (RTOs), having EV demand managed by a smart end point will allow the EV market to come on to the grid without overburdening it.

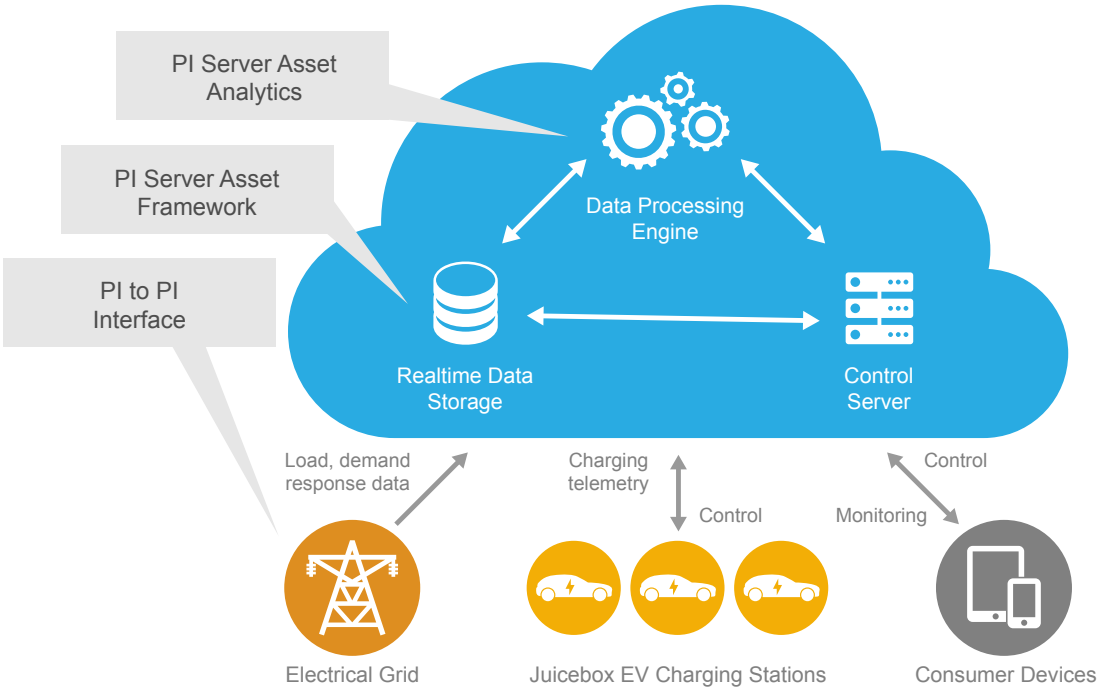
Smart EV networks at the edge of the grid will generate data that will help ISOs and RTOs, as well as local utilities, to make decisions about grid load balancing and to understand long-term trends. What's more, car manufacturers can better understand the efficiency and operation of their battery charging systems, and the market benefits as technology advances make EVs much more appealing.

Integrated into eMotorWerks' JuiceNet platform is OSIsoft's PI System, which combines sensor-based data from eMotorWerks' network of JuiceBox charging stations with data from electrical utilities and ISOs. The result is a robust, complete overview of charging loads and real-time grid conditions used in the JuiceNet load dispatch algorithms, providing eMotorWerks EV customers with faster, easier, and more secure access to the status of their charging stations.

eMotorWerks uses the PI System to collect and store real-time data from the JuiceBox chargers, including charging state amperage, voltage, power, power factor, frequency, temperature, and charging session energy. The PI System performs the analysis for the JuiceBox to process, analyze, and make decisions at the grid edge to trigger responses to key events.

The PI System also incorporates a cloud-based energy market engine that reads data from PI-to-PI transfers of data from ISOs, utilities, and large commercial customers for wholesale pricing and to determine the best way to respond to events.

Figure 4



JuiceBox EV charging stations uses real time data and analytics for cloud-based load management and cloud-based energy market engine.

eMotorWerks Solution

Asset Frameworks organizes basic data points from the UDP JuiceBox Listener. A PI System Connected Service Agreement forms a shared data ecosystem that enables eMotorWerks to provide valuable cloud-based services to ISOs and utilities to deliver superior charging performance and efficiency.

PI System-based load management allows eMotorWerks to manage thousands of stations with sub-3-second control latency for instantaneous response to grid events. Other services include frequency regulation and peak shaving.

Conclusion

Variable renewable energy places new strains on the stability and optimization of the grid. Using the PI System as a data infrastructure, a diverse group of enterprises is gaining insight into grid events and the ability to optimize distributing resources to support grid management. These companies' offerings are diverse, spanning service provision and research, renewable energy generation, large-scale energy storage, and consumer-market products. Common to all these new players on the edge of the grid, though, is the ability to deeply integrate with the entire grid: the ability to quickly respond to grid conditions, to address demand, and optimize availability, all while reducing cost.

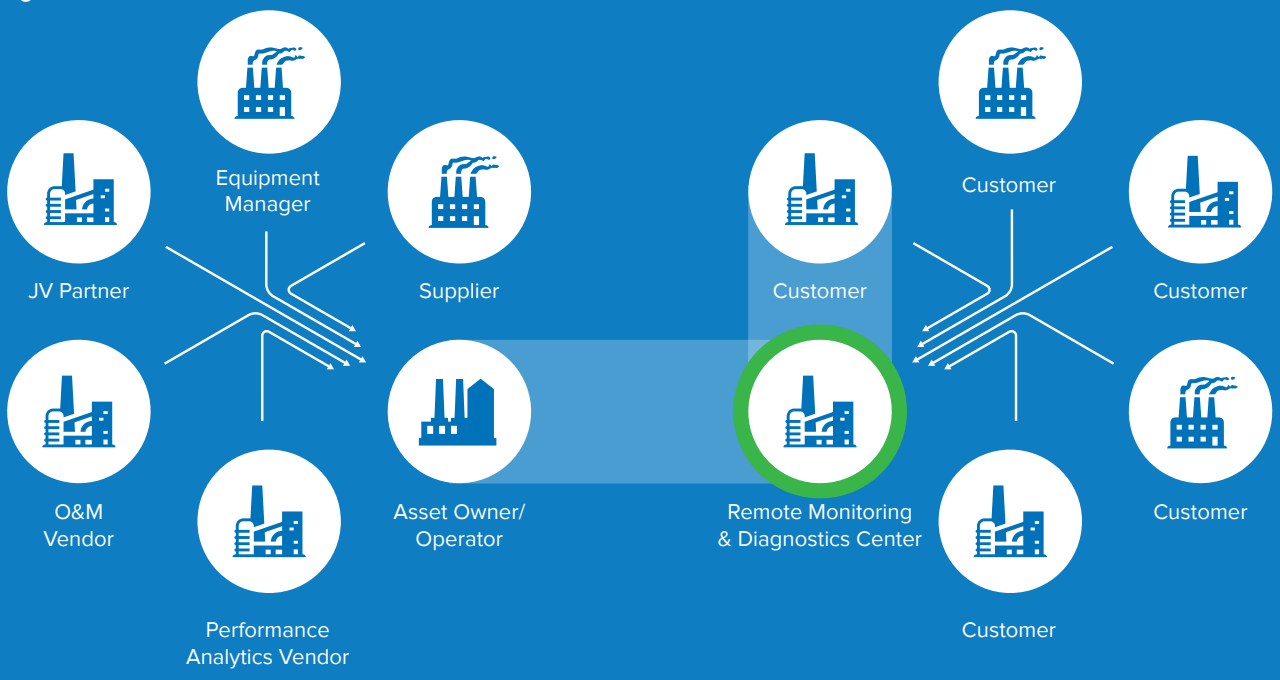
About OSIsoft, LLC.

OSIsoft, a global leader in operational intelligence, delivers an open enterprise infrastructure to connect sensor-based data, operations and people to enable real-time and actionable insights. As the maker of the PI System, OSIsoft empowers companies across a range of industries in activities such as exploration, extraction, production, generation, process and discrete manufacturing, distribution and services to leverage streaming data to optimize and enrich their businesses. For over thirty years, OSIsoft customers have embraced the PI System to deliver process, quality, energy, regulatory compliance, safety, security and asset health improvements across their operations. Founded in 1980, OSIsoft is a privately-held company, headquartered in San Leandro, California, U.S.A, with offices around the world.

Connected Services

Connected Services in a flexible, “pay-as-you-grow” subscription model that allows service providers to apply the benefits of real-time data analysis to transform their service offerings without incurring high up-front capital costs. A Connected Services enables service providers to remotely access real-time data from client assets to gain insights into critical business operations. The agreement defines a customizable architecture that uses OSIsoft’s PI System via a secure network to clients’ assets to store, analyze, and visualize real-time, sensor-based operational data. The PI System works in conjunction with a service provider’s server, network and storage resources to form a remote monitoring and data center. These systems can be located on the service provider’s premises, in a data center, or in the cloud.

Figure 5



OSIsoft’s Connected Services enables service providers to access real time data from distributed assets

PI System:

The PI System is an open data infrastructure consisting of multiple elements that together can deliver operational intelligence for IoT and distributed from multiple sources and systems.

PI Interfaces

With more than 450 interfaces and connectors to link to a diverse group of operating sensors and devices, the PI System can connects PI Systems to data sources across the entire ecosystem.

PI Connectors automatically deliver data from new and existing sensors and control systems. PI Connectors can intelligently scan a data source and start sending data to the PI System with minimal configuration.

PI Server

The PI System's PI Server™ stores operating data in single stored location that ensures asset owners, service providers, analytic partners and other members of the value chain are using the same data.

- Asset Framework (AF) stores data in an easy-to navigate hierarchy that enables users to identify assets and access data. Moreover, AF correlates time-series data with metadata, including maintenance histories, events and equipment data to more easily spot problems, simplify decision making and prepare data for analysis and visualization.
- Notifications enables users or systems to be notified when key events occur. If a notification recipient is unavailable, notifications can alert other users.
- Event Frames automatically bookmark the PI System data related to a specific asset and a related condition. Each event frame has a start and end time, enabling users to calculate the duration of an event and capture the associated data or condition.

PI System Tools

PI ProcessBook™ allows users to create graphics and displays to highlight critical operating data including dashboards, process flows and detailed equipment schematics.

PI Coresight™ enables users to instantly access PI System data on tablets, phones or the web to understand and analyze data.

PI DataLink® brings PI Server data into Microsoft® Excel® for data analysis for automated daily reports, data summaries and other functions.

PI Integrator: The PI Integrator cleanses, augments, shapes and transmits the data captured and stored by OSIsoft's PI System so that it becomes suitable for other uses such as business intelligence applications or further analysis, the cloud environment.