City of Pittsburgh Office of Management & Budget

RFI Number: 2017-0001
Smart Streetlights

Submitted by Duquesne Light Company
April 3, 2017

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DUQUESNE LIGHT CO.

April 3, 2017

Mr. Thoryn Simpson
Senior Procurement Analyst
City of Pittsburgh Office of Management and Budget
City-County Building, Room 502
Pittsburgh, PA 15219

cc: Ms. Jennifer L. Olzinger
Assistant Director/Procurement Manager
City of Pittsburgh Office of Management and Budget

Dear Mr. Simpson:

Thank you for providing Duquesne Light Company (DLC) the opportunity to respond to the City of Pittsburgh's Smart Streetlights Request for Information (RFI).

DLC understands the City's immediate interest in replacing its remaining HID streetlights, while at the same time forming partnerships to develop, operate, and/or fund next-generation Smart City projects. We believe through our OpenWay Riva Communications Network and longstanding relationship with the City, DLC can be the ideal partner in helping the City achieve these objectives.

We acknowledge that all responses to this RFI may be considered public information in accordance with the Commonwealth of Pennsylvania Right to Know Laws as described in Section 5 of the RFI document. Additionally, DLC acknowledges its ongoing business relationship with the City as its electric distribution service provider.

Once again, we appreciate the opportunity to respond to the City's Smart Streetlights RFI, and we look forward to having an opportunity to discuss our proposal with you.

Sincerely,

Joseph DeMatteo
Director of Business Development
Duquesne Light Company
411 Seventh Avenue
Pittsburgh, PA 15219
Mail Drop 15-1
(412) 393-4625

Executive Summary

For over 100 years, Duquesne Light Company (DLC) has been supplying the City of Pittsburgh with reliable electric service. Through periods of economic growth and recession, from the sweltering weeks of August to the frigid days of February, DLC has kept the heat and the lights on for our region. Today, just as the City is undergoing a substantial transformation, DLC is also in the midst of significant change. At DLC, we are transforming the company from merely an electric utility into a next generation energy company that meets the growing energy and communications needs of our customers.

DLC recognizes the City's needs outlined in the Smart Streetlights Request for Information (RFI), and we believe we can help the City meet its near-term objective of replacing its remaining HID streetlights. In doing so, we also plan to create a dynamic platform that allows DLC and the City to collaboratively pursue future Smart City initiatives.

To help the City achieve its Smart City vision, we have partnered with Itron, Inc. in responding to this RFI. As a global technology and services company that enables the more efficient use of energy resources, Itron has partnered with cities and utilities worldwide to improve their operational efficiency. Itron is currently assisting DLC with the deployment of its advanced metering infrastructure (AMI), and their technological expertise will be key to creating a "smarter" Pittsburgh.

Two critical components of DLC's AMI deployment are its communication network and operations center, both of which are being constructed to enable applications outside of data exchange with the company's smart electric meters. To meet the City's Smart Street lighting needs, we intend to leverage these assets along with Itron's streetlight control node, controller software and inventory management application, and provide the City a "Street Lighting as a Service" solution. This will transform the City's streetlights into energy efficient LED lights, at no upfront cost to the City, but rather a monthly fee to DLC that covers electric consumption, operations & maintenance, and network services.

These assets and this partnership will create the platform and network connectivity necessary to pursue future Smart City initiatives. To stay ahead of new technology and product offerings that could make Pittsburgh a smarter, more efficient City, DLC plans to leverage its longstanding relationships with the local universities, foundations, and start-up community. Tapping these relationships for their wealth of technical expertise will enable the City and DLC to maximize the utilization of the networked asset platform created through the Smart Streetlights initiative.

DLC and the City of Pittsburgh have a long, successful history of working together, and both organizations have helped the City grow to what it has become today. DLC looks forward to this Smart Streetlights project as an opportunity to broaden its relationship with the City and to play an integral role in shaping the region for the future.

Section 4 - Responses

Your response to this RFI should be no longer than 10 pages. A response may include, but is not limited to, the following items listed below:

1. Project Overview

Describe the solution you are proposing and its objectives. Provide designs that help us understand how it would work with the existing streetlight poles and other infrastructure on our streets. Detail the scale, scope and stage of your idea. Has it been deployed elsewhere? If so include detailed materials describing that deployment. If not, provide as much technical details as you can. If the idea is in beta or more nascent, please indicate this; ideas at all stages are of interest to the City.

Response:

As described in the Executive Summary, DLC has a long history of providing the City of Pittsburgh with high quality, reliable electricity. Now, DLC, in partnership with Itron, believes it is ideally positioned to help the City realize its Smart City vision. Beginning with a more efficient, equitable, networked street lighting system. Leveraging the network and operations center serving our AMI infrastructure, DLC can provide the City an innovative smart streetlight solution that enables the City to replace its high energy and high maintenance HID luminaires with smart LED luminaires. While the core initiative for this project is streetlight modernization, partnering with DLC and Itron will allow the City to utilize the connected street lighting platform to deploy additional technologies, such as traffic sensors and controls, to further develop the "Smart Pittsburgh" vision. Technology is converging with broader markets for smart grid, smart cities, and the Internet of Things (IoT), and DLC has the flexible and scalable infrastructure to support this transformation.

Based on information provided in the RFI, we understand the City's immediate objective is to replace approximately 35,000 remaining streetlight with LED luminaires that can be remotely controlled and managed. To achieve this goal, the City could utilize a variety of business models, considering several alternatives to build, own, operate, and maintain the lighting assets, communications network, and operations center needed to activate the smart streetlights infrastructure. We also understand the City financed the conversion of 4,500 streetlights to LED through an Energy Savings Performance Contract (ESPC) in 2012, eliminating or limiting the need to expend precious upfront capital. With this in mind, DLC/Itron is proposing a SaaS solution that eliminates the need for the City to devote capital dollars to modernize its remaining streetlights.

The details of DLC's SaaS solution is as follows:

- DLC will be responsible for the upgrade and installation of the LED luminaires and controls technology, inclusive of all labor and material costs;
- Communications, control and monitoring of the Smart Streetlights would be through DLC's IPv6 AMI communications network.
- DLC would leverage its AMI network operations center to enable real-time remote management of the streetlights;

- DLC would create an easy-to-use interface for the City to have input into the functionality and operation of the streetlights;
- DLC would be responsible for the maintenance associated with the streetlights.

Rather than incurring substantial upfront capital costs upgrading the streetlights, building a communications network, and creating an operations center, the City would simply pay for these services through a long-term SaaS contract with DLC. By leveraging our communications network and operations center being deployed with our smart meter program, DLC believes we can offer this service to the City at a competitive price. Ultimately, this will allow the City to devote capital and maintenance dollars previously earmarked for street lighting to other programs more beneficial to the growth of the City.

The solution is a combination of best in class LED lighting and robust and secure control technology. The solution includes, a streetlight controller with an integrated Itron Network Interface Card (NIC), associated Itron hosted controller application, a field inventory management tool, training on the streetlight controller software and luminaire installation services.

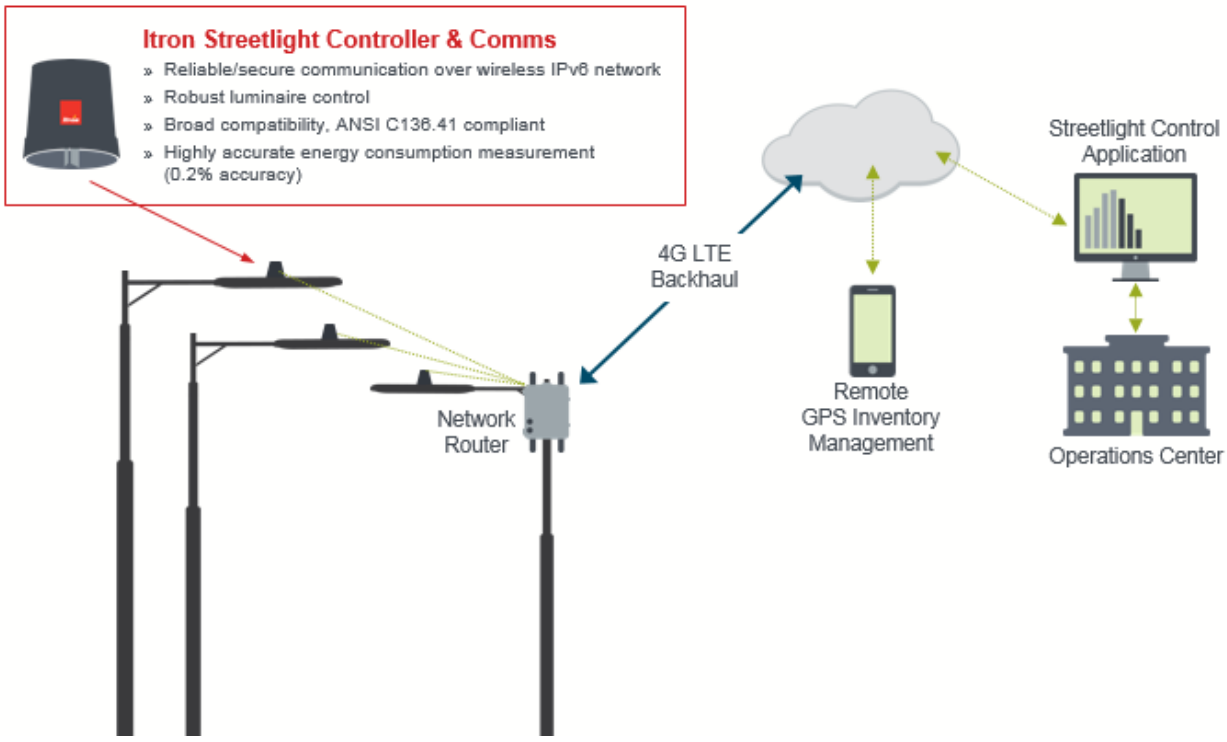
Smart streetlight benefits include:

- Dimming functionality to increase energy savings.
- LED technology to decrease streetlight operating and maintenance costs.
- Controller software to adjust the streetlights remotely so you have flexibility in how you control the lights for the diverse communities you serve.
- A streetlight controller that enables third-party devices like sensors, to attach to the luminaire.
- Integrated real-time operational and inventory management of the luminaires.
- Robust 0-10V and bi-level dimming functionality, which provides the ability to use only the minimum light level required for specific situations such as low traffic times and weather conditions.
- Streetlight control technology that provides “revenue grade metrology” in every streetlight, to ensure accurate measurement and recording of energy consumed.
- Flexible Grouping to address public safety or local neighborhood needs.
- A solution that can be deployed without interrupting ongoing AMI metering operations.
- A partner who’s network supports applications like, hot water heater control, Home Area Networks and electric vehicles, to name a few.
- A partner who’s network has scalable technology that can support millions of devices, including gas and water meter communication modules.

There is considerable evidence that show LED streetlights will provide the following benefits compared to HID:

- *Improved nighttime visibility and safety through better color rendering, more uniform lighting distributions and the elimination of many dark areas between poles*
- *40-80% energy savings*
- *50-75% street lighting maintenance savings*

The DLC streetlight solution and use of DLC's implementation of the Itron OpenWay Riva network will ensure the City stays in the forefront of technology and you're achieving the most value for your investment.



Networked Streetlight Solution

WORRY FREE SOLUTION MODEL

DLC owns the Itron OpenWay Riva IPv6 network and the network management systems. This means the City will not have to worry about financing and managing network equipment. And because DLC will host the streetlight control application and the GPS field inventory manager application the DLC will handle all software upgrades and system enhancements. DLC will also manage firmware updates. With the SaaS model, the City will be responsible for controller application services and configuration settings. Budget planning can be streamlined because you will pay a predictable monthly subscription fee. Moreover, utilizing DLC's datacenters avoids up-front IT expenditures in server hardware and staffing.

Itron's SaaS model includes:

» Software licenses and maintenance
» IT infrastructure and maintenance
» System setup

- System maintenance
  - Database backups
  - Disaster recovery
- System monitoring
  - IT network performance
  - Availability
  - Security
- System service-level commitments
  - System availability
  - File delivery
- Enterprise-level, scalable IT architecture
- Managed IT environment
- Application access via web client
- Help desk support

A SaaS model offers the following benefits:

Reduced Upfront Costs — Itron is responsible for the upfront investments of setting up data centers, installation of equipment, and system integration.

Accelerated Time to Value — Itron will leverage our experienced personnel and existing operations to reduce the set-up and ramp-up time needed to deploy your OpenWay Riva solution. You can begin realizing benefits from the AMI solution faster.

Immediate Expertise — Itron will provide highly trained and knowledgeable personnel to manage and maintain the IT aspects of the OpenWay Riva system, allowing your staff to focus on core business rather than adding in-house IT personnel.

FUTURE PROOF SOLUTION

DLC views the City's vision on streetlights as a structural backbone that will allow future deployments on a number of innovative programs in the future. To ensure this vision becomes reality, we have partnered with a number of local universities and our partner Itron, through their "Idea Labs", to make sure this solution can support such smart city programs, like:

1. Real-time traffic monitoring
2. Adaptive traffic management (traffic flow management)
3. Traffic signal control
4. Parking space management
5. Parking policy enforcement

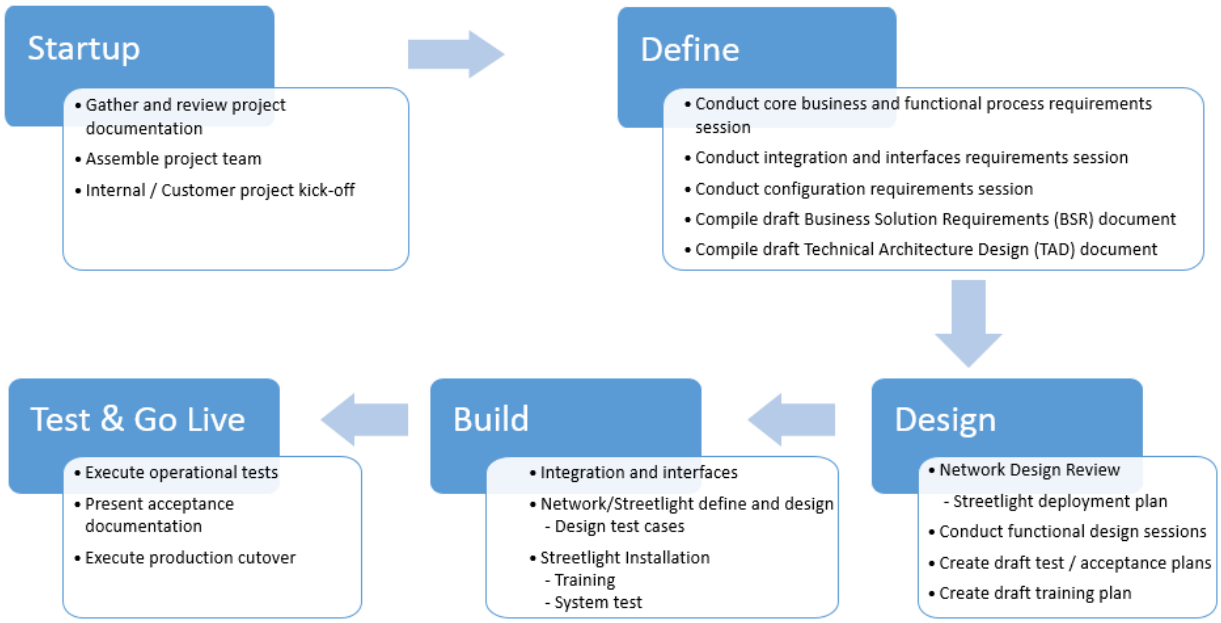
6. Real-time incident alert and dispatch of police / emergency vehicles in response to road emergencies
7. Dynamic pricing (parking)
8. Infrastructure / road condition monitoring
9. Pedestrian safety
10. Car counting
11. Pedestrian counting
12. Crowd monitoring (scene anomaly detection)
13. Left object detection
14. License plate recognition
15. Fused video + acoustic gunshot detection
16. Fused video + strike proximity detection
17. Video surveillance

2. Deployment Plan

Please let us know how specifically this project will deploy across Pittsburgh's infrastructure. Would you recommend a pilot deployment before undertaking the full project? If so, describe the scale of the pilot and parts of the city you feel would make the best testbed for your idea, and why.

Response:

DLC, along with our partner Itron have a long history of successful project deployments., utilizing a standard and proven implementation methodology outlined below. The proposed deployment strategy would be a full project due to the ability to leverage our OpenWay Riva network and pre-existing Operations Center. This approach would then reduce the project effort, starting with layering the streetlight design over the DLC network which extends over the City's territory. We would then resolve any coverage issues, and proceed to installation of streetlight equipment.



Sample Project Plan Process

3. Technical Specifications

Provide as much technical detail for the project as you can, including its power, sensor and communications technologies. Any solution will be selected based on a technical evaluation of not just its Smart City aspects but also its traditional technical aspects, such as the color temperature, photometric and other details of the LED luminaires. (Note that should we proceed through an RFP process, all devices will be tested in the real world.) Describe your plans for data ownership, transmission, security, and privacy. Open standards and industry best-practices will be applied in considering ideas.

Response: Because of page limit constraints we provided technical specifications in a separate document, titled “Section 4 Technical Specifications”, located in Appendix 1.

4. Business Model

Describe any business model or revenue sharing you imagine supporting your idea. None is required, outside of a basic discussion of the feasibility of your idea based the revenue streams identified above, but the City is interested in hearing any such ideas.

DLC’S SMART CITY VISION

A city isn’t smart because it uses technology. A city is smart because it uses technology and data to help drive efficiencies, create sustainable initiatives and actions, and engage citizens to improve community life. To help overcome challenges stemming from population growth and the need to better manage vital resources, DLC is leveraging its core expertise—monitoring,

measurement and control, communications, data management and analytics—to deliver new innovations that accelerate Smart City initiatives.

While others may propose a network that is designed and built strictly for smart lighting, DLC is proposing the City partners with us and leverage our secure, multi-purpose, open-standards-based, IPv6 IoT communications platform for your streetlight solution.

In addition to streetlight management, our OpenWay Riva IoT communication network can also deliver other citywide services and monitoring capabilities. These include traffic flow management, parking management, air quality sensing and noise detection sensing, to name a few examples.

5. Evaluation

Please evaluate of your idea's strengths and weaknesses, with hard data if available. Describe how you would analyze, and recommend we analyze, any data produced by your idea to gauge the effectiveness and civic value of the project.

As with any project of this scope, it is recommended a return on investment study be completed prior to proceeding. The DLC team would welcome the opportunity to work with the City on this study in detail to determine accurate costs and savings. At a high level should the City of Pittsburgh decide to proceed with the Streetlight project with any vendor there would be two areas of expected savings. The first area would be in the reduction in maintenance on the streetlights, with expected service visits reduced to once every ten years from the current level. The second area of savings would be in energy savings, driven by use of energy efficient luminaries and the improved use of dimming via software management. The savings from these improvements have been estimated between 60-80% of current levels. Earlier in this document we included a list of possible future applications that could be implemented once the base streetlight project has been deployed. Each of these applications would bring additional returns that would be estimated during detailed evaluations.

The second input on a return on investment evaluation is the cost, and this is where DLC believes our response brings unique value. Any response to this RFI will include four main costs; those being the cost of the streetlight luminaries and controls, the network to communicate with the streetlights, the software to control the streetlights, and the operations center. DLC already owns and operations two of the four cost drivers, those being the communications network and the operations center deployed to support our AMI implementation. This gives DLC a unique ability to offer the City of Pittsburgh a lower cost than any other vendor, an ability to rapidly deploy a turn-key solution, and the flexibility to proceed in a SaaS model preserving capital for other critical projects within the city.

Appendix 1 - Technical Specifications for Section 4

Provide as much technical detail for the project as you can, including its power, sensor and communications technologies. Any solution will be selected based on a technical evaluation of not just its Smart City aspects but also its traditional technical aspects, such as the color temperature, photo metrics and other details of the LED luminaires. (Note that should we proceed through an RFP process, all devices will be tested in the real world.) Describe your plans for data ownership, transmission, security, and privacy. Open standards and industry best-practices will be applied in considering ideas.

Response:

SOLUTION HARDWARE AND SOFTWARE COMPONENTS

LED LIGHTING TECHNOLOGY

There are a multitude companies that manufacture LED luminaires. Duquesne Light Company (DLC) will work with the City to select the appropriate luminaire manufacturer(s) for this project. However, in order to answer the technical specification section, our responses are based on LED luminaires manufactured by Neptun Light.

Incorporated in 2002, Neptun Light, Inc. is a diversified manufacturer of energy conservation lighting systems, such as Induction and Light Emitting Diode (LED). Since 2013, 400,000 Neptun LED fixtures have been installed in the U.S. and globally.

With various styles, optics, and wattages, lighting fixtures by Neptun offers the best solution in roadway design. Their designs comply with roadway standards in North America and around the world.

Listed below are some of the applications they manufacture lighting for.

Village Street Lighting

Simple, low wattage fixtures are a great solution for small roads. They provide just enough light without being overwhelming, and they come in a bright, white color to provide visibility and safety for pedestrians.

Models:

- LED-81xxx-L1
- LED-776xxx-L2
- LED-882xxx-L2

Residential Streets

A wide range of versatility. They come in multiple distributions with unique light angling technology to direct light exactly where it needs to be. They are also available in a bright, white color for safety to passing pedestrians.

Models:

- LED-778xxx-L3
- LED-882xxx-L3
- LED-89xxx-M2

Major Streets

These fixtures combine architectural form and versatility, making it an excellent choice for new construction or retrofit applications. Multiple distribution patterns and unique light angling technology allow you to obtain the most ideal lighting patterns for their application.

Models:

- LED-771xxx-L4
- LED-882xxx-L4
- LED-89xxx-M4

Interstate highways

These high-output LED fixtures set a new standard for energy efficiency, light quality, and beam control. Highly engineered optics and advanced housing designs deliver outstanding visibility and light distribution to meet various Highway and Interstate lighting standards.

Models:

- LED-882xxx-L6
- LED-779xxx-L6
- LED-89xxx-M6

High Mast Streets

Neptun's revolutionary High Mast Luminaires set the standard in energy savings and beam control with a modular design and State of the Art SSL technology. Light output is virtually absent of any deviation in efficiency and color temperature over the product's 75,000 hour life, greatly reducing maintenance costs.

Models:

- LED-31xxx-M5
- LED-HM62xxx

The Neptun Light LED fixtures specification chart is shown below.

PRODUCT	WATTAGE	LUMENS	CRI	HID REPLACEMENT	WARRANTY	0-10V DIMMING
LED-776xxx-L2	30w-60w	3,600-7,200	80+	70w-150w	10 Year	Yes
LED-778xxx-L3	70w-90w	8,400-10,800	80+	150w-250w	10 Year	Yes
LED-777xxx-L4	100w-120w	12,000-14,400	80+	150w-250w	10 Year	Yes
LED-777xxx-L5	130w-150w	15,600-18,000	80+	250w-400w	10 Year	Yes
LED-779xxx-L6	160w-190w	19,200-22,800	80+	250w-400w	10 Year	Yes
LED-779xxx-L7	190w-220w	19,200-36,400	80+	400w	10 Year	Yes
LED-89xxx-M2	50w-80w	6,000-9,600	80+	400w	10 Year	Yes
LED-89xxx-M3	100w-120w	12,000-14,400	80+	250w-400w	10 year	Yes
LED-89xxx-M4	140w-160w	16,800-19,200	80+	250w-400w	10 year	Yes
LED-89xxx-M5	180w-200w	21,600-24,000	80+	400w	10 year	Yes
LED-89xxx-M6	220w-240w	26,400-28,800	80+	400w-750w	10 year	Yes
LED-451xxx	40w-80w	4,000-8,000	80+	70w-175w	5 Year	Yes
LED-452xxx	100w-160w	10,000-16,000	80+	250w-400w	5 Year	Yes
LED-883xxx	30w-80w	3,000-8,000	80+	150w-250w	5 Year	Yes
LED-884xxx	100w-180w	10,000-18,000	80+	250w-400w	5 Year	Yes
LED-81xxx-L1	40w-80w	4,600-9,600	80+	70w-175w	10 year	Yes
LED-81xxx-L2	100w-120w	12,000-14,400	80+	250w	10 year	Yes
LED-81xxx-L3	140w-160w	16,800-19,200	80+	250w-400w	10 year	Yes
LED-83xxx-L1	40w-80w	4,000-8,000	80+	70w-175w	10 year	Yes
LED-83xxx-L2	100w-120w	12,000-14,400	80+	250w	10 year	Yes
LED-83xxx-L3	140w-180w	16,800-21,600	80+	250w-400w	10 year	Yes
LED-20xxx	35w	4,200	80+	100w-150w	5 Year	Yes
LED-HM62xxx	5OOw	48,000	80+	1000w	5 Year	Yes
LED-31xxx MS	400w	48,000	80+	1000w	10 year	Yes

MULTIFUNCTIONAL CONTROL NODE

The Itron Streetlight Control Node revolutionizes the way streetlights are managed and controlled. Operating on a highly secure, encrypted IPv6 wireless network, each bi-directional communication node is capable of data transmission and reception, as well as, complete control of the streetlight fixture. The Itron IPv6 NIC is integrated directly into the control node.

The node is mechanically and electrically compatible with all modern lighting fixtures, such as LEDs, that are equipped with ANSI C136.41 standard receptacle.

Its communication is built on Itron's **OpenWay Riva™ Adaptive Communications Technology,** and delivers seamless, reliable connectivity and operation. Control and monitoring functions are performed via the cloud-based, Control Management application.

The main body and cover housing is made of semi-transparent plastic material, and does not require any window for the photocell transistor to operate.

It has the capability to store all historical events data and energy consumption data for 31 days - in internal memory. It is programmed to store "current node status" in memory, and refresh that status every 30 seconds.

Features:

- Compatibility and Interoperability: Compatible and interoperable mechanically and electrically (directly attached without external wiring or cables) with all of the Streetlights equipped with ANSI C136.41 receptacle.
- ON/OFF State: Capable of actuating the ON state and OFF state of the Streetlights, where the OFF state results in ZERO power to the Streetlight.
- DIMMED State: Capable of actuating a Streetlight DIMMED state by creating a control signal that complies with the specified 0-10V standard and at a rate of 1% per second.
- Electrical Measurements: Measure and monitor RMS input voltage (V), RMS input current (A), true input power (W) and power factor.
- Time Logging: Log cumulative hours in the ON state and energy consumption for each Control Point
- Offline Time-stamped Storage: Capable of STORING, during Offline Operations, the following TIME-STAMPED Control point parameters:
  - Controller status (Online, Offline, Warnings, Errors);
  - Streetlight status (ON, OFF, Dimmed State, Warning);
  - Cumulative ON state time (minutes);
  - Cumulative energy consumption (kWh)
- Offline Electrical Data Storage: Capable of storing, during offline operations, measurements of voltage, current, power, power factor, energy (kWh) and ON time, where frequency and the number of days to be stored are user configurable.

- Autonomous Photocell Operation: Full autonomous photocell, where dependency on the wireless network is not necessary to turn ON or OFF the Streetlight.
- Operational Indicator Lights: Internal lights visible through photocell semi-transparent body to indicate operational state of the Node.

Physical Characteristics:

- Housing: Hi impact resistant, UV stabilized polybutylene terephthalate and polycarbonate
- (PBT + PC). Color coded per ANSI C136.10.
- Base: Hi impact resistant, UV stabilized polybutylene terephthalate and polycarbonate
- (PBT + PC).
- Contact Blades: Solid brass, three (3) prong, locking type per ANSI C136.10 and two (2) additional contacts and provisions for future contacts per ANSI C136.41 (ANSI Dimming)
- Gasket: Medium cellular silicone for outdoor use
- Dimensions: < 3.5” diameter x 3.5” height
- Weight: < 1 pound
- Operating Temperature: -40°C to +50°C
- Compliance: Wet Rated, Type 2 Outdoor per UL 773

Electrical:

- Input Voltage, Frequency: 120-277 VAC, 50/60 Hz.
- Power Consumption: < 2W at 120-277V
- Dimming: 0 – 10V per IEC 60929
- Load Switching Capability: 20,000 operations at 600 W load.
- Rated Load: 600W max.
- Surge Protection 6kV, 3kA combined wave per ANSI C62.41
- Turn On to Turn Off Ratio Per ANSI C136.10
- Sensor Type: Silicon phototransistor with IR filter.
- Energy Measurement Accuracy: < 0.5% (Utility Grade) per ANSI C12.20

Wireless Network:

- Radio Frequency: 902 – 928 MHz
- Network Communications Protocol: IEEE Standard 802.15.4g, IETF 6LoWPAN Data Compression
- OpenWay Riva™ Adaptive Communications Technology

- Spread Spectrum: Frequency Hopping (50 channels)
- Addressing: IPv6
- GPS Accuracy: 3 meter
- Security: 256-bit Secure Hash Algorithm (SHA-256)
- Encryption: Advanced Encryption Standard AES-256 with certificate based authentication
- 8. Compliance: FCC Part 15

Highly Sophisticated Security Device

Atmel Crypto Authentication Device, with the following features:

» Cryptographic Co-processor with Secure Hardware-based Key Storage

» Performs High-Speed Public Key (PKI) Algorithms

» NIST Standard P256 Elliptic Curve Support

» SHA-256 Hash Algorithm with HMAC Option

» 256-bit Key Length

» Intrusion Latch for External Tamper Switch or Power-on Chip Enablement

The Control Node is fully capable of monitoring and controlling lights of Smart Cities, Smart Airports, Multi-Facility Corporate Campuses, and Parks and Recreational Department needs.

In the event of power loss to the light pole, theft of the Node, or theft of the entire fixture - the Node will send three alert messages to a specified email address or phone. The alert includes description of alert and current GPS coordinates of the Node.

DLC'S IPV6 COMMUNICATIONS NETWORK

The Cisco Connected Grid Router (CGR) with adaptive communications technology (ACT) provides the network infrastructure for our IPv6 field area network (FAN).

The CGR 1000 Series is a ruggedized communications platform optimized for use in FAN applications. The modular CGR is a proven field area router, currently supporting multiple wide area network (WAN) and neighborhood area network (NAN) technologies at multiple Itron OpenWay deployments.

Key features include:

» Two router models, both of which are designed to meet the stringent environmental compliance requirements of IEC-61850-3 and IEEE 1613

- 4-slot router designed for pole-top installations with a rugged NEMA 4 (IP 67) enclosure for deployment in extreme weather
- 2-slot chassis rated at IP30 that can be din-rail mounted inside a secondary substation

- Modular WAN interfaces that support a wide range of backhaul connectivity options such as Ethernet (RJ45 or fiber SFP), 4G LTE, WiMAX, and Wi-Fi
- Modular NAN interfaces that support Itron networking technologies such as Riva ACT RF/PLC, 900 MHz RF Mesh, and Itron 100 and 500 Series ERT® Modules
- Integrated switch for LAN connectivity and serial ports for legacy devices
- Integrated AC/DC power supply supporting wide voltage-range for worldwide use
- Integrated Wi-Fi for local router access with future upgrade to allow managing of other devices connected to the router
- Integrated GPS function for tracking, theft and physical security along with provision for tamper detection alarms

Modular interfaces, antenna options, and backup battery unit options, offer simplified upgrades, increased bandwidth, a diversity of connection options, and network resiliency, in support of low latency, high bandwidth smart grid applications.

Cisco's zero-touch deployment capabilities enable a factory-configured CGR, with configuration and security elements configured specifically for the needs of each utility, to self-discover and automatically register with the network management system to receive the configuration and other attributes that will enable it to function as an IPv6 network enabling device. There is no need for specially trained technicians to deploy any of the devices. This is a unique capability for the Itron-Cisco IPv6 network that makes field deployment easier and more cost-effective.

STREETLIGHT CONTROL MANAGEMENT SYSTEM

The Control Management application is a comprehensive cloud based software with two components:

1. Cloud based streetlight control and management application.
2. Cloud based GPS Streetlight Inventory Manager Application, running on the Panasonic Toughpad FZ-N1 handheld device.

Graphic User Interface (GUI)

The GUI displays the following features and functions:

- Map Data (streets, street names, etc.)
- Satellite Image Data
- Control Point location
- Control Point equipment type (i.e. Streetlight type, sensor type)
- Controller and Gateway status (i.e. online, online reporting error, offline)
- Streetlight status (On, Off)
- Streetlight Dimmed State
- System power quality requirements (Current requirement, Peak requirement in last prescribed time period e.g. Peak in last 24 hours)

- System energy consumption (Daily over last prescribed time period – e.g. Daily for last 7 days
- Streetlight location via controller integrated GPS receiver

Functional Management Features:

- CMS retrieves and stores the following online control point parameters:
  - Controller status (Online, Offline, Warnings, Errors)
  - Streetlight status (ON, OFF, Dimmed State, Warnings, Errors)
  - Average input voltage (RMS) in ON state
  - Average input current (mA) in ON state
  - Average input true power (W) in ON state
  - Average input power factor in ON state
  - Cumulative ON state time (minutes)
  - Cumulative energy consumption (kWh)
  - GPS location (via integral sensor)
- Reporting Frequency
- All or single control point reporting
- Customized Remote Monitoring Reports
- Defining Streetlights groups
- Manual Control of the ON/OFF and DIMMED state of a single Streetlights or group of Streetlights
- Scheduled Control of the ON/OFF and DIMMED state, according to a predefined schedule
- Up to 6 scheduled events per day
- Time-based/Event-based Scheduling

  Time-based Scheduling parameters:
  - On a daily recurring basis
  - On a weekday recurring basis
  - On a weekend recurring basis
- Pre-defined Remote Monitoring Reports:
  - Instances of communication loss between Field Devices and the Central Management System
  - Control Points with error conditions, sorted by error type and/or Electrical Service Point location
  - Energy Consumption Data for individual Streetlights and/or groups of Streetlights

- True Input Power Control - the DIMMED state is actuated to achieve a desired true input power (percent relative watts).
- Constant Light Output - the DIMMED state is automatically actuated to achieve a maintained constant light output (lumens) over time, by compensating for Streetlights lumen depreciation.
- Error Message Generation - comparing all reported control point parameters with optional pre-defined maximum and minimum thresholds, and generating error messages in real-time (based on reported data availability) for any condition that violates a specified threshold a specified number (1 or more) of times.
- Report Notification - specified Remote Monitoring reports (predefined or customized) are sent to assigned users and/or user groups via text message (SMS) and/or email. Reports are exportable in Excel or “csv” format.
- Wire Theft Detection - through use of an algorithm that identifies when the following conditions exist:
  - A user-defined number of controllers report a loss of electrical service
  - The loss of electrical service occurs within a user-defined time window
  - The Controllers are physically located consecutively along a roadway
- Supports multiple developer frameworks and an ecosystem of applications services to build, test, deploy, and scale future intelligent devices, such as Gun Shot Detection, Motion Detection, Environmental Monitoring and Analysis, Video Surveillance, Traffic Analysis, Traffic Optimization, Vibration Detection, and Parking Optimization.
- End-to-end security using certificate management.
- Auto registration and provisioning
- Remote configuration of control node

GPS STREETLIGHT INVENTORY MANAGER

The cloud based GPS Streetlight Inventory Manager Application provides efficient logging of any asset locations, based on its GPS location, creating a robust asset tracking system. The Streetlight Inventory Manager App will link all activities of installers to the Control Management System, including initial installation of assets data at a specific GPS location; and complete update of data of assets inventory during any service or replacement performed at that specific GPS location.

The application supports Barcodes as well as QR codes and NFC tags to track the assets GPS location and enables asset search mechanism. The application runs on Toughpad FZ-N1 handheld.

Toughpad FZ-N1 Handheld Specifications:

HARDWARE & SOFTWARE	Android 5.1.1 Qualcomm® MSM8974AB 2.3GHz Quad Core
DURABILITY	IP65 (high-pressure jet spray) and IP67 (submersible up to 3.3ft. for 30 minutes)
DISPLAY	4.7 inch high definition 1280 x 720 sunlight-viewable display; 10-point capacitive multi-touch with rain sensing and glove touch mode, optional stylus pen (Active or Passive)
POWER SUPPLY	Quick charging 3200 mAh Li-Ion standard battery pack, and optional 6200 mAh long life battery back; Warm Swap capability
INTERFACE & EXPANSION	Angled 1D/2D barcode reader, NFC, GPS, MicroSD, Dual SIM, USB 2.0 port(micro USB) x 1
WIRELESS	WiFi 802.11 a/b/g/n/ac; 4G LTE, HSPA+, UMTS, EDGE, GPRS, CDMA 1x, EVDO Rev.A
WEIGHT	Approx. 0.61 lbs.
WARRANTY	3-year limited warranty, parts and labor

INTEGRATING WITH OTHER NETWORK SYSTEMS

OpenWay web services dynamically interact with other web services-based applications using industry XML messaging protocols based on W3C standards, such as SOAP (XML over HTTPS) and Web Services Definition Language (WSDL). Itron web services comply with major international standards, such as, DLMS/COSEM, IDIS, and ANSI. Itron and Cisco also provide standard APIs to facilitate interfacing with third-party utility business systems. Itron system data can also exported in CSV, CEF, or CRF file formats.

SOLUTION SECURITY

Security is the most critical and foundational concern in defining requirements for smart grid-enabling networks. By leveraging Cisco's security expertise, DLC's OpenWay Riva network has layered security controls and management to protect the multi-service IPv6 field area network.

The entire solution is designed to ensure compliance with critical security principles that protect the solution from incursions and attacks. Principles include data confidentiality, data integrity, system availability, authentication, authorization, timeliness (time-stamps and logs), non-repudiation, component identity, network security availability, and encryption key management.

OpenWay Riva's advanced security architecture conforms to industry-recognized security standards and guidelines such as NERC CIP, ISO, NIST, and AMI SEC. Specific standards and guidelines that drive the cryptographic capabilities within the Itron/Cisco solution include those from the IEC, IETF, ISO, and NIST

Network Layer Security

The multi-service IPv6 network provides consistent security controls for all applications using the Field Area Network (FAN). Cisco's FAN architecture provides unprecedented:

- **Access Control** — Strong authentication of nodes can be achieved by taking full advantage of a set of open standards such as IEEE 802.1x, Extensible Authentication Protocol (EAP) and RADIUS. This "white-listing" approach requires that every device joining the IPv6 mesh network must be authenticated before being allowed access to the mesh network. The Connected Grid Routers (CGRs) pass on a new device's credentials to the centralized AAA server. Once authenticated, the new device is allowed to join the mesh, provided an IPv6 address, and will be authorized to communicate with other nodes. Similarly, the IEEE 802.1x authentication mechanism can be used for locally connected distribution automation devices and can be combined with address allocation schemes such that only authenticated nodes can obtain an IP address.
- **Data Integrity, Confidentiality, Privacy** — Cisco's approach uses network-layer encryption (AES with IPsec) in the WAN and link-layer encryption (AES on IEEE 802.15.4g or IEEE 1901.2).
- **Threat Detection and Mitigation** — a simple but powerful network security technique is to logically separate different functional elements that should never be communicating with each other. For example, traffic originating from field technicians should be logically separated from AMI and DA traffic. Cisco's security architecture supports tools such as Identity Services, VLANs, secure tunnels, Virtual Routing & Forwarding (VRFs), or Generic Routing Encapsulation (GRE) to achieve network segmentation. Additionally, access lists and firewall features can be configured on CGRs and substation routers respectively, to filter and control access in the distribution and substation part of the grid.
- **Device and Platform Integrity** — Field area routers are built with tamper- resistant mechanical designs and generate alerts for physical tampering. Additionally, each CGR motherboard is equipped with a dedicated security chip that provides secure unique device identifier (802.1AR), immutable identity, and certifiable cryptography, entropy source with true randomization, memory protection and image signing / validation.
- **Secure Field Tools** — Both Itron and Cisco provide secure access to devices in the field using digitally signed time-based credentials. This ensures the rule of least privilege can be applied to field access, as well as preventing any contractor/field tech from be able to see device passwords or from performing higher-privileged commands on devices.

Application Layer Security

At the application level, Itron Enhanced Security provides a security architecture that emphasizes integrity of control, availability, and confidentiality. Commands and payloads are encrypted and digitally signed before they are transferred over the network. In this manner, the messages between the applications and meters are protected, regardless of the underlying

network infrastructure. Itron Enhanced Security also provides auditing of both the security activities and the events being returned by the meter, managing the encryption keys and managing the larger set of security components deployed with the system. The Itron Enhanced Security model operates from the headend system to the register in the endpoint, therefore, the endpoints only operates on authenticated control commands. Itron Enhanced Security operates over any underlying network communication technology.

Operational Considerations

Provide detailed information about the useful life of the component technologies included in your proposed project, along with specific information about how and where any of its technologies have been field tested. The City will need to fully understand the additional investment required to maintain technology over the life of the project, as well as the proposed maintenance model. Will the City or partner vendors maintain components in the field? What failure rate would be expected and what costs incurred by the City for replacement components?

Response:

Since the launch of the OpenWay solution in 2005, Itron has demonstrated their commitment to customer success with continuous investment in the OpenWay platform. Much of our R&D effort over the last decade focused on evolving our AMI solution to meet quickly changing market requirements and business challenges. The result is a highly flexible, open, and upgradable solution connecting more than 20 million edge devices, with millions more under contract.

			2005 - 2015	2016	Today 2017	2018	Total
AMI Gen1			CenterPoint Energy, DTE Energy, Duquesne Light, Glendale Water & Power, San Diego Gas & Electric, Southern California Edison	14,000,000		*Introduction of OpenWay Riva Gen3 technology to Gen1 and Gen2 customers will begin in 2018.*	
	Smart Grid Gen2		BC Hydro, Consumers Energy, Duke Energy, FirstEnergy (Penn), FortisBC, National Grid (Pilot)	5,000,000	*1,500,000*	*1,500,000*	12,000,000
		Active Grid Gen3	Tonga Power	*500*	*3,000*		12,000
			Eletrobras	*2,500*	*40,500*	*62,500*	600,000
			Avista		*25,000*	*120,000*	400,000
			Public Service Company of New Mexico	Selected		Start	531,000
			National Grid (MA)	Selected		Start	1,300,000
			Peoples Natural (Pittsburg)		Selected / Start		422,000
			Unnamed Gas Utility		Selected / Start		830,000
			Unnamed Gas Utility	Selected	*50,000*	*110,000*	160,000
			AVANGRID, NY (Pilot)		Selected / Start		19,000
			Roswell, NM		Selected / Start		19,000
			Tampa Electric (Pilot)		*2,700*		2,700
			Actew (Australian Capital)		Selected / Start		100,000
			Gen1 Total	14,000,000	14,000,000	14,000,000	14,000,000
			Gen2 Total	5,000,000	6,500,000	8,000,000	12,000,000
			Gen3 Total	3,000	124,200	416,700	4,395,700
			OpenWay Totals	19,003,000	20,624,200	22,416,700	30,395,700

Italics = Annual Deployment

OpenWay Deployments

- **AMI** (Gen1) — Itron developed the first generation of the OpenWay solution with an Itron RF LAN network and successfully deployed it in support of some of the largest and most visionary early AMI projects in North America.
- **Smart Grid** (Gen2) — Itron partnered with networking giant Cisco in 2010 to evolve the proprietary Itron RF LAN to an IPv6 network that implements open standards at all layers of the OSI stack. This non-proprietary, interoperable network incorporated Cisco network management, routing, and security while maintaining the platform's industry-leading AMI capabilities. This best-in-class combination set the standard for multi-application Smart Grid networks.
- **Active Grid** (Gen3) — Itron evolved the OpenWay platform to enable Active Grid innovations. OpenWay Riva adds two features to the existing standards-based platform: advanced PLC connectivity within the IPv6 mesh network and a computing platform embedded in every meter and device to enable real time analysis of data at the edge of the network. Together, these innovations enable an array of new Active Grid use cases and applications for grid efficiency, reliability and safety, as well as consumer engagement.

Cisco Connected Grid Router 1000 Series are offered with a standard 5-year warranty as well as a world-class maintenance and support program. Cisco certifies the CGR MTBF as: 540,460 hours.

The Neptun luminaires have a 10 year warranty. Neptun certifies their LED fixtures at 100,000 hours. LED bulbs can last up to 20 years, so any maintenance costs would be minimal.

With Itron SaaS model Itron will take care of system implementation, software applications, server infrastructure, system monitoring and maintenance.

Obsolescence Protection — Flexibility to Grow with your Needs

OpenWay Riva is built on a foundation of open standards at every layer and on all equipment technology. The network provides a platform that allows virtually any smart grid application or sensing device to be seamlessly integrated; and allows for development of a constantly expanding portfolio of valuable apps from a variety of sources. With such versatility, OpenWay Riva provides an AMI platform that will last.

Additionally, the OpenWay network can push over-the-air firmware downloads to the streetlight control nodes. This capability provides a fast and efficient manner to evolve the system over its life. This is a critical feature for preventing obsolescence.

Appendix 2 – Itron OpenWay Riva Network Overview

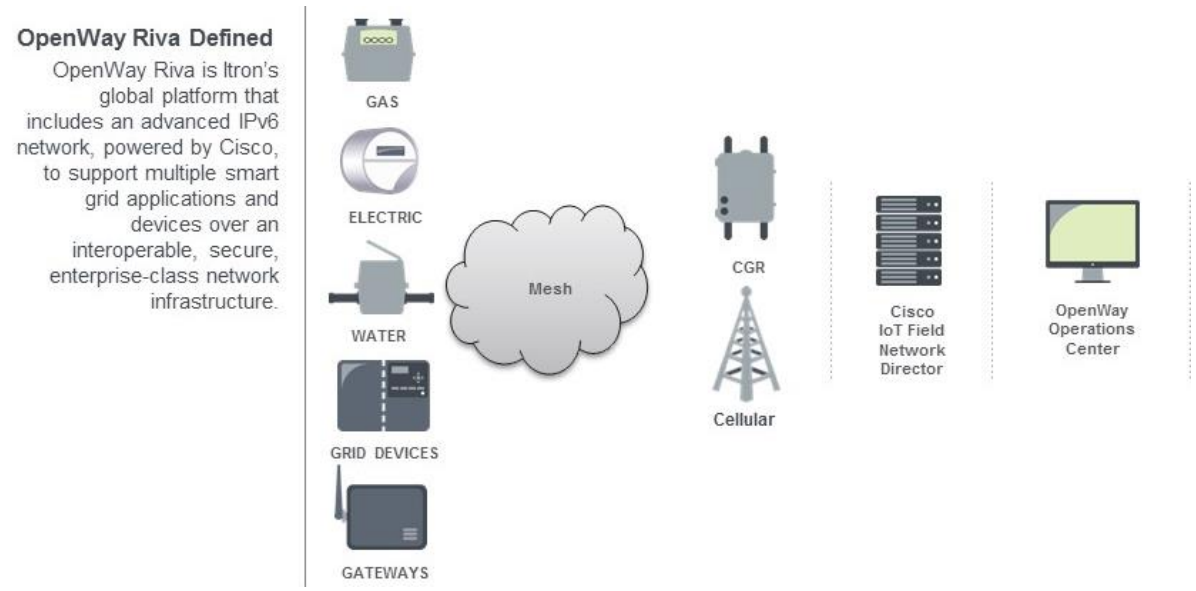
Itron's OpenWay Riva solution combines robust software, flexible communications, and smart metering capabilities, making it possible for the transformation of your energy distribution system into an Internet of Things (IoT) platform. OpenWay Riva redefines what is possible for grid-based use cases by bringing together a powerful distributed computing platform with new communications capabilities that combine both radio frequency (RF), wireless, and advanced power line carrier technologies in a single meter or grid device running on an open, standards-compliant IPv6 network.

OpenWay Riva devices instantly analyze large volumes of highly detailed data at the edge of the utility network, delivering distribution system awareness and taking action in real time to manage rapidly changing grid conditions. Delivering processing power, situational awareness, and actionable intelligence all the way to the endpoint, OpenWay Riva paves the way for utilities to use their data and their IPv6 network to achieve distribution efficiencies, deliver customer savings, and capitalize on new business opportunities.

At Itron, we call this the Active Grid, and with OpenWay Riva technology, utilities are changing the way they operate in the IoT world.

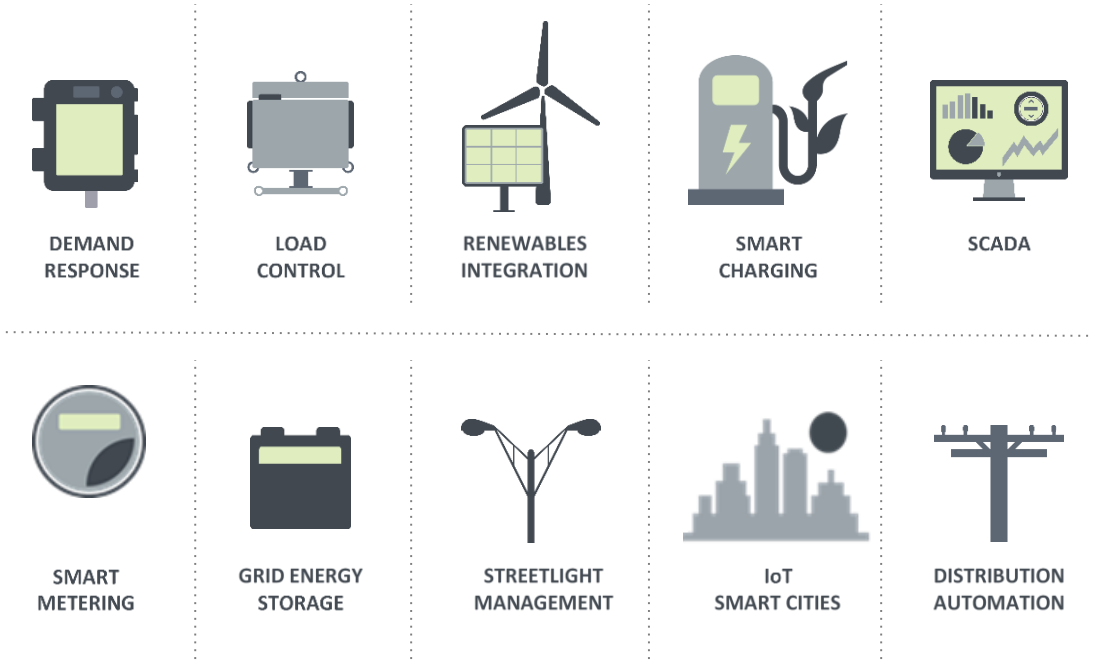
WHAT IS OPENWAY RIVA?

OpenWay Riva is the latest version of Itron's proven, standards-based OpenWay solution. A proven AMI solution for electric, gas, and water utilities, OpenWay's underlying communications platform powered by an IPv6 reference architecture co-developed with Cisco functions like a standard IT network in the field, allowing multiple services to coexist over the same field area network (FAN). This means the system's network management, security, and other infrastructure components are the same, no matter how many applications use the FAN. This structure simplifies the process of expanding the network solution to include new applications and devices to support AMI, distribution automation, distributed energy resources, streetlights, electric vehicles, and other smart grid use cases.



OpenWay Riva Provides a Unified Communications Platform for Utilities

OpenWay Riva takes this proven foundation for AMI and smart grid applications and adds support for the growing Internet of Things (IoT). The market for AMI technology is converging with broader markets for smart grid, smart cities, and the Internet of Things (IoT). Utilities that deploy OpenWay Riva for AMI today are deploying a multi-application, standards-based network infrastructure and IoT technology platform for which advanced metering will be the first and foundational application. Secure and open, OpenWay Riva enables a communications platform that can be leveraged for new business model trends. And it establishes services that can provide growth far beyond optimized energy and water delivery and use



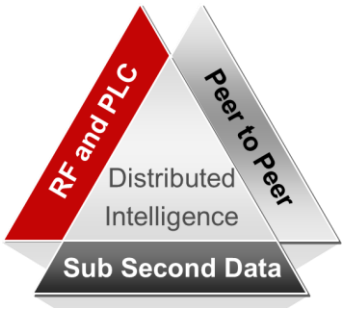
OpenWay Riva Enables Multiple Smart Grid Use Cases

Key OpenWay Riva solution features include:

- **Multi-application Field Area Network** — OpenWay Riva provides the most advanced, flexible, and secure platform available on the market, with an open architecture that supports the widest range of applications and communication protocols. Everything from advanced metering infrastructure (AMI), to distribution automation (DA), to streetlight controls can leverage the same network resources. Built upon our Cisco partnership, OpenWay Riva implements IT industry standard network protocols, application environments, and security models in a truly interoperable IPv6 network—where all devices are IPv6 endpoints for interoperation of diverse grid devices/assets/applications.
- **Assured Connectivity** — Active Communications Technology (ACT) in each of the endpoints provides multiple dynamic communications options (RF, PLC, and Wi-Fi) on the same chip-set. Endpoints automatically and continually evaluate the optimal path and modulation rates. This approach maximizes coverage and minimizes deployment and operational costs for electric, gas, and water utilities. ACT simplifies AMI deployments, assures high degrees of connectivity, reduces network mitigation / maintenance, extends

mesh capacities, lowers network device counts, and reduces backhaul costs — all of which result in a lower total cost of ownership (TCO) over the life of the system.

- **Locational Awareness** — OpenWay Riva devices always know where they are in relation to distribution system assets to provide unprecedented confidence and precision in real-time, automated grid operations.
- **Robust Computing Power** — OpenWay Riva computing power is equal to putting a smart phone in every edge device to process high-resolution data at the edge of the grid. This distributed intelligence drives localized and real-time management of changing grid conditions while optimizing network efficiency.



- **Peer-to-peer Communications** — OpenWay Riva devices share data and information via peer-to-peer in real time for local pattern recognition, analysis, and "learning" which facilitates inter-device command and control. This peer-to-peer communication capability allows an OpenWay Riva solution to surpass other solutions in areas of voltage regulation, outage detection, and other use cases that require near real time grid awareness.
- **Multi-protocol Platform** — OpenWay Riva delivers an open application environment that supports multiple application and communication protocols. This allows diverse grid devices and assets to communicate and work together locally to solve problems and create opportunities for increased efficiency and cost reduction.
- **End-to-end Security** — Itron's best-in-class, standards-based security, strategically locates multiple layers of protection throughout the architecture. OpenWay Riva's underlying security controls are based on widely adopted cryptographic and security standards, while also reflecting specific innovations by Itron and Cisco.
- **Vibrant Ecosystem** — OpenWay Riva is open to unlimited innovation. Any company can develop products for the OpenWay Riva platform using standards-based, open interfaces. OpenWay Riva takes full advantage of the global IoT investment being made by Cisco, the leader in networking and network security. With this platform, utilities benefit from the innovative products and services that are being developed by a large and growing global Cisco IoT ecosystem. Itron is already bringing to market new distributed intelligence applications. We are also building an Itron Riva developer's network to support innovation from third parties for this technology platform. Third-party developers can invest in a developer kit to get started creating new applications, and even their own networked devices, which take advantage of the full power of Advanced Communications Technology. Details about Itron's developer program for OpenWay Riva are available at https://www.itronriva.com

What Makes OpenWay Riva Better?

Itron's OpenWay Riva solution redefines what is possible for utility AMI and smart grid use cases. At a high level, this latest release of the Itron's widely deployed OpenWay AMI solution delivers four differentiating capabilities that deliver on the promise of the Active Grid:

Active

Meters and grid devices to access and analyze high-resolution data in real time at the edge of the network and take action. Using **distributed intelligence** and **peer-to-peer communication**, smart devices can detect a leak or avoid an outage where the problem occurs.

Connected

OpenWay Riva assures connectivity and network reliability with **simultaneous RF and advanced PLC in one device, plus Wi-Fi ready.** Multiple communications media deliver high performance with assured connectivity, both at a local level and across the entire network.

Open

Built on open standards, the OpenWay Riva solution promotes interoperability and interchangeability. A **vast developer ecosystem** avoids vendor lock-in and expands choice.

Unified

OpenWay Riva unites electricity, gas, water and smart city devices on one **unified, multi-purpose IPv6 network.** All connected devices leverage the same investment in network management, security, and quality of service.