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EXECUTIVE SUMMARY

Effectively Using Sensing Technology for Monitoring Distribution Assets

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KEY TAKEAWAYS

- Aging utility infrastructure and changing customer needs are driving grid monitoring solutions.
- FPL has developed a vision of a grid of the future and a technology strategy to maximize smart grid value.
- FPL and Ubicquia defined three grid sensor requirements for their data and utility solutions.
- FPL and Ubicquia capitalized on their respective strengths to co-develop two initial products.
- Artificial intelligence predicts and extends the longevity of assets.

in partnership with

ubicquia

Effectively Using Sensing Technology for Monitoring Distribution Assets

OVERVIEW

The US electric grid is aging. As this occurs, maintenance expenses are rising. To address this challenge and to prepare for the future, Florida Power & Light (FPL) has developed a vision of the future grid—which uses sensing and monitoring technology—along with a technology strategy that focuses on maximizing smart grid value.

To realize this vision and execute this strategy, FPL partnered with Ubicquia to develop intelligent utility solutions using sensing technology for monitoring disparate grid assets. Based on identified gaps, Ubicquia and FPL have initially developed two sensing-technology-based solutions: distribution transformer monitors and pole tilt sensors.

These solutions gather and analyze real-time endpoint data, pulling the information over LTE networks into Ubicquia's cloud-based platform. Integration between FPL's systems and Ubicquia's database provides actionable information on utility assets. Through the application of AI-informed predictive models, FPL is able to perform anticipated maintenance ahead of time (before failure) and thus extend asset life.

CONTEXT

Jow Ortiz and Charlie Nobles discussed the aging US electric grid and described how the sensing and monitoring solutions created by FPL and Ubicquia are helping facilitate the shift to a condition-based asset management program.

KEY TAKEAWAYS

Aging utility infrastructure and changing customer needs are driving grid monitoring solutions.

The US grid is aging, causing a lack of infrastructure resilience in the industry. The average age of all deployed power transformers in the United States is 35 years, and 70% of transmission lines are 25 years or older. Utility poles skew even older. Additionally, the sheer size of the grid requires high spend on assets in the field and the cost of maintenance of those assets is simultaneously increasing. Annual spending on distribution systems—the "last mile" of the grid—grew 54% over the past two decades. And challenges are not limited only to aging infrastructure; weather and environmental impacts are also affecting resilience and associated maintenance costs.

> In one survey, [one West Coast utility] showed over half their poles are 50 years old. Over a quarter are over 60 years old . . . replacing the poles on a regular basis is just more than they can do. This is driving some of the lack of resilience that we're seeing in the industry, and it's a major problem.
>
> *Charlie Nobles, Ubicquia*

Further driving changes to utility operations is the significant shift in customer usage, including an increase in electric vehicles and distributed energy resources such as rooftop solar and battery storage. This shift requires utilities to sectionalize the grid, which allows companies to restore power more quickly in the case of an outage and to improve safety, but also drives up cost and complexity.

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FPL has developed a vision of a grid of the future and a technology strategy to maximize smart grid value.

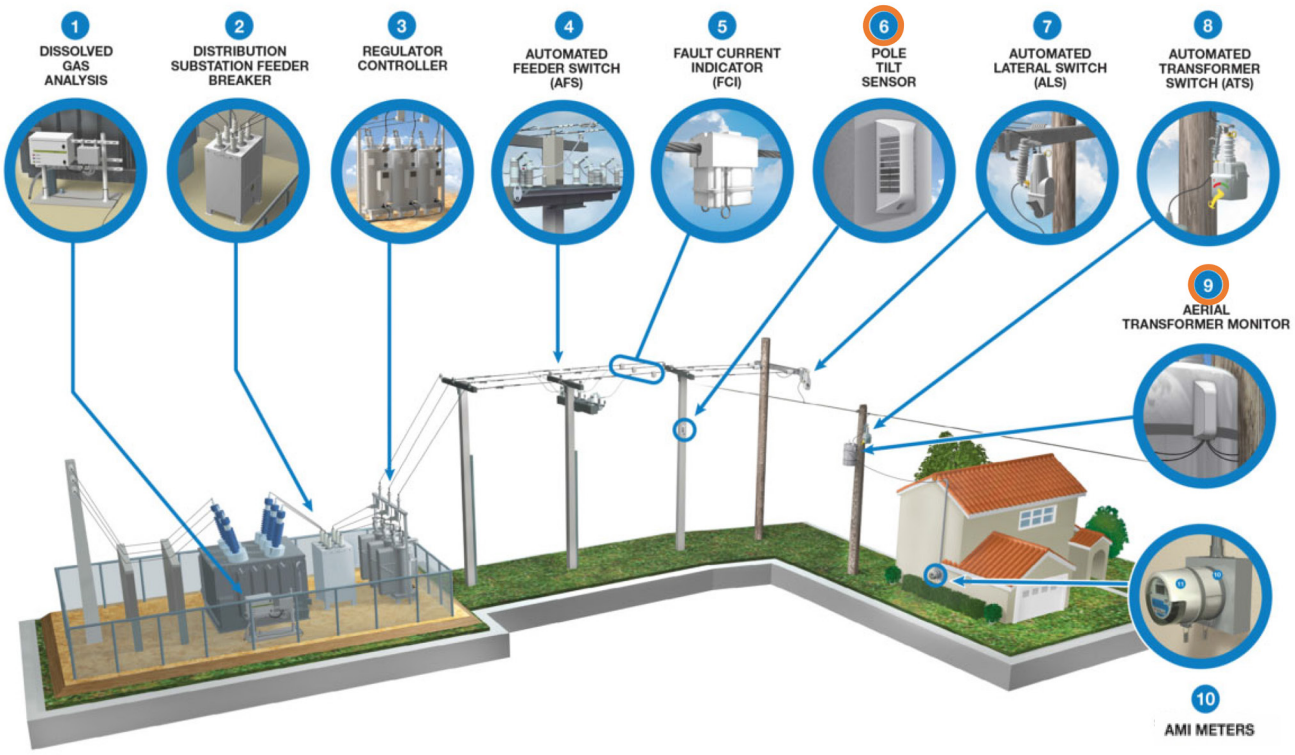
Recognizing that the current US grid is aging and that environmental impacts and shifting customer usage present additional challenges, FPL developed what Mr. Ortiz termed "a vision of the utility grid" and the "ultimate grid of the future."

Among the elements of this smart grid of the future are: 1) dissolved gas analysis for station transformers; 2) distribution substation feeder breakers; 3) regulator controllers; 4) automated feeder switches (AFS); 5) fault current indicators (FCI); 6) pole tilt sensors; 7): automated lateral switches (ALS); 8) automated transformer switches (ATS); 9) aerial distribution transformer monitors; and 10) AMI meters.

To pursue this vision, FPL developed a technology strategy to maximize smart grid value. It has four areas of focus:

1. Hardware that captures high-quality data at the grid edge.
2. High-speed, high-volume, low-lag communications. The system needs to communicate rapidly and reliably.
3. System health that identifies and corrects data quality issues—to self-check, so to speak, and ensure data integrity.
4. Algorithms that identify problems and operationalize data into actionable tasks.

Figure 1: Smart grid of the future



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For maximum value, FPL focused its initial partnership with Ubicquia on creating a solution that would fall into the overlap section of these four focus areas. What resulted was an articulation of the type of equipment that was needed.

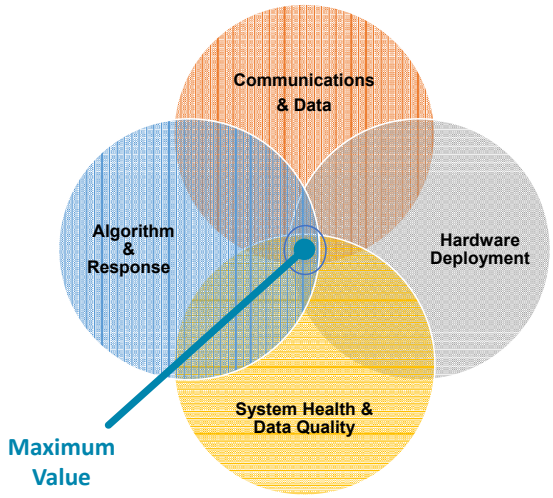
> We really need to have reliable equipment that's easy to deploy that provides sound data that's doing self-checks on the information coming through in the data so we can make intelligent decisions.
>
> *Jow H. Ortiz, FPL*

FPL and Ubicquia defined three grid sensor requirements for their data and utility solutions.

Working together, FPL and Ubicquia developed three grid sensor requirements that initially informed decisions around design methodology focused on distribution transformers and utility poles. These requirements are:

1. **Providing critical data.** This is high quality at the grid edge. This critical data includes real-time monitoring of parameters such as power output and percent capacity, oil temperature and hotspots, dynamic oil pressure, and pole tilt and vibration. *Example: measuring the right information, not just easy-to-measure data.*
2. **High-speed, low-latency communications** in the network of choice to get data in a time-sensitive manner. Communication is provided by leveraging secure LTE communications networks, both public and private, to get data in real time, allowing users to provision and report the data on an intuitive cloud-based dashboard. Ubicquia's cloud-based environment and APIs also enable customers to port that data into other systems such as SCADA, outage, or work order systems. *Example: real-time pole tilt and vibration measurements can indicate a falling pole.*
3. **Actionable insights** based on algorithms and intelligence both at the edge and head end, to operationalize processes based on analyzed trends. *Example: assessment of damage to grid assets while a storm is happening allows for earlier staging of repair crews and equipment.*

Figure 2: The four areas of focus of the FPL technology strategy



Meeting these three requirements provides a picture of the grid assets' true condition, and thus enables predictive modeling, which in turn results in proactive decision-making—rather than post-incident reactions—and extends the life of assets. FPL's intent is to invest capital to lower operating and maintenance costs.

> The real value here is when you know the transformer is in distress before it fails, not after it fails.
>
> *Charlie Nobles, Ubicquia*

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FPL and Ubicquia capitalized on their respective strengths to co-develop two initial products.

FPL and Ubicquia worked together to create and implement two initial products based on FPL's strategy and requirements. This partnership allows FPL to focus on its primary mission: to provide power to their customers, while leveraging the sensing technology and network expertise offered by Ubicquia.

> Communications is 80% of the problem with utility-grade equipment. The other 20% is the longevity of the equipment.
>
> *Jow H. Ortiz, FP&L*

In prioritizing the opportunities for data gathering, potential outage prevention, and/or equipment life extension, FPL identified two products for development: distribution transformer monitors and distribution pole tilt sensors. Ubicquia houses the data collected from these products on its servers in a secure, cloud-based environment. Customers like FPL can access this data through Ubicquia's web front end and use APIs to pull data straight into their software applications in real time for visualization and data analysis.

- **Distribution transformer monitors.** FPL has over 1.2 million transformers but understanding the condition of them was extremely difficult. FPL and Ubicquia developed the first scalable sensor that monitors the key attributes of a distribution transformer in real-time to actively reduce transformer tickets. The data measured by the monitors enables transformer health analytics, integrated with AI, to determine failure prediction and prevention. The monitors also contribute to the asset catalog with transformer location and specs.

  Information such as real-time transformer electrical parameters such as voltage, current, and delivered kVA (to determine if current diversion, overloading, or voltage anomalies are occurring) are collected for real-time analysis. In addition, oil temperature and pressure are measured to identify early signs of dielectric breakdown and thermal conditions in the transformer. Coupled with external factors such as tilt of vibration driven by environmental conditions, the utility gets a full view of the true health of the asset.

  The monitors also immediately notify operations if a fault occurs, such as the activation of a pressure relief device, resulting in cost savings via a lower time-to-restore. Analyzing these data points and applying AI models forms a more accurate characterization of life loss and helps to better understand assets.

- **Pole tilt sensors.** Florida's landscape often results in poles being placed where there is a lot of muck (a combination of mud and dirt) in the ground. Poles supporting more load from mounted equipment in these soil conditions can shift and lean after several years and pole tilt sensors track both location (within three meters) and tilt angle (within one degree) to measure these effects. Data collected about pole tilt allows FPL to reinforce or secure poles in anticipation of a failure, rather than after. Pole tilt sensors are also equipped with an accelerometer so in the event of a vehicle or tree striking a pole, that information is transferred instantaneously to the Ubicquia cloud-based database, further improving situational awareness of assets. By having these devices self-powered via integrated solar arrays and internal rechargeable batteries, they can easily be placed on utility pole transmission and distribution structures.

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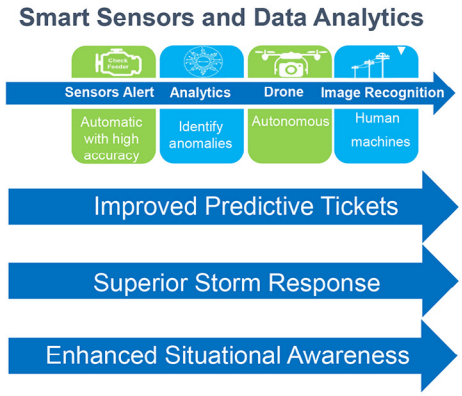
Figure 3: Future benefits of sensors

Adding sensors to our systems could lead to future algorithms such as:

- Enhanced fault location
- Disconnect switch status
- Transformer health monitor
- Better storm damage model
- Pole tilt status
- Customer power quality issues
- DG, EV and battery storage visibility



Smart sensors will increase visibility and help to predict outages before they occur.

Artificial intelligence predicts and extends the longevity of assets.

Because the FPL and Ubicquia solutions allow customization of data collected at endpoints and provide low latency and/or real-time data access, algorithms using AI built off of that information allow for predictive ticketing. In addition, the Ubicquia platform allows users to logically group assets, so preventative action can be taken based on vendor, size, or other attributes of assets.

The operationalization of the grid based on real performance data reduces outage time for customers, lowers operational costs, improves reliability of equipment, extends the longevity of assets, and more.

Ubicquia® started with a simple idea: we can use existing streetlights and utility poles to make communities smarter, safer and more connected. Since then, the company has helped municipalities, utilities and communication service providers control lighting costs; accelerate 5G deployments; extend public WiFi; deliver video security services; and protect against grid failures. Ubicquia's products are compatible with more than 360 million streetlights and 500 million utility poles worldwide. We are dedicated to making technology that is easy to install and affordable.

BIOGRAPHIES

Jow H. Ortiz

Special Projects Manager, Power Delivery -Technical Services, Florida Power & Light Company

Jow Ortiz is the manager of special projects for power delivery – technical services for Florida Power & Light Company (FPL). He is responsible for the design, specifications, construction, maintenance, and operations of the various corporate-wide projects related to IoT devices, analytics, AI development, and solutions development.

Charlie Nobles

VP of Sales, Ubicquia

Charlie Nobles is a telecom and energy veteran with 25 years of experience leading diverse sales, marketing, and product development teams. Charlie is the VP of sales for Ubicquia, a global smart solutions leader which offers utilities, municipalities, and communication service providers a cost-effective, reliable, and modular platform for deploying smart utility and smart city solutions and broadband services. Charlie heads Ubicquia's utilities segment, bringing a deep knowledge of utility grid operations from roles at Progress Energy (now Duke Energy Progress) and vendors that supported utility operations.