Jefferson County PUD #1

Jefferson PUD Metering System Upgrade Project
Meter & Advanced Metering Infrastructure Proposal

Submitted by Itron, Inc.
April 19, 2017

The information provided herein is being provided subject to the condition that (i) it be held in confidence except to the extent required otherwise by law and (ii) it will be used only to evaluate Itron's proposal. Any third party that is given access to such information shall be similarly bound in writing.

This proposal may contain forward-looking statements regarding the timing and release of certain features or functionality. This forward-looking information is intended to outline Itron's general product direction. It should not be relied upon in making a purchasing decision and may not be incorporated into any contract.

Table of Contents

April 19, 2017

Jefferson County PUD
Attn: Alyson Dean
310 Four Corners Road,
Port Townsend, WA 98368

Dear Ms. Dean:

Itron would like to thank Jefferson County Public Utility District (PUD) for this opportunity to provide a response to your Meter and Advanced Metering Infrastructure Request for Proposal. We understand the PUD's desire to replace your existing remote electrical meter reading system with an Advanced Metering Infrastructure System (AMI) including a Meter Data Management System (MDMS). Additionally, you would like the MDMS to integrate with your existing NISC and Survalent systems, and the Itron water reading system.

We are pleased to offer our OpenWay Riva AMI and Itron Enterprise Edition Meter Data Management solution, as a Software as a Service (SaaS) model, where Itron's Cloud Services team will manage the IT infrastructure to maintain system availability, perform database backup, software updates, other support services. There will be no need for the PUD to add IT staff, hardware, or IT space to accommodate our solution.

Itron has mastered the accurate, efficient delivery of essential AMI functions, such as automated data collection, streamlined delivery of comprehensive billing determinants, remote connect and disconnect service, and outage notification and restoration. Our OpenWay Riva solution delivers assured coverage and provides the PUD a foundation for future growth. We are confident we can deliver all the AMI functionality you need to streamline and automate your electricity services, as well as automate your water services, when you are ready to seamlessly add that functionality.

Should you have any questions please feel free to contact me. I look forward to discussing our proposal with you.

Sincerely,

Rob Rickard
Area Manager
(509) 990-9216
rob.rickard@itron.com

Corporate Office

2111 N. Molter Road
Liberty Lake, WA 99019
800-635-5461

www.itron.com

Executive Summary

Itron thanks Jefferson County Public Utility District (PUD) for the opportunity to respond to your Meter and Advanced Metering Infrastructure RFP. We understand the importance of the project to the PUD and the objectives you are committed to achieving.

Our proposal covers all three prescribed Solutions — AMI, MDMS and electricity meters – an all Itron solution. Additionally, our proposed MDMS will integrate with your existing NISC, Survalent and Itron water reading systems.

As the PUD team evaluates proposals from Itron and others, we believe it is important to emphasize several aspects of Itron's proposed solution that not only differentiate it from those of our competitors, but also position the PUD for success beyond smart metering, and for a long term strategic partnership with Itron.

BUILDING A PARTNERSHIP FOR SUCCESS

Itron is proud of the numerous long-term relationships developed over our 40-years serving the utility industry, and the key partnerships developed on projects like the one the PUD is embarking on. A true customer-vendor partnership is the key to a successful project. It would be a privilege to serve as your technology partner on this project.

OPENWAY RIVA: UNIQUE, TRANSFORMATIONAL TECHNOLOGY

The next generation of our widely deployed OpenWay solution, OpenWay Riva, provides the most advanced, flexible, and secure network platform available. OpenWay Riva's open architecture supports the widest range of applications and communication protocols. From advanced metering infrastructure (AMI), to distribution automation (DA), demand response (DR), all on the same network with true plug-and-play support.

Two OpenWay Riva capabilities that are truly unique to the industry and transformational for utilities are:

- **Adaptive Communication**s — deploy a single network solution that incorporates three communications technologies – RF Mesh, PLC and Wi-Fi – working in concert in every meter. The technology automatically utilizes the most reliable and fastest communication path and most efficient modulation scheme based on location and network operating conditions to provide coverage that will exceed the RFP 99% network coverage requirement.
- **Distributed Intelligence** — puts intelligence in the most appropriate place at the edge of the network to enable better and faster actions to operational challenges - without having to move massive amounts of data over the network or into third-party systems for analysis and resolution.

EXPANDING VALUE OVER TIME

With OpenWay Riva, we have purposely created a platform that allows virtually any approved smart grid application, device or sensor to be seamlessly integrated, enabling a constantly expanding portfolio of valuable apps from a variety of sources. The following descriptions highlight several optional value-added applications currently available:

- **Locational Awareness** —Meters self-identify their location on the electrical network, resulting in a highly accurate, automatically updated connectivity model from transformer, to phase and to

feeder. (Please note that the roadmap release dates for this product are Q4/2017 – Feeder and Transformer; 1H 2018 - Feeder, Transformer and Phase)

- **Intelligent Voltage Monitoring** — Meters use 1-second voltage measurements and configurable voltage alarms for real-time monitoring of conditions across all customers, by transformer and feeder. This allows utilities a much more granular view into their system voltage profiles and allows voltage compliance monitoring for increased effectiveness of programs such as Conservation Voltage Reduction (CVR) and Volt/VAR programs. (Roadmap release date 2H 2018)
- **Energy Diversion Detection** — Using Distributed Intelligence within each meter, precise alerts of location, magnitude, and diversion type are available in near real time from the meter. Back office versions are typically only about 20% accurate at best. The accuracy of the distributed intelligence alarms are more than a 300% increase of that.
- **Outage Detection and Location** — Real time outage detection as well as analysis of location and scope, with a model that updates in just a few minutes. Not just relying on power outage/restoral messages and complex algorithms, Outage Detection and Location reduces the requirement for back office infrastructure by using peer to peer communications over the network to allow the devices that have power to determine which devices are offline. This yields a highly accurate outage model that updates quickly as restoration efforts begin, ensuring nested outages are resolved before crews leave the area and expediting the restoration effort.
- **Detection of High-Impedance Connections** — The High Impedance Detection App gives an electrical identification of a poor connection anywhere in the low voltage secondary. More than just a hot socket detector, this app will detect slowly increasing impedance connections before they become a hazard, as well as, sudden changes in impedance due to a downed wire or otherwise suddenly failed connection. The alarms that the utility will receive will include location, severity, how long the condition has persisted, whether it was sudden or slowly surpassed a threshold and information about the most likely cause to aid in an expedient resolution. An additional benefit of this app is the improved customer service experience it brings to the end customer. By addressing failing connections before they cause voltage problems, many customer complaints will be prevented altogether. For instances where it cannot be avoided, a customer call with a voltage complaint will be quickly resolved by instantly determining if a bad connection in the secondary as a possible cause.
- **Load Disaggregation** — Meters use 1-second measurements to non-intrusively provide real time disaggregation of total premise load into individual appliance usages to target load control efforts and increase the effectiveness of energy efficiency programs.
- **Water Reading Integration** –- Leverage the next generation IPv6 water endpoint, and support many of your existing Itron ERT modules. Seamlessly integrate water when the PUD is ready.

EXTENDING THE PUD ENTERPRISE NETWORK

With our proposed OpenWay Riva network, smart meters as well as other grid devices like grid sensors, distribution automation devices, or even smart cities and Internet of Things (IoT) devices will be capable of “plug and play” on the network – similar to the way a new laptop, printer, or smartphone is added to an enterprise IT network.

Our commitment to standards-based interoperability protects your investment long into the future. As new devices and applications hit the market, our network design supports easy adoption, when and where it makes sense for the PUD.

PUTTING THE SMARTS INTO THE GRID

OpenWay Riva delivers significant advantages in outage detection, conservation voltage reduction (CVR), theft detection, demand response effectiveness, and the capability to improve safety by detecting unsafe distribution conditions. These capabilities enable the PUD to build on to business case benefits and create new value.

Our solution exceeds customer expectations time after time:

- We optimized Avista's CVR efforts to ensure compliance and maximize savings.
- We enabled Southern California Edison to shave 30MW of peak load through a mass-market peak-time rebate program.
- We empowered Centerpoint Energy to detect outages and respond before the first customer call.
- We created value for Montana-Dakota by providing meter data through their network to a neighboring water utility.

SOFTWARE AS A SERVICE

Our Software as a Service (SaaS) approach is the most cost effective and lowest maintenance AMI/MDMS solution, because there is no headend for the PUD to purchase, install, or maintain. Itron SaaS provides a secure, scalable, multi-environment platform for development, test, QA and production. Data is always safe and backed-up. And software is continuously updated. IT disruption is minimized with our solution.

WHY ITRON IS THE RIGHT CHOICE FOR THE PUD

Successful AMI/MDMS projects strike the right balance between technology, cost, and risk. Itron offers the PUD the best technology solution available at a competitive cost of ownership, and the most reliable, most capable, and lowest-risk business partner. We have successfully connected and automated more than 150 million electricity, water, and gas meters in North America. Itron brings in-depth knowledge, experience, and the resources to ensure project success – on-time, within budget, to meet your business objectives and exceed expectations.

The PUD can depend on Itron!

Table of Contents

Solution Overview

At Itron, we understand Jefferson County Public Utility District (PUD) is looking for a vendor to provide a solution that seamlessly allows the PUD billing system to maintain full functionality as the meter reading systems transition to an Advanced Metering Infrastructure (AMI) and Meter Data Management (MDM) system.

As a **trusted partner** to the global utility industry for more than 100 years, and your partner for more than 15 years, Itron is the right choice to help you implement an AMI and MDM system. Our solution can deliver all the AMI functionality you need to streamline and automate your electricity services, and also automate your water services, when you're ready to add it. You can continue reading your water endpoints as you do today, and that data will be collected by our MDMS and sent to your NISC and Survalent systems for appropriate processing. Our world-leading Itron Enterprise Edition Meter Data Management (IEE MDM) system is a highly scalable enterprise application platform that manages critical meter data collection, Validation Estimation & Editing (VEE), billing determinant calculations, and data exchanges. IEE MDM stores register, interval, tamper, outage, and meter event data, including raw, validated, and estimated data. Your OpenWay Riva AMI network will be the foundation and help you realize additional opportunities, in the future.

We are is proposing our fully automated OpenWay Riva AMI solution with integrated IEE MDM, to deliver two way communications on an open-standards, truly interoperable IPv6 field area network. The network will expertly handle the transmission of data using only a fraction of available bandwidth with the remaining capacity available for numerous additional applications like, distribution automation, conservation voltage reduction, etc.

The differentiating features of our solution makes it possible for Itron to deliver AMI services with assured connectivity, and exceptional service levels. Your AMI system will:

- Seamlessly capture and transfer data from meters without truck-rolls
- Facilitate automated transfer of AMI data to PUD NISC and Survalent systems
- Connect and disconnect customers remotely, typically completed and acknowledged in 10 seconds (competitive solutions take almost a minute)

- Upgrade firmware and configurations Over the Air
- Obtain an on-demand read within 3 seconds (on average), which is more than twice as fast as the 7 seconds claimed by competitive solutions
- Expand billing opportunities (time of use, pre-pay, etc.)
- Support Demand Management with the ability for 2-way control devices to connect through the OpenWay Riva network

- Support transformer loading management
- Support numerous additional network opportunities, such as Home Area Networks (HAN), customer engagement, distribution automation, streetlight control, and interoperability with intelligent Internet of Things (IoT) devices.

You will not find a competitive solution that delivers the processing power, reliability, speed, and connectivity packaged into the OpenWay Riva platform. The technology that delivers excellent AMI services, while making IoT services available, is woven into every component of our OpenWay Riva

solution. These components combine to deliver state of the art AMI functionality that simply isn't possible with competitive solutions.

SOLUTION COMPONENTS

Itron is proposing a robust, efficient, open-standards, OpenWay Riva AMI network comprised of the following components:

- Itron-Cisco IPv6 network, with two-way communications, multiple backhaul technology options such as RF, WiFi, fiber and cellular, to name a few
- Robust headend, hosted by Itron Cloud Services — for meter provisioning, data collection, configuration management, storage, network management, and end to end security
- OpenWay Riva CENTRON meters with two-way adaptive communications technology and support for edge analytics and Home Area Network activity
- Cisco Field Area Network Connected Grid Routers
- Itron Enterprise Edition Meter Data Management system

1. Solution Applications Implementation

We are proposing our Software as a Service (SaaS) solution with the AMI headend hosted by Itron Cloud Services. With a SaaS implementation, there will be no need for PUD to add staff, hardware, or IT space to accommodate our solution. PUD will pay a predictable monthly fee. Application updates, upgrades and maintenance costs are included in the monthly fee.

Itron will:

- Procure all hardware and software components required for the solution
- Collect requirements, build, stand-up, and test the solution
- Support PUD staff in the establishment of standard application protocols for transfer of data to and from your NISC and Survalent systems
- Monitor IT infrastructure with regards to performance, availability, and possible intrusions
- Maintain the AMI headend with guaranteed system availability of 99.5%
- Perform application patch updates and upgrades
- Perform regularly scheduled backups

Once the system is up and running, tested, and accepted by PUD, the experienced members of the Itron Cloud Services team will continue to provide the following services at the intervals specified:

Task	Frequency
Monitor IT infrastructure to maintain system availability at 99.5%	Daily
Perform Database Backups	Daily
Perform Intrusion Detection Analysis	Monthly
Perform Software Upgrades	As needed – generally once a year

Provide Support Services	As needed
Execute disaster recovery plan	As needed

We currently have approximately 850 customers subscribing to our various Itron Cloud services offerings and achieving very positive, value driven outcomes.

By adopting ISO 27001 standard principles, Itron data centers comply with security concerns pertaining to data center security, network security, system management, and access control.

- **Data Center Security** — Itron Cloud Services maintains stringent physical security policies and controls access to the data center. The first layer of security includes photo ID proximity access cards. Proximity card reader devices are located at major building entry points and are used to secure the data center. Access to data center controls is further restricted to select employees. All perimeter doors are alarmed and monitored. Authorized customers and vendors are only allowed into the data center with an escort. The access control system continuously monitors and logs all entries. Access records are stored for reference.
- **Network Security** — Data center networks are protected using redundant enterprise-class firewalls. Firewall rules are specific with respect to address and destination port and are custom-configured for each system. In addition, Internet-facing servers reside in a DMZ. Networks are monitored and managed using state-of-the-art tools.
- **System Management** — Itron's experienced professionals configure all customer systems to use enterprise-class storage and RAID configurations to ensure redundancy, security, and high performance levels.
- **Access Management** — Role-based security is used to limit and control access. Only those given access by agreement or written approval are granted access to the system at the defined level. Active Directory is used when appropriate. Itron Cloud Services use domain forest trusts. Proprietary private message queues are used for customers. Group policies ensure product services are running and proper rights are enforced. User access to any internal employee is immediately revoked upon termination of employment.

2. Meter and Network Equipment Installation

Itron understands PUD will install the meters and network equipment. With our "zero-touch" deployment, installation couldn't be easier. When a meter or router is added to the network, the devices will self-discover and automatically register with the network management system. This fully automated process ensures OpenWay meters and Connected Grid Routers (CGR) can securely authenticate on the OpenWay Riva network without requiring any manual configuration.

The total time to install a Cisco Connected Grid Router (CGR) is approximately 30 minutes. The system's zero touch deployment capabilities eliminate the need for the installer to interface with the CGR during deployment.

The Itron headend provides auto-discovery services for smart meters - through standard application protocol registration. When a meter becomes aware on the network, it sends a registration request to headend. Initial meter provisioning can take a few seconds to several minutes and includes a key exchange process that establishes mutual authentication between the smart meter and the headend.

No intervention is required from the field technician. Based on the imported information and system settings, the headend determines if the device is allowed to become part of the smart metering network.

3. OpenWay Cellular Options

In those instances where a less dense meter population may result in less than optimal communications performance using Riva ACT, Itron provides a selection of point-to-point communications to WAN networks using 4G/LTE digital cellular. Cellular electricity meters are managed through the same OpenWay Operations Center and Cisco IoT Field Network Director software used for Riva ACT meters, giving utilities access to all the same robust smart metering functionality regardless of the communication technology used.

Cellular electricity meters also offer a cost-effective way to support point-to-point communications for targeted deployments such as opt-in type pilot programs where there may be as few as one customer in an area that needs to be automated.

We will work with the PUD to determine the most cost-effective deployment the cellular electricity meters.

4. Optional Functionality

Growing portfolio of analytics applications. As utilities look beyond meter-to-cash, the data collected by IEE MDM has untapped value to be leveraged to extend benefits related to improving reliability of the distribution grid and improving customer satisfaction. IEE MDM serves as the central data "hub" of high quality data that is shared across the architecture to support each utilities unique "Big Data" strategy. In addition, Itron offers purpose-built analytical applications to solve customer problems. Whether you're looking for immediate value from an Itron Analytic or to distribute data across the architecture to other best-of-breed applications, IEE MDM is the foundation for a highly reliable data management strategy

Itron recommends several optional IEE MDM modules and Itron Analytics applications. We selected these applications to help PUD maximize the benefits and economic outcomes associated with IEE MDM.

IEE MDM comes pre-integrated with Itron Analytics, which is a series of applications that create additional value and insights from smart metering data. Itron Analytics turns metering data into actionable intelligence to improve operations, distribution system efficiency, system reliability, and asset management.

The following table summarizes each recommended "optional" application.

Application	Description	Why You Need It
Itron Analytics: Reliability Analysis	This analytics application presents precise historic information of the exact start and stop times of service interruption at each service delivery point, and uses these results to measure improvement in restoration time from automated distribution processes. It also reports the outage scope and cause at higher levels in the circuit.	Reliability Analysis displays outage information to identify poorly performing feeders, transformers, meters, and other devices so you can target them for remediation. Users can also track and report KPIs according to feeder, substation, and service territory.

Application	Description	Why You Need It
	Reliability Analysis provides reliability indices such as SAIDI/SAIFI/CAIDI, and other indices as defined by IEEE.	
Itron Analytics: Transformer Load Management (TLM)	This analytics application provides accurate connectivity mapping of transformers to actual load. OpenWay Riva devices monitor power flows locally on both sides of the transformer and manage the bidirectional load in real-time to ensure that it does not exceed the rated capacity of the transformer. This application provides real-time, local monitoring of transformer loading.	TLM manages transformer loading locally and intelligently, controlling both load and distribution energy resources (DER). This application also performs loss-of-life analysis, which predicts when transformers need to be replaced.
Itron Analytics: Voltage Analysis	This analytics application monitors voltage at every delivery point in the distribution network. Analysts can monitor trends and develop system improvements through a holistic approach using measured data, rather than reacting to individual customer complaints or relying solely on system models.	Voltage Analyst can help reduce technical loss, identify conservation voltage reduction (CVR) opportunities, and reveal Volt Var Optimization (VVO) opportunities. By proactively resolving conditions before they become serious issues, a utility can increase customer satisfaction and prevent equipment damage.
Itron Analytics: Outage Detection	This analytics application performs a distributed analysis of outage data via peer-to-peer communications.	This application determines the scope of the outage and continuously monitors and updates the extent of the outage based on updates from power-up/down messages from the meters. It can also forward summarized outage information to the OMS to estimate restoration time.

RFP Functional Requirements

INSTALLATION AND INTEGRATION REQUIREMENTS

1. General Installation and Integration Responsibilities

The selected Vendor will provide the PUD with the required meters for installation by the PUD, or a PUD contractor. Due to the availability of funds and personnel, this period could extend over a three to four year period.

The selected Vendor shall coordinate with the PUD to develop a detailed implementation plan and schedule. The schedule should include any required outages and interruption to customer service and provide a description of the implications to the Electric or Water System functionality.

It is envisioned that the PUD will install all of the new meters in a regional approach, requiring the collection system to be designed to expand coincidentally or preceding the regional meter installations.

The Vendor shall be responsible for all other equipment required for the AMI system. The Vendor may propose an approach, utilizing the PUD equipment, crews, or PUD employed and approved Contractors, for field installation of devices that require mounting locations throughout the PUD System. In all cases the work shall be done only with the approval of the PUD.

Response: Itron understands and will comply with the installation and requirements listed above.

METER DATA MANAGEMENT SYSTEM

1. **The Vendor is to provide a meter data management system (MDMS) to meet the PUD requirements and integrate with the PUD NISC and Survalent systems. The Vendor shall gain the approval of the PUD regarding the location and capacity of data storage requirements.**

Response: IEE MDM meets the requirements of the PUD and supports integration to PUD's NISC and Survalent systems. We will also consult with PUD regarding data storage requirements.

2. **The MDMS must be able to output the appropriate billing determinates to the PUD existing customer information system and meter reading interface system allowing for future rate designs including, but not limited to, metered consumption, flat rates, tiered rates, time-of-use rates, prepayment and demand rates. A sample copy of the proposed MDMS System reports, along with any user defined reporting capabilities, shall be provided with the Vendor's Technical Proposal.**

Response: Itron's IEE MDM system complies with this requirement.

The AMI Interval Data Billing module aggregates meters and/or channels as needed to calculate billing determinants. Stored formula channels can aggregate and store the interval data by customer and rate class. It can also separately calculate billing determinants for meters or channels that are part of aggregated (or virtual) meters.

Please refer to Supporting Material, item B, for documentation on standard IEE MDM reports.

3. **The MDMS is required to provide data validation, editing, storage, archiving, retrieval, and will interface with a large variety of critical utility business systems. The MDMS will provide the meter data storage and management platform, allow links to business applications and analysis tools to enable staff to make use of the AMI data and will supply available data to Customer Information Systems. The minimum services the MDMS will provide are collection, storage, management, and validation of meter readings (including estimations and data editing), meter asset management functions, support for virtual connects and disconnects (through the electric meters), load-limiting, on-demand reads, high/low usage monitoring, and coordination of service orders, and support for rate design and analysis.**

Response: Itron's IEE MDM system complies with all the all requirements listed above.

The IEE MDM system is the world's leading MDM solution. IEE MDM is a highly scalable enterprise application platform that manages critical meter data collection, Validation Estimation & Editing (VEE), billing determinant calculations, and data exchanges. IEE MDM stores register, interval, tamper, outage, and meter event data, including raw, validated, and estimated data. Its function is to centralize the collection, processing, storage, and complex analysis of meter and other utility-related data.

The optional Service Order Module allows IEE to automatically generate service order requests (field activities), and send them to the NISC for follow-up.

During phase one of the implementation process Itron will conduct Requirement Workshops to establish PUD's exact requirements around service orders, and then determine if this optional module is appropriate and/or required to meet your business objectives.

4. **The MDMS shall also provide support for customer service representatives, customer bill inquiries, real-time customer support via phone, e-mail, and online web access, data transfer to outage management system (OMS), enhanced customer support and information, electric system planning and design, system loss detection/estimation and other advanced applications.**

Response: IEE CSR Module provides utility personnel with an easy-to-use interface to view a customer's historical usage information, view meter events recorded by the smart meter, and execute two-way control commands to the AMI meters, and data transfer of outage information to OMS.

METER AND AMI REQUIREMENTS

1. **The successful bidder shall supply all meters described in this specification and an Advanced Metering Infrastructure System (AMI) that is fully and completely compatible with the supplied meters.**

   The AMI system must interface with the PUD Survalent SCADA system, NISC customer information meter reading system that may include additional future customer information system modules.

Response: Itron's proposed solution complies with this requirement.

Itron has performed Supervisory Control and Data Acquisition (SCADA) integrations with several vendors including Alstom IDMS/SCADA, Telvent OASys at BC Hydro/Power Tech Labs, and Survalent OMS/DMS/SCADA at EdG (Ecuador). We can also integrate with systems from other vendors via published OpenWay Riva and Cisco northbound APIs.

Itron is working with partners like OSIsoft to provide connectivity to different SCADA systems on the water side.

2. **The AMI system will provide near real time data to the PUD office for power and water consumption measured by each of the respective meters in the system hourly. The AMI system should also be capable of transporting data from third party devices for use by the Survalent SCADA System.**

Response: Itron's proposed solution complies with this requirement.

3. **The Vendor must provide, and integrate all required information technology network hardware and software. The primary hardware and software are to be suggested by the Vendor and may be located at the PUD Irondale electric service center communications room with PUD approval.**

Response: We are proposing a Software as a Service hosted solution supported by Itron Cloud Services and will integrate all required hardware and software.

4. **All Software licenses shall be provided in the PUD's name.**

Response: Itron will comply with this requirement.

The minimum AMI System requirements are outlined below. This list is not intended to limit innovative solutions and other options that meet or exceed the PUD requirements.

ELECTRIC METER REQUIREMENTS

1. **The following types of meters shall be provided:**

   a. **Residential Home Meters: Form 2S CL200 240V, or approved equal**

Response: Itron can provide this meter.

   b. **Residential Meters with remote disconnect: Form 2S CL200 240V, or approved equal**

Response: Itron can provide this meter.

   c. **Small Business Meters: Form 2S Demand CL320 240V, Form 2S Demand CL200 240V Form 4S Demand CL20 120 to 480V, Form 12S Demand CL 200 120V, or approved equal**

Response: Itron can provide these meters.

   d. **Large Business/Commercial: Form 9S (8S) Demand CL20 120 to 480V, and Form 16S (15S, 14S) Demand CL200 120 to 480V, or approved equal**

Response: Itron can provide these meters.

   e. **Bidirectional Meters (for small distributed generation): Form 2S Net CL200 240V and Form 9S (8S) Meter CL 20 120 to 480V, or approved equal**

Response: Itron can provide these meters.

   f. **Residential Network Meters Form 12S CL200 120V, or equal**

Response: Itron can provide this meter.

   g. **Residential Network Meters with remote disconnect: Form 12S CL200 120V, or approved equal**

Response: Itron can provide this meter.

2. **Compatibility**

   All new meters shall have the AMI Module installed as a factory component.

Response: Itron electricity meters comply with this requirement.

Any system employing ERT reading shall be fully compatible with the PUD's water meters that are equipped with the Itron 50W, 60W and 100W ERT modules.

All new meters shall be fully compatible with the AMI specifications as stated below.

3. **Functionality**

   The following list is a set of minimum requirements for the meters used for the AMI system. This list is not intended to limit innovative solutions and options that meet or exceed the PUD requirements.

   a. **All AMI System shall maintain time synchronization for all meters, nodes, and other devices connected to the network.**
   b. **All AMI meters shall provide time-stamp capabilities.**
   c. **All AMI meters shall be uniquely identified in the network.**
   d. **All alarm, fatal and nonfatal errors, and consumption information shall be "pushed" as events occur or consumption periods end from the AMI module to the AMI server.**
   e. **All residential electric meters shall be capable of reporting meter reads hourly.**
   f. **All commercial electric AMI meters shall be capable of reporting meter reads every 15 minutes.**
   g. **All AMI meters shall have the ability to monitor and report voltage in a time frame that allows the utility to respond proactively to the information.**
   h. **All meters shall have remote programming capability, including firmware updates.**
   i. **All meters shall be able configurable for time of use (TOU), critical peak pricing (CPP) and real- time clock.**
   j. **All meters shall be capable of two-way communications.**
   k. **All meters shall support outage detection, restoration and reporting.**
   l. **All residential meters shall support tamper detection.**
   m. **All commercial meters shall have a minimum of 45 days of data storage capability (4 channels 15 minute intervals).**
   n. **All meters shall have near real-time on demand reading capability.**
   o. **All meters shall provide near real-time voltage quality data (outage alarms, restoration notices, and voltage alarms) to support system operations, and other distribution system applications.**
   p. **Remote disconnect meters must report disconnect status.**

q. **All meters shall have consistent accuracy throughout the 20 year expected life of the meter of at least 0.5%.**

r. **All meters to have compatibility and optional Power Quality functions available that can be communicated to the PUD electric SCADA system.**

s. **All meters shall have a power outage carryover feature (battery or super capacitor).**

t. **All meters shall be solid state digital.**

u. **All meters to have upgradeability for advanced features.**

v. **All demand meters shall be configurable for rolling 5 minute interval data (T=15 or T=60).**

w. **Current limiting capabilities for remote disconnect meters.**

x. **All Meters shall have a Bidirectional metering feature option. All meters shall have field communication and reconfiguration capability.**

Response: Itron meters comply with requirements a-x above.

y. **All Meters shall include Hot Socket detection**

Response: Planned for a future release. The functionality will support for a programmable temperature threshold. The threshold value will be set as part of the meter's configuration. When the threshold is exceeded, the meter will automatically log an event (with date and time stamp) and send a subsequent alarm. In the event the temperature drops below the programmable threshold; the meter will log a temperature threshold cleared event with date and time stamp.

Additionally, the meter temperature will be captured and stored in the meter daily and can be retrieved locally as well as by upstream reading systems.

z. **Any special tools, communication hardware, or software required for field communication and configuration of the meter shall be supplied to the PUD.**

Response: CENTON meters support zero touch deployment. Itron will provide FDM Tools for deployment diagnostics communications with the meter.

4. Data to Transmit

The meters shall have the functionality and ability to transmit the data elements listed below. The Bidder shall indicate to the PUD at the time of the bid if there are additional costs or fees above and beyond the cost included in the bid for specific data elements on the list below. The PUD shall then select the data elements to include prior to the awarding of the contract.

1	Consumption View for Single Phase Meters	Included	Optional
a.	Meter ID:	•	
b.	Meter Type:	•	
c.	Product:	•	
d.	Disconnect Status:	•	

e.	Meter Form:	•	
2	**Consumption Information**		
a.	kWh:	•	
b.	kW:	•	
c.	kVAh:	•	
d.	kVA	•	
3	**VQM (voltage quality monitor)**		
a.	Last VQM Time:	•	
b.	Last Min Voltage:	•	
c.	Last Max Voltage:	•	
d.	Events:	•	
e.	Last Outage:	•	
f.	Last Sag:	•	
g.	Last Swell:	•	
h.	Date/Tim	•	
i.	Blink Count: Response: An outage occurs when the meter powers down.	Not available	
j.	Last Blink Count: Response: Power outage is date and time stamped.	Not available	
k.	Number of Blinks: Response: Supported by the Itron Analytics Reliability Analysis application.		•
l.	Minimum Voltage:	•	
m.	Maximum Voltage:	•	
n.	VQM Status Reports per interval:	•	
4	**Polyphase meters**		
a.	Meter ID:	•	
b.	Meter Type:	•	

c.	Product:	•	
d.	Firmware Version:	•	
e.	Meter Form	•	
5	**Transformer**		
a.	CT Ratio: if programed into meter Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
b.	Transformer Ratio: if programed into meter Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
c.	PT Ratio: if programed into meter Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
d.	Installed Switches: Response: Transformer meters do not support a switch. Disconnect switch is supported on Form 1S, 2S, and 12S/25S meters.	•	
e.	Device Selected:	•	
f.	Device Type:	•	
g.	Assoc. Status: Associated	•	
h.	Service Status: In Service	•	
6	**Consumption Readings**		
a.	Last Read kWh: Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
b.	Last Read kVAh: Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
c.	Last Read kVARh: Response: All readings are secondary in the meter. Meter multipliers are applied at the headend.	•	
d.	Voltage Readings	•	

e.	Last Read Time: Response: Supported by the voltage monitoring profile in each interval.	•	
f.	Last Read Volts A: Volts	•	
g.	Last Read Volts B: Volts	•	
h.	Last Read Volts C: Volts	•	
i.	Current Readings Response: Instantaneous Average supported.	•	
j.	Last Read Time: Response: The OpenWay system captures and stored information specific to each endpoint registered on the system. These Endpoint Details include serial number, device type, network device id, registration status, firmware versions, recent job history, fatal error history, last read time, bound HAN devices and group membership status, and more. From this window an operator can node ping, register and check the disconnect switch of a meter over the air.	•	
k.	Last Read Current A: Amps Response: Please refer to our response to item “j” above.		
l.	Last Read Current B: Amps Response: Please refer to our response to item “j” above.		
m.	Last Read Current C: Amps Response: Please refer to our response to item “j” above.		
7	**Power Quality**		
a.	Last Read Time: Response: The CENTRON polyphase meter provides advanced power quality monitoring capabilities to help C&I customers monitor and ensure that their equipment is receiving the high-quality power that it needs.	•	
b.	Power Factor:	•	
c.	Line Frequency (Hz):	•	
d.	Voltage Harmonic Content		
e.	Voltage Sag/Swell Qualification Period: (all phases)	•	

f.	Volts Phase A	•	
g.	Volts Phase B	•	
h.	Volts Phase C	•	
i.	Sag Voltage: Volts	•	
j.	Swell Voltage: Volts	•	
k.	Monitor Sag/Swell On/Off	•	
l.	Outage Monitoring	•	
m.	Phase A Outage Qualification Period: (1 – 10 sec.) Response: The meter supports a programmable inst. voltage high/low latency time that is applied to all phases.	•	
n.	Phase B Outage Qualification Period: (1 – 255 sec.) Response: The meter supports a programmable inst. voltage high/low latency time that is applied to all phases.	•	
o.	Phase C Outage Qualification Period: (1 - 255 sec.) Response: The meter supports a programmable inst. voltage high/low latency time that is applied to all phases.	•	
8	**Peaks**		
a.	Peak kW:	•	
b.	Peak Time:	•	
c.	Coincident kVA: Response: On the product enhancement roadmap.	Not available	
d.	Reset Time:	•	
e.	Coincident kVAR: Response: On the product enhancement roadmap.	Not available	
f.	Peak kVA:	•	
g.	Peak Time:	•	
h.	Coincident kW:	•	
i.	Reset Time:	•	
j.	Coincident kVAR	•	

k.	Peak kVAR:	•	
l.	Peak Time:	•	
m.	Coincident kW: Response: On the product enhancement roadmap.	Not available	
n.	Reset Time:	•	
o.	Coincident kVA: Response: On the product enhancement roadmap.	Not available	

Please refer to Supporting Material, items F, G and H for CENTRON meter product specification sheets.

PROJECT SCOPE AND EXPECTATIONS

The PUD goal is to deploy an AMI system covering 99% of the metered endpoints in the PUD service territory. The existing meters will be replaced with a solid state electronic meter designed to communicate with an AMI system capable of supporting the features discussed in this RFP. More than one communication technology may be necessary to meet geographic, population density, and availability constraints. Interoperability, therefore is going to be a key consideration in this project and in the selection of the AMI and MDMS systems.

The PUD is planning to implement the AMI system in multiple phases.

Response: Our proposed solution supports multiple communication technologies and interoperability. We recommend implementing the AMI network in one phase, preferably in phase 1. Project meters can be rolled out in phases. We will work with PUD to develop an efficient and cost effective implementation plan.

Please refer to the sample project implementation plan located in Supporting Material, item D.

PHASE 1 – AMI SYSTEM AND INITIAL METER INSTALLATION

Install AMI system to include primary and backup systems.

Install 30 electrical meters for PUD commercial and industrial customers. Install 500 electric meters for PUD residential customers.

This group shall be set up with final remote reading capability to include daily reads (hourly), ping ability, remote disconnect, demand reads, limited storage.

The Vendor shall begin AMI system training to PUD staff. This will involve two groups. One will be accounting/billing staff and the other will be engineering and operations. This initial Training should be sufficient to allow the PUD to operate the Phase I installation.

Response: We will work with PUD to develop and implement an efficient and cost effective plan to meet PUD Phase 1 requirements.

OTHER PHASES

The balance of the deployment will be coordinated and scheduled with PUD Operations after the successful completion of Phase I. It is anticipated that the meter deployment will proceed by selecting a number of small manageable geographic areas across the Utility Service District until full coverage is achieved.

Response: Itron can support PUD Operations after Phase 1 as the meter deployment proceeds, based on PUD requirements. Zero-touch deployment capabilities allow PUD to deploy at desired speeds - in small manageable geographic areas until full coverage is achieved.

AMI SYSTEM TRAINING

1. Overall AMI System Introduction

This training will be an introduction of the AMI system to include relevant services. This will be a general course and the intended audience will include most of the PUD staff.

Response: Itron will comply with this requirement.

2. Electric Meter Installation

This training will cover the installation of electric meters and the operations and maintenance. The intended audience of this course will be personnel involved with meter installation and maintenance and will include operations and engineering staff.

Response: Itron will comply with this requirement.

3. AMI System Hardware and Software

This section of training will include all of the AMI system components but not limited to; hardware, network software. The staff included with this training will be system operators and network personnel. This may include NISC and other Systems Vendors used by the PUD.

Response: Itron will comply with this requirement.

4. Consumer Billing

This section should include how to import and retrieve data from the AMI system and the PUD's current NISC customer information system. Included in this training specifically must be how to view and interpret near real-time consumer data and proper operation of remote disconnects. This training will include operations, administrative, customer service representatives and network staff. This may include NISC and other Systems Vendors used by the PUD

Response: Itron will comply with this requirement.

5. Operations

The purpose of this training will be to instruct PUD system operators how to effectively use the AMI system and services. This training will include but not limited to; logging into the system, obtaining on demand meter readings, historical data, remote connect/disconnect, field device operation and programming, configuring for various features and functions, communications with third party devices, any required System or Data maintenance, on site

trouble shooting, and the outage management application. This training will include operations, network staff and may include NISC and other Systems Vendors used by the PUD.

Response: Itron will comply with this requirement.

QUALIFICATIONS AND EXPERIENCE

The Vendor shall describe their background and history in providing AMI systems and installation services. This should include the number of years of experience in AMI Systems, the services currently provided to other Utilities, and the Vendor's position in the AMI market. Any experience with integrating the AMI system with NISC, Survalent, or similar software that may be pertinent to this project.

Response:

From manufacturing our first electromechanical meter in 1899 as the Sangamo Electric Company, to our current high-technology global operations, Itron has evolved to become the leading global provider of solutions to the utility industry.

We were incorporated as Itron, Inc. in 1977, and since that time, we have dedicated ourselves to developing technologies to allow our customers to transition from manual, labor-intensive processes to more automated and efficient systems for a wide range of utility applications.

Beginning in 2002, we aggressively and selectively expanded our capabilities through strategic global acquisitions. These acquisitions included ***Silicon Energy*** in 2003, ***Schlumberger Limited Electricity Metering*** in 2004, and, most recently, ***Actaris Metering Systems*** in 2007.

Today Itron is a leading global provider of meter information collection and analysis systems, as well as applications and services to optimize the delivery and use of electricity, gas, and water.

We are trusted to supply smart city components to some of the world's most innovative and forward-thinking utility AMI and smart city projects.

Itron has managed the installation of hundreds of AMR/AMI systems and over 20 million AMR/AMI meters, including projects that have required the installation of 1million plus meters in a given year. Information in the following tables is not intended to be a comprehensive list, but is representative of the installation projects we have worked on in the past five years.

AMI Deployment

Customer Name	AMI Product	Total # meters /endpoints	# meters / endpoints deployed to date
CenterPoint Energy	Electric	2,300,000	complete
DTE Energy	Electric	2,250,000	2,200,000
Duquesne Light Company	Electric	600,000	100,000
FortisBC	Electric	120,000	complete
Public Service New Hampshire	Electric	540,000	complete
San Diego Gas & Electric	Electric	1,400,000	complete
Texas New Mexico Power	Electric	240,000	156,000

City of Baltimore, Maryland	Water	405,000	380,000
Cleveland Water Department	Water	385,000	complete
City of Madison, Wisconsin	Water	68,000	complete
City of Ottawa, Ontario	Water	210,000	complete
Suffolk County Water Authority (New York)	Water	350,000	300,000

Recent Itron Enterprise Edition Meter Data Management (IEE MDM) System integrations

MDMS	Customer	Number of meters
IEE MDM	Southern California Edison	5 million
IEE MDM	San Diego Gas and Electric	2.4 million
IEE MDM	BC Hydro	1.9 million
IEE MDM	DTE Energy	3.4 million
IEE MDM	FirstEnergy	2 million
IEE MDM	Duke	315,000
IEE MDM	Glendale Water and Power	120,000
eMeter EnergyIP	CenterPoint Energy	2.2 million
eMeter EnergyIP	Burlington Electric Department	20,000
Oracle MDM	Duquesne	600,000
Oracle MDM	Los Angeles Department of Water and Power	50,000

For detailed information about our implementation methodology please refer to the Itron Advantage Implementation Methodology document located in Supporting Material, item E.

Itron has performed Supervisory Control and Data Acquisition (SCADA) integrations with several vendors including Alstom IDMS/SCADA, Telvent OASys at BC Hydro/Power Tech Labs, and Survalent OMS/DMS/SCADA at EdG (Ecuador). We can also integrate with systems from other vendors via published OpenWay Riva and Cisco northbound APIs.

In addition, Itron's IPv6 co-development effort with Cisco supports the transport of DA application protocols such as DNP3 and IEC 61850 over the IPv6 field area network.

Itron is working with partners like OSIsoft to provide connectivity to different SCADA systems on the water side.

OTHER REQUIREMENTS AND CRITERIA

1. Domestic Content of the system, meters, and critical hardware components

Response: Itron CENTRON meters are manufactured in the USA. Cisco Connected Grid Router network equipment is also manufactured in the USA.

2. PUD duties/responsibilities to operate and maintain the AMI System

Response: With our proposed SaaS model Itron installs and maintains all necessary computer systems at our professionally-managed data centers, effectively acting as PUD's private offsite IT department. Itron will provide PUD assigned personnel with user identifications and passwords ("User IDs") to access the Software-as-a-Service applications. PUD will have full access to the software application. PUD will be responsible for the daily operations (e.g., data collection, reports generation, event & alert monitoring, configuration settings, etc.)

3. Operating Software and Hardware System is to be at least 10 years from installation to obsolescence, and for the Meters 20 years.

Response: The OpenWay Riva system's ability to download firmware to all components of the network over-the-air provides a fast and efficient method to evolve the features and functionality of this system throughout its 20-year operating life. Critical for preventing obsolescence. The ability to download firmware to all components of the network, including field area routers and non-meter edge devices, provides utilities a fast and efficient manner to evolve the system over its life.

Itron meters are designed to have a life expectancy of 20 years and a long, maintenance-free operating life.

4. Any proposed exceptions to the RFP or AMI system agreement

The Vendor shall state any exceptions to this RFP and/or AMI system agreement.

The Vendor must submit a Proposal that conforms to the PUD terms and conditions set forth in this RFP, and the AMI System Agreement. However, the Vendor may also propose exceptions or clarifications to the terms and conditions of the AMI System Agreement that will materially affect the Vendor's charge for services.

For each proposed exception or clarification, the Vendor must provide a description of the proposed exception or clarification that identifies the page number, section number, and paragraph number (if applicable) of the appropriate text and must include a revision of that text that reflects the Vendor's exception or clarification. For each exception the Vendor must state the amount by which the proposed service charge would change should the PUD agree to the proposed exception.

Response: Itron is pleased to submit this proposal to Jefferson County Public Utility District ("Customer") in response to its Request for Proposal for Meter and Advanced Metering Infrastructure (the "RFP"). Our proposal is being made subject to the condition that Itron and Customer subsequently reach and enter into a mutually agreeable definitive written agreement for the proposed project. The Itron Master Sales Agreement template is included with Itron's proposal as an example of Itron's standard approach to transactions such as the one contemplated by Customer. If we are awarded this project, we intend to negotiate in good faith with Customer to reach such an agreement as expeditiously as possible.

The Itron Master Sales Agreement template is located in Supporting Material, item K.

Proposal Cost Sheet A

JEFFERSON PUD METERING SYSTEM UPGRADE PROJECT
REQUEST FOR PROPOSALS FOR
METERS AND ADVANCED METERING INFRASTRUCTURE (AMI)

Proposal of Itron, Inc. (hereinafter called "VENDOR"), organized and existing under the laws of the State of Washington, doing business as Itron, Inc.. To Jefferson PUD (hereinafter called "OWNER").

In compliance with the Request for Proposals for Meters and Advanced Metering Infrastructure (AMI), VENDOR hereby proposes to perform all WORK for the supply of the required meters and the supply, installation, startup of the AMI component in strict accordance with the RFP all documents in The Request for Proposals for Meters and Advanced Metering Infrastructure (AMI), within the time set forth therein, and at the lump sum price stated below.

By submission of this PROPOSAL, each VENDOR certifies that their PROPOSAL has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this PROPOSAL with any other VENDOR or with any competitor.

The undersigned VENDOR, having examined and determined the scope of the Request for Proposals for Meters and Advanced Metering Infrastructure (AMI) including RFP Documents, hereby proposes to perform the work described for the following unit cost amounts. Unit costs will be summed to a total project cost that will be used for evaluation of the RFP.

Proposal Cost Sheet A

	Meas. & Pmt. Reference	Item	Quantity	Unit	Unit Price	Amount
1	16400SP	Residential Meter – Form #2S CL200 240V	9500	EA	$78.25	$743,375.00
2	16400SP	Residential Meter W/Remote Disconnect Form #2S CL200 240V	7500	EA	$99.25	$744,375.00
3	16400SP	Small Business Meter – Form #2S Demand CL320 240V	500	EA	$88.00	$44,000.00
4	16400SP	Small Business Meter – Form #2S Demand CL200 240V	500	EA	$78.25	$39,125.00
5	16400SP	Small Business Meter – Form #4S Demand CL20 120-480V	400	EA	$175.00	$70,000.00
	16400Sp	Small Business Meter – Form #12S Demand CL200 120V	100	EA	$102.25	$10,225.00
6	16400SP	Large Business Meter - Form #9S (8S) Demand CL20 120 -480V	80	EA	$200.00	$16,000.00
7	16400SP	Large Business Meter – Form 16S (15S, 14S) Demand CL200 120-480V	150	EA	$200.00	$30,000.00
8	16400SP	Residential 12S CL200 120V 480V	200	EA	$200.00	$40,000.00
9	16400SP	Bidirectional Meter – Form #2S meter CL200 240V	250	EA	$78.25	$19,562.50
10	16400SP	Bidirectional Meter – Form #9S (8S) meter CL20 120-480V	20	EA	$200.00	$4,000.00
11	16400SP	AMI Network Infrastructure:	1	LS	$106,493.00	$106,493.00
11a	16400SP	Local System (~~servers~~, software, installation, etcetera)	1	LS	$268,065.00	$268,065.00
11b	16400SP	Field Collection Devices (number to be determined by vendor)		EA		N/A
11c	16400SP	Other Infrastructure	1	LS		N/A
11d	16400SP	Deduct for removal of Water Meter Reading Requirement	1	LS		N/A
		See Itron Pricing Summary for notes and assumptions				
					Total	**$2,135,220.50**

Respectfully Submitted:

Signature: 

Vendor: Itron, Inc.

Date: April 14, 2017

Proposal Cost Sheet B

JEFFERSON PUD METERING SYSTEM UPGRADE PROJECT
REQUEST FOR PROPOSALS FOR
ANNUAL TECHNICAL SUPPORT & HOSTING SERVICES

Proposal of Itron, Inc. (hereinafter called "VENDOR"),
organized and existing under the laws of the State of Washington, doing business as
Itron, Inc.. To Jefferson PUD (hereinafter called "OWNER").
In compliance with the Request for Proposals for meters and Advanced Metering Infrastructure (AMI),
VENDOR hereby proposes to provide technical support and data hosting services in the form of a renewable annual agreement in strict accordance with all documents in The Request for Bids for Meters and Advanced Metering Infrastructure (AMI), within the time set forth therein, and at the annual price stated below.

By submission of this PROPOSAL, each VENDOR certifies that their PROPOSAL has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this PROPOSAL with any other VENDOR or with any competitor.

The undersigned VENDOR, having examined and determined the scope of the Request for Proposals for Meters and Advanced Metering Infrastructure (AMI) including RFP Documents, hereby proposes to perform the work described for the following annual amounts.

No.	Meas. & Pmt. Reference	Item	Quantity	Unit	Unit Price	Amount
12		~~Annual AMI System Support~~ Connected Grd Router (CGR) Maintenance Support	17	Yearly	$693.50	$11,789.50
13		Off Site AMI Systems Processing and Maintenance	1	Yearly	$134,686.00	$134,686.00
14		Deduct for removal of Water Meter Reading Support				N/A

Respectfully Submitted:

Signature: 

Vendor: Itron, Inc.

Date: April 14, 2017

Itron

Electric / Gas / Water
Information collection, analysis and application

2111 N. Molter Rd.
Liberty Lake, WA 99019
fax: 866-787-6910
www.itron.com

Pricing Summary for

Jefferson County PUD

BMR# 12358-17 Ver1 Apr
April 17, 2017

Item	Category	Description	Qty	Unit Price	Extended Price	Notes
Meters						
1	Meter	OpenWay Riva CENTRON 2S CL200 no-switch	10,250	$78.25	$802,062.50	
2	Meter	OpenWay Riva CENTRON 2S CL200 with-switch	7,500	$99.25	$744,375.00	
3	Meter	OpenWay Riva CENTRON 2S CL320 Demand	500	$88.00	$44,000.00	
4	Meter	OpenWay Riva CENTRON Polyphase 4S	400	$175.00	$70,000.00	
5	Meter	OpenWay Riva CENTRON 12S Demand 120v no-switch	100	$102.25	$10,225.00	
6	Meter	OpenWay Riva CENTRON Polyphase 9S	100	$200.00	$20,000.00	
7	Meter	OpenWay Riva CENTRON Polyphase 16S	150	$200.00	$30,000.00	
8	Meter	OpenWay Riva CENTRON Polyphase 12S 480v	200	$200.00	$40,000.00	
9	Meter	Cellular adder - singlephase	TBD	$85.00	TBD	
10	Meter	Cellular adder - polyphase	TBD	$85.00	TBD	
		Meter Total			**$1,760,662.50**	
Network Infrastructure and Software						
11	Network	Connected Grid Router - CGR 1240, 4G w/CAM	17	$5,794.00	$98,498.00	*(1)*
12	Network	OpenWay Riva Routing Node (ORRN), Base	15	$533.00	$7,995.00	
13	Software	IoT Device Manager Application	1	$3,250.00	$3,250.00	
		Network Infrastructure and Software Total			**$109,743.00**	
Professional Services						
14	Services	Project Management Services			$214,640.00	*(2,3)*
15	Expenses	Project Management Expenses (estimated)			$10,380.00	*(2)*
16	Services	CGR Integration Services (Utility Customizations) - One time fee, per CGR	17	$350.00	$5,950.00	
		Professional Services Total			**$230,970.00**	
Itron Cloud Services						*(4)*
17	One-time	One Time - Initial Set-up Fee			$33,845.00	
					Annual	
18	Operations	Software as a Service - OpenWay			$134,686.00	
		Itron Cloud Services Total			**$168,531.00**	
		OpenWay AMI System Total			**$2,269,906.50**	
Annual Maintenance						
19	Maintenance	Connected Grid Router Support	17	$693.50	$11,789.50	

Itron

Electric / Gas / Water
Information collection, analysis and application

2111 N. Molter Rd.
Liberty Lake, WA 99019
fax: 866-787-6910
www.itron.com

Pricing Summary for

Jefferson County PUD

BMR# 12358-17 Ver1 Apr
April 17, 2017

Notes and Assumptions

(1) Final number of Connected Grid Routers and OpenWay Routing Nodes may vary based on actual field conditions. A site survey will be performed to determine the final configuration.

(2) Professional services pricing is based on the scope in the RFP along with assumptions that need to be confirmed. In order to create a formal Scope of Work and confirm the services bid, a discussion of project requirements will be necessary. Travel and expenses are included and will be billed at actual.

(3) Professional Services
Assumes SaaS configuration
Assumes all work, except workshop and training, will be remote.
Assumes use of gold copies for OW and IEE.
Assumes meters and network equipment installed by PUD.
Assumes 1 CGR and 10 meters installed in month 3 to facilitate system testing.

(4) Cloud Services - Software as a Service
Cloud Services to be provided from Itron's Cloud Services Data Center. Any services from an alternate data center will incur additional fees.
One system upgrade is included annually. Any configuration updates, training, data migration, integration and extended testing support and project management is not included and will be addressed via an SOW.
Pricing includes all hardware, labor, 3rd party software and maintenance in accordance with Itron's standard terms and SLAs for use of Itron application software.
Includes one production environment.
Servers deployed in a high availability environment.
Additional environments such as Disaster Recovery and Test environments are not included.
System configured to support up to 19,200 endpoints.
Up to 1 VPN tunnel is supported
Includes use of Oracle database as needed.
Where Microsoft SQL Server Standard edition or BI is required, it is provided for up to 5 users.
Under a SaaS offering, [Utility] will be responsible the day-to-day operation of the system and applications.
Itron to perform server administration, database administration, local area network administration, monitoring software administration, security administration.
Customer to perform CGR monitoring and troubleshooting.
Customer to perform interrogation monitoring, scheduling and troubleshooting.
Customer to perform endpoint exception monitoring and troubleshooting.
Customer to perform management and troubleshooting for MDM data imports/exports.
Itron assumes its IEE MDM can be integrated with customers CIS System using standard Itron supported APIs. If integration is not support through Itron APIs, additional services will be required.
Monthly wireless communications fees included for WAN backhaul.
Software subscription and Cloud Services pricing is based on a 5 year contract.
Contract term for a minimum of 12 months.

(5) Pricing is based on existing agreements or Itron's standard terms and conditions: Equipment Purchase Agreement, Maintenance and Support Services Agreement, Master Solution Agreement, Private Cloud Services Agreement, Professional Services Agreement, and Software License Agreement.

(6) Taxes, duties, and tariffs are not included. Prices are in US dollars. Prices are valid for 90 days.

Itron

Electric / Gas / Water
Information collection, analysis and application

2111 N. Molter Rd.
Liberty Lake, WA 99019
fax: 866-787-6910
www.itron.com

Pricing Summary for

Jefferson County PUD

BMR# 12358-17 Ver2 Jun
June 2, 2017

Item	Category	Description	Qty	Unit Price	Extended Price	Notes
Meters						
1	Meter	OpenWay Riva CENTRON 2S CL200 with-switch	17,750	$97.25	$1,726,187.50	
2	Meter	OpenWay Riva CENTRON 2S CL320 Demand	500	$88.00	$44,000.00	
3	Meter	OpenWay Riva CENTRON Polyphase 4S	400	$175.00	$70,000.00	
4	Meter	OpenWay Riva CENTRON 12S Demand 120v no-switch	100	$102.25	$10,225.00	
5	Meter	OpenWay Riva CENTRON Polyphase 9S	100	$200.00	$20,000.00	
6	Meter	OpenWay Riva CENTRON Polyphase 16S	150	$200.00	$30,000.00	
7	Meter	OpenWay Riva CENTRON Polyphase 12S 480v	200	$200.00	$40,000.00	
8	Meter	Cellular adder - singlephase	TBD	$85.00	TBD	
9	Meter	Cellular adder - polyphase	TBD	$85.00	TBD	
		Meter Total			**$1,940,412.50**	
Network Infrastructure and Software						
10	Network	Connected Grid Router - CGR 1240, 4G w/CAM	17	$5,794.00	$98,498.00	*(1)*
11	Network	OpenWay Riva Routing Node (ORRN), Base	15	$533.00	$7,995.00	
12	Software	IoT Device Manager Application	1	$3,250.00	$3,250.00	
		Network Infrastructure and Software Total			**$109,743.00**	
Professional Services						
13	Services	Project Management Services			$214,640.00	*(2,3)*
14	Expenses	Project Management Expenses (estimated)			$10,380.00	*(2)*
15	Services	CGR Integration Services (Utility Customizations) - One time fee, per CGR	17	$350.00	$5,950.00	
		Professional Services Total			**$230,970.00**	
Itron Cloud Services						*(4)*
16	One-time	One Time - Initial Set-up Fee			$33,250.00	
					Annual	
17	Operations	Software as a Service - OpenWay			$98,353.00	
		Itron Cloud Services Total			**$131,603.00**	
		Subtotal			**$2,412,728.50**	
		System Discount			**($49,176.50)**	
		OpenWay AMI System Total			**$2,363,552.00**	
Annual Maintenance						
18	Maintenance	Connected Grid Router Support	17	$356.25	$6,056.25	

Itron

Electric / Gas / Water
Information collection, analysis and application

2111 N. Molter Rd.
Liberty Lake, WA 99019
fax: 866-787-6910
www.itron.com

Pricing Summary for

Jefferson County PUD

BMR# 12358-17 Ver2 Jun
June 2, 2017

Notes and Assumptions

(1) Final number of Connected Grid Routers and OpenWay Routing Nodes may vary based on actual field conditions. A site survey will be performed to determine the final configuration.

(2) Professional services pricing is based on the scope in the RFP along with assumptions that need to be confirmed. In order to create a formal Scope of Work and confirm the services bid, a discussion of project requirements will be necessary. Travel and expenses are included and will be billed at actual.

(3) Professional Services
- Assumes SaaS configuration
- Assumes all work, except workshop and training, will be remote.
- Assumes use of gold copies for OW and IEE.
- Assumes meters and network equipment installed by PUD.
- Assumes 1 CGR and 10 meters installed in month 3 to facilitate system testing.

(4) Cloud Services - Software as a Service
- Cloud Services to be provided from Itron's Cloud Services Data Center. Any services from an alternate data center will incur additional fees.
- One system upgrade is included annually. Any configuration updates, training, data migration, integration and extended testing support and project management is not included and will be addressed via an SOW.
- Pricing includes all hardware, labor, 3rd party software and maintenance in accordance with Itron's standard terms and SLAs for use of Itron application software.
- Includes one production environment.
- Servers deployed in a high availability environment.
- Additional environments such as Disaster Recovery and Test environments are not included.
- System configured to support up to 19,200 endpoints.
- Up to 1 VPN tunnel is supported
- Includes use of Oracle database as needed.
- Where Microsoft SQL Server Standard edition or BI is required, it is provided for up to 5 users.
- Under a SaaS offering, Jefferson will be responsible the day-to-day operation of the system and applications.
- Itron to perform server administration, database administration, local area network administration, monitoring software administration, security administration.
- Customer to perform CGR monitoring and troubleshooting.
- Customer to perform interrogation monitoring, scheduling and troubleshooting.
- Customer to perform endpoint exception monitoring and troubleshooting.
- Customer to perform management and troubleshooting for MDM data imports/exports.
- Itron assumes its IEE MDM can be integrated with customers CIS System using standard Itron supported APIs. If integration is not support through Itron APIs, additional services will be required.
- Software subscription and Cloud Services pricing is based on a 1 year contract.
- Contract term for a minimum of 12 months.

(5) Pricing is based on existing agreements or Itron's standard terms and conditions: Equipment Purchase Agreement, Maintenance and Support Services Agreement, Master Solution Agreement, Private Cloud Services Agreement, Professional Services Agreement, and Software License Agreement.

(6) Taxes, duties, and tariffs are not included. Prices are in US dollars. Prices are valid for 90 days.

Itron Enterprise Edition Meter Data Management

System Overview

Table of Contents

Itron Enterprise Edition Meter Data Management — System Overview

As utilities consider the benefits of advanced metering infrastructure (AMI) and smart grid solutions, it's critical that they consider the potential impact of these new technologies on current business processes and IT infrastructure.

Purpose-built to isolate utility business processes and business systems from the details of advanced metering and data collection in a multi-vendor, multi-technology environment, ***Itron Enterprise Edition Meter Data Management (IEE MDM)*** — the world's leading meter data management system — was designed from the ground up to centralize the collection, processing, storage, and complex analysis of meter and other utility-related data. The result is a system that effectively applies consistent processes and maintains consistent interfaces, independent of how, when, or where various meter reading technologies are deployed. This simplifies and significantly reduces the likelihood of errors in business processes that make use of meter data. It also allows utilities to deploy the most cost-effective AMI/AMR meter reading technologies, without affecting upstream billing processes.

With three times the global market share (36%) of the nearest meter data management software alternative, Itron Enterprise Edition Meter Data Management (IEE MDM) is the most widely deployed meter data management system in the world. IEE MDM is in use at more than 75 utilities, managing data from more than 40 million meters — including more than 30 million interval meters.

IEE MDM Leads the Industry in MDMS Deployments

Itron has more production customers with systems managing more than 2 million meters than any other MDM provider. These utilities include BC Hydro, Florida Light and Power, San Diego Gas & Electric, Southern California Edison, and Southern Company. This breadth and depth of experience is reflected in the robustness of our product as we've encountered and supported AMI use cases for more than a decade. In that time, as well, Itron has successfully replaced multiple competing MDMS vendors at customer sites, including Southern California Edison and DTE Energy, as a result of proven performance, especially around processing of interval data.

Over the years, our customers have created a large, active, and engaged user community which is a tremendous asset in itself. IEE MDM business and IT users gather in person several times each year to share best practices for leveraging IEE MDM to its fullest. As a result of this large and engaged customer base, Itron is able to re-invest in the features and usability enhancements requested by users to ensure the evolution of the product over the life of the investment.

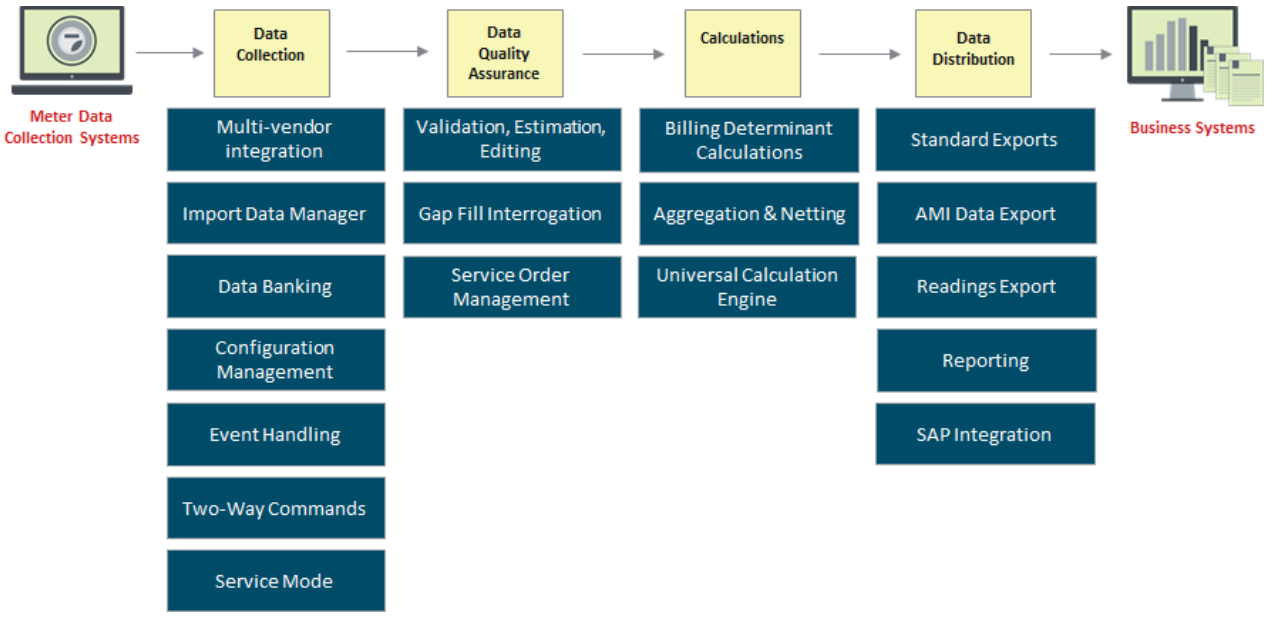
IEE MDM has long been positioned by Gartner, Inc. in the Leaders quadrant of the Magic Quadrant for Meter Data Management Products. Itron was ranked as a Leader for 2013, 2014, 2015, and 2016.

> *Itron's network of partners, base of customers, managed smart meters, and entrenchment in the market solidify its position as the top MDMS player in this Leaderboard. While the competition are all in close pursuit, Itron was able to differentiate itself by its roadmap and revamped strategy for its MDMS offering. The company is preparing a new strategy to meet the needs of customers in an IoT future. These innovations and upgrades will bring new technologies and capabilities to the market; this has the potential to revolutionize Itron's already comprehensive MDM solution.*
>
> Paige Leuschner
> Research Associate
> Navigant Research

Itron was recently ranked the Top Leader in the Navigant Research Leaderboard Report on Meter Data Management Systems (MDMS). According to the report, published in Q4 2015, Itron surfaced as ***"the company to beat, as it is firmly entrenched in the MDMS market and has big plans for the future."***

SYSTEM CAPABILITIES

Itron Enterprise Edition Meter Data Management is a highly scalable enterprise application platform designed to manage the critical meter data collection, validations, billing determinant calculations, and data exchanges needed to support today's AMR, AMI, and smart grid systems. IEE MDM stores register, interval, tamper, outage, and meter event data, including raw, validated, and estimated data. Its function is to centralize the collection, processing, storage, and complex analysis of meter and other utility-related data. It also provides consistent, meaningful data to other utility business applications in a multi-vendor, multi-service, and multi-technology environment.



High-level Meter Data Management Capabilities

DATA COLLECTION AND STORAGE

IEE MDM provides long-term storage, serving as the database of record for meter and event data from AMI and legacy AMR systems. The IEE MDM relational database provides a central repository for integration, and access by all utility business and analytical systems and users of meter data. IEE MDM provides long-term storage of scalar, interval, tamper and outage, and meter event data, including raw, validated, and estimated data. The data stored within IEE MDM is fully versioned. All data and all system activities are time-stamped, and the source of all data is recorded. All corrections or changes in the relationships and attributes of each configuration object are stored for future auditing. IEE MDM maintains an audit trail for all collected and modified data. IEE MDM will easily accommodate a utility's data storage and secure access requirements.

Multi-vendor Integration

IEE MDM provides the enterprise with a collection of key meter data management services that are standards-based and loosely coupled. IEE MDM's Collection System Integration functionality allows multiple advanced meter reading technologies from multiple vendors to be seamlessly deployed in conjunction with traditional meter reading methods. IEE MDM will import and manage data from the Itron OpenWay, MV-90, MV-RS, FCS, and Fixed Network solutions as well as from third-party headend system such as Aclara TWACS, Silver Spring Networks, Landis+Gyr, Sensus (FlexNet), EKA, Trilliant, Cannon (PLC), SmartSynch, and utility home-grown meter reading systems. This ability to manage data from modern and traditional meter reading methods and technologies, without impacting or modifying upstream billing processes, is critical for utilities. Itron's technology follows WS-* standards to ensure interoperation between our services and ESBs.

Import Data Manager

The Import Data Manager manages how data is imported into IEE MDM. Data can be sent directly from collection systems or through the IEE Reading XML file format. As readings arrive, the Import

Data Manager performs basic configuration validation to ensure readings data can be stored with the intended service point. The Import Data Manager provides four configurable routing options when importing meter data from collection systems.

- **Discard** — The data is not needed in the MDMS and can be discarded. Discarded data is not stored in the database and no additional processing of the data is performed.
- **Normalize and forward** — The data is needed to support data presentment and analytics scenarios that do not require additional validations and estimation. This data is immediately exported to the target application.
- **Standard Import Process** — The data is needed in the MDMS and will be stored. Readings are validated, estimated, and stored as they arrive.
- **AMI Import Process** — The data is needed in the MDMS and will be stored. Readings are processed as a whole day. As the last readings arrive, during our data collection window, the readings are validated, estimated, and stored in the MDM database. At the end of the data collection window, the process estimates all missing readings (such as occur due to RF communication failures).

Data Banking

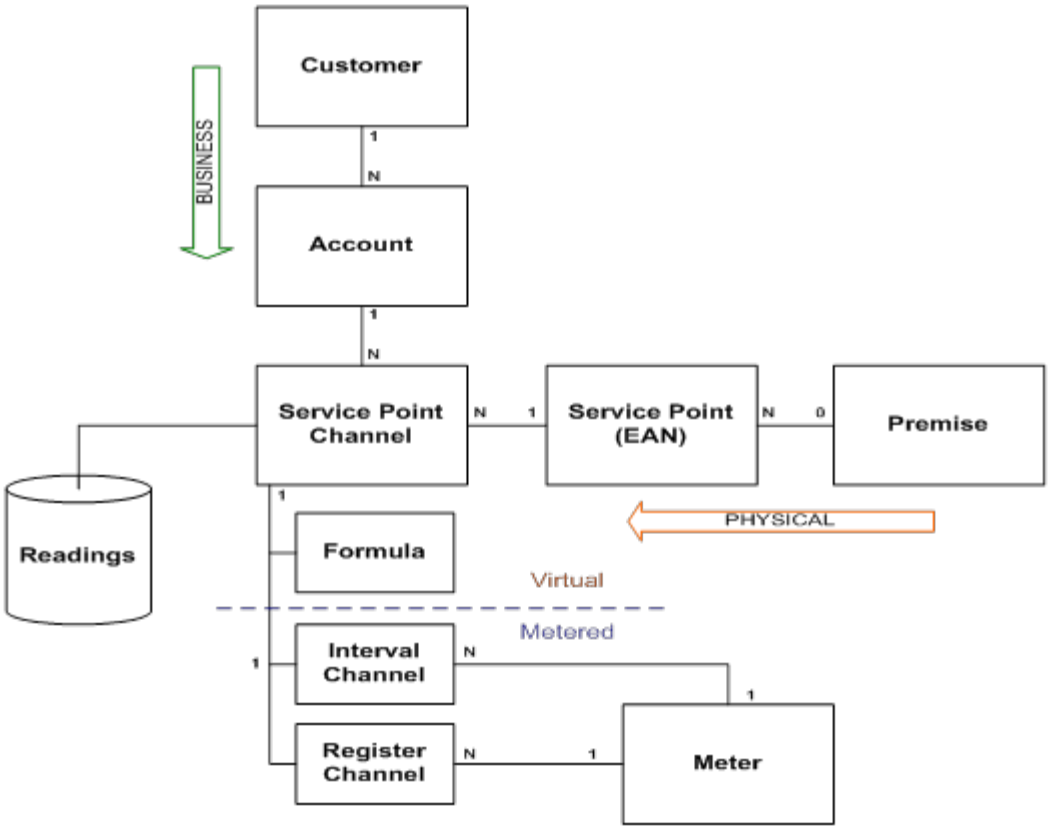
Data that cannot be imported is banked in the Banked Data Queue. Data is banked for the following reasons:

- No configuration for meter
- Data cannot be associated with a Service Point channel
- Missing external system UOM mapping
- Invalid interval length

The "banked data" process is instrumental in storing data from meters with incomplete configurations. In the event a meter sends readings to IEE MDM before it has been configured in the CIS, IEE MDM will import the new meter's readings and place them in a queue of banked data. This process will automatically resubmit the reading data to the IEE MDM database on a user-defined basis, so that no manual intervention is required on the part of the System Operator to re-import the meter reads. Banked data can be viewed, sorted, and manually resubmitted for processing.

Configuration Management

The IEE MDM data model manages the key data entities that provide detailed information about a service point at any point in time. The data model associates a service point with a meter, channels (registers or interval), and endpoints (or other vendor modules). Optionally, it also identifies the associated customer, account, premises, collectors, routes, and transformer. Each of these main entities has many attributes. For example, customers have customer name, address, etc.; meters have manufacturer, type, serial numbers, etc. The utility can also create user-defined attributes to associate any elements not tracked by the standard IEE MDM data model. These relationships are maintained in a persistent data store as long as the meter data is maintained, enabling the utility to identify all of the meters feeding a given account over time, with effective dates, and all of the accounts where a given meter has been installed over time, with effective dates.



IEE MDM Data Model

Customers, accounts, premises, service points, meters, channels, endpoints, and collectors are linked together in flexible relationships that are managed over time. Energy data streams may be collected from physical metered channels, endpoints, or modules, or calculated on-the-fly as needed.

As customers move in and out and as meters are exchanged, the current and previous locations of each entity are stored in a persistent data store. This allows users to easily identify all of the meters feeding a given account over time, with effective dates, and all of the accounts where a given meter has been installed over time, with effective dates.

All corrections of errors with these entities are also maintained in IEE MDM. Functionality allows comparisons between versions and also allows previous versions to be restored. For all changes and corrections made in IEE MDM, information about who (or what system) made the change, when the change was made, and why the change was made is maintained in audit logs.

Users can load, change, correct, and view the IEE MDM configuration data using the following packaged tools:

- Configuration Management User Interface
- XML Configuration Import API (batch or real-time)
- XML Configuration Export API (batch or real-time)
- Configuration Attributes Reports

Event Management

IEE MDM receives, stores, filters, normalizes, and transfers event data returned from the utility's meter reading systems. IEE MDM will support the event and alert data reported from the data collection systems. Currently, more than 2,000 event types are defined. IEE MDM also provides event filtering to ensure that only relevant event types are passed to each interfaced system or sent through email or other means to external subscribers.

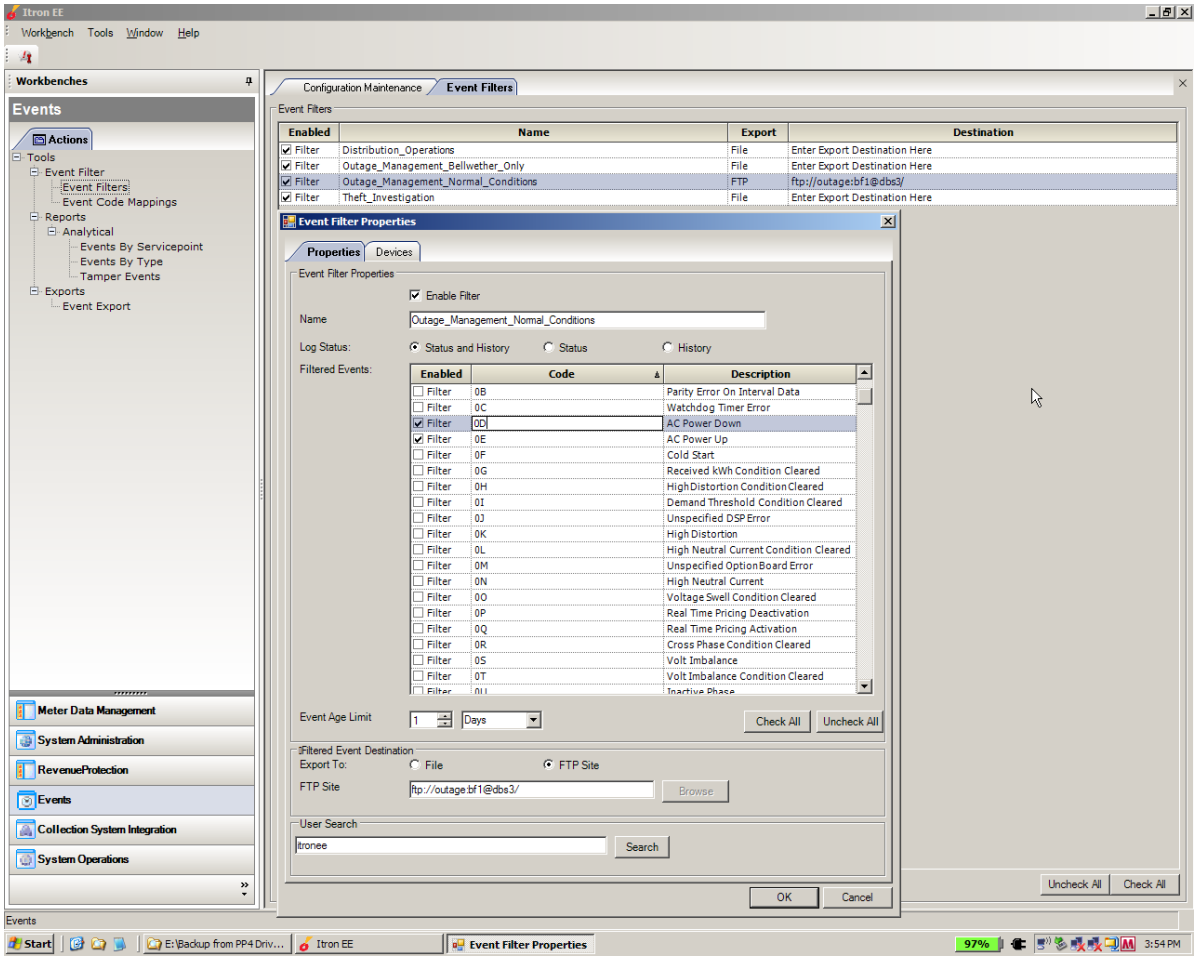
Mapping

Each meter reading technology and each meter type in a multi-vendor collection system environment may utilize a different coding system for events. For example, one system might return a literal ASCII message "power off" when an outage occurs; another might return a code like 30 or H3; and a third might return some abbreviation like PO.

IEE MDM normalizes events during the import process by mapping external system codes to a common internal event code. IEE MDM provides standardization for these messages in its XML interface so that an upstream OMS receives the same message for "power off" or "power on" regardless of which meter reading system returned it. Event mapping also allows customers to discard events without saving to the IEE MDM database.

Filtering

The Event Manager can provide filtering so that an external application receives only those events that are relevant to that application. For example, an outage management system generally wants to receive only relevant event types, such as power off and power on, and only if the event is not older than some predefined period.



Event Filters

IEE MDM can temporarily filter event reporting for a given meter during meter maintenance so that the system does not transfer false outages to outage management. In these instances, an alert or flag may need to be removed. For example, IEE MDM can filter events to help remove false positive tamper flags in instances where utility staff are performing maintenance at a meter installation.

IEE MDM provides the following event filters:

» Event time (the age of the event)

» Event type (‘choose many’ from event codes)

» List of meters

» Temporary block for maintenance

Event filters ensure that only those event types specified by the filter configuration are passed to each upstream interfaced system. The automated transfer of events to upstream outage management systems can be triggered based on an event arriving and passing the filter criteria. Events are transferred to upstream systems via a standard XML format.

IEE MDM also supports the option to send events to a queue to which one or more external systems can subscribe. This provides a reliable, scalable, and SOA-friendly mechanism for sending a large volume of device events to third parties or to an enterprise service bus (ESB), which can route the messages to another system, such as OMS. This approach is designed to accommodate the large number of device events typical in a mass outage scenario.

Service Orders

IEE MDM's event filters can also be used to generate service orders in the event that specific, user-selectable events occur. Using the event filtering capabilities, IEE MDM can notify the CIS or other system when certain events are received so that service orders can be created as needed. The optional IEE MDM Service Order Initiation and Tracking module also supports automatic service order request generation for specific meter event codes.

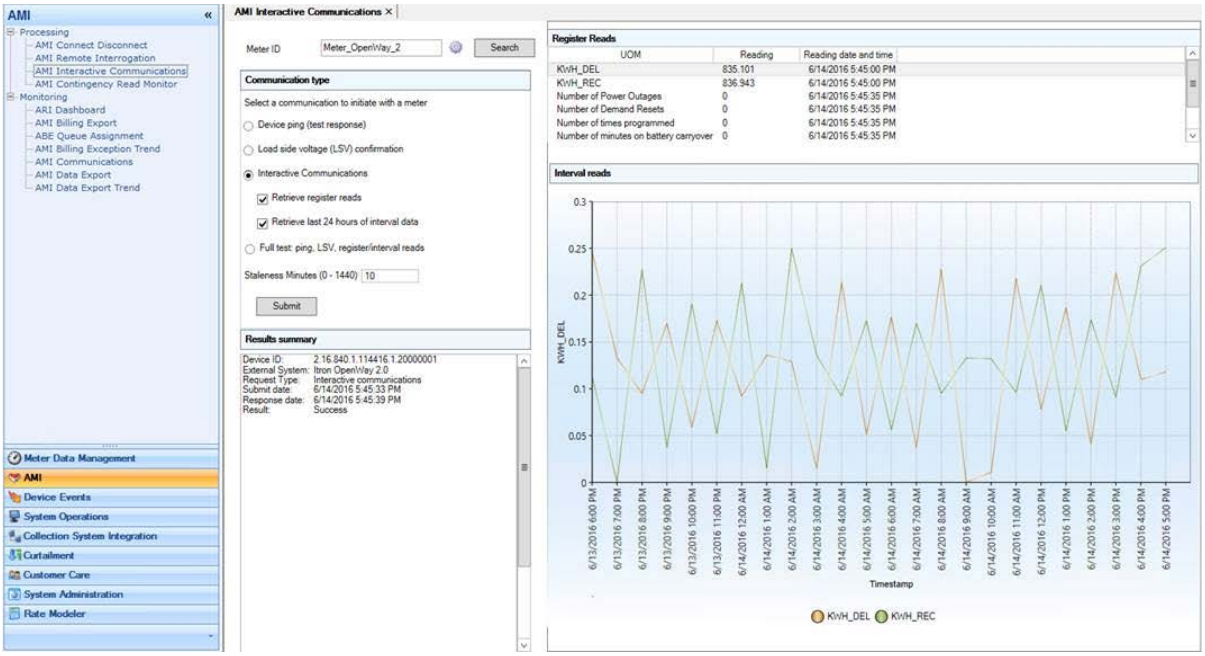
For more information on IEE MDM Service Order Initiation and Tracking, please see "Service Order Management" on page 17.

Two-way AMI Commands

IEE MDM users can execute control commands for AMI systems through the IEE MDM user interface or through web service integration with other utility systems. Two-way control capabilities include:

- Remote connect/disconnect of a service switch
- Data requests for load profile and registers
- Diagnostic requests for meter status, including energized status checks, load side voltage checks, disconnect switch status
- Meter pings, load side voltage checks, disconnect switch status, and meter program change through the rich client user interface or through Web services integration with other utility systems.

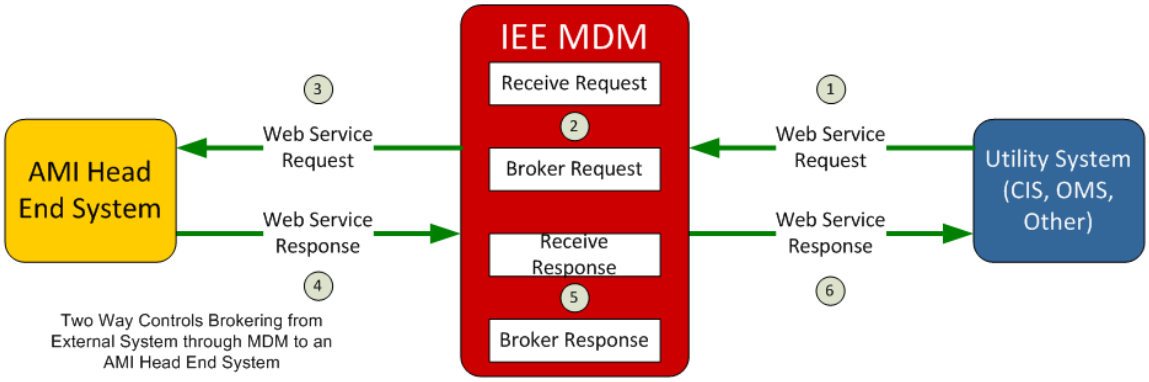
Authorized users can issue commands from the IEE MDM user interface.



Two-way Commands Issued through the User Interface

IEE MDM's role-based security governs access to two-way commands issued by utility users. These security controls determine who (or what systems) can access data, what data they can access, and what actions they can perform on that data.

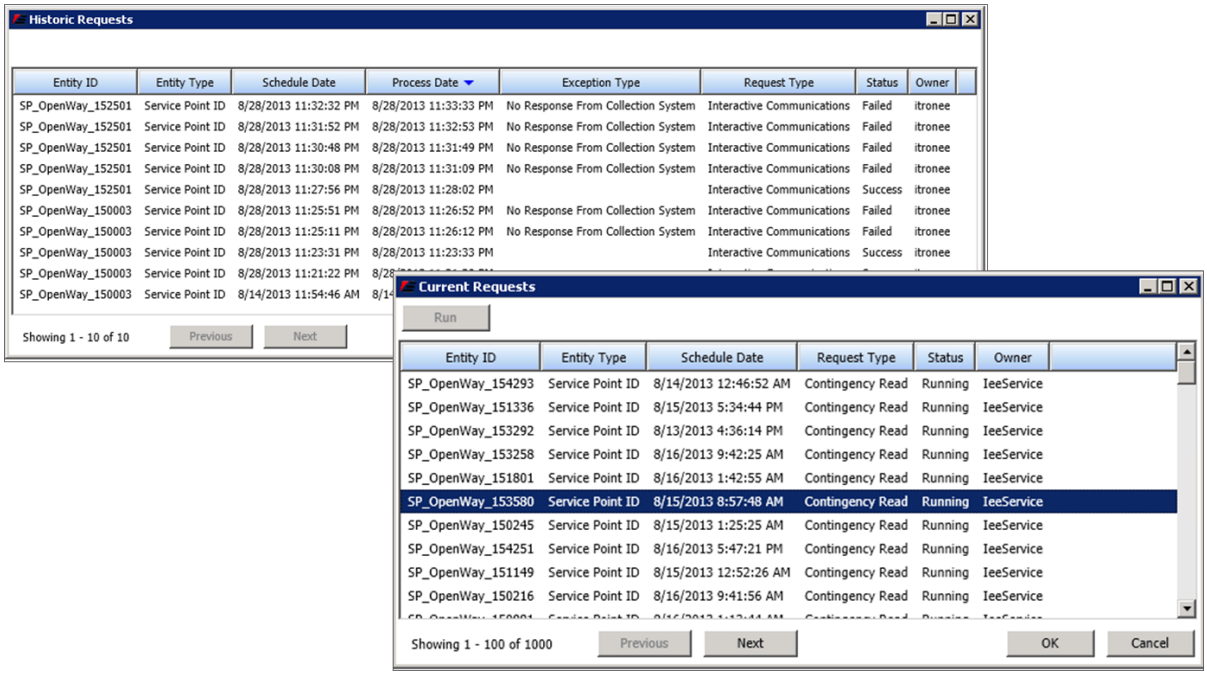
For web service interfaces, both transport level and message level security are supported enabling heightened security requirements at command and control interfaces such as remote disconnects. Configuring these at deployment allows support for a variety of AMI headend system security protocols, thereby allowing a truly end-to-end security solution from the issuing third-party application, through the MDMS, and down to the meter.



Two-way Command Processing Between Systems

IEE MDM maintains performance statistics for each integrated collection system, based on the successful receipt of data and the quality of the data received, including statistics for reasons for

failure. IEE MDM includes the AMI Communications Dashboard (shown below) which presents the status of all two-way AMI control commands.



AMI Communications Monitoring

This dashboard includes both current day and historical views and show totals group by command type and status (pending, success, failed. There are summary views and also drill down capabilities for detailed investigation and problem resolution.

Service Mode for C&I Data Collection

Service Mode is an optional onboard data collection engine that is used primarily to collect commercial and industrial (C&I) interval metering data from multiple collection engines. Service Mode incorporates Itron's proven MV-90 xi communication components (which is in service at more than 500 utilities, worldwide) to manage multiple concurrent collection systems.

Service Mode can collect data from 300+ electricity and gas metering devices via 150+ available Translation Interface Modules (TIMs). Service Mode also supports a variety of communications, including PSTN, cellular, and TCP/IP.

DATA QUALITY ASSURANCE

Identifying and addressing the inevitable missing and incorrect data that comes from meter data collection systems is a core strength of IEE MDM. IEE MDM validates all incoming data based upon configurable rules and provides a Gap Fill Interrogation process to automatically issue contingency read requests for the missing intervals. Where necessary, IEE MDM estimates missing reads based upon another set of configurable rules. Exceptions can be reviewed by utility personnel to ensure an acceptable level of data quality. Operators can also issue service order requests in response to exceptions raised by reading validation failures or warnings, billing determinant calculation

exceptions, or any other exception identified by IEE MDM using IEE MDM's optional Service Order Initiation and Tracking Module.

Validation, Editing, and Estimation

The Validation, Editing, and Estimation (VEE) engine validates energy consumption according to the utility's data quality requirements and provides estimates for the inevitable missing and incorrect data that comes from meter data collection systems. The VEE engine continuously reviews and repairs problematic data. VEE fills in gaps, flags where corrections have been made, and triggers manual review where the data cannot be repaired using standardized logic. All versions of readings, including raw, validated, estimated, and edited, are stored and available for audit.

Validation

Validation rules are the core of the validation engine and govern how IEE validates reading data. Administrators set the parameters for each validation rule when creating a validation set. The rules fall into two categories:

- **Parameter-based** — These are IEE MDM's standard validation rules included in validation sets. These rules use custom logic that allow the utility to set values for some of the parameters needed to run the rules. The user specifies only the values that the validation rule will check against. For example, a parameter-based rule could be one that checks for a high limit. In this case, the user specifies the high-end threshold that sets the rule's upper limit.
- **User-defined** — These are custom rules that associate Universal Calculation Engine (UCE) formulas with the validation process. With user-defined validation rules, the user can specify both the validation logic and the value to apply the logic against. User-defined validation logic can use any of the functions supported by IEE MDM's Universal Calculation Engine.

When validation failure occurs, the user can define IEE MDM system behavior down to the meter and channel or register level. The system can be configured to transfer the reading with a failed validation status, auto-estimate the reading, or pass a no-read with reason and to produce a failed-validation report.

Interval-based Validations

Historical Comparison Checks
High Low Usage Check
Historical Max Usage Per Diff

Spike and Demand Checks
Demand High Limit
Demand Low Limit
Usage High Limit
Usage Low Limit
Spike Tolerance Per Diff
Gap Check
Overlap Check

Comparative Channel Checks
Kvarh Check
Reference Channel

Contiguous Data Checks
Australian Gap Check

Load Statistics Checks
Load Factor High Limit
Load Factor Low Limit
Power Factor Low Limit
Demand Tolerance for Consecutive Intervals

Usage Tolerance Per Diff
Usage Tolerance Per MM Diff

Seasonal Usage Patterns
Max Zero Intervals
Min Zero Intervals
Usage on Inactive Meter
Zero Usage on Active Meter

Usage Tolerance Checks
Usage Tolerance Abs Diff
Usage Tolerance Dual Method

Register-based Validations

Delta High Limit
Delta High Limit Per Diff
Delta High Limit Ratio Per Diff
Delta Low Limit
Delta Low Limit Per Diff
Delta Low Limit Ratio Per Diff
Overflow check
Register Gap Check
Register High Limit
Register Low Limit
Rollover Check

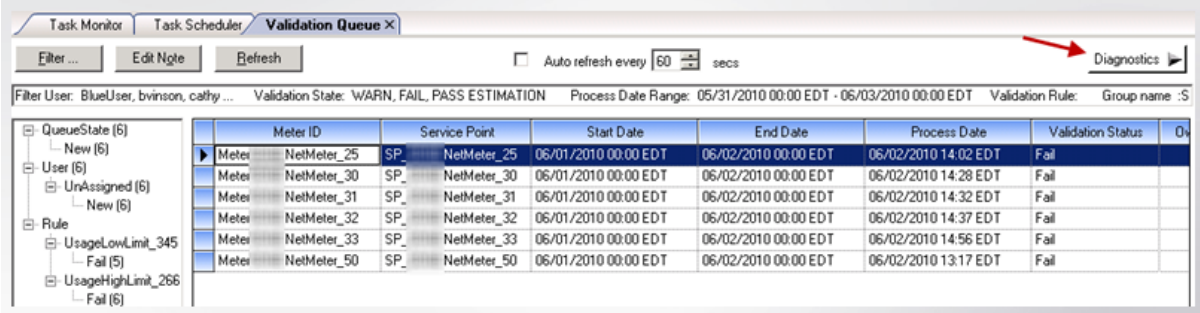
Service Mode Only Checks

Time Tolerance Check
Interval Tolerance Check

Custom Validation Rules

Status Count
User Defined Formulas (highly configurable)

The Validation Work Queue is a central location for manually managing validation exceptions. The queue lets users view and resolve failed items without having to filter the Validation Log and process each failed item individually.



Validation Work Queue Supports Exception Management for Operators

The Validation Work Queue provides a workflow for validation exception resolution and allows the automatic routing of failures associated with specific meters to different operators for resolution. It also supports work order generation and provides tools for data analysis, editing, and estimation. The Validation Work Queue also provides a means to track the validation exception and resolution process.

For failures and warnings that occur during live operations, the Validation Queue provides a "to do" list of failed validation items that an operator can work with. For example, an operator can fix accounts that have problematic data that are not ready for billing purposes.

VEE includes reports and logs to identify the meters that were validated and/or estimated, the reason for the estimate, and the original and estimated values.

Validation Log Provides an Audit Trail for VEE Processes

The Validation Log provides an audit trail of the validation rules applied to a service point channel, to capture a historical record of the validation process. The Validation Log is the system of record in

case an operator must investigate an old validation to see why it failed at a certain point in time. Validation Logs are saved for both interval and register validations.

Estimation & Editing

Readings that fail any of the validation rules are marked with appropriate reading status codes and flagged for estimation. Editing and estimation can be manually initiated through the user interface, or configured to run automatically based on specific criteria, such as failed validation, or missing data being true. Automatic estimation can use parameter-based or user-defined estimation algorithms. User-defined estimation algorithms can use any of the functions already available in the UCE.

IEE MDM includes the following parameter-based estimation algorithms:

- Interval Estimation Algorithms
  - Linear Interpolation
  - Historical Data Algorithms
    - Historical
    - Multi-Week Average
    - Two-Week Like Day Historical
  - Replacement Algorithms
    - Average Daily Load
    - Check Meter
    - Load Profiling
    - Numerical Replacement
    - Zero Fill Inactive
- Register Estimation Algorithms
  - Average Recent Load Projection

The following routines are available for automatic and manual estimation/editing.

- Automatic Editing Capabilities
  - Estimate interval data based on meter readings
  - Replace all values with constant value
  - Multiply or divide by a constant value
  - Add or subtract a constant value
  - Copy values from a reference channel or register, with or without scale value
  - Copy values from a previous time period
  - Perform linear interpolation
  - Slide a range of interval data ahead or back in time
  - Split or combine intervals

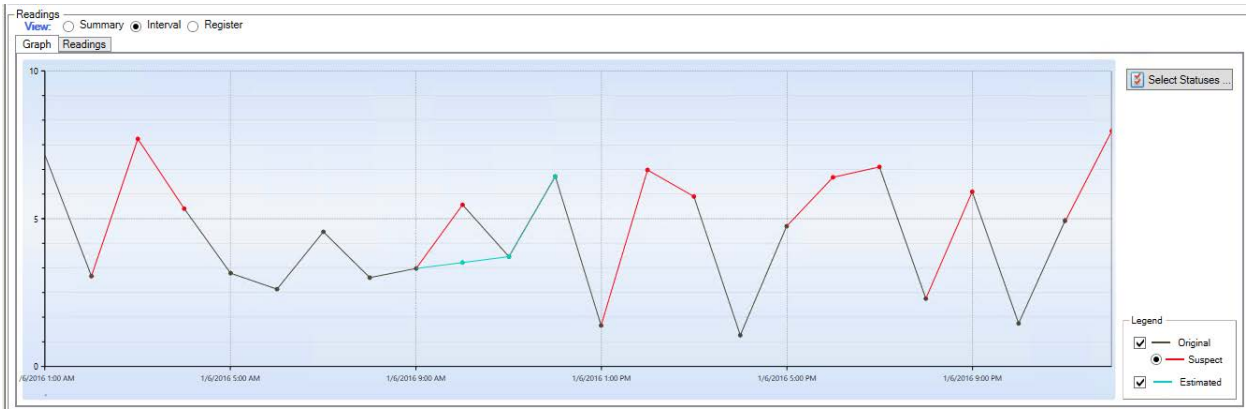
- Set or reset one or more statuses
- Restore previous version
- Delete data (mark as deleted)

» Manual Editing Capabilities

- Add or replace values manually on-screen
- Modify status manually on screen
- Display and/or edit multiple channels on the same screen
- Copy or cut and paste a string of values and statuses from one channel to another
- Copy or cut and paste a string of values from spreadsheet
- Copy or cut and paste values and statuses within the same channel

Once readings have been estimated, the VEE engine performs one final validation. When final validation passes, the readings are stored and versioned in the database. If final validation fails, the exceptions are sent to the Validation Queue for manual investigation.

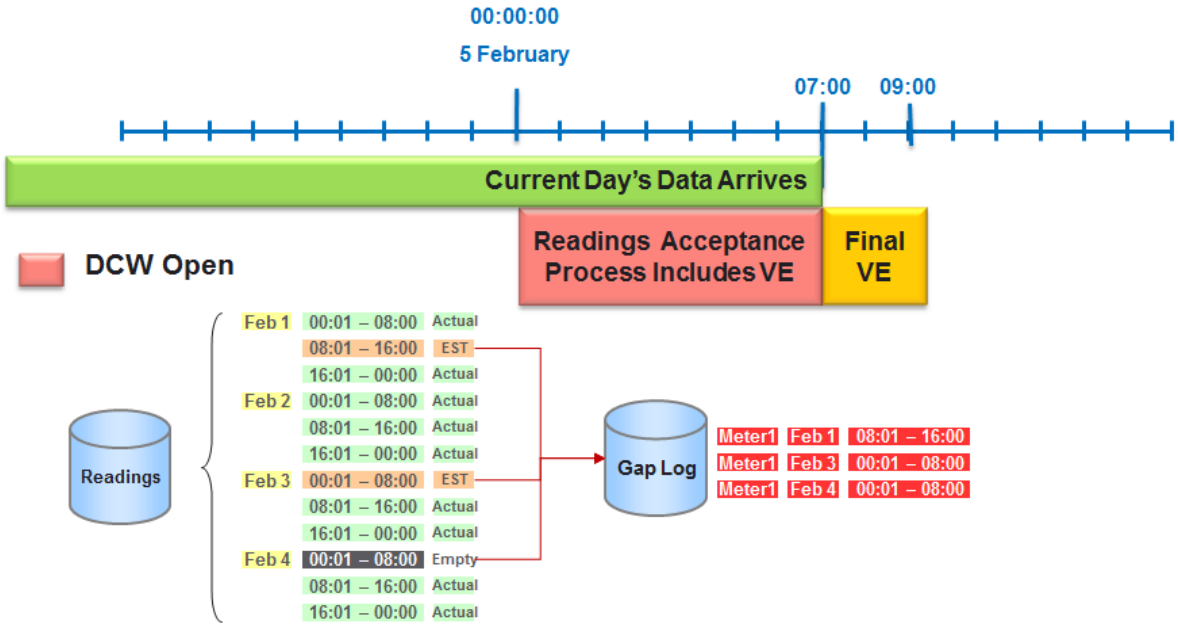
Estimated data is clearly marked with a status code indicating that the interval was estimated and also what type of estimation routine was used to estimate the data (e.g. historical, linear interpolation, etc.).



Estimated Data is Clearly Shown in the User Interface

Gap Fill Interrogation

IEE MDM uses a contingency read process called Gap Fill Interrogation to fill gaps in data not addressed by the data collection process. IEE MDM identifies contingency read candidates, submitting read requests to the responsible AMI headend system. Gap Fill Interrogation can also be used to re-interrogate a meter for data that failed initial validation upon import. As the contingency reads are imported and stored, any associated validation queue exceptions are automatically resolved.



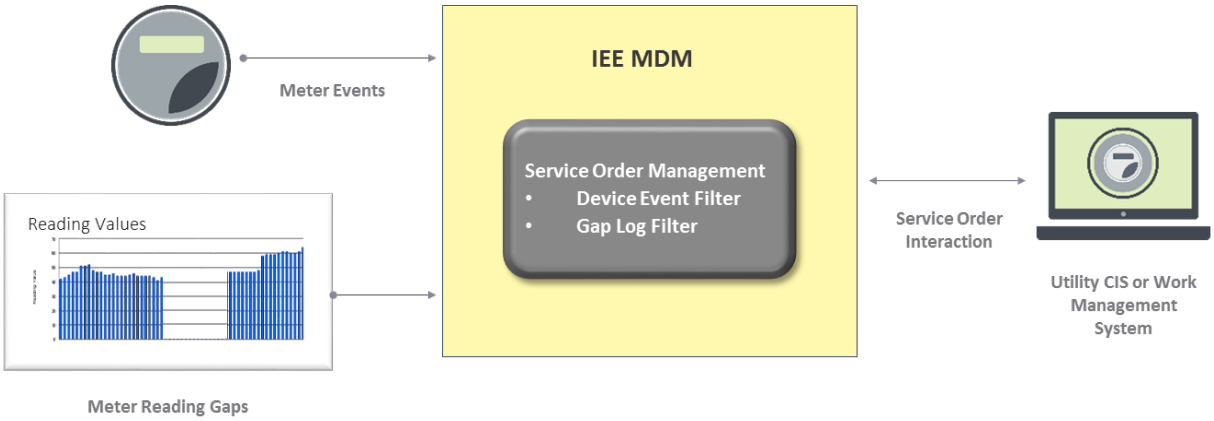
Automatic Contingency Reading Process

Successful new readings create a new version of the data. The process also retains the earlier versions of data that contain the previous estimates or empty reads. This results in more accurate data for billing, while retaining the flexibility to view or use the original versions of data for other purposes.

Contingency read requests run automatically at periodic intervals. It may take more than one retry attempt to contact the meter. If gaps persist for days, the non-communicating meter may need attention in the field. IEE MDM's optional Service Order Initiation and Tracking module can be used to automatically send a service order request to the service/work order system to investigate the issue.

Service Order Management

The IEE MDM Service Order Initiation module provides the link between the identification of hardware issues by IEE MDM and their resolution by the appropriate party. It is a highly configurable solution which can be used to detect probable field device defects and to automatically initiate service order requests to a service order management system. It also supports the raising of service order requests by IEE MDM operators, in response to exceptions raised by reading validation failures or warnings, billing determinant calculation exceptions, or any other exception identified by an IEE MDM component or operator.



Service Order Initiation

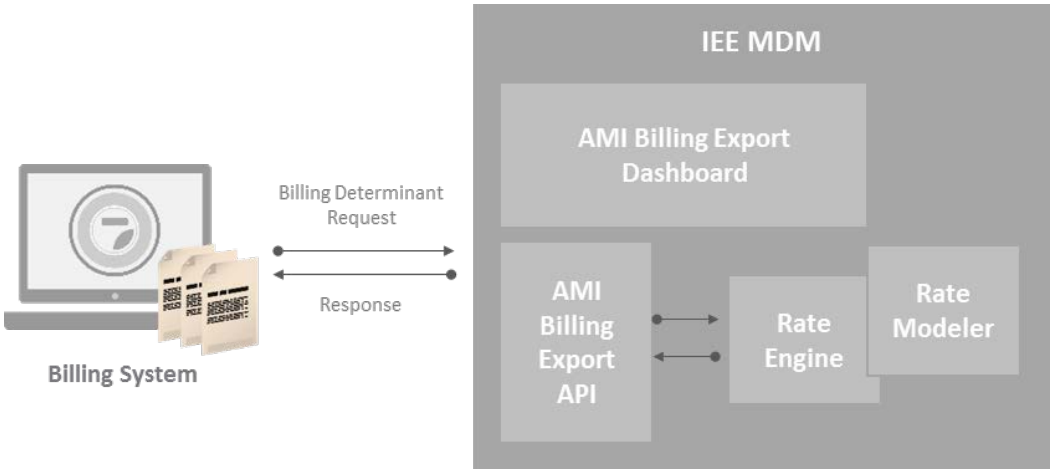
Service orders are tracked through their entire lifecycle, from open to close. Through out-of-the-box system interfaces, IEE MDM can communicate with a utility's service order management system to obtain status updates and field notes for service orders initiated by IEE MDM, as well as those opened by other processes. The utility can decide whether IEE MDM should have an awareness of all service orders related to meters managed by IEE MDM, or just orders of certain types or codes—whatever is most useful to the utility and its IEE MDM operators.

CALCULATIONS

IEE MDM provides advanced calculation capabilities throughout the system. Calculation abilities include billing determinant calculations, unit and interval conversions, aggregations for billing and non-billing purposes, and calculations for reports.

Billing Determinant Calculations

IEE MDM includes mature and highly flexible Rate Modeler, Rate Engine, and Billing Export components to execute billing determinant calculations. IEE MDM's Rate Engine and Rate Modeler fully support calculation of TOU billing determinants, including total usage (consumption), demand, and critical peak pricing and PTR calculations based on the utility's approved rules.



AMI Billing Export Process

Billing determinants are modeled using the Rate Modeler tool that includes a number of standard billing determinant types (e.g., total energy, max demand, demand ratchets, etc.) and demand response event handlers (different baseline calculation methods for PTR programs). Both standard billing determinant types and TOU definitions can be shared across many different rate schedules making it easy to model and maintain different rate programs.

Standard billing determinants supported with Rate Modeler include:

- Time-of-Use energy and demand
- Critical peak price periods
- Baseline calculations and usage credits
- Capacity reservation quantities
- Net metering determinants
- Average, maximum, and minimum demand

IEE MDM also has the ability to perform calculations on stored data using the Universal Calculation Engine (UCE) which enables analysts to evaluate characteristics for segments of customers.

Aggregation and Netting

IEE MDM fully supports data aggregation and totalization using virtual meters. Using IEE MDM, a master meter can be a physical meter or a virtual meter that is solely made up of the sub-meter loads. IEE MDM keeps the data streams for the sub-meters separate from the master meter, and this data from the sub-meters can be used to create individual billing determinants, as well as totalized (all sub-meters) billing determinants.

For billing purposes, meters are aggregated by the AMI Billing Export Module at the time billing determinants are calculated. For non-billing use cases, users can set up virtual meter points using the Aggregation function in the user interface. IEE MDM can also receive the configuration of these virtual meter points using the Configuration API. Calculations and exports for these virtual meter points can be set up to run automatically, on-demand, or through the interactive graphs. The Universal Calculation Engine (UCE) provides a formula builder to create aggregation formulas for virtual meter points (also called formula channels).

AMI Billing Export API

AMI Billing Export is a request / response-based web service and XML file-based API that supports billing determinant requests originated by the billing system. The AMI Billing API makes calls to the IEE Rate Engine in order to compute billing determinant values for the specific request. The AMI Billing Export process is designed to support the high-scale data processing requirements of an AMI deployment where all or most meters are collecting interval data and billing determinants must be calculated from interval data. It is designed to scale to support processing of billing determinant requests for hundreds of thousands of service points each day within a two- to four-hour time window.

One of the key advantages of IEE MDM's AMI Billing Export process is that it utilizes the same API and process to support on-cycle, off-cycle, and cancel/re-bill, and any other ad-hoc requests for billing determinants. The CIS would send a billing request to IEE MDM through a web service call or XML

file transfer. IEE MDM will receive this request, validate the data in the request (e.g., are the service point IDs valid? are the dates valid? etc.) and then perform the billing determinant calculations and deliver the results to the billing system in an XML file.

Universal Calculation Engine

The Universal Calculation Engine (UCE) provides advanced calculation capabilities throughout the system and is used for non-billing aggregations (e.g., for load research), unit and interval conversions; user-defined validation, editing, estimation algorithms; and the calculations on all reports and exports. The UCE supports standard mathematical operators, unit conversion functions, conditional and logical operators and interval status functions, and date and time functions.

UCE Capabilities

Standard Mathematical Operators

+, -, *, /, square root, sine, cosine, etc.

Unit Conversion Functions

KWH, KVARH KVAH or power factor, V2H V, etc.

Conditional and Logical Operators

IF/AND/OR/NOT,<.>, etc.

50 levels of nesting

Interval Status Functions

Conditional functions based on status

Read statuses

Write statuses

Date and Time Functions

Date and time evaluations

TOU functions

Date and time offsets

All formula definitions for calculated channels and registers are fully versioned, and are tracked for both corrections and for changes over time. When a formula has changed over time, the appropriate formula is used in calculations for each timeframe.

The UCE is also exposed in an API so that external systems can take direct advantage of its built-in processing capabilities and business logic.

DATA DISTRIBUTION

IEE MDM provides long-term storage of register, interval, tamper, outage, and other meter data, including raw, validated, and estimated versions of usage data. The IEE database serves as the utility's database of record, and provides seamless integration and secure access for all business and analytical systems users of meter data throughout the utility.

IEE MDM provides several methods for exporting data to external systems:

- **SOAP / Web Services** — To ensure cross-platform compatibility, IEE MDM exposes APIs by using lightweight wrappers that are exposed as SOAP-based web service. These adhere to common industry standards and provide flexible security configurations and interoperability.
- **File Exports** — IEE MDM supports numerous file formats to ensure backward compatibility with Itron and 3rd party products. Any XML format can be converted to any other format using off-the-shelf tools using XSL style sheets.

  IEE MDM includes high volume batch export capability, request/response, immediate export as raw data is received from the headend, and the ability to export only data that has been modified in the MDMS (i.e. editing or estimated).

- **ODBC** — IEE MDM is deployed on ODBC-compliant databases, and data can be accessed by Excel and exported in CSV or XML formats

Standard Exports

Standard web service-based APIs support data import and export, data synchronization, and message exchanges with other systems. These include APIs to import and export measurement data, import meter status data, import and export meter events, synchronize master data (transformer, customer, account, premise, service point, meter, recorder, and endpoint devices), and execute on-demand reads from collection systems that support this functionality.

The following exports are available using IEE MDM web services:

- Readings
  - Reading XML Export
  - Lodestar & Lodestar Enhanced Export
  - MV90 Mainframe & Spreadsheet Export
  - MVRS Export
- Events
  - Device Event Export
  - Tamper Event Export Adapter
- Configuration
  - Customer Configuration Export
  - Program-Based Configuration Export
- Billing
  - AMI Billing Export
  - Bill XML Export
  - Curtailment Rate Event Export
  - Curtailment Settlement Export
- Other
  - Custom SQL Export
  - Process Reporting Export

Beyond the built-in reporting tasks and XML APIs, IEE MDM can support reporting through its native .Net API, and through SQL or Oracle. For ad hoc queries, Itron offers a secure custom query task within the application. Custom queries can be written by utility or Itron personnel to run on schedules or on demand. These queries can provide output in XML or CSV formats. The query is monitored within the application so that operators can see these tasks running and cancel them if needed. Volume, frequency of extracts, and data requirements will dictate whether a web services based approach or a database level extract is the preferred approach.

AMI Data Export

The AMI Data Export (ADE) process exports large volumes of data in a fast, proficient manner. ADE hosts a separate Export Dispatcher application service, task templates that can be used to run the export, a graphical user interface (GUI) for monitoring and working with exports, and an ADE Trend Report user interface to view summary information about the export.

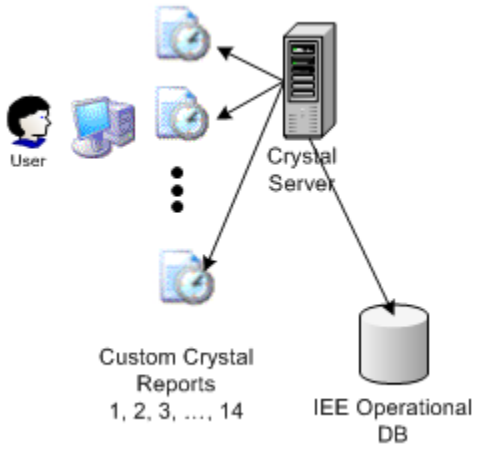
Readings Exports

IEE MDM provides several methods for exporting meter reads to external systems. We typically use file-based or web service-based XML transfers. IEE MDM typically integrates with other utility systems through a library of standard application program interfaces (APIs). The APIs use XML-based web services based on standard XML messaging protocols, including SOAP and WSDL. These APIs adhere to common industry standards to ensure cross-platform compatibility and to provide flexible security configurations and interoperability.

- **Import Data Manager Immediate Export —** One of the standard options available with the Import Data Manager is to normalize the readings and export them immediately to another system without importing the data into IEE MDM. This is especially useful for raw data such as voltage information that is not required for billing purposes.
- **Meter Reading Synchronizer —** The Meter Reading Synchronizer (MRS) exports new and changed readings that are stored in IEE MDM. MRS detects and pushes changes based on timestamps (e.g., new and changed readings since the last synchronization) and combinations of reading status categories (e.g., Estimated, Edited, Aggregated, and/or All).
- **AMI Data Export —** The AMI Data Export XML API is a high-volume exporter of meter data. Similar to the AMI Billing Export process, the AMI Data Export (ADE) can be run on a schedule or as request/response process with an external system. ADE can export both meter readings and meter events. Export templates support a wide range of customer groupings, even down to user-defined attributes. The groupings are dependent upon configuration; data status flags are included when extracting the data. IEE MDM includes the AMI Data Export Queue that can be used to monitor the status of exports through the user interface.

Reporting

The IEE MDM user interface displays all graphs and reports, and allows users to print and save reports as spreadsheets, electronic files, or images for use in external reports or other presentations. Many reports can be run in batch mode and automatically distributed to other applications or as emails to specified email recipients. Within the user interface, graphs provide zoom-in/zoom-out functionality, and provide mouse-over displays of specific data points within a graph. Custom reports and graphs can also be configured using IEE's XML data export capability (described above), along with third-party style sheets or reporting tools.



Standard Reports

IEE MDM includes more than 40 standard reports to examine the quantity and quality of data that has been collected. This includes exception reports listing meters

that are not currently providing any readings and event reports showing asset diagnostic flags that have been received.

The following standard reports are included with IEE MDM.

» **Multipurpose Reports**

- Validation Report — Shows detailed results of interval validation with accompanying information on associated register reads. This report is multi-faceted in that it can be used to investigate interval validation failures, meter start and stop reads, pulse and meter multipliers, min/max values, power factor calculation and KVA from pre-defined KVA channel sets. It also includes associated device event information where applicable.
- Reading Detail — Meter, register, most recent readings—Presents reading values in graphical and tabular form.

» **Interval Data Only**

- Detail Demand – Peak day, Summary, KVA/PF, Load duration — Presents interval data in graphical and tabular form; accesses Universal Calculation Engine to perform calculations on-the-fly
- Validation Log — Details results of validation process.
- Edit Log — Shows interval data and register data editing activities.
- Engineering Units — Demand, consumption, pulses by day, detail, peaks—presents interval data in engineering units.
- Coincident/Non-coincident Peaks — Identifies coincident and non-coincident peaks.
- Weekly Detail – Demand, Consumption, Pulses by detail, Peaks — Presents interval data in week increments in tabular form.
- KVA – By Day, Detail, Peaks — Calculates KVA and presents in tabular form
- Time of Use (TOU) — Calculates TOU values based on TOU definitions.
- Data Available — Interval Data Available Report, designed for use by Commercial & Industrial implementations, lists all service point channels for the selected service point ID, and contains the following information. Use this report to see how much and for what dates interval data has been stored for a service point.
  - Service point description
  - Service point channel number
  - UOM
  - Start/End Date
  - Recording device ID
  - Source meter ID
  - Account number
  - Customer ID and name
  - Route

- Premise
- Formula
- Gaps — Lists the gaps found within interval data streams.
- Interval Status — Provides a listing of readings with specified interval status values.
- Missed Readings – Interval — Indicates if any interval data is missing for a specified time period.

» **Register Data Only**

– Readings by Source — Counts readings collected by source and service point.

– Missed Readings – Register — Indicates whether any meter is missing readings for a specified time period.

– Usage for Inactive Premises — Shows inactive premises for which usage was found.

– Zero Usage at Active Premises — Shows active premises for which no usage was found.

– Register Read Editing and Validation — Allows users to view and edit register-only data and show results and previews of register validation.

» **Operations**

– Audit Logs — Lists configuration data changes as well as changes to system settings, task templates, validation sets, formulas, and other data that can affect processing. This is used to track modifications to critical data in the MDM and provide an audit trail to accommodate business processes.

– Cycle Due Date — Identifies tasks that are due to process on various cycle dates. The Cycle Due Date Report, designed for use by Commercial & Industrial implementations, returns all Service Point Channels for the following items:

- Retrieved on cycles during a specified date range, but which do not have the expected data.
- Exported on cycle during a specified date range, but which did not have the data exported.
- Aggregated on cycle during a specified date range, but for which data was not aggregated.

– Export Status — Indicates the status of exports and is designed for use by Commercial & Industrial implementations, lists all successful export task information by specific entity type (such as Service Point and Customer), and entity ID, the exported file name and location, and task running time period. Use this report to verify successful completion of the exports scheduled to run on a data driven schedule.

– Meter Change Report — Shows meter change events captured.

– Configuration Attributes – Customer, Account, Premise, Route, Service point, Meter, Interval channel, Register, Recording device — Lists configuration objects with selected attributes (i.e. meters by manufacturer, premises by status).

- Readings Not Processed — Lists log information about readings that could not be saved due to configuration mismatches.
- Billing System Cycle ID — The Billing System Cycle ID Report is an operational report that lists entity types by billing system cycle ID. For example, you can generate a report that lists service points assigned to each billing system cycle IDs.

» **Configuration Reports** — Users can generate reports based on configuration attributes stored in the IEE persistent data store. IEE MDM supports reports for the following entity types:

- Route Attributes — A collection of service points that is read on a specific schedule.
- Customer Attributes — Information about the residential and commercial consumers served by the utility.
- Account Attributes — The contractual relationship between a customer and one or more quantities delivered at one or more service points. An account is referred to by its account number or ID. Most billing systems use account numbers as the primary mechanism to track loads and revenues.
- Meter Attributes — Information regarding the meter, such as meter multiplier, pulse multiplier, fixed offsets, CT ratio, PT ratio, loss constant(s), plus information such as warranty date, and an unlimited number of user defined constants.
- Register Channel Attributes — Register readings usually indicate consumption. Register quantities usually represent total or summary values over a much longer time period than interval values. Some common quantities stored by registers include Total kWh, Peak kW, Accumulating kWh readings, Total kWh for various TOU blocks, and Number of Resets.
- Interval Channel Attributes — Stores a data quantity recorded by a metering device for a set frequency. For example, with a 15-minute interval, register values are recorded every 15 minutes. The time between readings is both predictable and exact. The interval length, also called the interval frequency, is the number of minutes that elapse between recording register values. Partial intervals are not allowed in IEE MDM. Interval lengths divide evenly into 60, with the exception of the 1440-minute interval that represents 24 hours.
- Service Point Attributes — The physical location (or locations) on a premise, where the utility company considers the commodity that it supplies (water, gas, energy, and so on), to be delivered to the customer.
- Premise Attributes — A physical location, such as a building, apartment complex, or street address. A premise can have one or more service points associated with it.

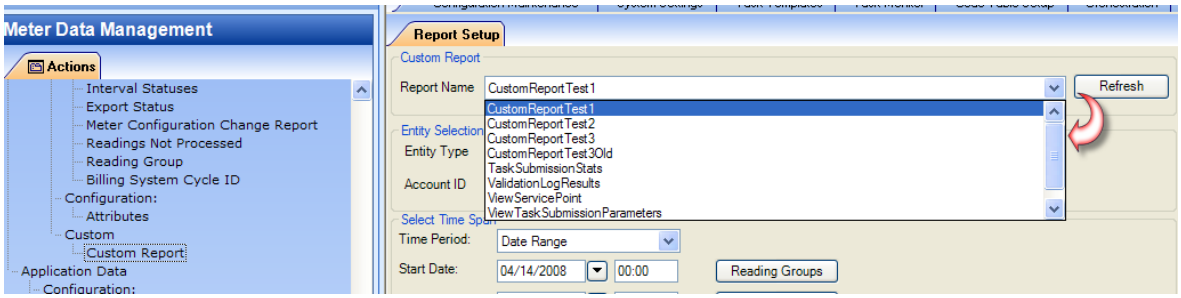
» **Events**

- Events by Service Point — Lists events captured for specified service points.
- Events by Type — Lists all events that occurred for all service points by type.
- Tamper Events — Lists tamper events captured for specified service points.

Custom Reporting with Crystal Reports

Custom reports are those reports that the utility has created from scratch using their own installation of Crystal Reports software. IEE MDM comes prepackaged with a runtime version of Crystal Reports.

With Crystal Reports, you can create custom reports and have them available from within the IEE rich client user interface. You can also schedule these reports on a recurring or data-driven basis. This is done by accessing the operational database, and a thorough understanding of the IEE data model is required. This includes navigating between business objects, following links to correctly recognize effective dates, and retrieving interval and register data.

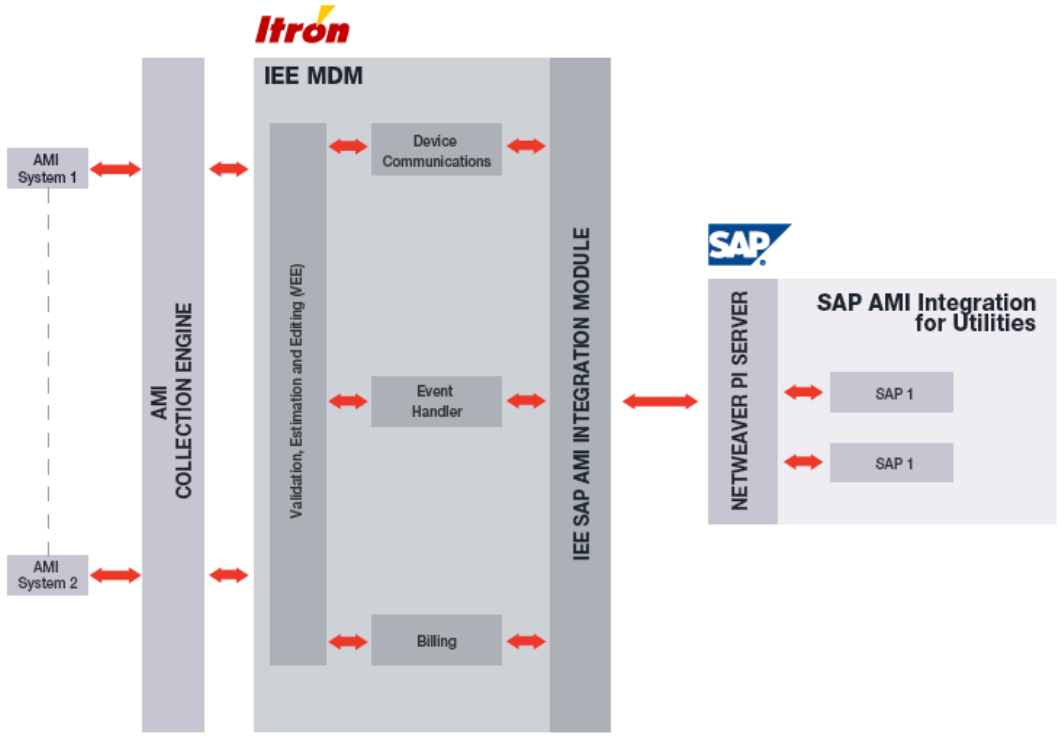


Custom Reports Are Available in the User Interface

Once created, you can drop new custom Crystal RPT files into a specified directory. This makes the custom reports available in the user interface. You can then run and schedule these reports from the user interface, just like any of the standard reports that come pre-packaged with IEE MDM. This feature, together with IEE MDM's Task Automation capabilities, enables IEE MDM to automatically email custom reports to specified email recipients.

SAP AMI Integration

Itron provides the optional Itron SAP AMI Integration Module (ISAIM) for utilities that want to take advantage of SAP's AMI Integration for Utilities interface platform. ISAIM implements SAP's Meter Data Synchronization and Unification (MDUS) approach to AMI integration. The combined solution provides utilities with a seamless, end-to-end business process, reducing implementation time and risks and lowering total cost of ownership.



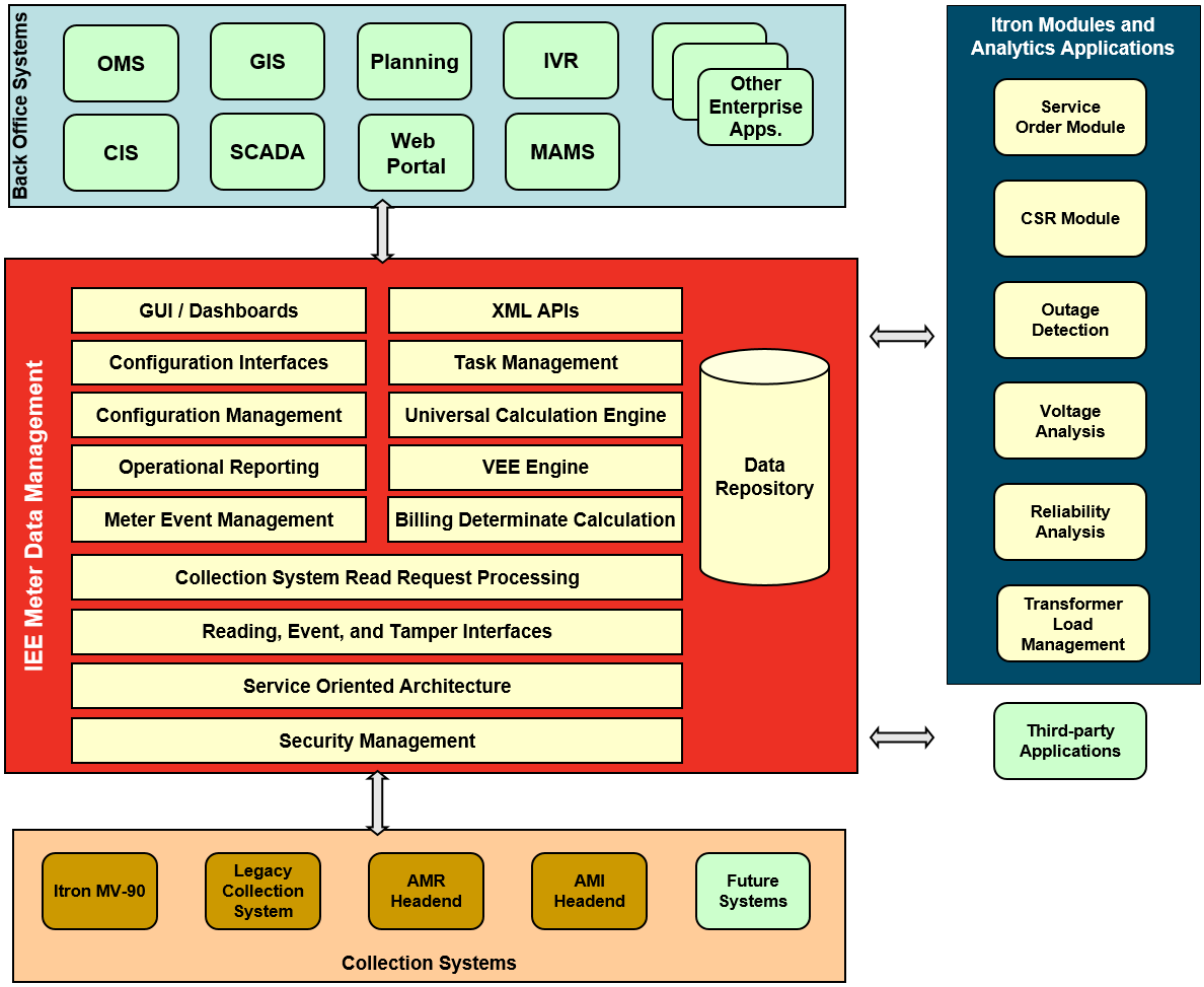
Itron's SAP AMI Integration Architecture

The solution uses service-oriented architecture (SOA) — both file-based and robust asynchronous and synchronous web service APIs — for two-way integration with smart grid/AMI collection systems, an enterprise service bus, and utility operations systems such as billing, work and outage management. IEE provides out-of-the-box integration with Itron's OpenWay smart metering solutions and production proven integration with other third-party AMI technology providers.

Itron is a founding member of the SAP Lighthouse Council and the first company to be certified as an SAP Qualified Business Solution (QBS) Partner. This requires AMI/MDM/SAP application level integration with solution qualification by SAP to ensure end-to-end business processes and a product roadmap guided by SAP based on a Cooperative Development Agreement. The ISAIM is certified by SAP for integration with the SAP NetWeaver® technology platform.

SYSTEM ARCHITECTURE

IEE MDM provides a superior product architecture with proven scalability — an important consideration to support large AMI deployments, expanding DR programs, and future Smart Grid requirements. The cornerstone of Itron's architectural design philosophy is a solution that is open, modular, and extensible, allowing integration with any other open system design using standard APIs. IEE MDM relies on the inherent flexibility and transparency of the underlying service oriented architecture (SOA) to enable integration with third-party systems.



IEE MDM Solution Architecture

IEE MDM's architecture is designed to deliver the power, security, expandability, and usability that makes IEE MDM the most widely used MDMS in the world. In its simplest form, the IEE MDM architecture is composed of three basic components: client, application server, and database server.

Client / Server Architecture

The IEE MDM client and server both interact directly with the IEE MDM database, allowing client updates to proceed, even when the application servers are under heavy load. The client and server also communicate directly to handle specialized functions, such as task management. IEE MDM's application servers link to collection systems and upstream consumers of data via file transfers and web services. IEE MDM also provides a specialized high throughput protocol for interfacing directly with collection systems. This protocol provides not only for the exchange of meter data, but also all the necessary metadata associated with collection, and status information for up-to-the-minute monitoring of the interrogation process.

Distributed Task System

At the server, IEE MDM's task system provides a fully extensible architecture. There is no limit to the number or type of tasks that can be added to the system. As customers require new functionality, new tasks can be added to the system. Add-on packages for IEE MDM can include a combination of new back-end tasks and front-end GUI plug-ins to expose additional data fields and features. The Task Management System supports scalability of the system as well as automatic failover. Each physical server hosting the IEE MDM software can be assigned a set of task types to perform. Configuring several servers to perform the same tasks provides redundancy. IEE MDM supports a distributed failover capability. Each application server will periodically send a time-stamped heartbeat to the database. If an application server fails to register a heartbeat within a specified interval, another application server will take notice and initiate the failover process. This essentially involves a) alternate application servers claiming application services from a failed server and b) resubmitting any hung tasks from the failed application server back to the task system.

IEE MDM includes a robust Server and Service failover feature that supports a configurable failover matrix strategy whereby multiple servers and services can be configured to automatically failover to another server. This feature also includes a dashboard to configure all Application Servers and services deployed on each server (including failover strategy).

Application Architecture

In addition to the task subsystem, IEE MDM provides several other services which run on the application servers. These services include the calculation engine, IEE MDM's service for consistent, centralized, formula-driven manipulation of meter data; the import dispatcher, a service for launching import tasks when data is delivered to the system; the report engine, a service for generating scheduled reports for delivery to disk or printer; the cycle service, which manages the process of performing tasks on cycle basis, and coordinating data-dependent jobs; and web services. Web services are hosted through IIS and expose a variety of different APIs to external systems, including the ability to post and retrieve customer and account data, meter configurations, meter readings, and meter events.

SYSTEM PERFORMANCE

Itron has produced an optimized, high-speed API for the reading import task, to accommodate large volume imports. Depending on validation, estimation, and other processing requirements (e.g., aggregation or billing determinant calculations), IEE MDM can import, validate, estimate, and store data at rates up to 30,000 readings per second.

To optimize processing speed, IEE MDM distributes processing across multiple Application Servers and Database Servers and can dynamically reallocate server resources as needed. In vital, mission-critical systems, distributed clusters can be used. IEE MDM's Task Manager manages multiple servers and processors, load balancing across these servers.

IEE MDM is in production at scale and supporting AMI data management and business processes at utilities across the world. Some of our largest installations in North America include:

- **BC Hydro** – IEE MDM in production with 1.9 million smart electric meters (OpenWay AMI)
- **Florida Power & Light** – IEE MDM in production with 5 million hourly interval meters (non-Itron AMI headend)

- **Pepco Holdings** – IEE MDM in production with 1.2 million meters (non-Itron AMI headend)
- **San Diego Gas & Electric** – IEE MDM in production with 1.4 million smart electric meters and 850,000 gas meters (OpenWay AMI)
- **Southern California Edison** – IEE MDM in production with 5 million hourly smart meters (OpenWay AMI)
- **Southern Company** – IEE MDM in production with 5 million meters (non-Itron AMI headend)

In addition to the processing power of IEE MDM, Itron's experienced Solution Delivery teams configure all customer systems to use enterprise-class storage and RAID configurations to ensure redundancy, security, and high performance levels.

Itron incorporates performance benchmarking as a standard component of our development life cycle. We periodically benchmark our product on the two underlying databases supported by IEE MDM – Oracle, and SQL Server. Tests are conducted both in our own performance lab in Raleigh, NC as well as at our third-party technology partner labs.

INTEGRATION WITH UPSTREAM SYSTEMS

IEE MDM's inherent flexibility and standards-based components, along with the transparency of the underlying service oriented architecture (SOA) enable Itron to integrate our solution with each utility's existing IT infrastructure. The use of open standards frees the system from any proprietary communication restraints.

Service Oriented Architecture

IEE MDM provides a complete API set for full integration with point-to-point or database-based corporate architectures. IEE MDM offers a single source to requesting systems for validated meter and event data across the enterprise. IEE services can be invoked asynchronously by a compliant ESB. Most of 60+ worldwide deployments are using ESB technologies to integrate through standards-compliant web services. Use of an ESB simplifies the interfaces between IEE MDM and the utility's data collection systems as well as the CIS, asset management, outage management, and other utility applications. Itron has experience integrating IEE MDM's web services with solutions such as TIBCO, WebMethods, SeeBeyond, and MQ Series.

The primary integration method between IEE MDM and external applications is web services. Web services are implemented in Microsoft .NET Framework 4.5, using Windows Communication Foundation (WCF) .NET technologies and are interoperable with Java and other enterprise development software architectures.

IEE MDM integrates with the AMI headend, as well as with the back office and analytics applications, through a library of standard APIs that use XML-based web services to perform operations either directly or through an ESB. The APIs enable IEE MDM to send data and commands to the AMI headend and to receive data and commands from the AMI headend as well as to and from other interfaced applications (e.g., OMS or AMS). Available IEE MDM APIs include:

- Billing Export XML API
- Task Web Services XML API
- Customer Configuration XML API
- Events XML API

- Rate Assignment XML API
- Rate Maintenance XML API
- Readings XML API
- Curtailment and Demand Response XML API
- Device Communications XML API
- Investigation Log XML API
- Mass Market Account XML API
- Service Order XML API
- Log Event Publishing XML API
- Program-based Configuration XML API
- Security Services XML API

To facilitate interfacing, Itron provides Web Services Description Language (WSDL) XML documents to vendors of external systems. Itron also provides a WSDL dictionary to assist in developing publish/subscribe interfaces. During implementation, Itron deployment personnel work with the utility's project team to provide training and assistance to enable them to develop and modify APIs.

Integration Experience and Methodology

In addition to the openness and designed-for-integration features of IEE MDM, Itron personnel have a depth of technical expertise and broad project experience that brings a level of practical knowhow to interfacing IEE MDM with AMI headend and other enterprise applications. Our experts have experience interfacing solutions with all of the major ESBs. Our integration methodology and our adherence to best practices helps to avoid most issues and to quickly address those issues that do occur. We follow proven and systematic processes to ensure not only that all the interoperating systems communicate effectively, but also that the infrastructure on which they run is properly designed and sized to support all specified functionality.

SECURE BY DESIGN

Itron provides one of the strongest security postures in the smart grid industry. Security is built into our software and our solutions are tested for compliance with our stringent security policies at every stage of development and deployment.

Itron has adopted the Microsoft Security Development Lifecycle (SDL) as the basis for secure product development. By following SDL best practices for securing software we guard against any security vulnerability in the software itself. We ensure, for example, that no credentials are exposed in clear text, that all input validation is done in the rich client, and that all web services provide security for encrypting at the transport and message layer. We confirm that no confidential information is logged to files in clear text and that there is no information leakage through error messages and pop-up windows. We perform code review with all changes to software to make sure that any action in the system that changes critical information or system settings is fully tracked.

Itron has an active cross functional security team that is very involved in NIST and UCA security working groups and is a leading participant in the AMI-SEC working group that is addressing ongoing development of the AMI threat model and definition of approaches to mitigate these security threats.

Authentication

User authentication (user ID/password) can be maintained within the IEE MDM application or through Windows or LDAP single sign-on technologies. User authentication can be integrated with an LDAP-compliant directory service such as Microsoft Active Directory Domain Services. Identification and authentication functions are done using Active Directory and IEE MDM's strong built-in authentication mechanisms. System mechanisms exist for strong account management, including parameters for account lockout, password aging, password history, expiration, and length and type requirements. All IEE MDM user and group authorization is done via Active Directory and at the application level. IEE MDM users are not authorized to directly access system databases, but must be proxied through a single encrypted security token. All client access is performed under this credential once authorized using the application's role-based access controls.

Authorization

All access to data is controlled through IEE MDM's role-based security provisions. Users require no access to the database or to system directories. This prevents users from performing modifications to the data or system outside of the security controls within the IEE MDM application. Users are assigned to roles that control the functions they can perform and to security groups that limit access to only the meter data they are authorized to view. Role-based access controls determine which IEE MDM functions will be presented to users in the menus and windows that appear in the application. These same controls will also limit the specific data the users can access. Roles vary by project. Typical roles include Operator, Super User, IT Administrator, View Only, and Auditor.

IEE MDM's role-based security allows system administrators to configure four main components:

- **Security User** — Defines the user name and ID, the roles, workgroup, and group the user is assigned to
- **Security Role** — Defines the set of permissions granted to all members of the role
- **Workgroup** — Sets defaults (time zone, voltage, interval length, etc.) for all members in the workgroup
- **Security Groups** — Defines the database entities, including accounts, customers, and service points, that all members of the security group can see

Database Security

IEE MDM restricts database access from unauthorized users or programs. All data access is through the application, rather than directly through the database. A centralized login service provides credentials via a secure web service. Database credentials are stored on a secure server and obtained by the client on startup. This protects the database credentials from discovery and enables easier rotation of the credentials to meet utility security policy requirements.

Web Service Security

IEE MDM web services interfaces are developed using Microsoft's next generation services platform, Windows Communication Foundation (WCF). Both transport level and message level security are supported enabling heightened security requirements at command and control interfaces (such as over-the-air remote disconnects). Configuring these at deployment allows support for a variety of AMI headend security protocols, thereby allowing a truly end-to-end security solution from the issuing third-party application, through the MDMS, and down to the meter.

IEE MDM web services support the following security methods:

» **Transfer Security** — Protects the message from being viewed or changed by a third party during the transfer of the message from the client to the service.

  – SSL and HTTPS are used for transport-level security.

  – WS-Security and WS-Trust are used for message level security.

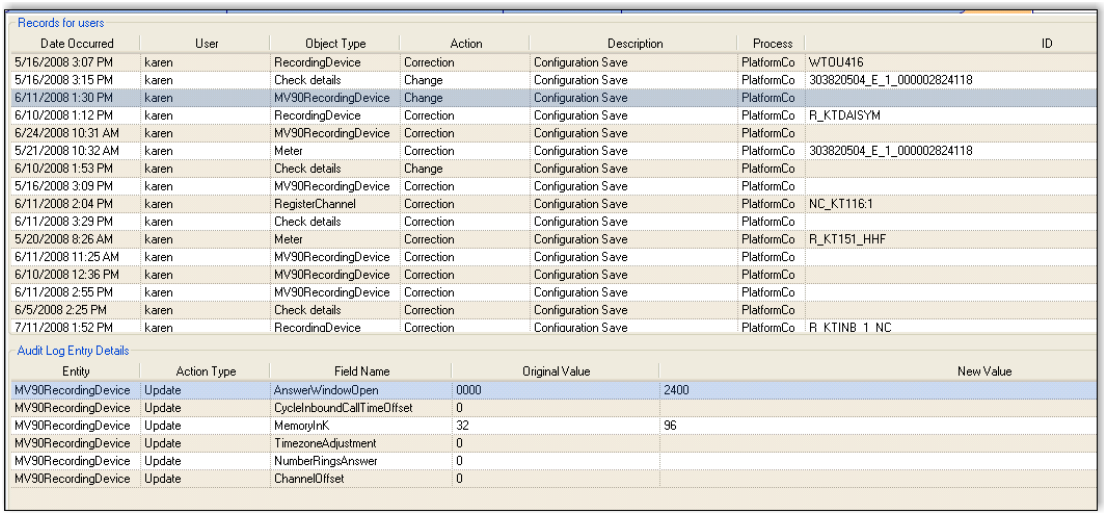
» **Authentication** — Verifies that the source requesting authentication is who or what it is declared to be. Authentication provides proof of the identity of the client and service to each other.

  – A server certificate is used to authenticate the server to the client.

» **Authorization** — Verifies that the client is allowed to access the service's functionality, or is allowed to access resources (such as data) that is requested from the service

Audit Trail / Logging

Accounting functions support non-repudiation and audit security services. Standard reports are available for user activity, audit logs, task logs, and non-critical debug logs which can be configured to send to an enterprise security event manager for identification of failed authentication attempts. All consecutive unsuccessful login attempts are tracked.



Records for users

Date Occurred	User	Object Type	Action	Description	Process	ID
5/16/2008 3:07 PM	karen	RecordingDevice	Correction	Configuration Save	PlatformCo	WTOU416
5/16/2008 3:15 PM	karen	Check details	Change	Configuration Save	PlatformCo	303820504_E_1_000002824118
6/11/2008 1:30 PM	karen	MV90RecordingDevice	Change	Configuration Save	PlatformCo	
6/10/2008 1:12 PM	karen	RecordingDevice	Correction	Configuration Save	PlatformCo	R_KTDAISYM
6/24/2008 10:31 AM	karen	MV90RecordingDevice	Correction	Configuration Save	PlatformCo	
5/21/2008 10:32 AM	karen	Meter	Correction	Configuration Save	PlatformCo	303820504_E_1_000002824118
6/10/2008 1:53 PM	karen	Check details	Change	Configuration Save	PlatformCo	
5/16/2008 3:09 PM	karen	MV90RecordingDevice	Correction	Configuration Save	PlatformCo	
6/11/2008 2:04 PM	karen	RegisterChannel	Correction	Configuration Save	PlatformCo	NC_KT116:1
6/11/2008 3:29 PM	karen	Check details	Correction	Configuration Save	PlatformCo	
5/20/2008 8:26 AM	karen	Meter	Correction	Configuration Save	PlatformCo	R_KT151_HHF
6/11/2008 11:25 AM	karen	MV90RecordingDevice	Correction	Configuration Save	PlatformCo	
6/10/2008 12:36 PM	karen	MV90RecordingDevice	Correction	Configuration Save	PlatformCo	
6/11/2008 2:55 PM	karen	MV90RecordingDevice	Correction	Configuration Save	PlatformCo	
6/5/2008 2:25 PM	karen	Check details	Correction	Configuration Save	PlatformCo	
7/11/2008 1:52 PM	karen	RecordingDevice	Correction	Configuration Save	PlatformCo	R_KTINB_1_NC

Audit Log Entry Details

Entity	Action Type	Field Name	Original Value	New Value
MV90RecordingDevice	Update	AnswerWindowOpen	0000	2400
MV90RecordingDevice	Update	CycleInboundCallTimeOffset	0	
MV90RecordingDevice	Update	MemoryInK	32	96
MV90RecordingDevice	Update	TimezoneAdjustment	0	
MV90RecordingDevice	Update	NumberRingsAnswer	0	
MV90RecordingDevice	Update	ChannelOffset	0	

IEE MDM Audit Log

Secure Development

Itron maintains a secure development lifecycle (SDL) as part of its product lifecycle for all software solutions, including IEE MDM. Itron has adopted the Microsoft Security Development Lifecycle as the basis for secure product development. The SDL consists of following best practices for securing software. This includes code reviews that make sure there no exposed credentials in clear text, that all input validation is done in the rich client, that all web services provide security for encrypting at the transport and message layer.

Code reviews verify that the system does not log confidential information to files in clear text and that, in general, and no sensitive information leaks through with error messages and pop-up windows.

Code reviews also verify that the system audits of all actions that change critical information or system settings.

Security Audits

Both Itron and our IEE MDM customers regularly commission independent third parties to evaluate the security of Itron components and solutions. Itron conducts independent assessments and penetration testing of IEE MDM with each major system release. These security assessments include bench test of physical attacks, port scanning, and system wide penetration attempts. The testing evaluates vulnerabilities found in previous assessments as well as submitted attack vectors from Itron against system areas of interest or with the intent to be the most disruptive.

SOFTWARE LICENSING OPTIONS

Itron offers two licensing options for the IEE MDM software: perpetual and term (i.e., subscription-based).

- **Perpetual license** — A one-time fee, the IEE MDM perpetual license is based on the number of endpoints processed by the system. This license entitles the utility to one production environment and multiple non-production environments (such as test, development, disaster recovery, etc.), for which the utility is responsible for purchasing, building, maintaining, and operating the IT Infrastructure. Software updates and support are available through annual maintenance programs.
- **Term / Subscription-based license** — A monthly fee, IEE MDM subscription licensing is calculated per meter per month and typically combined with Itron's Software as a Service (SaaS) service delivery option. The subscription includes the software, its associated IT infrastructure, and software maintenance. The standard term of the license is five years.

DEPLOYMENT & SERVICES OPTIONS

Itron offers the IEE MDM solution in a variety of on-premise and cloud-based models — all of which are tailored to your specific operational and business requirements. Delivery options include:

- **Standalone System** — Production system on premise, owned, and operated by the utility.
- **Software as a Service** — Production system installed and hosted in Itron Cloud Services environment, MDM operations performed by the utility. Provides customers with an application client and/or web browser access to IEE MDM running on a private cloud infrastructure.
- **Outcomes as a Service** — Production system installed and hosted in Itron Cloud Services environment, MDM operations performed and managed by Itron experts.

Utility size, staffing, and financial considerations are key factors that determine which delivery model is best suited for a given organization.

Microsoft Azure

Since July 2016, Itron has been consolidating its hosted software solutions around the globe into a single platform built on Microsoft Azure, the largest enterprise-grade cloud infrastructure available today. Azure—a growing collection of integrated cloud services such as analytics, computing, database, mobile, networking, storage and web—is the backbone for Itron Cloud Services, which provides business outcomes that address utility and smart city challenges in an Outcomes as a Service model to lower costs and improve performance.

With Microsoft Azure, Itron's customers have access to highly-available, scalable, and durable cloud storage, backup and recovery capabilities. Microsoft Azure maintains the infrastructure and performs routine maintenance, patching, load balancing, and health monitoring for continuous availability. This allows Itron and its customers to focus on running Itron applications rather than upgrading and maintaining hardware.

Managed Services

An increasing number of utilities are looking to Itron to provide outcome-based services approach focused on delivering critical MDM and AMI operational services. These services range from hosting the utility's production system in our cloud services environment to fully outsourced operation of the production system hosted by Itron. Itron offers the following managed services for IEE MDM:

- **Data Collection** – Ensure that data and meter events and alarms are collected from all metered endpoints on the network on a daily basis.
- **Versioned Data Storage** – Store all meter reading data online for three years from the time data is collected for the first installed meter. Track all versions of data if updated through the VEE process or through retries.
- **Validation, Editing, Estimation** – Execute industry-standard validation routines and identify any data that does not pass quality checks. Resolve failed validations through estimation or on-demand access to meter data. Issue work orders to investigate non-communicating meters or continued validation failures.
- **Event Management** – Collect, store and forward meter alarms and events (including outage events) in near real-time.
- **Billing Determinant Calculations** – Prepare calculation routines and ensure that billing determinant calculations are performed on cycle. These calculations could include measurement of performance in demand response programs, peak time rebate or other TOU rate plans.
- **Meter Reading Exports for Billing** – Deliver billing data to utility's Customer Information System for billing.
- **Provision of Data to External Applications** – Schedule and confirm export of data to customer data presentment application (Itron Analytics Customer Portal or third-party application), load research, forecasting, and other external applications.
- **IT System Performance Monitoring** – Monitor IT systems to ensure system availability and performance to meet utility service level agreements.
- **Software Updates** – Apply software patches and upgrades. Coordinate minor and major upgrades with utility approval.
- **Disaster Recovery System Preparedness** – Set up, manage, and monitor DR system.

CONCLUSION

IEE MDM is the most widely deployed meter data management system in the world, and Itron has more experience delivering meter data management solutions than anyone in the industry. Through the course of hundreds of project implementations, our role has gone well beyond that of technology vendor. Our engineering, systems implementation, and support teams actively collaborate with utility project teams to implement operational systems and processes, integrate with their larger IT

environments, and ensure business case benefits are achieved. Through this valuable business and technology experience, Itron delivers truly open, scalable, multi-vendor solutions with the greatest flexibility and extensibility, and with minimal implementation and maintenance services.

Itron Enterprise Edition Meter Data Management System (IEE MDM)

STANDARD REPORTS

IEE MDM provides the ability to produce data graphs and reports for all units of measure supported in the system. Graphs and reports can be produced for all metered and calculated channels. In addition, calculations can be specified at the time of producing graphs and most reports, and the graph or report will calculate the result on-the-fly and display the result. This is particularly helpful for analytical users of the system.

All graphs and reports can be viewed in the user interfaces, saved into spreadsheets, saved as electronic files, and saved as images for use in external reports, etc. Many reports can be run in batch mode. Graphs provide zoom in and zoom out functionality and provide mouse-over display of data points within the graph.

The following standard reports are included with IEE MDM.

Multipurpose Reports

- Validation Report — Shows detailed results of interval validation with accompanying information on associated register reads. This report is multi-faceted in that it can be used to investigate interval validation failures, meter start and stop reads, pulse and meter multipliers, min/max values, power factor calculation and KVA from pre-defined KVA channel sets. It also includes associated device event information where applicable.
- Reading Detail — Meter, register, most recent readings—Presents reading values in graphical and tabular form.

Please note: Custom reports and graphs can also be configured using IEE's XML data export capability (described below), along with third-party style sheets or reporting tools.

The AMI **Data Export XML Application Programmable Interface** (API) is a high-volume exporter of meter data. Similar to the AMI Billing Export process, the AMI Data Export (ADE) can be run on a schedule or as request/response process with an external system. ADE can export both meter readings and meter events. Export templates support a wide range of customer groupings, even down to user-defined attributes. The groupings are dependent upon configuration; data status flags are included when extracting the data. IEE MDM includes the AMI Data Export Queue that can be used to monitor the status of exports through the user interface.

Interval Data Only

- Detail Demand – Peak day, Summary, KVA/PF, Load duration — Presents interval data in graphical and tabular form; accesses Universal Calculation Engine to perform calculations on-the-fly.
- Validation Log — Details results of validation process.
- Edit Log — Shows interval data and register data editing activities.
- Engineering Units — Demand, consumption, pulses by day, detail, peaks—presents interval data in engineering units.
- Coincident/Non-coincident Peaks — Identifies coincident and non-coincident peaks.
- Weekly Detail – Demand, Consumption, Pulses by detail, Peaks — Presents interval data in week increments in tabular form.

- KVA – By Day, Detail, Peaks — Calculates KVA and presents in tabular form
- Time of Use (TOU) — Calculates TOU values based on TOU definitions.
- Data Available — Interval Data Available Report, designed for use by Commercial & Industrial implementations, lists all service point channels for the selected service point ID, and contains the following information. Use this report to see how much and for what dates interval data has been stored for a service point.

- Gaps — Lists the gaps found within interval data streams.
- Interval Status — Provides a listing of readings with specified interval status values.
- Missed Readings – Interval — Indicates if any interval data is missing for a specified time period.

Register Data Only

- Readings by Source — Counts readings collected by source and service point.
- Missed Readings – Register — Indicates whether any meter is missing readings for a specified time period.
- Usage for Inactive Premises — Shows inactive premises for which usage was found.
- Zero Usage at Active Premises — Shows active premises for which no usage was found.
- Register Read Editing and Validation — Allows users to view and edit register-only data and show results and previews of register validation.

Operations

- Audit Logs — Lists configuration data changes as well as changes to system settings, task templates, validation sets, formulas, and other data that can affect processing. This is used to track modifications to critical data in the MDM and provide an audit trail to accommodate business processes.
- Cycle Due Date — Identifies tasks that are due to process on various cycle dates. The Cycle Due Date Report, designed for use by Commercial & Industrial implementations, returns all Service Point Channels for the following items:
- Retrieved on cycles during a specified date range, but which do not have the expected data.
- Exported on cycle during a specified date range, but which did not have the data exported.
- Aggregated on cycle during a specified date range, but for which data was not aggregated.
- Export Status — Indicates the status of exports and is designed for use by Commercial & Industrial implementations, lists all successful export task information by specific entity type (such as Service Point and Customer), and entity ID, the exported file name and location, and task running time period. Use this report to verify successful completion of the exports scheduled to run on a data driven schedule.
- Meter Change Report — Shows meter change events captured.
- Configuration Attributes – Customer, Account, Premise, Route, Service point, Meter, Interval channel, Register, Recording device — Lists configuration objects with selected attributes (i.e. meters by manufacturer, premises by status).
- Readings Not Processed — Lists log information about readings that could not be saved due to configuration mismatches.
- Billing System Cycle ID — The Billing System Cycle ID Report is an operational report that lists entity types by billing system cycle ID. For example, you can generate a report that lists service points assigned to each billing system cycle IDs.

Configuration Reports

Users can generate reports based on configuration attributes stored in the IEE persistent data store. IEE MDM supports reports for the following entity types:

- Route Attributes — A collection of service points that is read on a specific schedule.
- Customer Attributes — Information about the residential and commercial consumers served by the utility.
- Account Attributes — the contractual relationship between a customer and one or more quantities delivered at one or more service points. An account is referred to by its account number or ID. Most billing systems use account numbers as the primary mechanism to track loads and revenues.
- Meter Attributes — Information regarding the meter, such as meter multiplier, pulse multiplier, fixed offsets, CT ratio, PT ratio, loss constant(s), plus information such as warranty date, and an unlimited number of user defined constants.
- Register Channel Attributes — Register readings usually indicate consumption. Register quantities usually represent total or summary values over a much longer time period than interval values. Some common quantities stored by registers include Total kWh, Peak kW, Accumulating kWh readings, Total kWh for various TOU blocks, and Number of Resets.
- Interval Channel Attributes — Stores a data quantity recorded by a metering device for a set frequency. For example, with a 15-minute interval, register values are recorded every 15 minutes. The time between readings is both predictable and exact. The interval length, also called the interval frequency, is the number of minutes that elapse between recording register values. Partial intervals are not allowed in IEE MDM. Interval lengths divide evenly into 60, with the exception of the 1440-minute interval that represents 24 hours.
- Service Point Attributes — the physical location (or locations) on a premise, where the utility company considers the commodity that it supplies (water, gas, energy, and so on), to be delivered to the customer.
- Premise Attributes — a physical location, such as a building, apartment complex, or street address. A premise can have one or more service points associated with it.

Events

- Events by Service Point — Lists events captured for specified service points.
- Events by Type — Lists all events that occurred for all service points by type.
- Tamper Events — Lists tamper events captured for specified service points.

Dashboards

In addition to standard reports, some of the AMI scale reporting in IEE MDM involves adding monitoring dashboards that provide feedback to users that track the health of the system. These are reports in the sense that they provide useful information but they do not necessarily provide PDF-style reports like many of the Operational, Analytical, and Configuration reports.

- AMI Readings Import — AMI Readings dashboard provides import, validation and estimation statistics, as well as exception notifications. This is similar in design and philosophy to the AMI Billing Export user interface described later. Users will be able to identify import exceptions, including readings data that was expected, but not received, and be able to hone in on statistics for meters related to a specific collection network, validation set, date range, or for newly installed meters only.

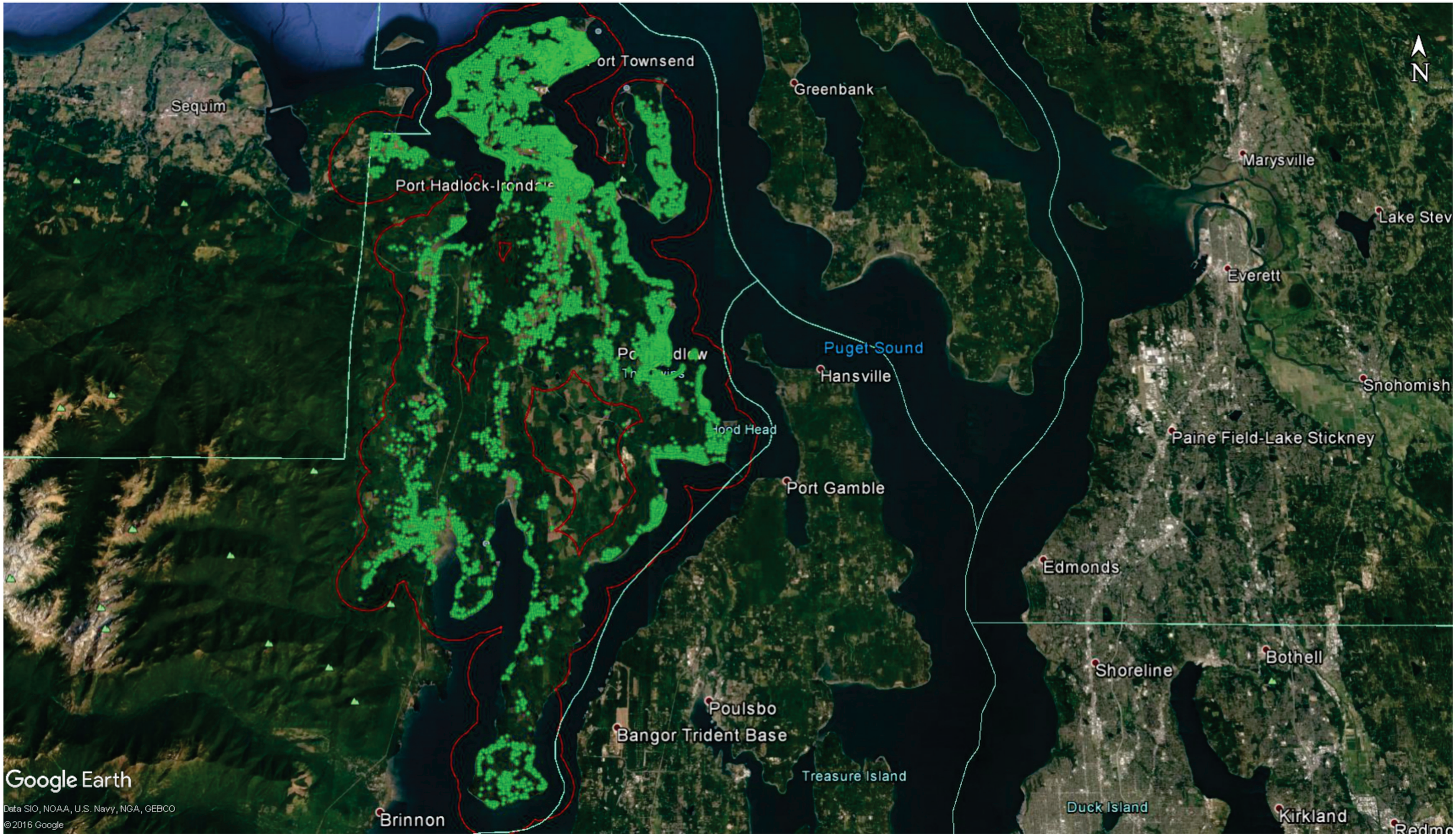
- AMI Communications — IEE MDM provides interaction and brokering of two-way controls through web services. This reporting screen provides the ability to monitor and manage exceptions through a simple but powerful user interface. It tracks historical status of two-way control commands and monitors currently pending requests. There are summary views and also drill down capabilities for detailed investigation and problem resolution.
- AMI Billing Export — this reporting screen enables users to easily monitor the state of the automated billing request, calculation, and response processes and to manage exceptions with intuitive filtering and grouping tools. The AMI billing export process calculates and exports billing determinants from readings data to support customer billing for residential, small commercial and large commercial accounts.

Jefferson County PUD Preliminary Propagation Study

Legend:
RF Mesh Boundry | CGRs | Range Extenders | Meters not covered

Jefferson County PUD Preliminary Propagation Study

Legend:
- Electric Meters



Preliminary Propagation Study

The images following this page show the preliminary network propagation study.

Notes and Assumptions:

- Final number of Connected Grid Routers, and OpenWay Riva Routing Nodes may vary based on actual field conditions. As part of project activities, a site survey will be performed to determine the final network configuration.
- Connected Grid Routers: 17
- OpenWay Riva Routing Nodes: 15
- Coverage: estimated at 99.7 % of meter locations provided in RFP.
- Uncovered meters: estimated to be 56, assumption that tree density appears to pose a problem, possible mitigation with OpenWay Riva cellular meters.

ID	Task Name	Duration	Start	Finish	Predecessors
1	**OpenWay Riva Sample SaaS Deployment Plan**	**1076 days**	**7/10/17**	**8/23/21**	
2					
3	**Startup**	**5 days**	**7/10/17**	**7/14/17**	
4	Gather and Review Project Documentation	1 day	7/10/17	7/10/17	
5	Setup Project Internals	0.5 days	7/11/17	7/11/17	4
6	Assemble Project Team	0.5 days	7/11/17	7/11/17	5
7	Internal Project Kick-off	1 day	7/12/17	7/12/17	6
8	Prep for Customer Project Kick-off	1 day	7/13/17	7/13/17	7
9	Customer Project Kick-off	1 day	7/14/17	7/14/17	8
10	**Define**	**10 days**	**7/17/17**	**7/28/17**	
11	**Conduct Solution Overview and Requirements Session**	**2.5 days**	**7/17/17**	**7/19/17**	
12	Integration and Interfaces Overview and Requirements	0.5 days	7/17/17	7/17/17	9
13	Configuration Overview and Requirements	0.5 days	7/17/17	7/17/17	12
14	System Administration and Security Overview and Requirements	0.5 days	7/18/17	7/18/17	13
15	Collection Engine Overview and Requirements	1 day	7/18/17	7/19/17	14
16	Compile draft Business Solution Requirements (BSR) document	1 day	7/19/17	7/20/17	15
17	Compile draft Technical Architecture Design (TAD) document	1 day	7/20/17	7/21/17	16
18	Customer review of deliverables - Draft BSR and TAD	2.5 days	7/21/17	7/25/17	17
19	Deliverable(s) update - BSR and TAD	1 day	7/26/17	7/26/17	18
20	Customer sign-off - BSR and TAD	2 days	7/27/17	7/28/17	19
21	**Design**	**15 days**	**7/31/17**	**8/18/17**	
22	Review Network design	2 days	7/31/17	8/1/17	20
23	Conduct Functional Design Session	1 day	8/2/17	8/2/17	22
24	Update and Review Data Integration Design (DID) document	1 day	8/3/17	8/3/17	23
25	Update and Review Test Plan	1 day	8/4/17	8/4/17	24
26	Update and Review Training Plan	1 day	8/7/17	8/7/17	25
27	Update and Review Production Cutover Plan	3 days	8/8/17	8/10/17	26
28	Conduct Deployment and Organizational Readiness Assesment	3 days	8/11/17	8/15/17	27
29	Customer sign-off Test, Training and Production Cutover Plans	3 days	8/16/17	8/18/17	28
30	**Build**	**25 days**	**8/18/17**	**9/22/17**	
31	**Install / Build enviroments**	**2 days**	**8/18/17**	**8/22/17**	
32	Install & configure database	0 days	8/18/17	8/18/17	29
33	Install & configure application	0 days	8/18/17	8/18/17	32

ID	Task Name	Duration	Start	Finish	Predecessors
34	Import test data	0 days	8/18/17	8/18/17	33
35	Conduct preliminary functional testing (component operational testing)	0 days	8/18/17	8/18/17	34
36	Update & finalize Product Configuration Design (PCD) document (as built)	2 days	8/21/17	8/22/17	35
37	**Integration & Interface**	**25 days**	**8/21/17**	**9/22/17**	
38	Build interfaces	4 wks	8/21/17	9/15/17	29
39	Interface Functional Testing	5 days	9/18/17	9/22/17	38
40	**Network/Meter Phase I installation**	**24 days**	**8/21/17**	**9/21/17**	
41	Assemble Team	1 day	8/21/17	8/21/17	29
42	Kick-off	2 days	8/22/17	8/23/17	41
43	Conduct Network and Meter training	1 day	8/24/17	8/24/17	42
44	Network equipment and Meter installations	20 days	8/25/17	9/21/17	43,36
45	**System Testing**	**11 days**	**9/22/17**	**10/6/17**	
46	Conduct Software training	5 days	9/22/17	9/28/17	44
47	Functional Testing	3 days	9/29/17	10/3/17	46
48	User Acceptance Testing	2 days	10/4/17	10/5/17	47
49	Customer Review of and sign-off on system testing results	1 day	10/6/17	10/6/17	48
50	**Full Network and Meter Deployment**	**1000 days**	**10/9/17**	**8/6/21**	
51	Install network equipment and meters	1000 days	10/9/17	8/6/21	49
52	Post go-live support	10 days	10/9/17	10/20/17	49
53	**Full System Testing**	**11 days**	**8/9/21**	**8/23/21**	
54	Conduct Software training	5 days	8/9/21	8/13/21	51
55	Functional Testing	3 days	8/16/21	8/18/21	54
56	User Acceptance Testing	2 days	8/19/21	8/20/21	55
57	Customer Review of and sign-off on system testing results	1 day	8/23/21	8/23/21	56
58	**Transition to support**	1 day	8/24/21	8/24/21	57

Project Management Methodology

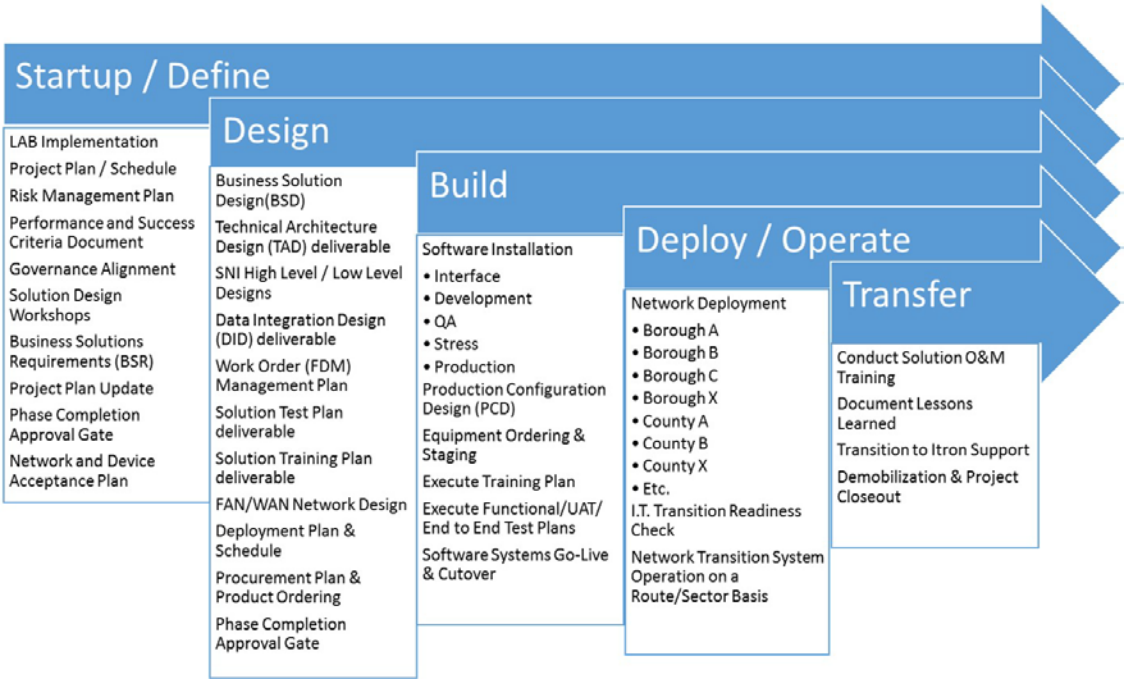
Itron has broad experience successfully deploying Smart Grid projects and their components - such as the AMI system - by ensuring project goals and objectives are met and benefit realization is achieved. We accomplish this by delivering and integrating a total solution suite of Itron products, our partner products, and your existing legacy devices into the utility's business processes and key IT systems. We leverage our project-proven methodology, called ***Itron Advantage***, to ensure that the project requirements are fully defined, understood by all involved, and that all tasks and dependencies are identified, assigned, and managed. This approach supports risk identification and mitigation, communications, reporting, change management, and issue resolution as well as providing the basis for executing project tasks and providing project deliverables on-time and within budget.

The Itron Advantage methodology is consistent across Itron solutions and provides for a controlled and measured phased delivery of the solution as shown in the following graphic:

Phase	Description
Define	Gathering resources and information needed to initiate and manage the project, understand the utility's specific needs and to communicate the objectives and plan to successfully deliver an Itron solution.
Design	Solution design specifications such as Business Solution Design and the Technical Architecture Design. It also includes plans to build, test, and deploy the solution.
Build	Execute to the design and plans to build and configure the solution, train the people, and test end to end in preparation for the Deploy / Operate phase.
Deploy / Operate	Activities to deploy, manage, run, and optimize the solution.
Transfer	Transitioning the support of the solution to the Utility and Itron Support Services, as well as project close-out activities.

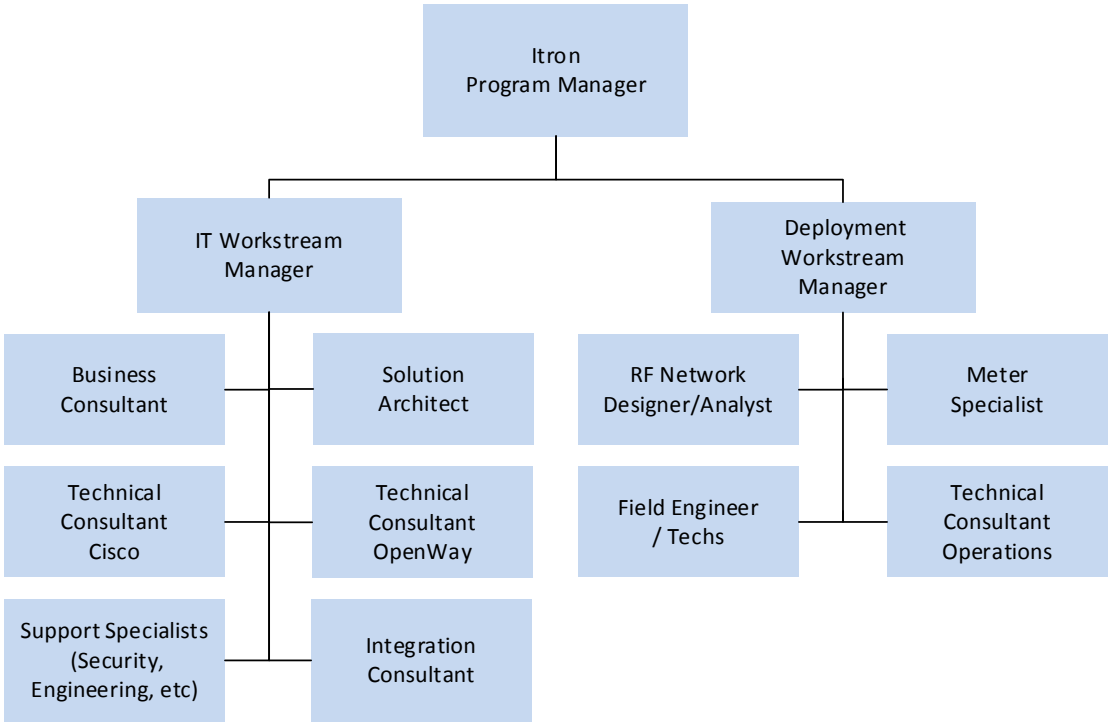
Itron Advantage Deployment Methodology

The following table provides a more detailed summary of the Itron Advantage tasks and activities



Implementation Approach

In Itron's experiences across projects, there is no "typical" project team; however there are key roles that we have identified that are critical to a project's success. As a utility embarks on a major strategic imitative like AMI, and assembles an extended team of industry participants, we have found that it is imperative to remain flexible on how the team is structured while focusing on where accountability resides across the AMI Program and with Program Partners and subcontractors.



Itron Program/Project Team Roles

Typicaly, Itron provides resources in the organizational structure shown above and described below. This structure has served our customers well on similar large and complex projects. Itron expects to leverage a single Program Manager throughout the project supported by two workstream Project Managers – one for the Systems installation/implementation related work activities (IT Workstream Manager) and the other for the Deployment of the FAN communications network, meters, modules, and industrial routers
(Deployment Workstream Manager). The Program Manager and Project Managers will be supported by a Program Analyst and specialists including but not limited to a Solution Architect, Security and Network Specialists. In addition, Technology and Integration Partners as well as other subcontractors will complement Itron's Program/Project organization as needed to meet objectives and requirements.

The onsite Program/Project organization works closely with and supports the Utility's participating business, technical, and administrative groups, its Program Management Office (PMO), and other Consultants and Contractors as may be assigned. Further, the onsite Program/Project organization will also work closely with Itron's Managed Services team, as applicable.

Itron's Proposed Roles and Responsibilities

For large projects, Itron typically designates both an **AMI Program Sponsor** and an **Executive Sponsor**. The Executive Sponsor works with and supports the Utility's Executives in creating a shared vision across both companies and creating an atmosphere of trust and open communications across all levels of our organization. Itron's Executive Sponsor is instrumental in identifying and ensuring strong leadership across the program, monitoring project progress, and supporting the AMI Project Sponsor in removing obstacles and addressing risks that impede project success.

The following table provides an overview of the various Itron project roles and responsibilities:

Itron Role	Responsibilities	Name
Executive Sponsors	• Supports development and execution of the Utility's corporate strategy as it pertains to the AMI Project. • Assists in the resolution of risks and the removal of project-related obstacles that impede achieving project success.	Bruce Husta, AVP Sales Colleen Thompson, Solutions Delivery Director
Program Sponsor	• Drives Project Charter for the company • Provides for resources • Removes obstacles • Reviews/Approves Plans, Agreements and changes thereto • Risk Management oversight • Steering Committee Participant (if applicable) • Itron Governance Committee	Udo Van Rijssen
Program Manager	• Contract Management, including change control process • Financial management, including budgeting, invoicing and analysis • Integrated Project plan development and maintenance • Delivery to schedule and budget • End-to-end AMI solution delivery responsibility • Program quality and safety • Risk Management tracking, reporting, resolution • Program Status and Issues Reporting • Bi-weekly (or more) Program meetings • Itron Governance reporting • Participant of PMO functions/activities	Piyush Sura*
Solution Architect	• Works closely with Itron's Integration Partner and other Solution Architects • Oversees overall network (FAN) and AMI systems (OpenWay Operation Center, etc.) design • Reviews and approves the Technical Architecture Design (TAD) and Data Integration Design (DID) document deliverables • Supports design/development/testing of integrations • Supports disaster recovery and system failover design • Develops and shares: - Data workflow design - Systems integration design - Scalability and security design - Solution and system test design	Jon Kilayko*

Itron Role	Responsibilities	Name
	- Hardware sizing/environment planning • Supports PMO functions/activities as necessary	
Security Specialist	• Consults on systems and network security • Reviews project deliverable documents from a security perspective	TBD
Network Specialist	• Supports network design and testing activities • Supports network security activities • Supports network troubleshooting and maintenance activities	TBD
Meter Specialist	• Provides meter-related subject matter expertise to the Utility • Assists with defining/testing meter programs • Supports meters/module maintenance/repair and replacement activities	
Project Manager – Systems	• Supports contract and financial management • Delivery to AMI Systems implementation schedule and budget • End-to-end solution delivery • Detailed project plan development/maintenance • Supports program quality and safety • Project related Risk Management tracking, reporting, resolution • Project Status and Issues Reporting • Weekly Project meetings • Itron Governance reporting • Works closely with Technology Partners (e.g., Cisco, Verizon, etc.) • Manages/Oversees Integration Partner and assigned subcontractors/vendors • Supports PMO functions/activities	TBD
Lead Business Consultant / Business Consultant(s)	• Works closely with the Itron-assigned Solution Architect and Test & Integration Lead • Supports requirements gathering through workshops • Identifies business impact from hot fixes and upgrades • From workshops, prepares the Business Solutions Requirements (BSR) and Business Solutions Design (BSD) document deliverables • Develops Test Plan deliverable document and associated test cases (initial install and upgrades) • Develops Training Plan document deliverable and provides requisite training materials • Coordinates, supports and/or participates in functional, integration, end-to-end, and user	TBD

Itron Role	Responsibilities	Name
	acceptance testing • Provides knowledge transfer and training to customer personnel	
Lead Technical Consultant / Technical Consultant(s)	• Works closely with the Itron-assigned Solution Architect and Test & Integration Lead • Supports requirements gathering through workshops • Prepares/maintains the Requirements Traceability Matrix • Provides Subject Matter Expertise (SME) for meter configurations, testing, etc. • Assesses and designs: - OpenWay technical architecture - NMS / SNI architecture - Security - System administration - Data workflow - Custom reports • Prepares Technical Architecture Design (TAD) document deliverable and provides input to the Data Integration Design (DID) document deliverable • Configures, and tests the OpenWay Operations Center • Coordinates, supports and/or participates in functional, integration, end-to-end, and user acceptance testing • Provides knowledge transfer and training to customer personnel	Tom King* Landon Fitts* Branson Blair*
Lead Testing & Integration Consultant / Technical Consultant(s)	• Oversees and works closely with Itron's Integration Partner • Works closely with utility Solution Architects regarding integration requirements/design • Provides input to the Technical Architecture Design (TAD) document deliverable • Prepares the Data Integration Design (DID) document deliverable • Supports design/development/testing of other applicable integrations	Rob Rector*
Project Manager – Deployment	• Supports contract and financial management • Develops/Maintains detailed deployment project plan • Supports program quality and safety • Deployment project related Risk Management Tracking, Reporting, Resolution • Deployment Project Status and Issues Reporting • Weekly Project meetings • Works closely with network-related Technology	TBD

Itron Role	Responsibilities	Name
	Partners (e.g., Cisco, Verizon, etc.) • Oversees Network Design & Control functions • Oversees Deployment functions for the FAN • Itron Governance reporting • Weekly/monthly plan for systems maintenance, updates/upgrades • Configuration Control Board (CCB) oversight • Monitors/manages the FAN and devices and meters • Supports FAN and meter mitigation activities • Manages/Oversees assigned subcontractors and/or vendors • Supports PMO functions/activities • Defines and executes route/system acceptance plans • Manages/Oversees Integration Partner (e.g., Accenture) and assigned subcontractors/vendors • Supports PMO functions/activities • Supports any Meter Lab and/or Meter Farm activities as applicable	
Network Design & Control Lead	• Establish Network & Design Control function • Provides for onsite systems (e.g., design POD, FDM, GIS) to maintain/control network design and deployments control • Oversees Dispatching coordination for network, meter, and home device deployment activities • Supports network mitigation activities	TBD
Deployment Lead –FAN	• Oversees and works closely with Itron's Technology Partners (e.g., Cisco, Verizon, etc.) for the network design • Oversees and works closely with Huntsville Utilities and/or installation vendor for the deployment of network devices • Provides for engineering coordination with the Technology Partners • Provides for Field Engineering to support network testing and deployment activities • Delivers to FAN installation schedule and budget • Delivers and/or ensures field deployment work order management system(s) and tools are in place	TBD
Field Engineer(s) –FAN	• Supports network design/testing • Supports network maintenance/repair and replacement activities • Supports applicable sustainability programs • Trains the Utility's installers and installation contractors on installation procedures and guides for network devices	TBD

Itron Role	Responsibilities	Name
	• Prepares site-specific installation instructions for network devices • Provides for oversight (safety, technical, quality, etc.) of field deployment activities • Performs Field/Site Surveys and oversee field installation activities with the Utility and/or contractors • Works closely with Dispatch Coordinator(s) in executing deployment plans with the and/or contractors • Supports desktop and field mitigation of network devices	
Technical Consultant – Operations	• Performs RMA processing and track/report on results • Supports applicable sustainability programs • Trains installation contractors (e.g., tbd) on installation procedures and guides for meters and modules • Provides for oversight (safety, technical, quality, etc.) of field deployment activities • Performs Field/Site Surveys and oversee field installation activities by contractors • Works closely with Dispatch Coordinator(s) in executing deployment plans with installation contractors • Supports desktop and field mitigation of the network and installed devices • Provides knowledge transfer and training to customer personnel	
* Assignment of this individual is subject to availability at time of contract award. Please see Attachment 28, *Itron Project Team Sample Resumes* for more information about these Itron Solution Delivery professionals.		

Project Governance

The Itron Project Team will be organized in a manner to be closely aligned with the Utility's overall project governance structure. As part of this, Itron assigns a Program Manager with overall responsibility for the engagement. The Program Manager will be supported by a Project Manager having responsibility for each proposed workstream (i.e., Systems and Deployment) that make up the overall AMI Program. This Itron Program/Project Management Team will be further supported by a Project Analyst who will assist with and facilitate the preparation and processing of data and reports regarding project activities and statuses. The Itron Program Team Management will work closely with the the Utility's management team, business units, PMO as well as other technology partners and contractors involved in the AMI engagement.

To help establish a sound foundation for Project Governance, the Itron Program Management will:

» Operate and interact with all extended team members in a manner that is consistent with a collaborative, constructive partnership.

- Clearly identify and describe Itron's roles and responsibilities for program leadership and our work-stream team members in the Project Charter or other similar project organization documents that may be published by the Utility's PMO.
- Adhere to the contract/project change control process put in place and agreed to by both the Utility and Itron. In conjunction with this, the Itron Program Manager will put in place an escalation and dispute management process.
- Develop and provide a detailed project plan that addresses the tasks/activities for each and across the agreed to workstreams. Further, the Itron Program/Project Management Team will work closely with the Utility's PMO to develop an Integrated Project Plan (IPP) that can be used to manage and track the performance of the overall project.
- Maintain agreed upon project tracking and reporting and maintain transparent communications and agreed upon program processes.
- Incorporate the Utility's quality and safety program policies/procedures into Itron's project controls and processes and into Itron's project team internal onboarding and training practices.
- Conduct periodic quality and safety reviews with project team personnel.
- Establish a clear issue escalation path and periodic executive level briefings to ensure clear communications so obstacle and issues are addressed and project progress is not impeded.

Project Governance is only effective when there are clear and timely communications along with the availability of pertinent project-related information and data to assess. To that end, the Itron Program/Project Management Team will participate in and lead meetings and provide status updates including but not limited to the following:

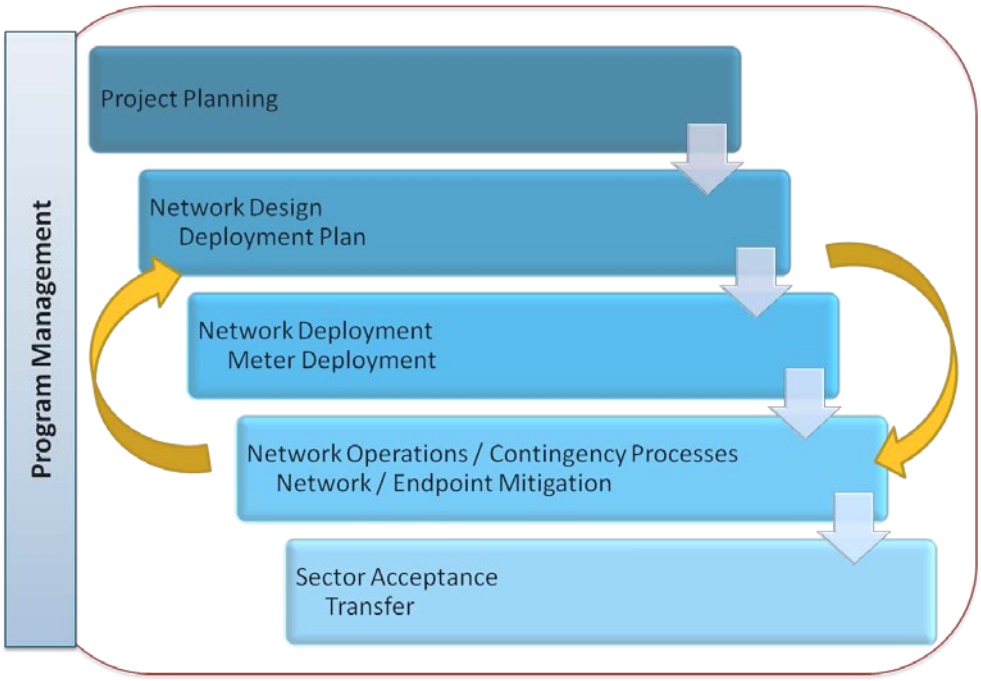
- Meetings
  - Weekly Workstream Review Meetings
  - Bi-weekly (or more often) AMI Program Meetings
  - Monthly Program Sponsor Review Meetings
  - Itron Governance Committee Meetings (as required based on pre-set metrics)
  - Weekly (assumed) the Utility / Itron PMO Meetings
- Reports
  - Weekly Project Status (by Workstream) Reports
  - Key Performance Indicators Tracking Reports
  - Project Risk Assessment and Tracking Reports
  - Issues and Defects Tracking Reports

Full Roll-out Deployment Management Considerations

Itron recognizes that the transition to new AMI systems is a major undertaking and is not simply a technology update or change-out. The overall approach to the project is as important as the underlying technology that the Utility chooses. Our proposal takes into account the importance of supporting the Utility's business and operational processes as well as updating/replacing AMI related systems (e.g., OpenWay Operations Center, etc.) that are integral to multiple utility programs.

The fundamental challenge in ensuring a smooth transition to the new Smart Grid Solutions Metering solution is to deploy the network and meters in a way that will support the most efficient and reliable network coverage so that meters will communicate quickly upon installation, minimize interruption to customers, and allow the new meter to be transitioned into metering/network operations as quickly as possible. This requires thoughtful and diligent leadership, detailed and well-understood business processes, and clear alignment across all program participants. Itron brings proven practices that have been successfully deployed across other projects that will provide the confidence and certainty that the Utility will require.

The key to this success is a detailed, comprehensive approach to network design and network installation following by a ***network-centric approach to network and meter deployment***. Ensuring smooth transition for all communication devices and meters will require focused collaboration between the network design team, deployment teams, the network operations teams, and subsequent mitigation teams. Based on recent experiences on other projects, and taking into consideration the connectivity benefits associated with the Itron Adaptive Communications Technology (ACT) communications capabilities, we are confident that we can achieve +99% communications rate of a target area during the deployment phase and thus minimizing the need for efforts to mitigate. This practice assures a robust system of network access paths to fully utilize all communications capabilities of ACT.



Network Deployment

Our deployment method assumes a sequential build-out of the field area network, network stabilization, and then pragmatic meter deployment. Unlike other approaches which tend to result in over-building the network, Itron's network-centric deployment has the following benefits:

- Focuses on network robustness, building a resilient ACT network in minimal time
- Requires more precision in the approach to meter deployment and requires careful control and management of the meter installation plan and consideration of omission (skip) from the tactical mass deployment for certain meters that are pre-determined to be challenging to cover with the mesh. In certain cases, this would leave a meter on an existing network/reading method to ensure reliable data collection and then a surgical exchange following area build-out to determine in-situ mitigation needs. The time between skip and mitigation is measured in days instead of pushing skipped meters to the end of the project.
- Uses the OWOC in support of "run operations" provides advanced reporting and network management tools to support quick identification of meters that have been deployed and may be challenged for connectivity.
- Experience proven mitigation tools and approach provide Itron with many options to quickly address coverage challenges and the use of point-to-point cellular meters for truly isolated installations. However, with Itron's ACT mesh and the ability to leverage multiple communications paths, such as PLC, these sorts of traditional RF-challenging "corner cases" become far fewer than with other AMI technology solutions.

Compared to other deployment methodologies, Itron's network-centric approach is proactive rather than reactive and yields early read performance as demonstrated in successes at FirstEnergy where network design and deployment processes are yielding results of greater than 98% on network communications on the first day of meter exchanges. Focus on early, reliable meter-to-network

communication and expeditious mitigation of meters that require additional considerations, our approach can be summarized as follows:

1. **Network Design and Planning**
   Advanced network design and planning efforts that includes location identification for network devices, network deployment planning and preparations including make-ready work activities, followed by identification and prioritization of meters for deployment with the creation of detailed meter installation plans. This planning will identify meters to be deployed that have high confidence of meshing and segregate those that have lower probability meshing as derived from our network design modeling. Field surveys will be used to validate network router locations, as estimated in the initial network design.

2. **FAN Canopy Deployment**
   Deployment of a robust FAN communications canopy ahead of meter deployment with additional network devices, where logical, to extend and strengthen the network. Network deployment is performed well ahead of meter deployment and efficiently uses utility-approved Line Construction resources. Simplified and faster CGR installation is enabled by the zero-touch deployment (ZTD) feature of the CGR which only requires mounting the device and supplying power. Upon initial power-up, the CGR self-configures and finds a path, via cellular connectivity (or via IP/fiber), back to the OpenWay Operations Center which provides a “single pane of glass” view for Huntsville Utilities to monitor in the Network Operations Center.

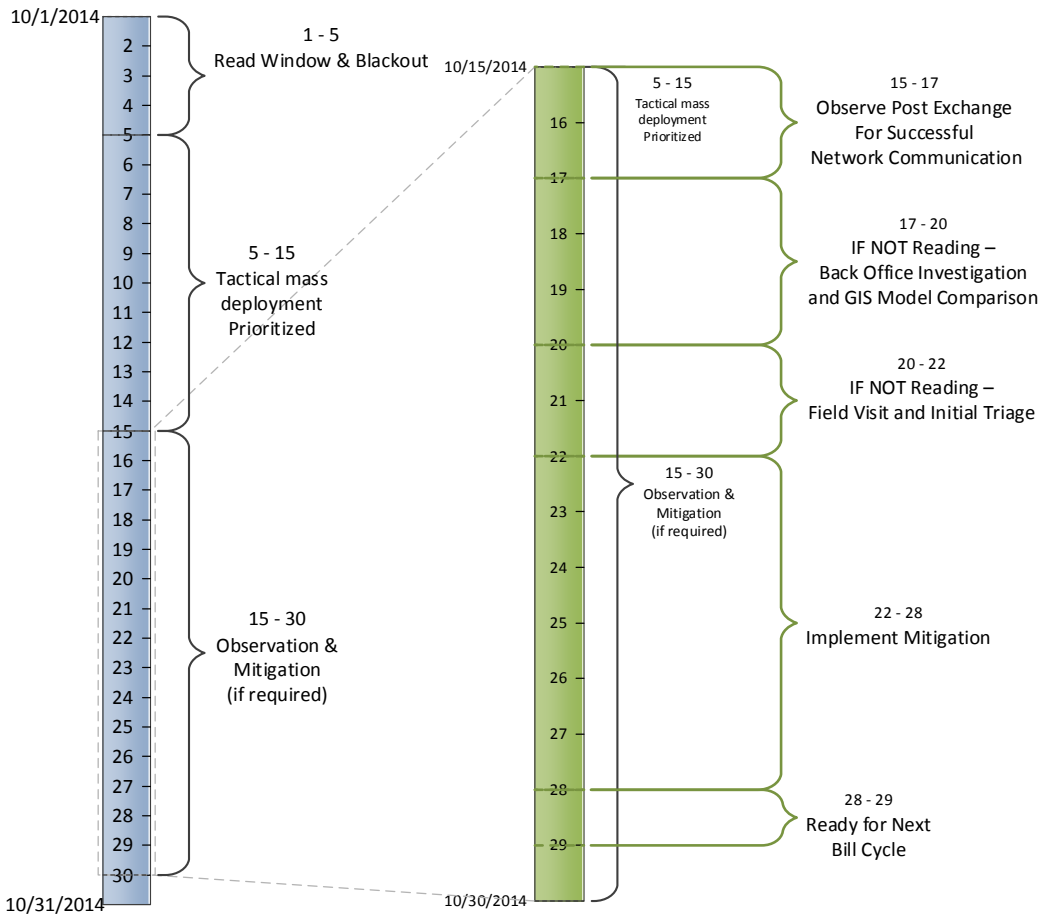
3. **FAN Communications Monitoring**
   As the FAN canopy is installed, operations are verified and managed in the Cisco Connected Grid Network Management System (CG-NMS).

4. **Meter Deployment**
   A precision, tactical meter deployment plan centered on ACT begins and prioritizes meter exchanges in a concentric pattern emanating outward from the Cisco Connected Grid Router (CGR).

   Meters that do not register within a time window agreed to by Itron and the Utility are optimized quickly in a pragmatic manner.

   > On the day after the new meter is installed, exception reports are generated from the NOC that Itron will maintain until final system acceptance. The Deployment and NOC teams collaborate with the Network Design teams to evaluate potential network optimization issues and make decisions on whether it is a failed meter or potential connectivity issues to support resolution to the problem. As the change-out of those devices close out the list of meters that are not responding, focus then shifts on the processes required to prepare the route for acceptance.

   The following ‘sample timeline’ compares the advantage of ACT connectivity compared to other Mesh or Star systems and demonstrates actions taken by day and illustrates the path for success.



Example Timeline for Network-centric Deployment (in Days)

The advantages to the Utility of this approach include:

- Accelerates the timing and benefits this technology can provide to the Utility. Itron has the only platform available with all of the *proven* technology and multiple communication paths for connectivity to achieve rapid route acceptance.
- Eliminates unnecessarily over-building the network and the O&M costs associated with additional unnecessary infrastructure such as extenders, antennas, and siting costs.
- Minimizes interruptions to customer service by utility teams, third-party installers, and others.

Finally, Itron believes that this is the easiest and lowest cost approach for the field transition of utility metering equipment.

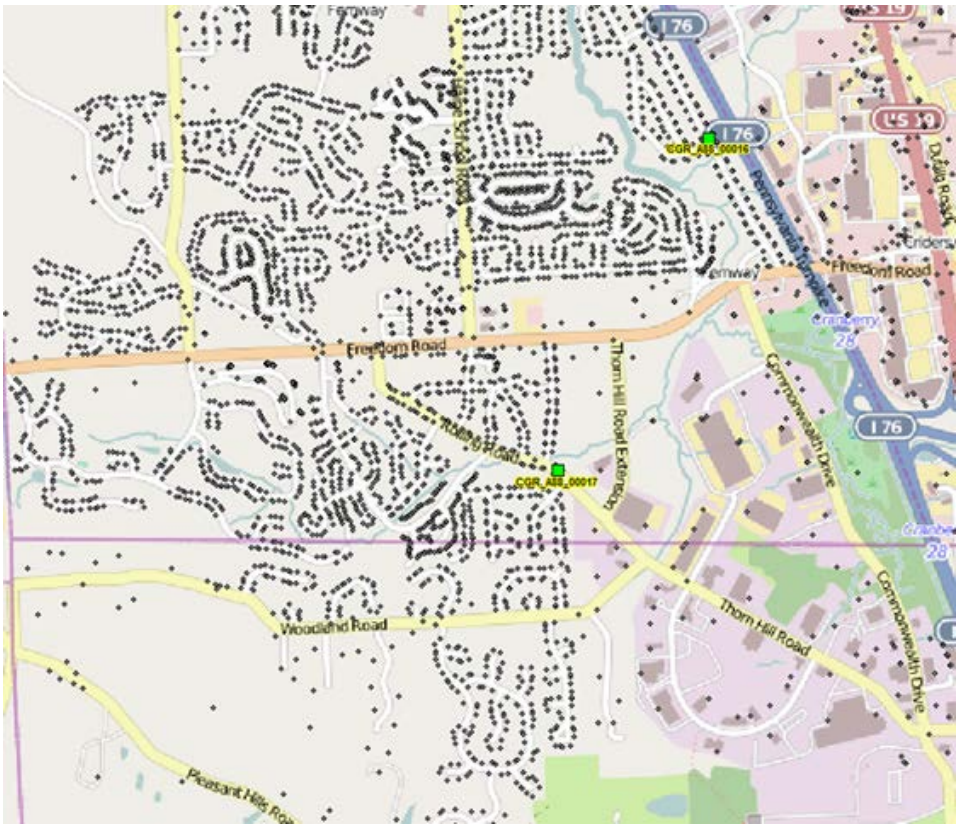
Priority Meter Deployment Plan – Real World Experiences

This section describes the network-centric deployment approach in action using a recent example from our current project at FirstEnergy. Our shared success with this project methodology gives us certainty that we can accomplish your project goals and be accountable to the Utility for the costs specified in our proposal.

Starting with the initial network design, the deployment planning process identified meters with high confidence of forming a mesh within the agreed-upon timeframe. Identifying these priority meters allowed Itron to systematically validate the initial design, update device locations, and identify additional infrastructure such as additional ACT devices / modules or cellular meters that were required.

This image generated from our network design tool shows the initial location of a CGR to support meters in the area along with the design model of meter connectivity and estimated hop count information.

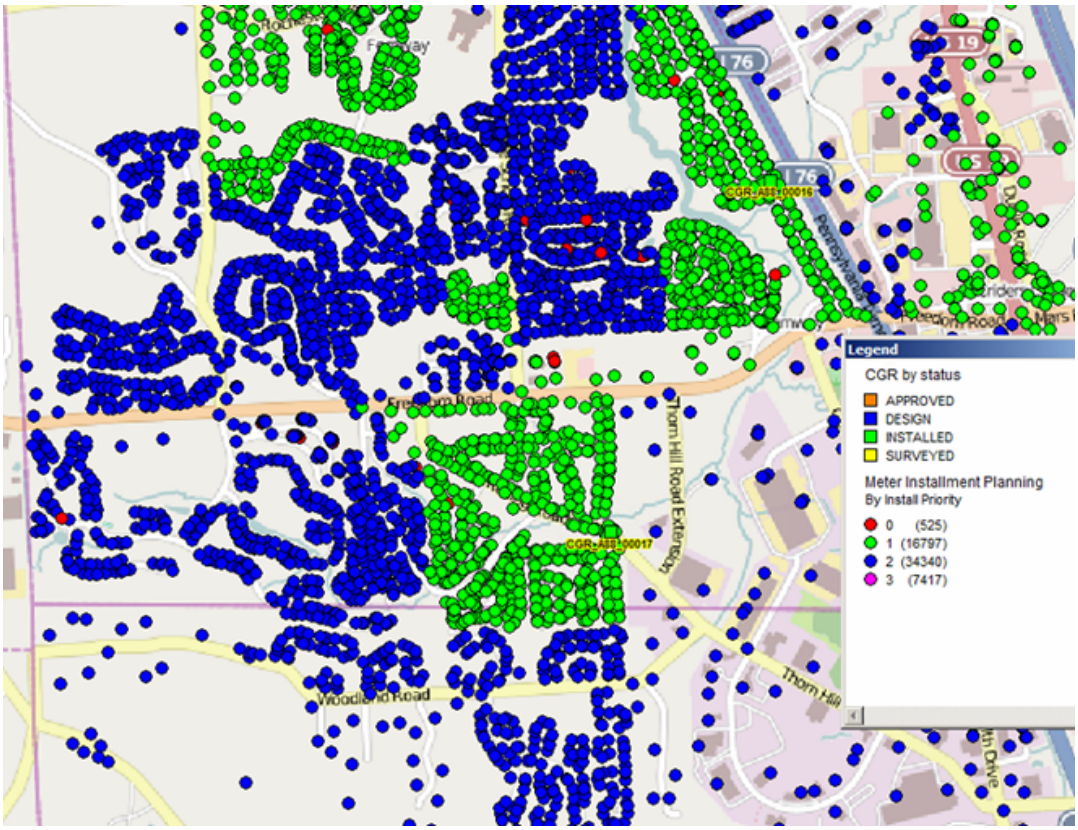
Itron then performed field surveys where both technical information and location data were collected to finalize agreed-upon network infrastructure installation locations. Itron has developed methods for field testing and troubleshooting that leverage the existing network devices such as the Mesh Extender and field tools from Cisco to troubleshoot non-connected devices or validate sites for network mitigation devices.



This image shows the design modification in which the CGR was relocated following the field survey.

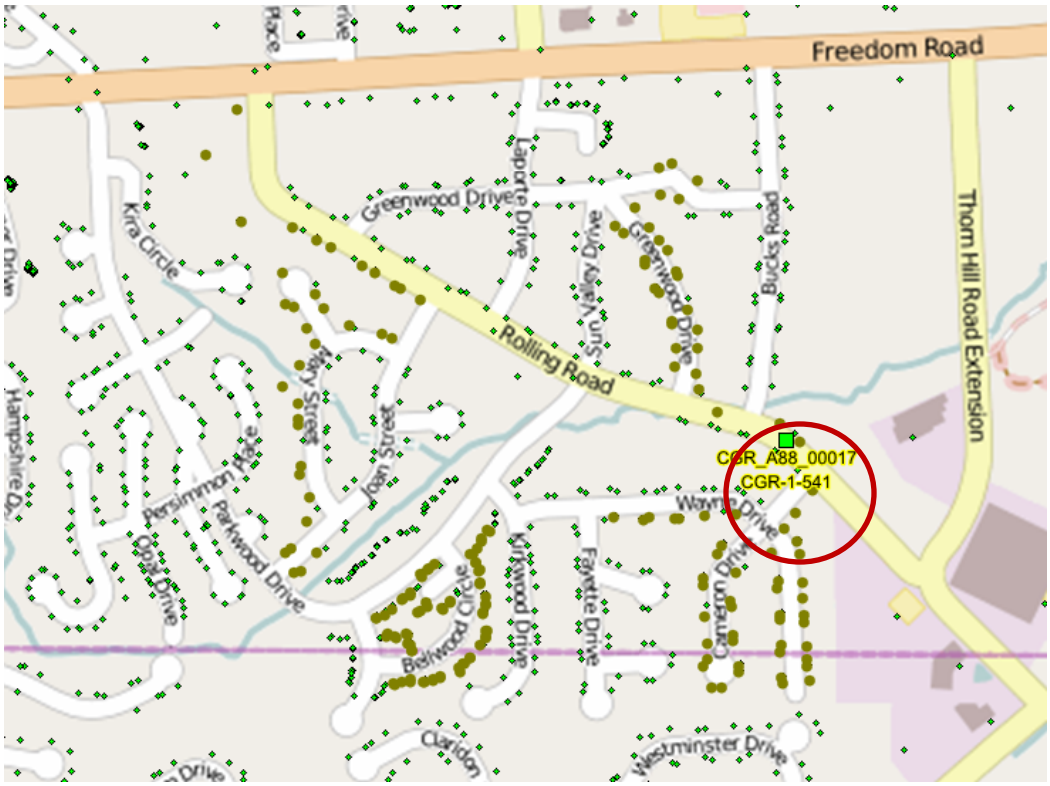
Once the CGR location was validated, Itron used the initial network design's hop count information to develop a priority meter deployment plan. As the following image shows, meters installed in close proximity to the CGR were expected to establish connectivity almost immediately (usually within 24 hours) and establish a base from which the mesh could extend efficiently to the next level of meters. We find that most meters in suburban/urban environments are able to connect to the network and the OpenWay headend system within 24 hours of installation.

In areas where we had more challenging linkages, this approach allowed us to highlight meters ahead of time and evaluate mitigation with additional networking connectivity devices before going into the field.



This image shows the priorities of meters around the target CGR that ensure the most efficient mesh formation.

Once the actual deployment begins, high priority meters (green in the previous image) are targeted for installation on Day 1 of meter exchanges. The following images show the actual results we experienced with FirstEnergy.



This image shows the locations of meters installed on Day 1. Note their close proximity to the CGR. The result was that all of these meters were communicating by the end of Day 1 (within 24 hours).

This image shows the location of Day 2 meters in red. Day 2 extended the area of installation with the established coverage of Day 1 meters. The result is that all meters installed on Day 2 were communicating by the end of Day 2.

This image shows the location of Day 3 meters in yellow. Again, Day 3 extended the area of installation with the established coverage of Day 1 and Day 2 meters.

For this Itron customer, the process of extending the mesh network in concentric rings around the CGR allowed new meters to take advantage of the already established, healthy mesh network. Working in this way, this mesh cell took 9 days in total to deploy and mitigate with nearly 98% of meters in communication with the OpenWay headend system within 24 hours of installation.

By using ACT in the Utility's deployment, we would expect a higher communication rate immediately following installation.

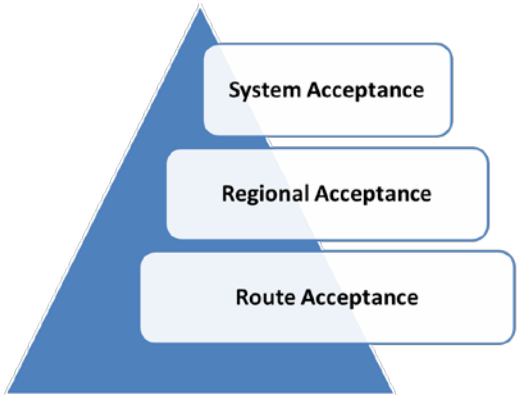
System Acceptance Approach

Once the network and meters are deployed, Itron's approach to System Acceptance is driven by the following primary business requirements:

- Ensure cost optimal and reliable network coverage through comprehensive approach to network design, deployment, operations, and clearly-defined user acceptance criteria
- Reliable, efficient, and cost-optimal systems operations through agreement on technical requirements for Acceptance Criteria and measurement of associated SLAs

Itron uses an incremental tiered approach for System Acceptance as the culmination of the smallest component – Routes, then aggregated Routes into Regions, then overall System Acceptance. Route

Acceptance is a critical component of transition to long-term reliable and efficient system operation. Route Acceptance is the validation of network communications from the meter through the Connected Grid Router (CGR) to the OpenWay Operations Center (and/or MDMS depending upon the scope and roles and responsibilities of the project



Tiered Approach to System Acceptance

To minimize impact to the utility's customers and existing metering operations, Itron's approach is to perform Route Acceptance early and often using diligent, methodical mitigation, where needed, quickly following mass-deployment saturation to a mutually agreed upon level.

Route performance metrics, durations, and final process of Route Acceptance testing will be mutually agreed upon during completion of the project Statement of Work to ensure business drivers and project drivers are met.

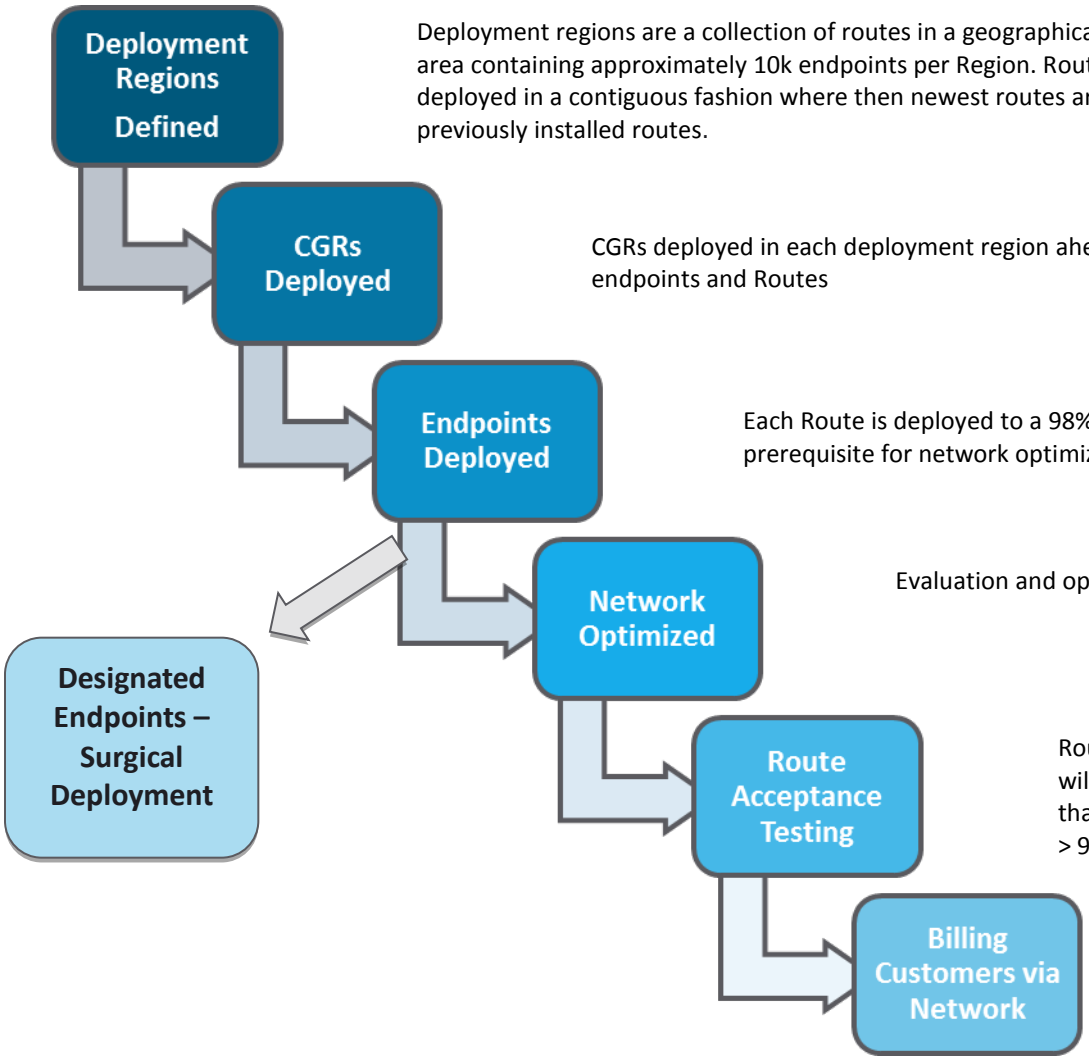
Following Route Acceptance, a plan for Regional (or District) Acceptance is expected. Regional Acceptance is the aggregate of multiple routes and again will be mutually agreed upon based on the utility's legacy meter reading districts, operational centers, or pure geography—whichever best meets the utility's business drivers.

Finally, upon satisfaction of Route / Region Acceptance an overall System Solution Acceptance is performed. The challenge here is that the dynamics of the utility's network and system will change with endpoint counts (additions / removals) that will occur over the lifecycle of the project. Roles and responsibilities need to be clearly aligned, and it is typical that final system solution testing design / criteria require flexibility to be able to adapt. As with all elements of the Acceptance Plan, it will be mutually agreed upon and Itron's experience is to have the working level teams collaborate in creating and finalizing the plan.

The following high level steps are the recommended steps for deployment and optimization of an OpenWay network.

1. Pre-deployment Activities – Business Processes Defined, AMI systems established and tested, etc.
2. Installation Planning – Define Routes/Areas (~10K per region)
3. Network Design & FAN Deployment by Route – prior to endpoint deployment
4. Endpoint Deployment by Route
5. Initial Deployment Route Saturation (~>98% Saturation)

6. Focused Network Optimization & Mitigation
7. Validate Performance and Begin Route Acceptance Testing
8. Route performance is proven and ready to support business operations by transitioning to the utility for on-going maintenance of route.
9. Complete Route Acceptance at an aggregate level, which would be the aggregate performance of multiple routes.



Deployment regions are a collection of routes in a geographically contiguous area containing approximately 10k endpoints per Region. Routes will be deployed in a contiguous fashion where then newest routes are adjacent to previously installed routes.

CGRs deployed in each deployment region ahead of endpoints and Routes

Each Route is deployed to a 98% saturation rate, a prerequisite for network optimization to begin.

Evaluation and optimization of network

Route Acceptance testing will be conducted on routes that have been saturated to > 98%

Performance SLAs are validated and Available meters tested in the Route. Route Performance is proven and ready to support business operations by turning Routes / meters to AMI Billing. Utility takes over maintenance of route.

Testing Methodology

Itron is committed to delivering high quality metering solutions to our customers. This starts during product design and development and extends to manufacturing and delivery. Itron follows a comprehensive, end-to-end testing regimen to ensure that every aspect of our solution is tested individually and as part of a system. Extensive testing is performed throughout software and firmware development and hardware manufacturing. The completed solution is then fully tested end-to-end by Itron prior to implementation. Testing during the project is extensive and Itron will work with the Utility to develop and conduct a comprehensive test plan that confirms the system functions as expected.

Meter Testing

Itron implements rigorous quality processes during product design, development, and manufacturing to ensure that each batch of meters and modules we ship meets the expectations of our customers. Itron conducts two types of reliability monitoring on hardware products that have been released to production: accelerated reliability tests and in-depth real-world testing and quality control using the meter farm at our ISO 9001:2008 certified Oconee manufacturing facility for electricity meters. Gas modules are manufactured and tested at our Waseca manufacturing facility in Minnesota.

Accelerated reliability testing involves taking samples from actual production lines, subjecting them to a variety of environments (high/ low/ typical temp, high/low/typical humidity, and high pressure in various combinations) for a year. Any failures are analyzed for cause, and product improvements are implemented immediately.

During the Utility's project, Itron's manufacturing process, components, assemblies, and products will be inspected at appropriate locations to ensure compliance to specified requirements. Inspection and testing are performed to detect any adverse quality trends and provide data necessary for adequately controlling the manufacturing process and assessing product performance. Final inspection and testing of products are performed to ensure that all quality and performance requirements have been met and that all prior inspection and testing requirements have been completed. Where applicable, these audits may be performed at subcontractor facilities to ensure the quality of Itron products.

Itron will customize a sample testing plan for the Utility. New meters and modules will be quarantined until sample tests are completed. Itron has the ability to provide inspection verification of each finished order ready for shipment at our facilities to ensure the excellent quality of our products has been met. This operation would be performed completely isolated from production equipment and personnel (where traditional testing of 100% of the meters is performed). The Quality Control Department can provide a certificate of the results found on inspection of each order.

Itron's Final Test is the last station a meter or module will run through before it is packed for shipment - 100% of meter production flows through these test stations. At the Final Test station, firmware versions are verified against the customer specification. In electricity meters, the register's control over the remote disconnect switch is exercised, the communication hardware functionality is verified, and the accuracy of the meter/module is validated against standards.

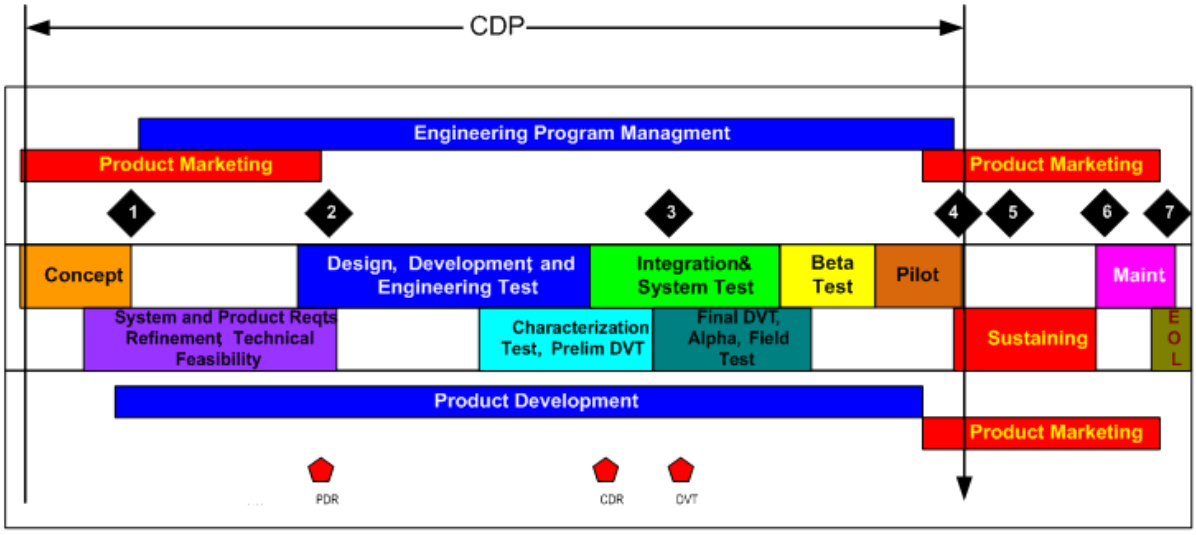
Itron conducts product quality reviews and QC testing at each stage of the development process and upon completion of each product release cycle. Individual products are introduced into our Meter Farm test area at our Oconee manufacturing facility for final product test. Once individual QC is completed, the product is transitioned to an independent SQL group based in Raleigh, NC which

reviews the individual product and performs full system integration and regression testing utilizing a full battery of tests developed in conjunction with customer input. The SQL Group does this testing across a mixed population of meter farm installations representative of live deployed system configurations of our customers. Upon final SQL the product/system release is provided to Customer Project Teams for testing and field qualification.

Approximately 4% of all meters are subsequently verified at a separate QC Audit, where all of the aforementioned tests are performed on independent test stations.

Solution Testing

To ensure that utility focus and quality assurance are maintained at every step of the solution lifecycle Itron has developed an ISO 9000-compliant Common Development Process (CDP). This process is maintained in every step of that cycle – from design and development, to manufacturing, to deployment and support. CDP defines and controls all aspects of the total program lifecycle, from initial concept and development, through ongoing maintenance and support.



Itron Common Development Process

Testing is conducted at multiple stages in the CDP to ensure the quality of all Itron components. All test plans require Itron's Marketing and Engineering teams to follow the artifact and intent of the CDP. This includes the following testing and QA procedures:

- Unit Testing — All solution components are unit tested by the component developer.
- Design Verification Testing — All solution components are tested by dedicated testing/quality assurance resources.
- Integration Testing — Incremental releases of components are provided to the headend system and field tool system teams to ensure continuous integration testing and early identification of issues.
- Automated Testing — Leveraging our experience developing 3rd-party (non-Itron) meter gateways, Itron has developed an extensive automated testing framework. This framework is designed to allow for quick and easy integration of new test cases and thorough automated

regression testing. Scripts are developed by firmware developers as well as software quality assurance (SQA) resources. These test scripts are documented, reviewed, and maintained on all future releases.

- Alpha Testing — As part of Alpha testing, Itron tests new components with all products created or modified to support the component. Itron also performs Accelerated Life Testing (ALT) on hardware devices.
- Qualification Testing — Itron performs all testing required to demonstrate the compliance of OpenWay components with applicable metering standards (i.e., ANSI, DLMS/COSEM, Smart Energy, etc.). Itron also performs meter qualification testing for our own independent verification.
- Certification Testing — Itron performs component testing required by the relevant regulatory bodies, which includes certification for all applicable communications regulations.
- Solution Testing — Itron's Solutions Team performs and documents end-to-end testing of each component within the overall solution.

Itron also incorporates performance benchmarking as a standard component of our development life cycle. We periodically benchmark our AMI solutions in our performance lab in Raleigh, NC as well as at our third-party technology partner labs.

For volume-based scale testing, Itron uses an internal engineering tool which simulates loading of the OpenWay system. The OpenWay Large Scale Meter Simulator applies stress to the system through simulating common interactions at scale running in parallel, such as readings, multiple configuration downloads, firmware downloads, registration, security, and load control. The tool is designed to scale to support 10 million meter scale tests.

Production Environment Testing

Itron works with each utility to define the appropriate tests and use cases for the project. During the Design phase, Itron will develop a Solution Test Plan that will reflect both parties' understanding of the Utility's business process and how the AMI solution will enable it. The Test Plan will identify the test approach, participants, schedule, environment setup, testing requirements, retesting strategy, test case listing, success / acceptance criteria, and test defect management processes. It will also be used to create the detailed test/use cases.

The following is a summary of the testing performed during implementation.

- **Product Installation Testing** – Following hardware installation, this test will be performed by Itron to validate the installation process and that appropriate communication has been established in upstream hardware/systems.
- **Unit/Functional Testing** – This testing is completed by Itron after product installation and configuration and prior to User Acceptance Testing. The purpose is to validate manufacturing, implementation and/or configuration processes.
- **Performance Testing** – In close cooperation with the customer, Itron will prepare a system performance test. This test will be performed by Itron and the results will be provided to the customer for review.
- **User Acceptance Testing (UAT)** – Following Unit Testing, UAT validates integration and system end-to-end capabilities / requirements defined in the specification / design documents

are met. Typically Itron performs this test initially and then supports the customer in its performance for their formal acceptance.

Test cases are designed to validate functionality, scalability, security, and usability. Test cases are developed based on the processes outlined in the Test Plan. Itron will support the Utility in the development of additional test cases. Test cases include the following types of information:

- Test condition
- Test steps for that test condition
- Expected result
- Actual result
- If test failed, identify impact (severity level)

Training Methodology

Knowledge transfer will begin almost immediately upon bid acceptance with baseline training for the Utility's project team members. Initial training focuses on system overviews and basic operations which results in a good understanding of how the base solution works and identifies what is not part of the solution. Once this training is completed, the Itron and the Utility's project teams will be ready to conduct the requirements analysis phase of the implementation project. Comprehensive system training continues throughout the entire lifecycle of the implementation project.

Itron typically employs a train-the-trainer approach. This technique has several advantages for our utility customers, including:

- It leverages training time and enables a large number of personnel to be trained in relatively small groups, enhancing the learning process.
- It is cost-effective. Its flexibility can minimize travel and disruption to normal operations.
- It maximizes utility knowledge by spreading training geometrically to many individuals.
- It allows utilities to incorporate their own company viewpoints and experience.

Training is typically conducted on-site and consists of a combination of classroom-type instruction and hands-on training. For new systems, Itron provides training in the following areas:

- Product technical training
- Product database and system administration training
- Product user training (train-the-trainer)

The training materials provided by Itron typically consist of the following:

- Training curriculum — Materials used to illustrate points and structure the learning.
- Training exercises — Exercises that follow the lessons identified in the training manual. Exercises can be quizzes, hands-on activities, and case studies.
- User guide (on-line help) — All Itron products come with thorough user documentation.

Class size is theoretically unlimited, but smaller groups provide more opportunities for interaction, personal instruction, and discussion. Itron recommends a class size of ten, but our experienced and

capable trainers can accommodate class sizes to suit the project's needs. Utilities only need to supply normal classroom equipment and access to the appropriate systems if applicable. The number and type of training sessions required are scheduled during development of the detailed project plan.

Instructors are usually the same individuals who are implementing the Itron solution. Whenever possible, they will incorporate their experience with past projects alongside training specific to the utility's solution. This includes information on best practice deployments, lessons learned, and recommendations pertinent to the customer's environment and business practices.

The table below shows the available baseline training curriculum available for the OpenWay system. These and additional requirements will be identified and agreed upon during the development of the project's Training Plan.

Class	Description	Target Audience	Estimated Class Length in Hours
Introduction to Smart Grid with OpenWay	Pre-requisite course for all specific OpenWay and AMI training. Describes the business cases of the Smart Grid and all component functions.	Everyone. Operators, meter managers, meter repairmen, network administrators, and developers.	7
OpenWay Hardware and Identifiers	Locate the serial numbers and MAC addresses of the OW meters, relays and range extenders.	Almost everyone. OpenWay Operations Center users, IR (IT), network administrators, meter managers, meter readers, meter installers, and Meter Shop personnel. Anyone who needs to understand the identifiers of OpenWay hardware including electric and gas meters, routers, and range extenders.	2
Solution Component Overview	An overview of all Itron, Cisco and third-party components in the system. Describes the role of each component. Includes common aliases.	Everyone.	1.5
FAR Joins SNI	Process flow of how the Field Area Router joins the Secure Network Infrastructure.	Network administrators and Meter Operations Center employees. Anyone who needs to understand the FAR joining process to support communication and troubleshooting.	1
Meter Authentication and Registration	Process flow of how a meter authenticates and registers on the mesh, the backhaul, and to the OpenWay Operations Center	Network administrators and Meter Operations Center employees. Anyone who needs to understand the meter joining process to support communication and troubleshooting.	1.5
Security Overview	Understand the basic concepts and technologies used to secure	Security owners, network administrators and Meter Operations	1

Class	Description	Target Audience	Estimated Class Length in Hours
	the OpenWay System from malefactors	Center employees. Anyone managing the security of any aspect for the OpenWay devices, networks, tools and cell relays. Also managers of the security team.	
Introduction to the OW Operations Center User Interface	Pre-requisite for all OpenWay Operation Center users. Browser requirements, login, interactive read and other basic functions, device classes.	Anyone using the OpenWay Operations Center or preparing data for the OpenWay Operations Center. Operators, meter managers, meter repairmen, network administrators, developers.	0.5
Creating Configurations Using the OpenWay Operations Center	Create meter configurations (programs) in OpenWay Operations Center	Meter managers, meter technicians and anyone configuring meters.	2.5
Meter Management Using the OpenWay Operations Center	Importing, grouping, security and encryption, monitoring of meters with the OpenWay Operations Center.	Meter managers, network administrators.	1
Firmware Management	Use the OpenWay Operations Center to update firmware in the meter.	Meter managers, Meter Shop personnel. Anyone updating the meter firmware.	2
Introduction to OpenWay Field Tools	Understand local access and field troubleshooting capabilities	Anyone who manages or uses OpenWay tools in the shop or in the field.	0.5

The Value of Hands-on Training

A key component of Itron's training approach will be the mentoring and hands-on knowledge transfer that will occur as Itron first runs and then transfers the system to the Utility or to Itron's Managed Services team. Our Run-Ops and NOC personnel will provide invaluable mentoring and support throughout the project, and in particular during the Deploy / Operate phase, to ensure that utility staff are knowledgeable and skilled with the AMI solution and Cisco field area network and ready to operate and manage the system effectively. While Itron personnel will operate the solution during this phase, utility personnel will act as "second seat" to Itron and gain the experience to take over full operation.

This approach has been used effectively across many successful projects. One example is our deployment of OpenWay at San Diego Gas and Electric (SDGE). Itron began working with SDGE in 2009 on their Smart Meter initiative. As part of their response to California's Energy Action Plan, SDGE replaced 1.4 million electric meters with OpenWay smart meters and upgraded nearly 900,000 natural gas meters with Itron 2.4GZ OpenWay Gas Modules. SDGE also deployed Itron Enterprise Edition Meter Data Management.

During the meter deployment, Itron conducted a Run-Operation of the SDGE AMI implementation. Itron provided two tiers of support:

- A 24x7 Tier 1 Team based in Itron's Liberty Lake Network Operations center consisting of a rotating team of 6-7 resources. They primarily monitored the system and performed a set of recurring daily tasks. The Tier 1 Team watched the system at all times.
- A Tier 2 On-Site project team in San Diego which consisted of five resources. All 5 resources supported the system during business hours with one resource designated as the weekly T2 escalation contact should after-hours support be required. The T2 team was further divided into Network Operations and System Operations. NetOps covered everything from the network down to the meter. SysOps covered from the network back to the application servers.

The Itron team operated the system as they worked with the SDGE Run team to help them become familiar with the Itron solution and continually increase their effectiveness and confidence in operating the solution. Initially, a number of SDGE team members focused on administering test environments, assisting in the testing of new releases, and performing production upgrades. As the need for releases slowed and the meter population grew, most of the team switched to operations. After this successful Run phase, Itron handed over complete operation of the SDGE system to onsite SDGE resources.

Additional Assumptions and Considerations

Our proposed services and transition plan are based on the following key assumptions and considerations:

- **Network Design** — Itron's deployment approach is based on a network-centric build out (or spiral) approach for each CGR (described in previous sections). Itron is taking this approach to ensure the best read rate possible from the onset of the meter deployments. This approach provides visibility to potential problem areas based on topology, density, etc. In such cases, Itron will be able to quickly assess problems and take appropriate mitigation actions such as adding network devices. This approach, of course, is closely integrated with the network design modeling effort and requires ongoing attention and feedback within the project team. Itron has included in its Deployment workstream the tools and resources to accomplish this.

- **Troubleshooting and Mitigation** — Troubleshooting and mitigation will begin with the meter installers and their use of the FDM work order management tool. FDM workflows will ensure the meter installation personnel perform certain validation checks to (a) identify meter-specific problems which will trigger mitigation actions different from those for a meter not reading on the network, (b) identify potential network problems which will trigger other mitigation actions.

  Subject to the validation checks and feedback from the installer, onsite review of data and reports from the OpenWay Operations Center, along with timely onsite assessment of the network design model, the Itron Deployment workstream team will be able to prescribe the most appropriate mitigation action.

Itron's Deployment workstream organization provides the expertise and tools needed to support the migration activities (network design consultants, field engineers, dispatch coordinators, technical consultants to manage and execute on the deployment approach outlined above.

- **Meter Readings and Meter Data Management** — Any manually-collected meter data that may be required will be managed and processed in a controlled manner. A reading data file will be created in a form and format that is mutually agreed to by and between Itron and the Utility. It is anticipated that this file will provide a level of validation and error checking to facilitate the quality of the data.

CRITICAL FACTORS AFFECTING PROJECT SUCCESS

Lessons learned from previous projects is the most important knowledge a project team can have, since AMI implementations impact a wide range of groups, operations, business units, personnel, processes, and day-to-day tasks within the utility. At the onset of the Utility's AMI program, the Itron Program Manager will review these documented lessons learned with the assigned Itron Program/ Project Team members and ensure each is appropriately factored into the plans, policies/procedures, and practices that will be used to control and govern the engagement going forward.

In addition to the specific factors already identified by our two teams, the following are general factors that we believe will affect the success.

- **Collaborative Control of Deployment** — Maintaining precision in the synchronization of network and endpoint deployment are critical to assure meter readings and communications are delivered in the time specific window. Itron's design and deployment planning tools allow accurate prediction of network and endpoint behavior along with contingency planning for those rare occasions when an endpoint fails to meet performance requirements.
- **Ensuring Proactive Customer Communications for Transition –** One of the most valuable lessons learned across projects is to engage customers early and often and communicate establish realistic expectations about the new smart meter system and what they might experience during the transition process.
- **Pragmatic Route Planning and Acceptance** — In order to assure timely, efficient transition of endpoints to billing the practice of acceptance is critical. Itron has experience from the most granular acceptance of a per meter basis to large endpoint routes.
- **Solid Understanding of Project Drivers** — Understanding the business and technical drivers for the project is a priority from day one. Itron's vast experience in meeting project drivers from multiple engagements in various domains allows us to implement alternative solution paths to ensure project drivers are met. For instance, the strategy of blending high-volume production deployment and surgical targeted deployment in concert with utilizing the legacy network as a transition ramp ensures billing fidelity and continuity.
- **Managing the Commitments of all Project Stakeholders —** There are many complexities to successfully deploying a new AMI solution. Depending upon the technology providers

selected, the Systems Integrator and PMO vendor selected, and the utility's own internal stakeholders, there will be inherent challenges in managing commitments and ensuring accountability. Developing a strong project governance structure and securing strong program leadership that will be empowered to make timely decisions will be critical to success.

Factors that are relevant to the success of any smart metering project include:

- **Leverage a proven methodology** — Itron's Advantage Methodology has been project proven and is routinely updated from lessons learned on many engagements. Following a proven and systematic methodology, such as Itron's Advantage, allows segmentation of activities in a sequence of order to ensure focused deliverables are carried out in a logical process pattern.
- **Use the right technology for the right solution and focus implementation on what is key** — The Solution Architect and other Specialists and Consultants assigned to the project team work in close concert with Itron's Product Line Management and Engineering staffs to ensure solution designs are appropriate to the specifications and needs of the project and the customer's ability to operate and maintain them. Itron strongly recommends a review through the joint SOW development process, a validation of system functional capability versus project implementation business requirements. Implementation needs to be focused on those key functions assigned to specific business case requirements. Keeping the project team focused on what is important instead of what might be nice, is critical to stay on track with the implementation and within budget.
- **Prepare a plan as a team and follow the plan** — Itron has extensive experience in developing in-depth project plans for the implementation of its software solutions and the deployment of its hardware devices. Further, Itron has worked closely with System Integrators in developing and managing to Integrated Project Plans. It is critical to ensure the combined team moves forward with one integrated plan. The initial project planning is an activity that should be jointly carried out by all involved managers. Having one team generate a project plan in a vacuum does not serve the best purpose. Having joint participation ensures that all teams have "buy in" to the plan, that all members understand their responsibilities and activities within the implementation, etc. Itron finds that this is why one of the most important steps in the AMI project is the "Start-up" preparation. Many people see this as more of a logistics phase, however Itron feels it is more than that. Having managers and stakeholders meet at the beginning of the project: (1) to develop/review the SOW along with deliverables/roles/responsibilities, (2) to develop/review the integrated project plan and/or schedule, (3) to discuss project risks and risk management, and (4) to review lessons learned, is key to kicking off a project successfully and ensuring that the management team starts on the right track with a common understanding.
- **Project reporting** — Itron's methodology and delivery approach provides for comprehensive reporting on all aspects of the project, from financial and project status reporting down to endpoints deployed to tracking mitigation activities. This broad/deep reporting has evolved by Itron meeting the needs and demands of many AMI customers. All reporting and meeting requirements and logistics should be represented in the jointly developed Project Governance Document. Structure of reports, information provided, frequency, distribution and follow up are key logistical requirements. Structure of meetings, agenda preparation, minutes, circulation, tracking of action items are also key aspects. The project team must ensure that

meetings are focused delivering actionable outcomes. This is even more critical for large projects that include a significant number of resources.

- **Make decisions and don't revisit them unless there is just cause to do so** — From previous project experiences, decision making is not only key to getting a project underway but to make progress against the plan. Integral to the PMO function is to identify high level project responsibilities, processes for various approval requirements whether they be for documents or decision requirements to address issues, recognition of approval authorities for the various aspects, recording of key decisions and proper communication or broadcast to the larger project team for a clear understanding of the decision and completion of the actions. Itron recommends accountability and processes as described above be clearly identified in the Project Governance Document and to the integrated project team early.
- **Have skilled and knowledgeable resources in the numbers needed to execute the plan** — Due to its previous AMI project experience, Itron has resources with the knowledge, skills, and abilities to execute the AMI project for the Utility. However, the project is not just an Itron deliverable. The Utility and its contractors, etc., all play a direct and applicable role in the delivery of this project. A clear understanding of those roles and their associated activities should be well defined during the startup and preparation phase, including during the development of the final SOW and Project Plan. It is also critical that those identified resources are properly skilled and knowledgeable of the tasks, activities, and type of work which they are responsible for. Active and knowledgeable participation in working sessions, training and general meetings is fundamental to ensure success.
- **Over communicate** — Routine meetings at the team, PMO, and management level are built into Itron's methodology and approach. Additionally, Itron has pre-identified Itron-internal meetings with its executives and governance committee when pre-set metrics are not met or when escalations are necessary to resolve obstacles impeding project progress or success. This said, Itron subscribes to an open communication philosophy to ensure all parties involved in the engagement are informed.

MEASUREMENTS OF PROJECT SUCCESS

Project success will be measured through tangibles and intangibles. Most measurements will be made during the project timeframe. Utilities may continue to track others far beyond project transfer.

Being able to measure success factors against the plan is not only key to understanding the true status of an AMI project but how and when to take actions to manage the outcome. The Itron project team provides the means to track and report the following success factors:

- Financial Performance (budget tracking/reporting, accounts receivables)
- Schedule Performance (schedule tracking/reporting)
- Application Performance (e.g., reporting & tracking on % up-time, etc.)
- Safety Performance (tracking & reporting against policies/procedures)
- Network Deployment Performance (installation tracking/reporting against deployment plan, mitigation plan)
- Network Monitoring (read rates, hop-counts, acceptance criteria)

- Meter Deployment Performance (meter access management, installation tracking/reporting against meter deployment plan, reading SLS, mitigation plan, acceptance criteria)
- Inventory Accountability (inventory levels, locations/traceability, availability)
- Complaints and Claims (volumes, response times, fulfillment)
- Quality Assurance (products and deployment services)
- Route/Region Transition (acceptances/turnover reporting/tracking)
- Business Performance (e.g., billing & billing accuracy)

However, in Itron's view, the three most important measurements of our project success will be:

- **Safety** — No work we do is so important as to jeopardize the health and safety of our employees, partners, or the public. Itron has extensive safety training, meter, and endpoint instruction and formal processes for installing or retrofitting meters as part of every project. Itron is committed to safely conducting its business in compliance with all applicable international, federal, state, and local health and safety laws and requirements not to mention the Utility's policies and procedures.
- **Customer Satisfaction** — Satisfaction is twofold, as it is the satisfaction of the utility as well utility customers and shareholders. Itron's strongest virtue lies in our team's ability to balance and advocate the utility's best interests. We take pride in delivering a solution above and beyond expectations. We are realistic in our expectations that a project of this complexity will have challenges but our handling and resolution sets us apart.

Itron OpenWay Meter Features and Functions

REGISTER CAPABILITIES

- Consumption registers
- Demand registers
  - Block demand
  - Sliding demand
  - Thermal demand
  - Cold load pick up parameters
- Instantaneous registers
- Self-read registers
  - Automatic scheduled in meter
  - Scheduled by meter data management system
- Real, Apparent, and Reactive Power Quantities
- Net (delivered minus received) quantities
- Sum (delivered plus received) quantities
- Time of use registers (TOU)
  - Consumption and demand
  - Multiple time of use blocks
  - Multiple date types
  - Multiple seasons
  - Current and previous season registers
  - User defined holiday schedules
- Critical peak pricing registers
  - Based on critical peak pricing event received by meter

INTERVAL DATA CAPABILITIES

- Up to four channels of interval data
- Real, Apparent, and Reactive Power Quantities
- Net (delivered minus received) quantities
- Sum (delivered plus received) quantities
- Dedicated voltage monitoring channel(s)
- Interval lengths = 5, 10, 15, 30, 60 minute
  - Up to a year's interval data storage depending on interval length and number of channels

DISPLAY

- Multi segment configurable display
- Register quantities available on display
- Instantaneous quantities available on display
- Phase voltage available on display
- Missing phase indicators available on display
- Load indicators available on display
- Network status and connectivity available on display
- User defined data available on display
- Independent display modes and quantities for normal and test mode
- Ability to automatically exit test mode after a configurable time

EVENTS AND ALARMS

- Extensive event and alarm capability (>100 types), including outage and restore events, multiple tamper event types, voltage threshold events, security events, and many others
- Events are written to the event queue for retrieval on regular schedules along with readings data
- Events can also be configured to be delivered immediately as soon as they occur from the meter, through the network, and through the OpenWay collection engine to business and operational systems
- Dedicated outage event functionality to maximize network efficiency and rapid delivery of outage events when wide scale outages occur

ZIGBEE 2.4 GHZ HOME AREA NETWORK (HAN)

- Standard on-board support for communication with ZigBee home area Network Devices using SEP protocol
- Tested and verified with HAN devices from multiple manufacturers
- Up to 10 HAN devices can be bound with a single meter
- Remote commissioning of HAN devices through OpenWay collection engine

OPTICAL PORT (OPTIONAL FEATURE ON SELECT MODELS)

- Standard and C12.18 optical port for onsite meter reading and data collection
  - Meter and network diagnostics
  - Maintenance
  - Program upgrade
  - Firmware upgrade

OVER-THE-AIR FIRMWARE DOWNLOAD

- Over-the-Air firmware download managed by the OpenWay collection engine
  - Meter register firmware
  - Meter network firmware
  - Meter ZIGBEE HAN firmware

OVER-THE-AIR METER REPROGRAMMING

- Ability to configure all meter program parameters remotely through the OpenWay headend

LOAD LIMITING

- Supports load limiting for emergency distribution network load control and for collection and nonpayment
- Three load limiting threshold category
  - Normal
  - Critical
  - Emergency
- Meter(s) can be moved from one load limiting threshold category to another individually or by group, remotely through the OpenWay network
- When load limiting occurs, meter can be configured to be reset:
  - After a configurable time
  - When customer manually pushes reset button on meter
  - Remotely by a an operator or business system through the OpenWay network

REMOTE CONNECT AND DISCONNECT

- Integrated remote connect/disconnect switch
- Reconnect can be configured to occur automatically when remotely selected through the network or only with user intervention (user pushes reset button on meter) for safety reasons
- Robust security to prevent malicious connect and disconnect operations

SITESCAN (POLYPHASE METERS ONLY)

- Diagnostic SiteScan capabilities to detect meter installation errors and mis-wired services
- SiteScan detects:
  - Phase voltage deviation
  - Inactive phase current
  - Phase angle deviation
  - Cross phase polarity errors

SECURITY

- Enhanced Itron security provides digital certificates on each meter
- OpenWay collection engine provides key management capabilities for key replacement and key refresh

OpenWay® Riva™ CENTRON® Meter

The OpenWay Riva CENTRON electricity meter combines robust smart metering functionality with new, high-performance communications capabilities and a distributed intelligence platform to deliver differentiating capabilities and new approaches to meter-to-grid applications.

In addition to providing full smart meter functionality, the OpenWay Riva CENTRON meter takes advantage of the latest developments in software-defined communications and affordable computing power to provide a robust distributed intelligence platform that is capable of processing and analyzing data at the edge to manage changing grid conditions in real time. These capabilities enable the OpenWay Riva CENTRON meter, as part of the OpenWay solution, to become a platform for an entirely new portfolio of distributed applications that deliver significant improvements in areas such as outage detection and analysis, theft detection, transformer load management, demand response and detection of unsafe grid conditions.

The OpenWay Riva CENTRON meter also provides a revolutionary new approach to meter and grid communications. With the meter's OpenWay Riva Adaptive Communications Technology, utilities can deploy a high-performance, IoT-ready communications solution that lowers costs and simplifies deployment by reducing the amount of infrastructure required to connect devices while delivering improved communications performance and reliability.

OpenWay Riva does this through its unique ability to combine multiple communications – RF mesh, powerline carrier and Wi-Fi – in the same OpenWay Riva CENTRON meter, or in any grid device for that matter. This enables dynamic and continuous selection of the optimal communications path, and the most appropriate frequency modulation at every link in the network to ensure the fastest and most reliable path back to the utility. No other smart meter can intelligently and continuously optimize its communication links in this way.

From dense urban centers filled with high rises to isolated rural farmlands, the OpenWay Riva CENTRON meter provides advanced metering capability with a single, unified communication technology for all types of service environments that delivers assured connectivity at the highest possible speed. Equipped with powerful microprocessors as well as an embedded Linux operating system, the OpenWay Riva CENTRON meter gives utilities the ability to create a highly flexible and programmable metering platform that is adaptable, secure and ready for the future.

SPECIFICATIONS

FEATURES AND BENEFITS

Flexible Two-Way Communications

- Execute all supported meter reading, configuration update and firmware download functionality
- Customize targeted meter firmware updates
- Support on-demand readings from the meter

Upgradable Firmware

- Customize firmware upgrades with the ability to automatically roll-back if activation fails
- Create multiple firmware images including primary and pending

Bi-Directional Metering

- Store received and delivered data metrics in the meter
- Support customers who own renewable energy facilities or participate in vehicle to grid systems with real-time data being sent back to the utility

Energy Quantities

- Wh Delivered, Received, Net and Uni-Direction
- VARh Delivered and Received
- VARh Q1-Q4
- VAh Delivered, Received and Net

Demand Measurements

- Max Watts Delivered, Received
- Max VA Delivered, Received
- Max VAR Delivered, Received
- Max VAR Q1, Q2, Q3, Q4
- Min Power Factor

Automated Meter Reading

- Receive and transmit meter billing data including interval data, register reads
- Transmit recorded events and exceptions with each interval to the head-end software, which interprets them and logs appropriate messages (such as time adjustments)

Real-Time Meter Event and Alarm Retrieval

- Automated alarms received by the head-end system via e-mail to a specific user or group of users

Tamper Detection

- Detect and report exceptions for events such as magnetic fraud attacks
- Communicate tamper indications in real time through the OpenWay system

Remote Disconnect/Reconnect

- Support integrated disconnect switch
- Perform remote disconnects/reconnects through the OpenWay Operations Center

Integration & Installation

- Fully integrated solution under-the-cover allows for plug and play installation in the field
- Shipped from the factory as one complete unit, ready for field deployment

Meter Security

- Platform Security with an encrypted file system and secure boot
- Standard DLMS Security
- Application Layer Enhanced Security
- Local Access Signed Authorization

Adaptive Communications

- Support both RF and PLC for “last mile” communication to the meters via the IPv6 Mesh
- Support standards based, true IPv6 mesh communication where each meter is assigned a global routable IPv6 address
- Power line carrier links implement the IEEE 1901.2 standard
- RF links implement IEEE 802.15.4g/e standard
- Meters dynamically select the optimal link based on channel conditions and the target QoS
- IPv6 mesh network uses the 6LoWPAN adaptation layer and RPL as a mesh routing protocol
- Embedded Wi-Fi communications for local access using common security model with OpenWay network communications

Technical Data

Meets applicable standards:

- ANSI C12.1 – 2008 (American National Standard for Electricity Meters – Code for Electricity Metering)
- ANSI C12.20 – 2010 (American National Standard for Electricity Meters – 0.2 and 0.5 Accuracy Classes)
- ANSI/IEEE C62.45 – 2002 (Guide to Surge Testing on Low-Voltage AC Power Circuits)
- ANSI MH 10.8 – 2005 Specification for Bar Code
- ANSI ASQZ 1.4 – 2008 Sampling Procedures and Tables for Inspection by Attributes
- IEC 61000-4-2 2008
- IEC 61000-4-4 2012
- IEEE C37.90.1 – 2004 SWC Surge Testing
- IEEE C62.45 Recommended Practice on Surge Testing for Equipment Connected to Low Voltage (1000V or less) AC Power Circuits C62.45 2002
- NEMA SG-AMI 1 – 2009 Requirements for AMI Meter Upgradeability
- UL 2735

Radio Specifications

- Radio Output Power
  - Configured at time of manufacture:
    - 500mW-1W

» Frequency Ranges

- Configured at time of manufacture (software controlled within ranges):
  - 902-928MHz
  - 870-876MHz

Product Availability

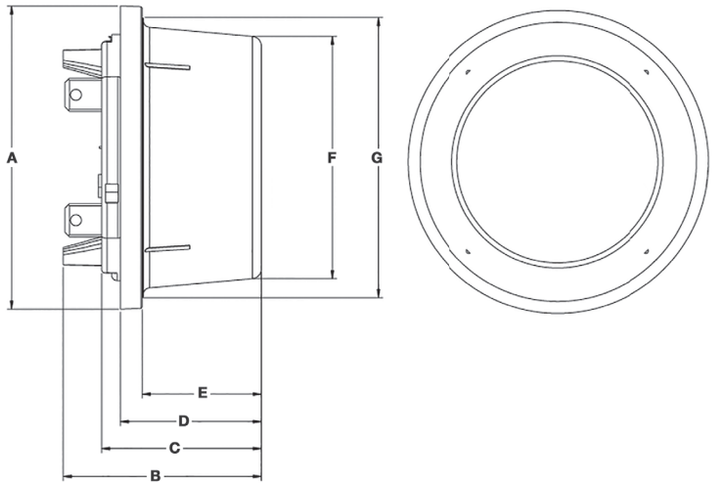
Volts/Service	Meter Class	Test Amps	Kh (Pulse/Wh)	Meter Form	Register Description
120	200	30	1.0	1S	OpenWay RF with or without Disconnect
240	200	30	1.0	2S	OpenWay RF with or without Disconnect
240	320	50	1.0	2S	OpenWay RF with or without Disconnect
120	200	30	1.0	12S/25S	OpenWay RF with or without Disconnect

Specifications

Power Requirements	Voltage Rating: 120V, 240V Operating Voltage: ± 20% (60Hz) Frequency: 60Hz (±3Hz) Battery Voltage: 3.6 V nominal
Operating Environment	Temperature: -40° to +85°C Humidity: 0% to 95% relative humidity
Transient/Surge Suppression	IEC 61000-4-4-2004-07 ANSI C62.45-2002
Accuracy	ANSI C12.20 0.5 accuracy class
General	Demand calculation: Block or Rolling Energy calculation: Bi-directional (Wh, VAh, VARh and VARh Q1-Q4))
Time Reference When Off Network	Line sync: Power line frequency Crystal sync: 5.8 PPM @ 25°C; 110 PPM over full temperature range
Display	Nine-digit liquid crystal display Six-digit data height: 10.16 mm Annunciator height: 2.24 mm Display duration: 1-15 seconds Two-digit code number height: 6.01 mm Three-segment electronic load indicator
Operating System	Linux

Dimensions

A	B	C	D	E	F	G
6.95”	5.27”	4.37”	3.97”	3.47”	5.68”	6.30”
17.66 cm	13.39 cm	11.10 cm	10.08 cm	8.82 cm	14.43 cm	16 cm



Join us in creating a more **resourceful world**.
To learn more visit **itron.com**

CORPORATE HQ
2111 North Molter Road
Liberty Lake, WA 99019 USA
Phone: 1.800.635.5461
Fax: 1.509.891.3355

OpenWay® Riva™ CENTRON® Polyphase Meter

The OpenWay Riva CENTRON Polyphase electricity meter combines robust smart metering functionality with new, high-performance communications capabilities and a distributed intelligence platform to deliver differentiating capabilities and new approaches to meter-to-grid applications.

In addition to providing full smart meter functionality, the OpenWay Riva CENTRON Polyphase meter takes advantage of the latest developments in software-defined communications and affordable computing power to provide a robust distributed intelligence platform that is capable of processing and analyzing data at the edge to manage changing grid conditions in real time. These capabilities enable the OpenWay Riva CENTRON Polyphase meter, as part of the OpenWay solution, to become a platform for an entirely new portfolio of distributed applications that deliver significant improvements in areas such as outage detection and analysis, theft detection, transformer load management, demand response and detection of unsafe grid conditions.

The OpenWay Riva CENTRON Polyphase meter also provides a revolutionary new approach to meter and grid communications. With the meter's OpenWay Riva Adaptive Communications Technology, utilities can deploy a high-performance, IoT-ready communications solution that lowers costs and simplifies deployment by reducing the amount of infrastructure required to connect devices while delivering improved communications performance and reliability.

OpenWay Riva does this through its unique ability to combine multiple communications – RF mesh, powerline carrier and Wi-Fi – in the same OpenWay Riva CENTRON Polyphase meter, or in any grid device for that matter. This enables dynamic and continuous selection of the optimal communications path, and the most appropriate frequency modulation at every link in the network to ensure the fastest and most reliable path back to the utility. No other smart meter can intelligently and continuously optimize its communication links in this way.

From dense urban centers filled with high rises to isolated rural farmlands, the OpenWay Riva CENTRON Polyphase meter provides advanced metering capability with a single, unified communication technology for all types of service environments that delivers assured connectivity at the highest possible speed. Equipped with powerful microprocessors as well as an embedded Linux operating system, the OpenWay Riva CENTRON Polyphase meter gives utilities the ability to create a highly flexible and programmable metering platform that is adaptable, secure and ready for the future.

SPECIFICATIONS

FEATURES AND BENEFITS

Flexible Two-Way Communications

- Execute all supported meter reading, configuration update and firmware download functionality
- Customize targeted meter firmware updates
- Support on-demand readings from the meter

Upgradable Firmware

- Customize firmware upgrades with the ability to automatically roll-back if activation fails
- Create multiple firmware images including primary and pending

Bi-Directional Metering

- Store received and delivered data metrics in the meter
- Support customers who own renewable energy facilities or participate in vehicle to grid systems with real-time data being sent back to the utility

Energy Quantities

- Wh Delivered, Received, Net and Uni-Direction
- VARh Delivered and Received
- VARh Q1-Q4
- VAh Delivered, Received and Net

Demand Measurements

- Max Watts Delivered, Received
- Max VA Delivered, Received
- Max VAR Delivered, Received
- Max VAR Q1, Q2, Q3, Q4
- Min Power Factor

Automated Meter Reading

- Receive and transmit meter billing data including interval data, register reads
- Transmit recorded events and exceptions with each interval to the head-end software, which interprets them and logs appropriate messages (such as time adjustments)

Real-Time Meter Event and Alarm Retrieval

- Automated alarms received by the head-end system via e-mail to a specific user or group of users

Tamper Detection

- Detect and report exceptions for events such as magnetic fraud attacks
- Communicate tamper indications in real time through the OpenWay system

Option Availability

- Manual demand reset

Integration & Installation

- Fully integrated solution under-the-cover allows for plug and play installation in the field
- Shipped from the factory as one complete unit, ready for field deployment

Meter Security

- Platform Security with an encrypted file system and secure boot
- Standard DLMS Security
- Application Layer Enhanced Security
- Local Access Signed Authorization

Adaptive Communications

- Support both RF and PLC for “last mile” communication to the meters via the IPv6 Mesh
- Support standards based, true IPv6 mesh communication where each meter is assigned a global routable IPv6 address
- Power line carrier links implement the IEEE 1901.2 standard
- RF links implement IEEE 802.15.4g/e standard
- Meters dynamically select the optimal link based on channel conditions and the target QoS
- IPv6 mesh network uses the 6LoWPAN adaptation layer and RPL as a mesh routing protocol
- Embedded Wi-Fi communications for local access using common security model with OpenWay network communications

Technical Data

Meets applicable standards:

- ANSI C12.1 – 2008 (American National Standard for Electricity Meters – Code for Electricity Metering)
- ANSI C12.20 – 2010 (American National Standard for Electricity Meters – 0.2 and 0.5 Accuracy Classes)
- ANSI/IEEE C62.45 – 2002 (Guide to Surge Testing on Low-Voltage AC Power Circuits)
- ANSI MH 10.8 – 2005 Specification for Bar Code
- ANSI ASQZ 1.4 – 2008 Sampling Procedures and Tables for Inspection by Attributes
- IEC 61000-4-2 2008
- IEC 61000-4-4 2012
- IEEE C37.90.1 – 2004 SWC Surge Testing
- IEEE C62.45 Recommended Practice on Surge Testing for Equipment Connected to Low Voltage (1000V or less) AC Power Circuits C62.45 2002
- NEMA SG-AMI 1 – 2009 Requirements for AMI Meter Upgradeability
- UL 2735

Radio Specifications

» Radio Output Power
- Configured at time of manufacture:
  - 500mW-1W

» Frequency Ranges
- Configured at time of manufacture (software controlled within ranges):
  - 902-928MHz
  - 870-876MH

Product Availability

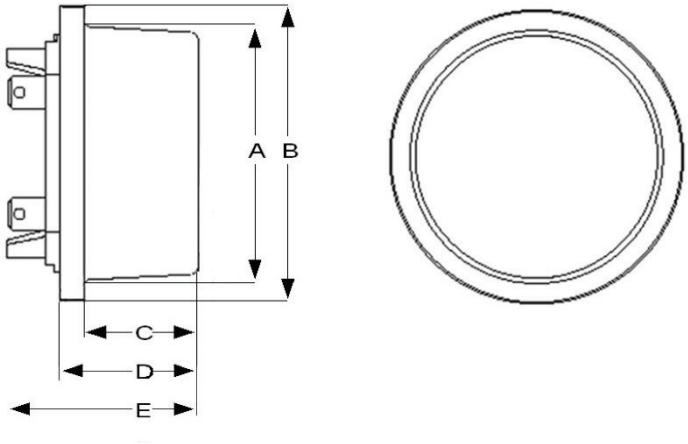
Forms	Class	Elements	Wires	Voltage	Test
1S	100	1	2	120V-277V, 345V-480V	15
2S	200	1.5	3	120V-277V, 345V-480V	30
2S	320	1.5	3	120V-277V, 345V-480V	50
3S	20	1	2	120V-277V, 345V-480V	2.5
4S	20	2	3	120V-277V, 345V-480V	2.5
9S (8S)	20	3	4	120V-277V, 345V-480V	2.5
9S (8S)/36S	20	3	4/3	120V-277V, 345V-480V	2.5
45S/5S	20	2.5	3	120V-277V, 345V-480V	2.5
12S	200	2	3	120V-277V, 345V-480V	30
12S	320	2	3	120V-277V, 345V-480V	50
16S (14S, 15S, 17S)	200	3	4	120V-277V, 345V-480V	30
16S (14S, 15S, 17S)	320	3	4	120V-277V, 345V-480V	50

Specifications

Power Requirements	Voltage rating: 120V-277V, 345V-480V Frequency: 60 Hz (50 Hz) Operating voltage: ± 20% (60Hz); ± 10% (50 Hz) Operating range: ± 3 Hz Battery voltage: 3.6 V nominal Battery operating range: 3.4 V-3.8 V
Operating Environment	Temperature: -40° to +85°C Humidity: 0% to 95% relative humidity
Transient/Surge Suppression	IEC 61000-4-4-2004-07 ANSI C62.45-2002
Accuracy	ANSI C12.20 0.2 accuracy class
General	Demand calculation: Block or Rolling Energy calculation: Bi-directional (Wh, VAh, VARh and VARh Q1-Q4))
Time Reference When Off Network	Line sync: Power line frequency Crystal sync: 5.8 PPM @ 25°C; 110 PPM over full temperature range
Display	Nine-digit liquid crystal display Six-digit data height: 10.16 mm Annunciator height: 2.24 mm Display duration: 1-15 seconds Two-digit code number height: 6.01 mm Three-segment electronic load indicator
Operating System	Linux

Dimensions

A	B	C	D	E
6.29”	6.95”	3.84”	4.30”	5.67”
16.00 cm	17.70 cm	9.80 cm	10.90 cm	14.40 cm



Join us in creating a more **resourceful world**.
To learn more visit **itron.com**

CORPORATE HQ
2111 North Molter Road
Liberty Lake, WA 99019 USA
Phone: 1.800.635.5461
Fax: 1.509.891.3355

Cisco 1000 Series Connected Grid Routers

The Cisco® 1000 Series Connected Grid Routers (CGR 1000 Series) 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 (AMI), distribution automation (DA), integration of distributed energy resources (DER), 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.

Product Overview

The CGR 1000 Series Routers are ruggedized, modular platforms on which utilities and other industrial customers can build a highly secure, reliable, and scalable communication infrastructure. The products are certified to meet harsh environmental standards. They support a variety of communications interfaces, such as Ethernet, serial, cellular, WiMAX, radio-frequency (RF) mesh, and power line communications (PLC).

The Cisco CGR 1000 Series run Cisco IOS® Software, the operating system powering millions of Cisco routers worldwide. Grid operators gain the benefits of Cisco IOS Software's wide variety of Layer 3 services such as FlexVPN. The distributed intelligence capabilities of the CGR 1000 Series allow customers to run 3rd party applications such as application protocol translation, distributed data processing and filtering, and application security on the routers directly leveraging Cisco IOx - an open, extensible environment for hosting applications at the network edge.

The Cisco CGR 1000 Series includes two platforms, shown in Figure 1: The Cisco 1120 Connected Grid Router (CGR 1120), which is designed for indoor deployments; and the Cisco 1240 Connected Grid Router (CGR 1240), which is a weatherproof router in a NEMA Type 4 enclosure for outdoor deployments.

Figure 1. Cisco 1000 Series Connected Grid Routers

Connected Grid Field Area Network Solution and CGR 1000 Series

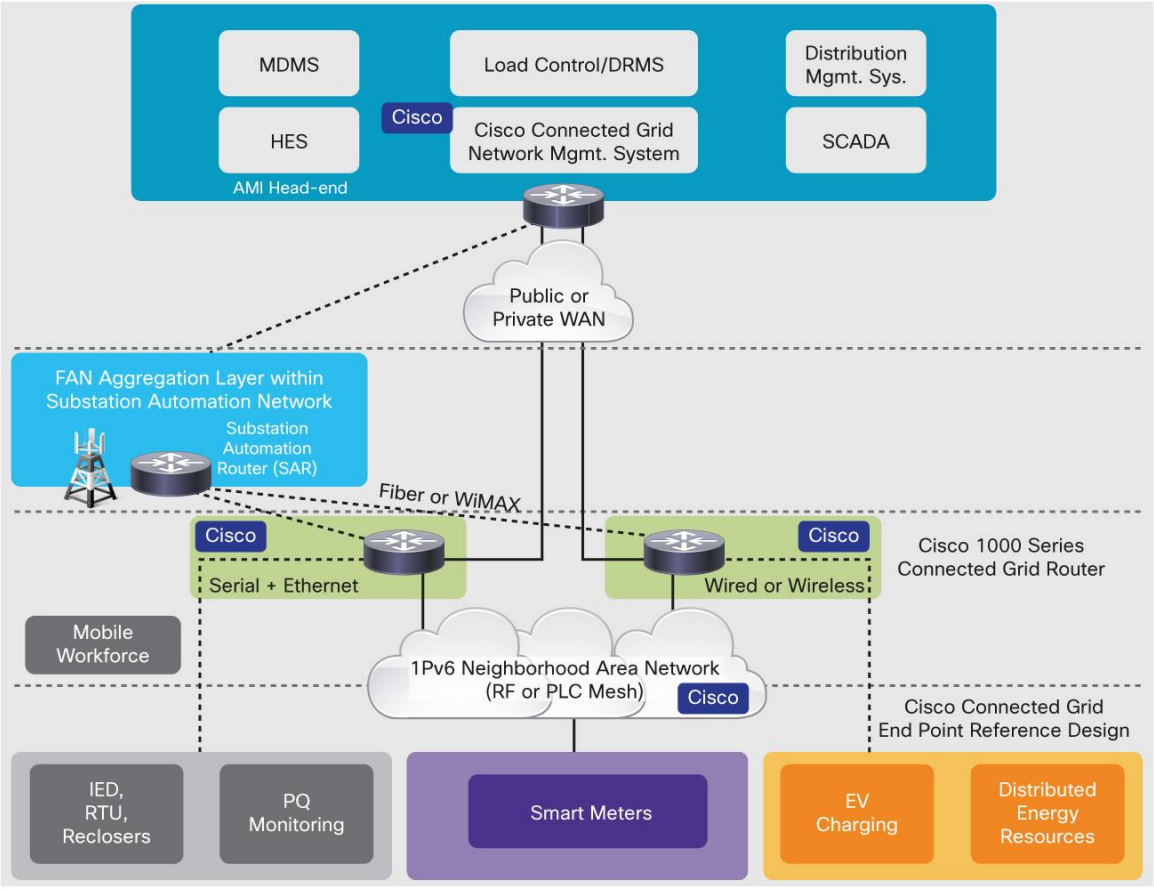
Utilities all over the world are transitioning their grids from transmission to consumption. Regulatory mandates are driving initiatives around smart metering, grid reliability, and the integration of solar and wind farms into the distribution grid. The situation imposes a unique set of challenges for utilities to build a bidirectional communications field area network (FAN) that enables these diverse applications and also scales across millions of endpoints.

The Cisco Connected Grid FAN solution has been specifically developed to meet these challenges, using design principles from industry-leading Cisco GridBlocks™ architecture. Under the GridBlocks architecture, a typical communications network for the distribution grid is a two-tier architecture with a neighborhood area network (NAN) and a wide area network (WAN).

The NAN provides network connectivity to endpoints such as smart meters, street lights, and other environmental sensors. These endpoints form a mesh network based on radio-frequency (RF) or power-line communications (PLC) technologies. The mesh network is aggregated at a CGR 1000 mounted on poletops or in secondary distribution substations. The CGR 1000 can also aggregate locally connected devices for distribution automation (DA). The WAN tier provides network connectivity from the CGR 1000 to the utility's control center over a public cellular network, a utility-owned (private) WiMAX or WiFi network, or an Ethernet fiber network.

Figure 2 displays the solution within the network.

Figure 2. Cisco Connected Grid FAN Solution



The Connected Grid FAN solution comprises the following products: Cisco CGR 1000 Series, IoT Device Manager, IoT Field Network Director, and Connected Grid End Point reference design (CG-EP). The CG-EP is an open standards-based IPv6 networking stack that can be embedded in a variety of smart grid endpoints, such as smart meters. Partners with sensors or actuators who want to integrate the CG-EP RF Mesh or PLC Mesh into their products need to join the Cisco Developer Network/DevNet: http://www.cisco.com/go/cdn.

Business Benefits and Architectural Features

The CGR 1000 Series Routers take full advantage of Cisco core IP networking technologies. Our hardware and software can be used to create an open platform for industrial customers to build highly secure, multiservice FANs while lowering their total cost of ownership.

Converged Multiservice Network Architecture

The CGR 1000 Series is a modular platform that supports various wired and wireless interfaces. It supports a 902-928 MHz IPv6 RF mesh that can aggregate up to 5000 endpoints such as smart meters. The router has integrated Ethernet and serial interfaces to connect to DA devices such as sensors, capacitor bank controllers, recloser controllers, and remote terminal units.

Supervisory control and data acquisition (SCADA) protocol (serial-to-IP) translation features allow customers to easily integrate legacy (non-IP) devices onto an IP network. An integrated Wi-Fi port can enable remote workforce automation and secure wireless console access while an integrated global positioning system (GPS) enables location mapping of the router. The modular design provides an easy upgrade path to future communication interfaces without platform replacement.

The CGR 1000 Series portfolio offers platforms for both indoor and outdoor deployments. These platforms come with flexible mounting kits that allow utilities to deploy the routers on a broad array of existing assets such as distribution poles, walls, and inside pad-mounted enclosures. In addition, the CGR 1000 Series offers a wide range of external antenna choices to meet coverage, throughput, and range requirements.

Cisco IOS Software provides a set of network- and application-layer services to help enable customers run multiple applications on a converged communication network. Network segmentation and quality of service (QoS) features allow the logical separation of application traffic with specific constraint policies applied on each traffic flow. In addition, the CGR 1000 Series is capable of integrating and hosting customer or partner specific applications.

This allows customers to eliminate the cost, space, power, and complexity of deploying and managing disparate devices.

Security

Cisco integrates security as a fundamental building block of the FAN architecture. The CGR 1000 Series security adheres to Cisco Connected Grid security principles and widely adopted cryptography and security standards (see Table 1).

Table 1. Cisco Connected Grid Security Principles

Security Principle	CGR 1000 Features and Capabilities
Access Control	• Mutual authentication and authorization of all nodes connected to the network • IEEE 802.1x-based authentication, role-based access control (RBAC) • Certificate-based identity, strong username, and passwords

Security Principle	CGR 1000 Features and Capabilities
Data Integrity, Confidentiality, and Privacy	• Link-layer encryption in the NAN mesh (AES-128) • Network-layer encryption in the WAN (IPsec and FlexVPN) • Scalable key management, generation, exchange, and revocation of encryption keys
Threat Detection and Mitigation	• Network segmentation of users, devices, and applications in NAN and WAN • Access lists on field area router to filter traffic between users and devices • High-performance firewall in the control center to protect critical assets
Device and Platform Integrity	• Tamper-resistant mechanical design; security alerts generated if compromised • Hardware chip to store the router's X.509 certificate and other security credentials • Tamper-proof secure storage of router configuration and data

Open Standards

The Cisco approach has been to encourage the creation and adoption of open communication standards for the smart grid. This approach promotes the growth of an ecosystem of standards-based, interoperable devices and applications from different vendors. An interoperable ecosystem ultimately reduces utilities' risk of adopting new technologies. The Cisco Connected Grid is built on several open standards, many of them adopted from IP technologies such as IPv6. With these standards, customers are able to architect and design their network independent of the application- or physical-layer infrastructure. This functionality protects existing investments while lowering the total cost of ownership for the communications network over time.

Network Reliability and High Availability

The CGR 1000 Series Routers contain both device-level and network-level reliability to meet harsh physical environments. The CGR 1000 Series is built to meet stringent compliance standards such as IEEE 1613 and IEC 61850-3. The routers have enhanced thermal design and conduction cooling with no moving parts. This attribute allows extended temperature support. Additionally, the routers offer mechanisms for backup power to increase uptime for mission-critical applications in the event of power outages. Finally, the support for multiple WAN communication modules and the network resiliency and routing features in Cisco IOS Software allow utilities to deploy enterprise-class high availability in their communication networks for the distribution grid.

Communications Network Management

Network management applications are critical for lowering utility operating expenses (OpEx) while improving communications network availability. These tools simplify and automate many of the day-to-day tasks associated with managing diverse network requirements. The embedded management features available in the CGR 1000 Series, along with IoT Field Network Director and CG-DM applications, allow customers to effectively meet these requirements.

IoT Field Network Director is a modular software platform for managing smart grid multiservice communication networks and security infrastructure. It is designed to foster an ecosystem of multivendor capabilities for interoperability across not only communications networks, but also legacy and next-generation power grid equipment.

IoT Device Manager is an easy-to-use Windows application that engineers and operators use to quickly configure, test, and troubleshoot Cisco 1000 Series Connected Grid Routers. For example, field technicians can check and update device configurations, perform firmware upgrades, and collect real-time router statistics.

The Cisco FAN solution provides operators with extensive instrumentation and diagnostic information for geographic locations, wireless interfaces, battery management, and other grid-specific details. This information can be fed into the IoT Field Network Director for day-to-day operations, operator dashboards, and real-time troubleshooting. Ease-of- use features such as secure zero-touch commissioning and a graphical field tool let non-IT field technicians deploy and manage FAN communications equipment.

In addition to the utility-specific functionality, the Cisco solution provides customers with true enterprise-class fault, configuration, accounting, performance, and security (FCAPS) functionality. Examples include a programmatic XML interface based on the Network Configuration Protocol (NETCONF) industry standard, role-based access control (RBAC), over-the-air software upgrades, and security management functionality.

Cisco 1000 Series Connected Grid Routers Specifications

Table 2 lists hardware specifications and Table 3 lists the features and protocols support for the CGR 1000 Series routers.

Table 2. Cisco CGR 1000 Series Hardware Specifications

	CGR 1240 (Pole-Mount)	CGR 1120 (Din-Rail or Wall Mount)
Physical Specifications		
Dimensions (Height x Width x Depth)	28.7 cm x 24.6 cm x 21.6 cm 11.3 in. x 9.7 in. x 8.5 in. (without antennas)	8.9 cm x 22.9 cm x 20 cm 3.5 in. x 9.0 in. x 7.8 in.
Rack Height	N/A	2 RU
Pole Mount	Yes	No
Wall Mount	Yes	Yes
Din-Rail Mount	No	Yes
Typical Weight Fully Configured	23 lbs (10.4 kg) Unit weight includes base chassis with four communication modules, AC power supply, and 8-Amp-hr battery backup unit	8 lbs (3.6 kg) Unit weight includes base chassis with two communication modules, AC/DC power supply
Operating Temperature[1]	−40°C to +70°C (-40°F to 158°F) with type test to 85°C (185°F) for 16 hours	-40°C to +60°C (-40°F to 140°F) with type test up to 85°C (185°F) for 16 hours
Typical Power Consumption or Dissipation	20-28 Watts depending on configuration (without battery charging) Additional power consumption for battery charging and external radios	16-23 Watts depending on configuration
Maximum Power Consumption or Dissipation	75 Watts	40 Watts
Communication Modules		
IEEE 802.15.4g WPAN	Yes	Yes
2G/3G/4G LTE for Global	Yes	Yes
2G/3G/4G LTE for North America	Yes	Yes
3.5G AT&T HSPA+/UMTS/GSM/GPRS/EDGE	Yes	Yes
3.5G (Non-US) HSPA+/UMTS/GSM/GPRS/EDGE	Yes	Yes
CDMA EV-DO Rev A/0/1xRTT-Verizon	Yes	Yes
CDMA EV-DO Rev A/0/1xRTT-Sprint	Yes	Yes
CDMA EV-DO Rev A/0/1xRTT-Generic	Yes	Yes
WiMAX: IEEE 802.16e- 1.4 GHz	Yes	Yes
WiMAX: IEEE 802.16e- 3.6 GHz	Yes	Yes

	CGR 1240 (Pole-Mount)	CGR 1120 (Din-Rail or Wall Mount)
WiMAX: IEEE 802.16e- 2.3 GHz	Yes	Yes
WiMAX: IEEE 802.16e- 1.8 GHz	Yes	Yes
Onboard Interfaces		
Gigabit Ethernet Combination Ports (10/100/1000 Copper, 100/1000 SFP)	2	2
SFPs Supported	GLC-SX-MM-RGD (1000BASE-SX Short wavelength, rugged) GLC-LX-SM-RGD (1000Base-LX/LH long wavelength, rugged) GLC-FE-100LX-RGD (100BASE-LX10 SFP, rugged) GLC-FE-100FX-RGD (100BASE-FX SFP, rugged) GLC-ZX-SM-RGD (1000BASE-ZX extended distance, rugged) Single Fiber Bi-directional transceivers: GLC-BX-D and GLC-BX-U	
10/100 Fast Ethernet Copper Ports	4	6
Wi-Fi (IEEE 802.11 b/g/n)	Yes (autonomous)	Yes (autonomous)
Serial (RS-232/RS-485)	2	2
GPS for Location	Yes	Yes
IRIG-B[2]	BNC connector	No
Digital Alarm Inputs[2]	2	3
Digital Alarm Outputs[2]	2	1
USB Type A host ports[2]	2	1
Console and AUX Port (RJ-45)	1	1
SD Flash Slot (Memory)	1 (2 GB)	1 (2 GB)
Power Options		
Power Supply	AC power supply: • 100-240 VAC	Integrated AC/DC power supply: • 3-phase AC power supply: 100-240 VAC • 10.6-52 VDC (nominal), 9-60 VDC (maximum)
Battery Backup Options	Integrated modular battery backup unit (BBU) and smart charging and monitoring system • CGR 1240 can be deployed with up to three BBU modules stacked and provide up to 12 Amp hours	N/A
Power Options for Third-Party Radios	The CGR 1240 provides support for powering third-party radios: • Voltage output: 12 VDC plus or minus 5 percent • Power output: 12 W (continuous)	N/A
Regulatory Compliance		
Environmental Compliance	• IEC-61850-3 • IEEE1613	• IEC-61850-3 • IEEE1613
Immunity	• EN61000-6-2 • IEC 61000-6-4 • IEC 61000-6-5 (AC, DC, I/O) • EN61000-4-2 (ESD) • EN61000-4-3 (RF) • EN61000-4-4 (EFT) • EN61000-4-5 (SURGE) • EN61000-4-6 (CRF) • EN61000-4-11 (VDI) • IEC 61000-4-12 (AC, DC, I/O) • EN 55024, CISPR 24 • EN50082-1 • IEEE 1613: High Voltage Impulse	• EN61000-6-2 • IEC6 1000-6-4 • IEC 61000-6-5 (AC, DC, I/O) • EN61000-4-2 (ESD) • EN61000-4-3 (RF) • EN61000-4-4 (EFT) • EN61000-4-5 (SURGE) • EN61000-4-6 (CRF) • EN61000-4-11 (VDI) • IEC 61000-4-12 (AC, DC, I/O) • EN 55024, CISPR 24 • EN50082-1 • IEEE 1613: High Voltage Impulse

	CGR 1240 (Pole-Mount)	CGR 1120 (Din-Rail or Wall Mount)
EMC	• 47 CFR, Part 15 • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI V-3 • CNS 13438 • EN 300-386	• 47 CFR, Part 15 • ICES-003 Class A • EN55022 Class A • CISPR22 Class A • AS/NZS 3548 Class A • VCCI V-3 • CNS 13438 • EN 300-386
Safety	• USA: UL 60950-1 • Canada: CAN/CSA C22.2 No. 60950-1 • Europe: EN 60950-1 • China: GB 4943 • Australia/New Zealand: AS/NZS 60950.1 • Rest of world: IEC 60950-1 • UL certified to UL/CSA 60950-1, 2nd Ed. • CB report to IEC60950-1, 2nd Ed., covering all group differences and national deviations • Insulation effectiveness: ◦ AC Input to chassis/ground - 1500V~/2121Vdc ◦ AC Input to output/accessible connectors - 3000V~/4242Vdc	• USA: UL 60950-1 • Canada: CAN/CSA C22.2 No. 60950-1 • Europe: EN 60950-1 • China: GB 4943 • Australia/New Zealand: AS/NZS 60950.1 • Rest of world: IEC 60950-1 • CSA certified to UL/CSA 60950-1, 2nd Ed. • CB report to IEC60950-1, 2nd Ed., covering all group differences and national deviations • Insulation effectiveness: ◦ AC Input to chassis/ground - 1500V~/2121Vdc ◦ AC Input to output/accessible connectors - 3000V~/4242Vdc ◦ DC input to chassis/ground/accessible connectors - no requirement

[1] Operating temperature range is impacted by choice of communication modules and battery backup options.

[2] Interfaces built into platform hardware. Software support will be available in future releases.

Table 3. Cisco IOS Features and Protocols Support

Protocols
IPv4 (RFC 791, 1812, 1918), IPv6 (RFC 2375, 2460, 2464, 2711, 3306, 3315, 3484, 3587, 3849, 4193, 4291, 4443, 4861, 4862), Static Routes, Open Shortest Path First-OSPFv2/v3 (RFC 2328, 2370, 3101, 3137, 5340), UDP (RFC 768), TCP (RFC 791), Multiprotocol Border Gateway Protocol (MP-BGP), Enhanced Interior Gateway Routing Protocol (EIGRP), Internet Key Exchange v2 (IKEv2)
Multicast: Internet Group Management Protocol (IGMPv3), Protocol Independent Multicast-PIM (RFC 4601), Multicast Listener Discovery Version 2- MLDv2 (RFC 3590, 3810)
Generic Routing Encapsulation (RFC 2473, 2784, 2890), PPP/CHAP
IEEE 802.15.4g/e, IEEE 1901.2, IETF 6LOWPAN (RFC 4919, 4944, 6282), IETF RPL (RFC 6550, 6551, 6553, 6554, 6206), IETF CoAP
Ethernet, Serial (RS-232/485), WiFi (IEEE 802.11b/g), WiMAX (IEEE 802.16e)
SCADA support over serial link: IEC 60870-5-101/104 protocol translation and DNP3 serial to IP protocol translation
Raw socket support on serial ports (for transport of non-IP protocols). Raw socket over L2 VPN.
Virtual Routing and Forwarding Lite (VRF-Lite), Virtual LANs (VLAN)
NTPv4 (RFC 5905), DHCP (RFC3246, 3260, 3736), DNS (RFC 1591, 3596), DHCP relay and server for IPv4 and IPv6
L2TPv3
Mapping of Address and Port Using Translation (MAP-T) Border Router (used with IR509)

Security
IEEE 802.1x
Encryption: IPSec VPN (RFC 4301-3, 4306, 4308, 4835), WPA2 for WiFi, FlexVPN
Dynamic Multipoint VPN (DMVPN)
Device identity: IEEE 802.1AR
RBAC for device configuration
L3-L4 ACLs
Authentication, Authorization: EAP TLS/EAP TTLS
RF and PLC Mesh security solution
Secure Shell v2 (SSHv2) and SNMPv3 Crypto
Control plane policing and protection
Certificate revocation list (CRL) and Online certificate status protocol (OCSP)
QoS (RFC 2475)
Classification and marking: ACLs, Layer 3-IP Precedence, Differentiated Services Code Point (DSCP)
Congestion management: Policing, Priority Queuing (PQ), class-based weighted fair queuing, low latency queue, weighted round robin with four priority queues
Embedded Management
NETCONF(RFC 6241), HTTPS (RFC 2818), SSH (RFC 4251-4), Syslog (RFC 5424, 5426)
SNMP v3, v2, v1 along with MIBs for interfaces and system parameters
Embedded Event Manager (EEM) and object tracking
Secure zero-touch commissioning
Battery health monitoring (not available for CGR 1120)
Door tamper detection (not available for CGR 1120)
Network Timing Protocol (NTP)

Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx. Accelerate your growth. Optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.

For More Information

For more information on the Cisco 1000 Series Connected Grid Routers, visit http://www.cisco.com/go/cgr1000.

For more information on the Cisco Field Area Network solution, visit http://www.cisco.com/go/fan.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C78-696278-06 06/15