Managing Power Outage and Reliability Issues with OpenWay®

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Itron White Paper
OpenWay® by Itron
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Overview</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Outage Reliability Issue</td>
<td>3</td>
</tr>
<tr>
<td>Types of Outages</td>
<td>3</td>
</tr>
<tr>
<td>Key Outage Measurements</td>
<td>4</td>
</tr>
<tr>
<td>Current Outage Management Practices</td>
<td>5</td>
</tr>
<tr>
<td>Smart Metering’s Contribution to Redefining Outage Management Practices</td>
<td>5</td>
</tr>
<tr>
<td>Outage Scenarios and Applications with OpenWay</td>
<td>8</td>
</tr>
<tr>
<td>Confirming Power Restoration</td>
<td>13</td>
</tr>
<tr>
<td>Validating Meter Outage Times</td>
<td>13</td>
</tr>
<tr>
<td>Developing Load Profile for Load Flow Models</td>
<td>15</td>
</tr>
<tr>
<td>Backhaul Capabilities for Other Distribution Nodes</td>
<td>15</td>
</tr>
<tr>
<td>Load Shedding and Management</td>
<td>16</td>
</tr>
<tr>
<td>Monitoring Power Quality</td>
<td>18</td>
</tr>
<tr>
<td>Benefits Provided by the OpenWay RFLAN</td>
<td>19</td>
</tr>
<tr>
<td>Conclusion</td>
<td>21</td>
</tr>
</tbody>
</table>
Executive Overview
Reliability issues represent ongoing challenges for utilities. Customers see these challenges in occasional loss of power to their home or business. Utility managers and shareholders see these challenges in rising stress on energy delivery systems and in scrutiny by regulators of the consistency and quality of service delivered to ratepayers. Managing outages and power quality has a significant impact on the bottom-line performance of a utility. For example, improving key indicators such as the System Average Interruption Duration Index (SAIDI) can save utilities millions of dollars a year and improve relations with regulators, ratepayers and shareholders alike.

This paper describes the types of reliability issues a utility can encounter; how utilities currently handle these issues; and how a radio-frequency-based (RF) local-area mesh network such as OpenWay by Itron (referred to as the OpenWay RFLAN or simply RFLAN throughout this article) can provide significant benefits in improving response times, reducing restoration time and costs, helping prevent future outages, and optimizing asset management.

Introduction to Outage Reliability Issue
The modern distribution system begins as the primary circuit leaves the substation and ends as the secondary service enters the customer's meter socket. A variety of methods, materials, and equipment are used among utilities across the U.S., but the end result is similar. The electricity leaves the substation in a primary circuit, typically including all three phases. Primary circuits or distribution feeders emanating from a substations are normally controlled by a circuit breaker which will open when a fault is detected. Automatic circuit reclosers may be installed to further segregate the feeder and minimize the impact of faults.

Distribution systems are typically designed either as a series of lines radiating out from a single substation, or as a network of interconnecting lines energized by more than one substation or other points of supply—again using reclosure switches to dynamically reconfigure the network as required.

Interconnected systems are generally found in more urban areas. Points of connection are typically open, but switches can be opened and closed as necessary to create varying power flow configurations. Switches can be operated manually by line crews or remotely from a central office. Interconnected systems are the most complex to build and maintain, but in the event of a fault or required maintenance, a small area of network can be isolated and the remainder kept on supply.

Radiating lines are typical of rural areas with load areas isolated by long distances. These systems may be easier to design, build, and maintain, but long distribution lines can experience voltage drops which require power quality monitoring and voltage regulators or capacitors for correcting fluctuations.

Types of Outages
The Institute of Electrical and Electronics Engineers (IEEE) defines three types of outages or power interruptions based on duration:

- **Momentary** - Power interruptions lasting up to 3 seconds.
- **Temporary** - Power interruptions lasting between 3 seconds and a minute
- **Sustained** - Power interruptions lasting longer than a minute
Utilities vary on how they define their outages; they may extend, shorten or even combine these categories. For example, some utilities may classify any outage less than a minute as “Momentary” and outages that extend longer than a minute as “Sustained”, totally eliminating the “Temporary” category.

Distribution system outages can be caused by a variety of events. In the United States, the most frequent causes of outages are from animal interference and accidents involving the distribution system. Outages caused from storms or natural disasters tend to be infrequent, but when they do occur are much larger in scale. Individual customers can also lose power due to localized problems such as overloading, poor wiring, and so on.

For the purposes of this paper, the classification of different Severity of the outage on the distribution system is also considered and shown below.

<table>
<thead>
<tr>
<th>Fault Type</th>
<th>Definition</th>
<th>Affected Area</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Fault on the customer premise</td>
<td>One customer</td>
<td>Cleared by correcting the localized fault such as closing the open circuit breaker at home or business</td>
</tr>
<tr>
<td>F2</td>
<td>Fault on a distribution line between a fused transformer and customer premises</td>
<td>Several customers</td>
<td>Cleared by the transformer fuse</td>
</tr>
<tr>
<td>F3</td>
<td>Fault on an upstream distribution lateral</td>
<td>100 customers or more</td>
<td>Cleared by a fuse on the distribution lateral and/or correcting the fault that caused the fuse to trip</td>
</tr>
<tr>
<td>F4</td>
<td>Fault is on a main distribution line</td>
<td>Several hundred customers</td>
<td>Cleared by a line recloser or station circuit breaker with reclosing relay</td>
</tr>
<tr>
<td>F5</td>
<td>Fault is on the transmission line</td>
<td>Several thousand customers</td>
<td>Cleared by a station circuit breaker</td>
</tr>
</tbody>
</table>

To take all of this together means that we have two classifications of potential faults that need to be considered; Duration (Momentary, Temporary, Sustained) and Severity (F1, F2, and so on)

**Key Outage Measurements**

Outage performance is commonly measured by indices defined in the IEEE P1366-2003 standard. The most frequently used performance indices are described below

- **SAIDI** – The System Average Interruption Duration Index is commonly calculated by customer minutes or hours of interruption and provides information on total average time that customers are interrupted.
- **CAIDI** – The Customer Average Interruption Duration Index represents the average time required to restore service to a given customer per sustained interruptions.
- **SAIFI** – The System Average Interruption Frequency Index is designed to give information about the average frequency of sustained interruptions system wide.
- **CAIFI** – The Customer Average Interruption Frequency Index is designed to show trends in customer interruptions per year. It also helps show the number of customers affected out of the total customer base.
- **MAIFI** – The Momentary Average Interruption Frequency Index is the average number of forced momentary interruptions experienced per customer for a period of time (typically a calendar year).

These indices are important tools for key stakeholders to measure reliability and customer service improvements throughout the distribution system. Utilities seek to improve these indices by improving restoration efforts, increasing prevention methods, and lowering overall costs to shareholders.
Current Outage Management Practices

At the core of a modern outage management system (OMS) is a detailed network connectivity model of the distribution system. A utility’s geographic information system (GIS) is usually the source of this network connectivity model. By combining the locations of outage calls from customers, an automated rules engine can predict the locations and severity of outages. For instance, since the distribution system is primarily tree-like or radial in design, all outage reports from an area that are downstream of a fuse could be identified as caused by a single fuse or circuit breaker upstream from the location of the outage reports.

Phone calls to report outages are usually taken by workers utilizing a customer information system (CIS) in a call center. Another common way for outage calls to enter into the OMS is by integration with an interactive voice response (IVR) system. OMS systems are also commonly integrated with supervisory control and data acquisition (SCADA) systems that can automatically report the operation of monitored circuit breakers, switches or other distribution assets.

In any outage, identification of the problem depends on duration and severity of the service interruption. Smaller outages, and ones that are more commonly caused by animals or accidents, have a lower probability of being detected and reported to the utility’s OMS. Large-scale outages have a greater probability of being detected and reported to the OMS system due to their impact on a significantly higher number of customers. However, because they are larger in nature, verifying restoration of power to homes and businesses can be difficult and costly. Moreover, compound outages resulting from a combination of issues are extremely difficult both to isolate and to confirm that restoration has occurred at every connection point. Take for instance a storm situation where a significant distribution primary feeder goes offline due to ice accumulation, and at the same time a fuse trips and a tree branch falls, taking down a customer’s secondary service. The ability to identify and isolate these “nested” outages—and confirm each has been resolved—is very complex. If crews are released from a particular service area prior to verification of restoration of each of these incidents it becomes inefficient and costly to reroute them back to the same service area if problems are not corrected the first time.

Smart Metering’s Contribution to Redefining Outage Management Practices

Fundamental to any AMI architecture is the smart meter. These smart meters must be able to measure, record and store both consumption and voltage on a real-time basis to ensure the users of that data (consumers, utilities, energy suppliers and regulators) can understand what is happening within the system at any given time. This dynamic view into the system helps support both dynamic pricing and overall system operations.

- Smart meters should be able to both log events that occur as well as asynchronously communicate alarms for critical events. Examples of these would include a significant variation in voltage (power quality), as well as the loss and restoration of power. The smart meter needs to time stamp and log these occurrences to support recreation and analysis to identify root causes and mitigation strategies.

- Smart meters can provide these capabilities, especially the ability to distribute “alarm” notifications when outages occur, thereby enhancing the presentation of data to the utility’s OMS. This critical data is currently only presented to the OMS when a customer calls to report an outage or when outgoing calls to customers confirm restoration. Smart meters using AMI architecture act as virtual calls to the OMS, allowing for more rapid identification and isolation of power interruptions.

- By logging events such as momentary or temporary outages and providing this data to utility distribution engineering and design personnel, utilities can perform root cause analysis and provide system upgrade and repair recommendations for events that are difficult to track and isolate in today’s operating environment.
Sophisticated AMI deployments provide the utility with the ability to query nodes attached to the communications infrastructure to confirm status and request critical data. By taking advantage of the two-way communications of the AMI architecture, the utility can monitor continuously changing conditions as the system both deteriorates and dynamically restores as remedial action is effected. Coordinating and balancing all this collective data into useful information is a significant task—the situation can shift rapidly, especially under adverse weather conditions and compound outages.

**Key Communication Considerations for Outage and Restoration**

Power interruptions resulting from animal intrusion or accidents are fairly manageable within most AMI implementations. Events related to single point failures are isolated, identified and resolved based on incoming outage alarm reporting from smart meters. However, the utility can never be absolutely confident that all customers have been restored until concrete confirmation is achieved. Current operating practices make it very cost-prohibitive to contact 100% of the effected locations to confirm restoration; even so, not all customers are necessarily able to be contacted, especially with the increased number of portable phones which rely on power to operate. As an alternative, each smart meters capable of logging restoration events provide the utility operations center with automatic and proactive resolution management—a significant improvement over today’s approach.

This situation becomes exponentially more difficult when dealing with large-scale and potentially compound (or nested) outage situations. First, the AMI architecture must be designed in such a way to support a tremendous amount of alarm events occurring almost concurrently. Second, the design must be able to support large-scale query capability so that significant groups of affected locations can provide actionable data in a timely fashion. For example, all of the meters related to a particular distribution primary feeder or under a single reclosure switch must verify their status before releasing a restoration crew from a particular service area. The worst-case scenario involves the crew leaving, only to later find out that one or more service locations have suffered a secondary outage. One way to minimize the necessity to query all the nodes related to a particular incident is to utilize smart meters to proactively notify that restoration has occurred; used in this manner, only those that fail to report need to be queried.

The implementation of Smart Grid, smart meters and AMI applications is extremely cost-sensitive. Providing the right balance of functionality, a robust feature set and cost-effectiveness is the core of the challenge. One way of addressing this balance is by layering various communication infrastructures within the architecture, allowing for the appropriate levels of support throughout the infrastructure. Therefore, not designing and building the system to the highest requirement possible—as well as the cost—would be like building superhighways to every subdivision in America. Rather, an overall architecture embracing a “network of networks” is required, designed with open-standards to achieve the most functionality for the optimal cost.

To accomplish this, smart meters connected to AMI implementations in contiguous, saturated deployments typically seek to leverage a local area network (LAN) at the neighborhood level. The OpenWay AMI architecture supports a number of communication networks through the ANSI C12.22 open standard. Itron provides its RF-LAN mesh radio network as one way of tapping into a LAN for effective communication.
Mesh radio networking is a way to route data, voice and commands between nodes. It provides a continuous connection between nodes, and allows for reconfiguration around broken or blocked paths by “hopping” from node to node until the destination is reached. Mesh networks differ from traditional point-to-point radio networks in that the component nodes all receive and forward data meant for other end points; this allows for dynamic connectivity via multiple retransmissions or “hops”.

The Itron OpenWay RF-LAN—like other mesh radio networks—is self-healing. The RF-LAN continues to operate even when a single or multiple nodes break down or a connection is severed. This self-healing attribute makes the RF-LAN very robust and reliable. Smart meters operating within this communications infrastructure are equipped with algorithms that manage real-time connectivity to the upstream wide area network (WAN) through an OpenWay Cell Relay by analyzing link margin, RF interference and the various available paths. Any node can dynamically change their connections to neighboring nodes or to alternate Cell Relays as conditions change, either immediately or over time. Each node retains intuitive knowledge of a number of different communication pathways at any particular time which allows it to adjust on the fly to ensure robust communications.

OpenWay provides self-healing benefits not only between nodes but also between Cell Relay points. The images below are real-life examples of what happened when lightning struck, rendering a Cell Relay inoperable. Notice how meters switched from associations with the yellow Cell Relay to the other Cell Relays after the interruption in service.

**Before**

Nodes reporting to a single OpenWay Cell Relay before a lightning strike are indicated by the yellow dots on the map.

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**After**

Nodes reporting to multiple OpenWay Cell Relays after the strike are represented by several colors. The meters have used the “self-healing” technique to find additional hop paths to ensure communications with the network.
Because of their defining communication characteristics, mesh networks like the OpenWay RF-LAN can play an important role in outage management when combined with other nodes on the distribution system such as switches, breakers and fuses, as well as provide valuable information to GIS systems for understanding the duration and severity on a utility’s connectivity model. The OpenWay RF-LAN can improve accuracy of outage identification and track which customers are out of power; as well as which customers have had power restored. Features such as outage messages, node pinging and restoration messages can be used to identify every customer who is out, when they first went out and when they were restored. Measuring and tracking these outage events is the key to accurately reporting and ultimately improving key outage indices. The table below illustrates this concept.

### Outage Scenarios and Applications with OpenWay

The application of the OpenWay RFLAN mesh network varies depending on the type of outage.

#### F1 Outage: Single Customer without Power

A customer contacts the utility to inform them of a power interruption. The utility needs to determine if the problem lies on the utility side of the electricity meter or within the customer’s premise. The ability to make this determination remotely eliminates the cost of unnecessary trips to the customer premise.

The OpenWay RFLAN presents a number of key features to verify where the outage condition lies.

- First, if the meter had suffered an outage due to an interruption on service at the distribution system an outage alarm should have been received, this is the utilities first indication that it is a customer-side fault.

- OpenWay provides “ping” and “ving” capabilities that can determine in 60 seconds or less if a single meter is energized, as well as the current voltage level on the meter (see the screen shot on the following page). By initiating an inquiry of this sort through the interface to the OpenWay AMI system, the call center operator can confirm whether power is available at the utility side of the meter, indicating the problem lies within the premise itself.

#### Table of Event Data

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<th>Item</th>
<th>Meter</th>
<th>Description</th>
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</table>
A customer service representative (CSR) can also verify with the meter data management (MDM) application to see if an outage notification was passed from the customer’s meter up through the system for verification. This eliminates unnecessary trips to the customer premise for “OK upon arrival” visits if the outage is actually on the customer side of the meter.
In a recent Southern California Edison (SCE) business case filing after a pilot OpenWay project, the published savings recognized by SCE was $76.8 million dollars or approximately $15.20 per meter over the life of the project by eliminating this type of activity. Itron estimates typical cost savings benefits of $1 per meter, per year, in savings.

**F2-F3 Outage: Neighbors or Neighborhood Without Power**

As previously mentioned, problems with a neighborhood distribution line will affect approximately four to 100 people.

When an OpenWay CENTRON meter loses power for one-tenth of a second it determines an outage event has occurred and stands by for four seconds. The media access control (MAC) layer—of the meter’s RFLAN connection—enters into a special mode in which the MAC layer stops listening to the mesh network and sends three very short messages (powered by the meter’s remaining energy stored in capacitors). The delivery of each message is randomized within a five second window. These outage messages are then processed by other meters that can hear them within the mesh network, even those not necessarily in the same cell. These messages are also identified by an outage number (incremented by outage events, not by sent messages). These messages are sent using the RFLAN native protocols to ensure they have the highest probability of being heard within the network.

If the meter recovers its power before the first outage message is sent, it cancels the outage notifications and may transmit a power recovery message. If the power comes back after the first outage message is sent, then the node will transmit the remaining two messages.

When an OpenWay CENTRON meter receives an outage message from a neighboring meter, its MAC layer indicates the outage notification along with the neighbor meter’s network address, the outage ID number and the time when the outage message arrived. The outage messages are forwarded to the OpenWay Cell Relay and immediately passed to the OpenWay Collection Engine as an alarm, which can then be displayed to system operators through various system interfaces. Other utility systems, such as an OMS, can subscribe to alarms received by the collection engine.
In the F2 and F3 scenarios, there is a high reliability that outage messages will be received and mapped. In general, for an outage affecting up to 100 meters, the utility will receive notification of the outage in less than 3 minutes with 95 percent reliability.

Once these messages are received, the OMS can begin predicting where the fault is located while crews are dispatched to the outage areas.

**F4-F5 Outage: Widespread Power Loss**

In large-scale outages, outage messages are transmitted and processed as described in the previous section. However, reliability of all the messages reaching the utility becomes an issue as the communications substrate—the mesh network—is essentially crumbling along with the power outage. The probability of nearby nodes hearing the outage message diminishes as meters in the outage area have lost their power and are unable to continue transmitting or passing the outage message to a Cell Relay and back to the utility. As messages are synchronized and mapped with GIS data, a perimeter describing the overall extent of the outage is created.
It is important to note that even with widespread loss of power, the mesh network is still capable of accurately describing where the outage is occurring. The network also provides important information on the magnitude of the outage, in addition to presenting operators with locations at which to open switches in the distribution system, containing the outage to the smallest possible area. As crews are sent out, dispatchers can provide nearly real-time data on where to look for the outage condition, saving windshield time and minimizing inconveniences to customers.

The OpenWay system can also ping a subgroup of meters that did not report an outage notification but are in the inferred outage area to validate they are in fact out of power.
Confirming Power Restoration

Accurately determining the location and extent of a power outage is only part of the equation. Equally important is accurately and quickly confirming power restoration after an outage has occurred. The OpenWay RFLAN provides several options for confirming power restoration. Similar to the characterization of outages by both duration and severity, we also need to consider these same grouping of events when discussing outages.

When power is restored to an OpenWay CENTRON meter that has experienced an outage, it generates a restoration message that is time stamped and transmitted within the standard C12.22 structure (as differentiated from the native RF LAN protocol in the case of an outage alarm message) and passed to the collection engine.

With the first option, other systems at the utility—such as the GIS, OMS, MDM and IVR—can subscribe to the restoration messages to automatically notify customers that power has been restored to their premise; provide dispatchers with a near real-time map of meters as power is restored; and guide field crews on whether they need to continue servicing their current area or move to another location.

The second approach is to map nodes in accordance with the utility’s connectivity model (such as by feeder and transformer level using OpenWay’s pinging capabilities) upon completion of power restoration by a crew. Upstream systems can initiate these commands to the individual meters to validate that power is restored. Upon validation, meter locations can be mapped to a GIS system to provide near real time guidance to field service crews.

Given the constraints on power and communications in a widespread outage, power restoration notification can vary according to size, time and reliability levels. In general, for outages affecting 100 to 500 meters, power restoration notification will arrive within 30 minutes with better than 90 percent reliability. For larger outages, restoration notification will arrive in the same approximate time window, but with slightly less reliability.

The meter outage message can be combined with critical location data; this information can be used to build enhanced connectivity models for transformers, feeders and substations across the service area. Automated algorithms with third-party vendors (such as OMS providers) can be developed to leverage this capability, providing operators and dispatchers with additional options for action. This include pinging meters based on transformer association according to the utility connectivity model as information becomes available, either from delivered restoration messages or updates from field crews on faults they have cleared. This provides valuable insight into whether correcting faults resolved all connectivity issues or gaps still exist. It also provides confidence for dispatchers and field crews to move along to other affected service areas.

Validating Meter Outage Times

In OpenWay CENTRON meters, every power outage and restoration is logged and stored in the meter as an event. During the next periodic read, the event passes through the OpenWay network and is managed and stored in the MDM application. Using the MDM, the utility can create reports on outage durations that fall within the time period they are analyzing, plus report on any interruptions that meet utility-specific definitions for momentary or sustained outages. Other key analytical work can analyze types of outages by feeder or frequency, or correlate it with other key data such as weather or CIS data to pinpoint recurring outage issues and fine tune planning and vegetation maintenance programs for these areas, thereby improving overall service to customers and reducing operational and maintenance expenses.
Analytics and reports such as these can provide time and cost savings when managing indices data and relay information to key stakeholders (such as management and regulators) in a timely fashion.

The table below is an example of key information that can be retrieved from the system to feed reports and compute indices.

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Item</th>
<th>Meter</th>
<th>Description</th>
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Developing Load Profile for Load Flow Models

OpenWay CENTRON meters and the RFLAN provide extensive meter and energy data for developing load profile curves. This information is available through OpenWay at any time and can be stored, pulled from and used by the MDM application.

With OpenWay CENTRON meters, utilities have the option of profiling data in four possible channels (on residential customers) and in up to eight channels on polyphase meters (most commonly used for commercial and industrial customers).

Profiling can be done in time increments of 5, 10, 15, 20, 30 and 60 minute interval lengths. Meters can profile the following energy values for kWh:

- Energy received
- Energy delivered
- kWh, kVAh received
- kWh, kVAh delivered
- Power quality information such as voltage

Meter configuration updates can be sent out and managed through the OpenWay Collection Engine. Meter reads can be collected as part of a scheduled task, or they can be collected on-demand with two-way communication from the collection engine down to the endpoint and back again. As with other meter reading applications, reading schedules are managed in the MDM application.

With OpenWay, utility personnel can obtain reads and perform analytics on the data from the MDM and update flow modeling scenarios, reduce collection efforts for load research costs for tariff designs, and analyze load specific segments of a utility grid during peak- and off-peak periods for improved asset management and load management of the system.

Backhaul Capabilities for Other Distribution Nodes

Because OpenWay is built on an open architecture platform, utilities can add any compliant nodes node within the network, such as AMI meters or Smart Grid nodes. Currently, any node that communicates using the ANSI C12.22 standard can be added to the system and utilize the RFLAN.
Itron is working with distribution industry leaders such as S&C Electric, Cooper Power, and Kinetics to integrate their products with the OpenWay RFLAN technology. At the current time, adherence to the ANSI C12.22 standard and high-latency product requirements enable use of the OpenWay RFLAN as a low cost “last mile” connectivity solution. This expands the value proposition to other grid devices with command and control switching or by providing mission critical information such as current, waveform data, and other critical distribution analysis (DA) application information.

At the cell relay level, utilities continue to adapt to current and future communication infrastructures such as public Wi-MAX or Wi-Fi and private networks. These networks can be used to execute DA applications across the distribution system, all controlled from one head-end system—the OpenWay Collection Engine.

Load Shedding and Management

OpenWay provides multiple options for utilities to shed load and manage outage conditions. One of its key features is a remote service switch, available as an option for the OpenWay CENTRON meter. This switch can be used to remotely connect, disconnect and limit power through a meter.

The load limiting capability provides a way to cap load at any particular residence by configuring the duration as well as amount of load that a customer can receive. This is performed at the collection engine or MDM application by scheduling disconnect events. In a November 2006 Smart Grid case study article, Southern California Edison (SCE) indicated a nearly $300 million savings from reducing the number of service calls related to disconnecting and reconnecting power at premises. This equates to nearly $60 per meter on average savings.
Load limiting can be configured based on intervals in the meter to control timing and impacts on customer loads. If the load exceeds the value specified, a switch opens and curtails usage. When aggregated with other premises, load can be capped to not exceed capacity on a transformer or feeder. This provides a contingency plan for conditions that happen upstream on a generation load or a downed transmission line. Public filings from Southern California Edison indicate that nearly $26 million in savings—about $5 per meter—result from reduced overtime costs for unplanned replacement transformer loading over a 20 year period.
The diagram below shows how these commands can be issued within the system for automatic disconnects, load limiting control, or in-home device management.

Monitoring Power Quality

The quality of power, not just its availability, is increasingly important to customers with sophisticated digital equipment. Power quality measurement and management can provide significant value to customers. OpenWay measures significant power quality values, provide utilities with tremendous insight for understanding and interpreting the load being delivered to customers. Utilities can realize savings once they understand when customers power quality is being compromised by environmental factors or when customers are using more than an average load due to adding and upgrading electronic equipment in their homes. Utilities can configure power quality events as alarms to provide near real-time notification of these events in suspected areas and provide faster response times when resolving power quality issues in the field.
The OpenWay CENTRON meter measures the following power quality indicators:

- **Configurable Voltage Thresholds**
  - Maximum instantaneous voltage/interval
  - Minimum instantaneous voltage/interval
  - Maximum average voltage/interval
  - Minimum average voltage/interval

- **Voltage Events and Alarms**
  - Maximum instantaneous voltage/interval threshold exceeded (based on maximum voltage per interval)
  - Minimum instantaneous voltage/interval threshold exceeded
  - Minimum average voltage threshold exceeded (based on average voltage at the EOI)
  - Maximum average voltage threshold exceeded (based on average voltage at the EOI)

Measurement intervals can be configured for time periods of one, five, 15, 30, or 60 minutes. Intervals can monitor voltage (Vh) for each phase, independent of billing interval data. Status bits are provided to indicate instantaneous minimum and maximum values.

All power quality events can also be configured as alarms that other utility systems can subscribe to through the collection engine.

**Benefits Provided by the OpenWay RFLAN**

The OpenWay RFLAN mesh network provides a number of outage and restoration benefits. Outage notification messages are presented to the utility in near real-time, without customer intervention through a traditional IVR system. These messages can be sent and processed within the OMS, and can provide outage location data to the GIS.
The following capabilities enable the dispatcher to process information through all stages of an outage.

**Enhanced Outage Detection and Reporting**
- Predict the most likely open point and meter sensor data inputs
- Recognize multiple system outages
- Dynamically change outage situations in real-time
- Monitor active outages
- Present which circuits are affected
- Identify customers affected by an outage
- Display the length of each active outage
- Manage crew assignments
- Reveal current outage status

**Enhanced performance indices**
- Improve power restoration, and thus reduce outage durations, due to outage location predictions
- Reduce outage duration averages due to prioritizing
- Reduce outage frequency due to use of outage statistics for making targeted reliability improvements

**Reduced costs**
- Eliminate wasted labor cost of “OK upon arrival” site visits—typically 70-75% of a utilities annual outage field visits
- Eliminate response times for restoration efforts to outage areas
- Avoid costs of returning to areas previously serviced
- Eliminate manual labor and errors when computing outage indices
- Optimize assets and field costs by proactively identifying malfunctioning equipment prior to failure
- Defer capital expenditures through better data-based planning

**Improved public relations**
- Improve customer satisfaction due to increased awareness and communication of outage restoration progress
- Provide estimated restoration times
- Improve media relations with accurate and timely outage and restoration information
- Reduce complaints to regulators with the ability to prioritize restoration of emergency facilities and other critical customers
Conclusion

OpenWay provides many important features intended to extend value to all stakeholders through improved operations, improved rates of return to shareholders, and new and interactive way to engage with your customers on the quality of their services..

OpenWay sets itself apart from the crowd of AMI systems flooding to market with several key and distinctive features including:

- Self-healing algorithms to improve overall connectivity of all nodes within the system.
- Proven open architecture and corresponding AMI ecosystem of best-in-class providers that enable OpenWay to deliver exceptional value.
- Extensive measurement capabilities of energy and power quality values for a more complete understanding of the load on your network.
- Significant alarms and notifications that improve the overall reliability and sustainability of your network.
- Load limiting capabilities that provide alternate contingency options for load management during unplanned or unforeseen events.

At Itron, all of our more than 8000 employees are committed to using our extensive experience, industry insight, and established and emerging technologies to deliver on our promise to help you optimize the delivery and use of energy within your system.
**About Itron**

Itron Inc. is a leading technology provider to the global energy and water industries. Itron Inc. consists of Itron in North America and Actaris outside of North America. Our company is the world’s leading provider of metering, data collection and utility software solutions, with nearly 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water. Our products include electricity, gas and water meters, data collection and communication systems, including automated meter reading (AMR) and advanced metering infrastructure (AMI); meter data management and related software applications; as well as project management, installation, and consulting services.

To know more, start here: [www.itron.com](http://www.itron.com).

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