



Solution and Product Overview

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Revisions

Number	Date	Revision
6	April 2015	Updated information for data sheets in Appendix A Silver Spring Product Documentation to match new updates on SpringBoard.
5	April 2015	Added more details to About Skipped Version Numbers in Appendix B Silver Spring Software and Firmware Version Numbering and Processes .
4	March 2015	Product additions and updates, provided links from document titles in Appendix A Silver Spring Product Documentation to their locations on Silver Spring SpringBoard, and added new Appendix B Silver Spring Software and Firmware Version Numbering and Processes .
3	November 2014	Added material throughout—including more information about which products can be used together—and an extensive index.
2	September 2014	Added SilverLink, the Silver Spring Street Light solution, SSNAgent, and other updates and general improvements.
1	June 2013	Added and modified product descriptions and details that have changes since the August 2012 publication.

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1 Introduction and Silver Spring Solutions

Introduction

This document provides information about Silver Spring Networks solutions, software, and hardware products. The following topics are included:

- This chapter describes Silver Spring advanced metering infrastructure (AMI), demand response (DR), Distribution Automation (DA), the SilverLink™ Sensor Network, and Smart Street Lighting solutions.
- [Chapter 2 Silver Spring Software Products](#): Describes software Silver Spring provides for AMI, DR, and DA solutions, device management, as well as firmware, security-related components, shared services components used by multiple Silver Spring applications, and field tools.
- [Chapter 3 Silver Spring Hardware Products](#): Describes the Silver Spring Communications Module and network interface card (NIC), Access Points and Relays, Bridges, Gas Interface Management Units (IMUs), Field Service Units (FSUs), faulted circuit indicators (FCIs), as well as hardware products that support electricity meters and gas and water modules.
- [Appendix A Silver Spring Product Documentation](#): Includes information about Silver Spring general reference, AMI, DR, DA, networking, security, field tools, installation, and release notes documentation.
- [Appendix B Silver Spring Software and Firmware Version Numbering and Processes](#): Includes information about software and firmware version numbering and processes.

Silver Spring Solutions

The Silver Spring advanced IP-based utility infrastructure provides solutions for any combination of electricity, water, gas, and street light controlling endpoints, DA systems communicating with Bridges, and HAN devices communicating with electricity meters.

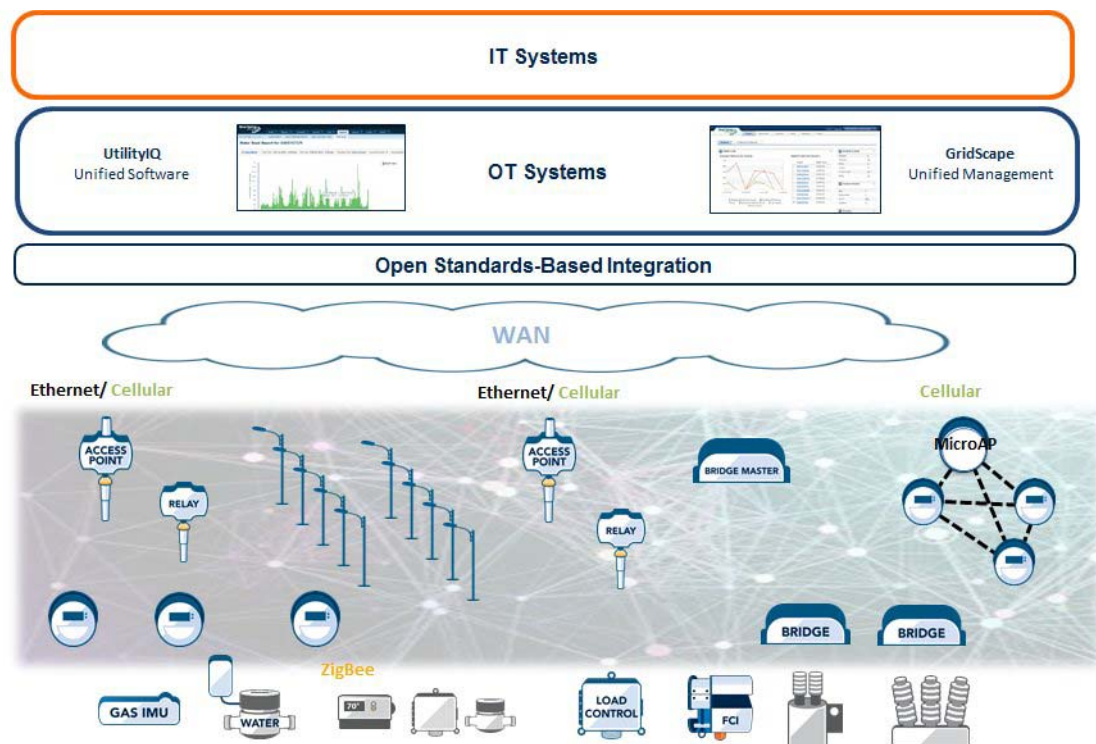
It offers multiple levels of redundancy and sophisticated outage and failover logic, ensuring that all endpoints are read consistently and that signal attenuation and outage effects are eliminated or reduced to a minimum. With automated outage detection and recovery logic, the system can return to full operation from an outage without data gaps and without manual intervention.

Following an overview of the Silver Spring infrastructure, this chapter describes Silver Spring smart grid solutions in the following categories:

- **Advanced metering infrastructure (AMI):** Solution for reading electricity, water, and gas meters using a self-organizing wireless network. See [Advanced Metering Infrastructure Solution](#) on page 8.
- **Demand response (DR):** This solution uses the same network as AMI, but extends the wireless communications to smart devices at customer locations. This enables collaboration between the utility and its customers to conserve energy. See [Demand Response Solution](#) on page 10.
- **Distribution automation (DA):** This solution extends the Silver Spring mesh network to substation equipment to provide secure two-way communications to protect and control devices on the distribution portion of the network. See [Distribution Automation Solution](#) on page 12.
- **SilverLink™ Sensor Network:** This solution collects and uses data from networked sensor devices that reside on the Silver Spring mesh network. See [SilverLink Sensor Network Solution](#) on page 14.
- **Smart Street Lighting:** This solution uses the Silver Spring Communications Module in street light control devices to manage, control, and monitor, and provide analysis for street lights across the Silver Spring mesh network. See [Smart Street Lighting Solution](#) on page 14.

As [Figure 1](#) shows, The Silver Spring Platform supports a range of smart infrastructure applications on a single open standards-based network.

Figure 1. Silver Spring Platform



Silver Spring Platform Overview

The Silver Spring Platform is made up of networking hardware, NIC-enabled endpoints, firmware (UtilOS®), and Silver Spring software. This infrastructure is capable of meeting many demands of the smart grid and it supports utilities' requirements in the following ways:

- Enables integration through web services with external applications, including but not limited to those serving CIS, billing, OMS, DA, and DR functions.
- Incorporates device, billing cycle, and location data from hardware manufacturers and the utility.
- Collects interval, register, consumption, security, and outage data from the NAN and can pass it on to AMM and external applications.
- Executes scheduled jobs, remote disconnect / connect, and load / price control signals.
- Executes data export jobs.
- Validates, stores, and detects changes in device programs.
- Provides robust security, authentication, and encryption.
- Communicates with field-deployed devices over Internet Protocol Version 6 (IPv6).
- Provides WAN communications through digital cellular and Ethernet.
- Enables two-way, 100-kbps NAN communications through 902–928 MHz—and 865–880 MHz for EU, Dubai, and other locations—Frequency Hopping Spread Spectrum (FHSS) from Silver Spring one-watt transmitters.

For descriptions and ordering information about all Silver Spring infrastructure hardware, see *Silver Spring Networks Infrastructure Hardware Guide*.

Note: The 902–928 MHz unlicensed frequency band used for NAN communications is subject to national regulation. In the US and Canada, for example, licenses are not required to transmit at 1-watt or less over the 902–928 MHz range. In Australia, the allowable range is 915–928 MHz.

APs, Relays, and Bridges deployed in the field are tested and configured using Silver Spring software products, including UtilityIQ and GridScape.

Advanced Metering Infrastructure Solution

The advanced metering infrastructure (AMI) solution manages the collection of electricity, water, and gas usage data, and support for functions and features listed in [Table 1](#) using UtilityIQ® applications.

Table 1. Functions and features supported by UtilityIQ applications

Functions and features	Using UtilityIQ application
Metering data collection monitoring and reporting	Advanced Metering Manager (AMM)
Remote service management (RSM) including scheduled disconnects, re-connects, pre-payment, and demand limiting	Advanced Metering Manager (AMM)

Table 1. Functions and features supported by UtilityIQ applications (*Continued*)

Functions and features	Using UtilityIQ application
Integration with utility applications such as those for meter data management and billing	Advanced Metering Manager (AMM)
Asset management	Advanced Metering Manager (AMM)
Firmware audits and upgrades using	Firmware Upgrader (FWU)
Meter program audits and upgrades using	Meter Program Configurator (MPC)
Fault management and performance management using	Network Element Manager (NEM)
Outage detection using	Outage Detection System (ODS)
Power monitoring and voltage optimization	Power Monitor and Voltage Optimizer

Note: Although Demand Optimizer and HAN Communications Manager are also included in the UtilityIQ suite, they are discussed in the demand response solutions sections of this document.

To deploy the AMI solution, you must install and run AMM. A typical AMI solution runs AMM, FWU, MPC, and NEM, and nearly all deployments include both FWU and MPC. You can install other AMI-solution applications to provide the functions described in [Table 1](#).

The AMI solution requires network-enabled electricity meters in utility-customer premises—and/or other devices that meter electricity usage—and APs and Relays.

The Silver Spring AMI solution supports the following hardware:

- Electricity meters with Silver Spring Communications Modules installed. See [Communications Modules and Network Interface Cards](#) on page 40.
- Gas meters with Silver Spring Gas IMUs installed. See [Gas Interface Management Units](#) on page 48.
- Gas or water meters with modules from third party manufacturers installed, including those manufactured by Aquiba, Itron, and Landis+Gyr. See [Silver Spring Support for Third-Party Gas and Water Modules](#) on page 52.
- APs and Relays made by Silver Spring to provide data routing and backhaul services. See [Access Point](#) on page 42 and [Relay](#) on page 43.
- Load control switch (LCS) devices with Silver Spring Communications Modules installed. See [Silver Spring Support for Third-Party Load Control Switches](#) on page 52.
- Street light control devices with Silver Spring Communications Modules installed. See [Silver Spring Street Light Control Devices](#) on page 51.

A typical AMI workflow includes running network jobs (such as those providing metering schedule from the back office). AMM sends data requests over the cellular or Ethernet wide area network (WAN) to APs. The APs, numbering approximately one for every 5000 electricity meters, re-send these data requests over the Silver Spring mesh neighborhood area network (NAN). Data requests can be routed through Silver Spring Relays or other Silver Spring devices on their way to endpoints.

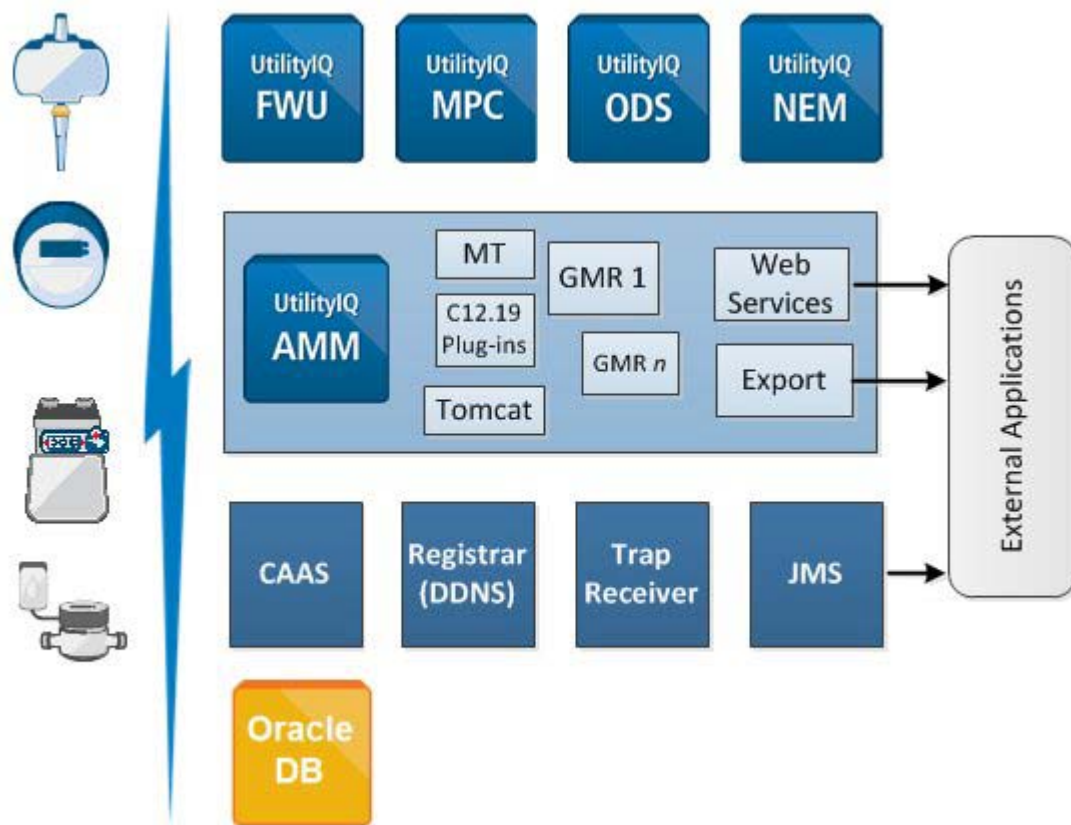
Each endpoint responds with the requested metering data and events, which it collects from the metrology board on the device every 15 seconds. Metering data and events are relayed

back through the NAN to the APs, and then to AMM and the Oracle database. AMM runs scheduled export jobs that upload data files onto a server, where they are picked up and processed by external utility applications, such as those for meter data management (MDM), billing, and outage management.

In a deployment that includes the Gen4 cellular Communications Module, data requests and responses bypass APs and are routed through a cellular modem on the meter's Communications Module. Nearby meters can use this Gen4 enabled meter as their backhaul, which together they form a Micromesh™ network.

Figure 2 shows dependencies for the Silver Spring AMI solution.

Figure 2. AMI dependencies



Demand Response Solution

The demand response (DR) solution enables utilities to collaborate directly with their customers to shift demand from peak to off-peak and ultimately to defer additional generation capacity. DR programs are based on contracts between the utility and its customers, and these programs are intended to provide incentives for utility customers to reduce demand during critical peak periods. Silver Spring DR solutions include HCM (for managing HAN devices and related functions), CustomerIQ (for reporting usage information to utility customers), and Demand Optimizer (for demand response management system functions). These products can be used individually or in combination.

- HCM is a Silver Spring application that enables utility companies to manage home area network (HAN) devices — including ZigBee® and Direct-to-Grid (DtG) devices — and Electric Vehicle Supply Equipment (EVSE), rate plans, and create and manage DR programs. A DR program is a contract between a utility company and their customers under which customers can elect to participate in or opt out of DR events that the company sends out during critical peak periods (such as during the afternoons of very hot days, for example, when a large number of air conditioning systems are likely to be running).

Note: HCM functionality was previously provided by UtilityIQ Demand Response Manager (DRM).

For further details, see [UtilityIQ HAN Communications Manager](#) on page 20.

- CustomerIQ is a web portal that utility customers can use to monitor their usage and receive energy conservation alerts and other information. The information that CustomerIQ uses is based on usage data provided by AMM.

For further details, see [CustomerIQ](#) on page 34.

- Demand Optimizer is a full-featured demand response management system (DRMS) that can act as a UtilityIQ head-end application for creating and managing utility DR programs, forecasting load and load shedding potential, and providing actionable analytics following events with information about load shed and customer participation.

For further details, see [UtilityIQ Demand Optimizer](#) on page 18.

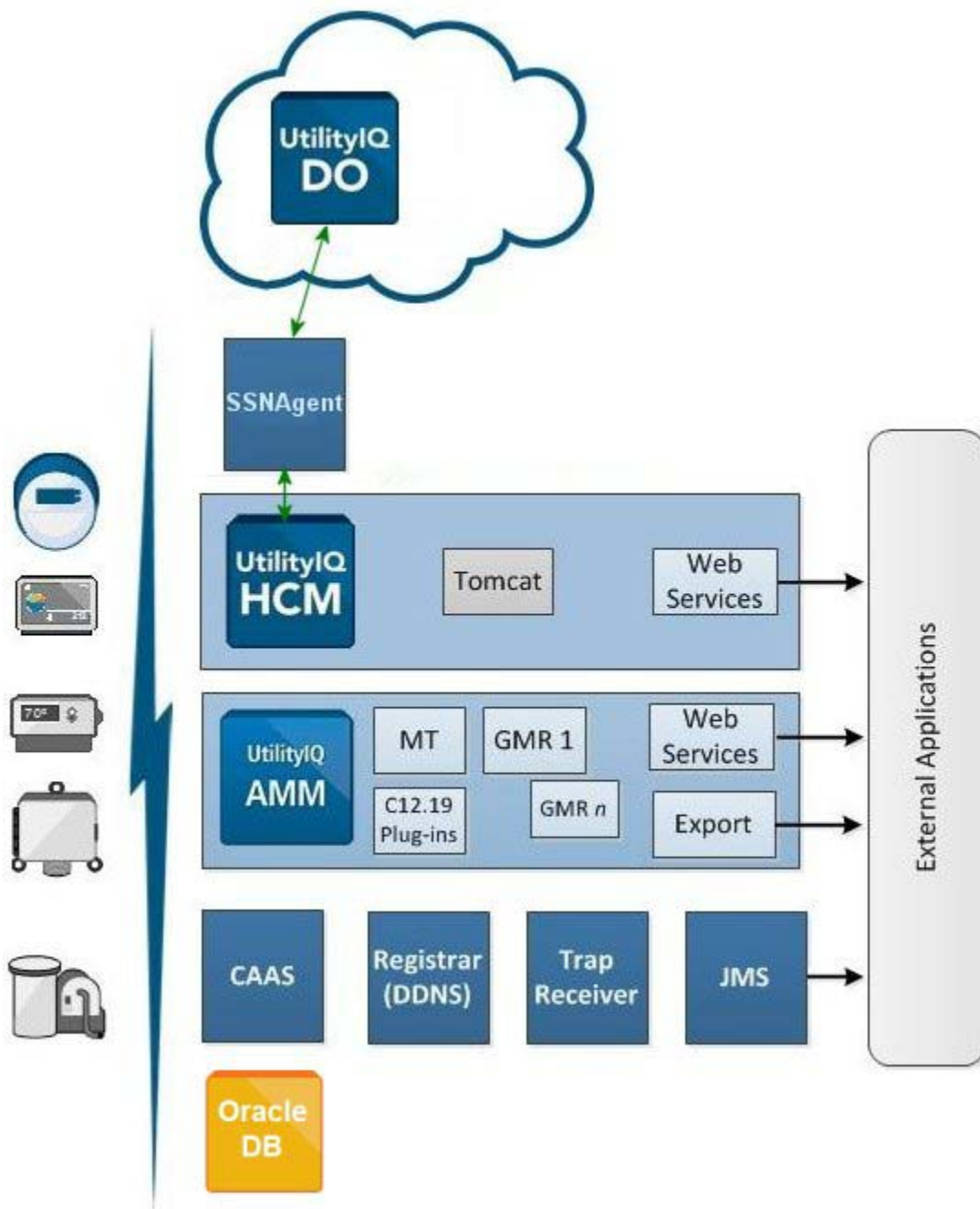
To implement the DR solution for ZigBee HAN devices, you must install both AMM and HCM. With HCM version 2.0 and later, if you have only DtG LCS devices in your service environment, AMM is not required.

The DR solution requires network-enabled electricity meters in utility-customer premises, APs and Relays, and connected devices that can respond to DR programs.

[Figure 3](#) shows dependencies for the Silver Spring DR solution with the exception of CustomerIQ, which reports utility customer information using interval data from AMM and

validation, estimation and editing (VEE) data from the utility meter data management system (MDMS).

Figure 3. DR dependencies



Distribution Automation Solution

The Distribution Automation (DA) solution provides efficient, reliable, and secure two-way communications to protect and control devices on the distribution portion of the Silver Spring mesh network. Bridges relay information between Supervisory Control And Data Acquisition (SCADA) systems and circuit reclosers, sectionalizers, feeder switches, capacitor banks and controllers, faulted circuit indicators (FCIs), transformers, and voltage regulators.

Understanding the status of these devices in real time enables rapid outage detection and notification, and improves fault location and isolation. It also increases energy efficiency through better capacitor and voltage control and improved asset management.

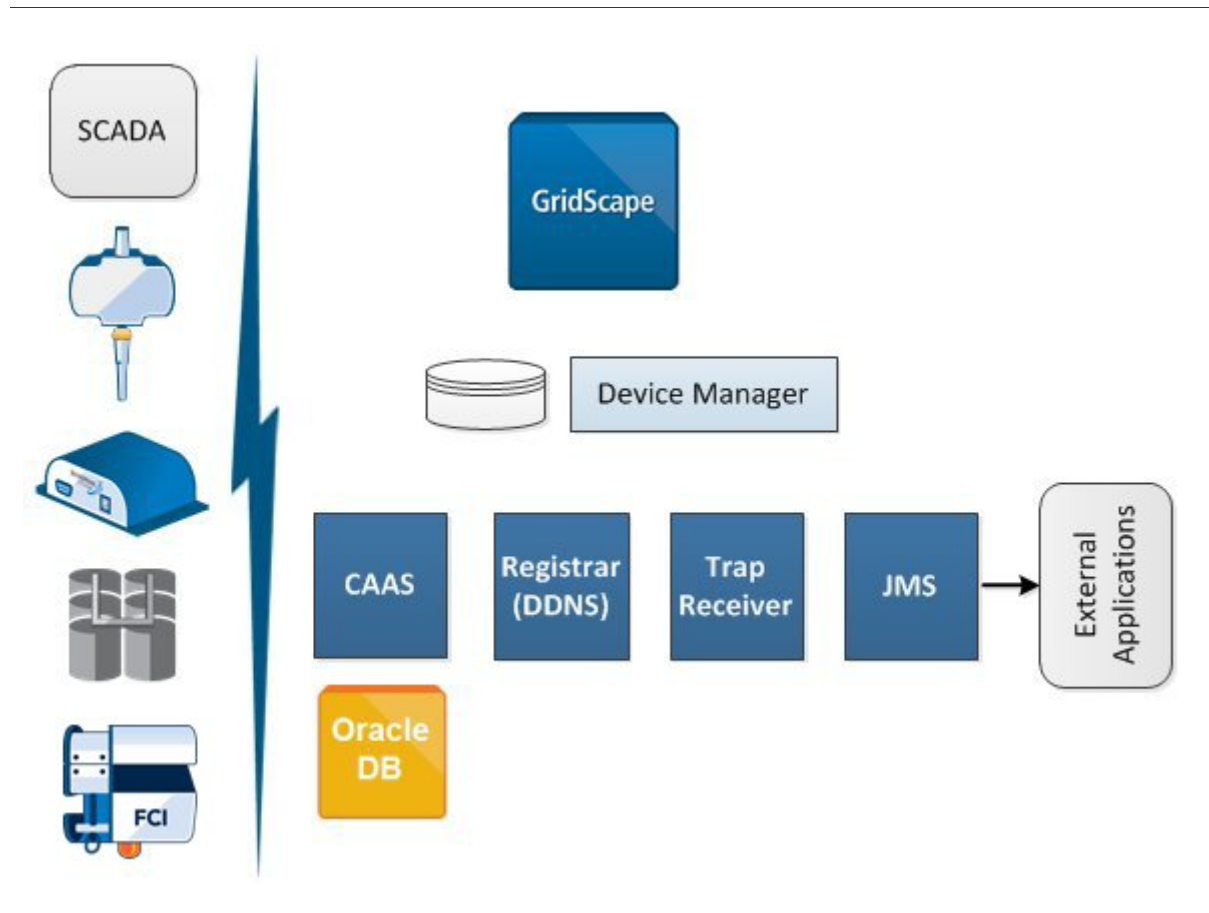
The DA solution consists of:

- Silver Spring Bridges that interface to various distribution-level SCADA devices. See [Bridge](#) on page 44.
- Faulted circuit indicators that are attached to distribution lines to provide real-time reporting of fault locations to a utility's SCADA system. See [Faulted Circuit Indicator](#) on page 46.
- GridScape™, a data center software application that provides secure configuration and management of DA communication networks. See [GridScape for the DA Solution](#) on page 26.
- Bridge Configurator, a field-level software tool that allows users to create DA networks. See [Bridge Configurator](#) on page 36.

The DA solution requires Bridges, APs and Relays, and substation equipment.

[Figure 4](#) shows dependencies for the Silver Spring DA solution.

Figure 4. DA dependencies

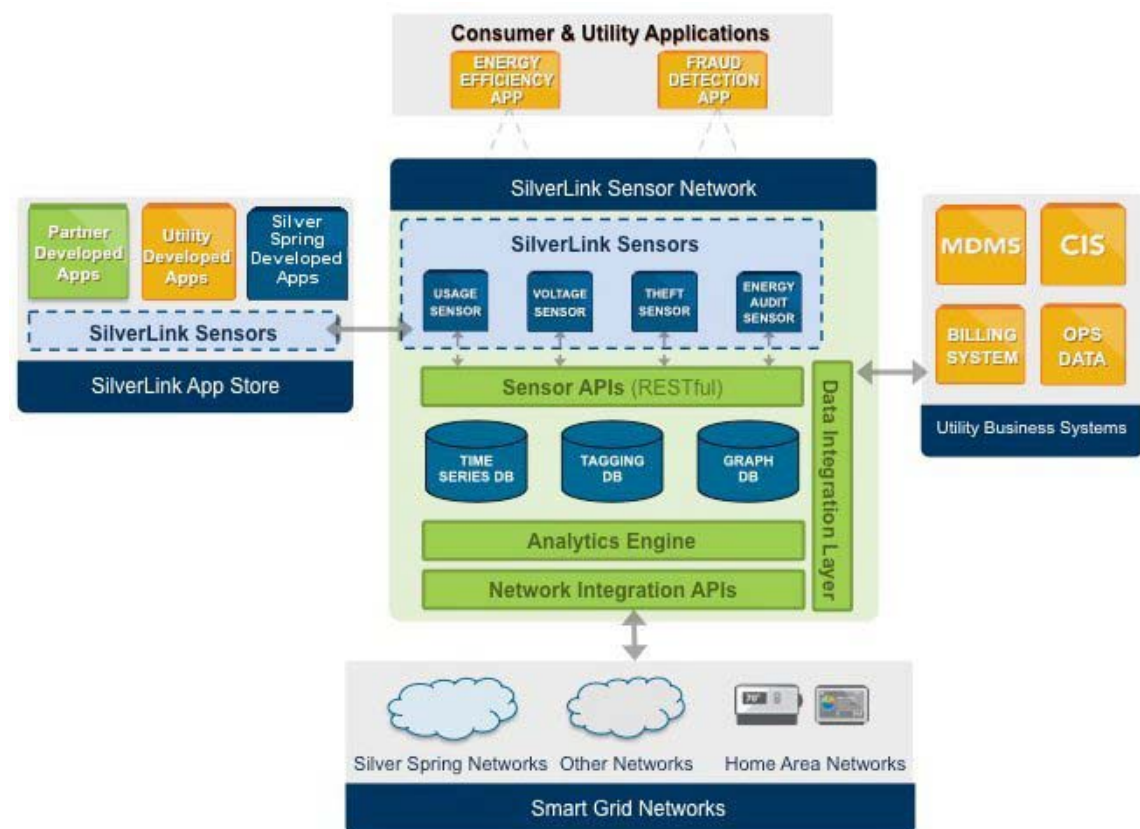


SilverLink Sensor Network Solution

The SilverLink Sensor Network open-standards software solution is designed to collect and use data from networked sensor devices such as usage, voltage, theft, and energy-audit sensors. The solution enables utilities to aggregate and organize these devices, and to analyze smart grid data quickly and cost effectively, which is particularly applicable for mission-critical operations and for customer engagement. The solution can be configured for broad integration and access by utility and consumer applications, utility business systems —such as MDMS, customer information system (CIS), and billing and operations systems— and through Silver Spring mesh networks, HANs, third-party networks, and legacy systems.

Figure 5 shows dependencies for the SilverLink Sensor Network solution.

Figure 5. Silver Spring Street Light dependencies



Smart Street Lighting Solution

The Smart Street Lighting solution allows utilities and municipalities to manage, control, and monitor, and provide analysis for street lights across the Silver Spring mesh network. Silver Spring Communications Modules are installed in street light control devices (such as in control nodes in photocells and controllers in cabinets) and communicate across the network

through a TALQ Bridge to the Streetlight.Vision central management software (CMS) and UtilityIQ for integration with other Silver Spring applications.

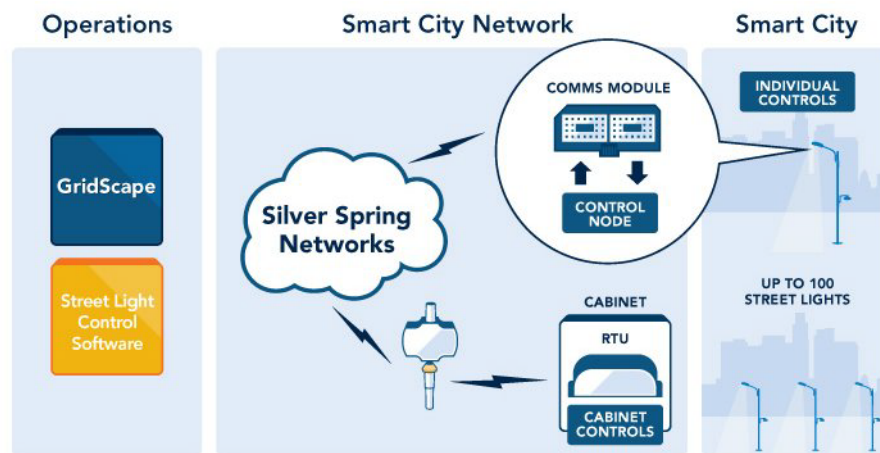
Note: For customers that wish to use a CMS solution other than Streetlight.Vision, please contact your Silver Spring representative for further information.

In addition to TALQ Bridge, Silver Spring provides a Provisioning API (PAPI), a simple provisioning web service interface that street light customers can use for device provisioning and other related purposes. PAPI is used through the central management software (CMS) or work order management system (WOMS) to notify Silver Spring of field work completion at each street light location, and new or changed information can be identified at that time.

TALQ Bridge and PAPI are included in Silver Spring Street Light Adapter software.

Figure 6 shows dependencies for the Smart Street Lighting solution.

Figure 6. Smart Street Lighting dependencies



2 Silver Spring Software Products

This chapter describes Silver Spring software products. These products include enterprise class Software As a Service (SaaS) suites such as UtilityIQ and GridScape, shared services components and applications outside of the UtilityIQ suite, field tools used to test and configure deployed devices such as meters, and diagnostic tools such as those used in meter shops.

Except for GridScape, information about requirements and compatibility for the software described in this chapter is provided in *Requirements and Compatibility Matrix for UtilityIQ* documentation. For GridScape, this information is provided in *Requirements and Compatibility Matrix for GridScape* documentation.

- [UtilityIQ Suite for the AMI and DR Solutions](#) on page 16
- [GridScape for the DA Solution](#) on page 26
- [UtilOS for All Solutions](#) on page 28
- [Security-Related Components for All Solutions](#) on page 28
- [Shared Services Components for All Solutions](#) on page 31
- [CustomerIQ](#) on page 34
- [SSNAgent](#) on page 35
- [Field Tools](#) on page 36

UtilityIQ Suite for the AMI and DR Solutions

The UtilityIQ suite of software products forms the foundation for the AMI and DR solutions (see [Advanced Metering Infrastructure Solution](#) on page 8 and [Demand Response Solution](#) on page 10) and includes the following products:

- [UtilityIQ Advanced Metering Manager](#) on page 17
- [UtilityIQ Demand Optimizer](#) on page 18
- [UtilityIQ Firmware Upgrader](#) on page 19
- [UtilityIQ HAN Communications Manager](#) on page 20
- [UtilityIQ Meter Program Configurator](#) on page 23
- [UtilityIQ Network Element Manager](#) on page 23
- [UtilityIQ Outage Detection System](#) on page 24
- [UtilityIQ Power Monitor](#) on page 25
- [UtilityIQ Voltage Optimizer](#) on page 26

UtilityIQ Advanced Metering Manager

Advanced Metering Manager (AMM) is the base platform on which other UtilityIQ products and components are built, and is the Silver Spring flagship software product. AMM functions allow you to do the following:

- Read utility usage data from electricity, water, and gas endpoints using configurable, automated metering schedules
- Monitor daily data collections
- View upcoming and completed metering schedules
- Configure RSM schedules for remote disconnects and re-connects
- Approve meter programs prior to accepting collected data
- Report on data collection and security
- Manage assets in the field
- Troubleshoot unread meters

AMM is integrated with mission-critical external applications—including but not limited to meter data management and billing systems—through automated XML data exports and programmatic web services.

AMM requires the following Silver Spring products:

- AMM WS-Route
- CAAS
- DMS
- ESB Server
- Meter plugins
- Mule ESB
- Registrar
- SSN Services
- Trap Forwarder
- Trap Router

the following third-party products:

- Apache Tomcat
- Oracle 11g database
- Oracle JDK
- Red Hat Enterprise Linux
- TIBCO EMS and conf files, which you obtain from Silver Spring

and SSL certificates for AMM Middle Tier and GMR, and PKI key material in a keystore or in KeySafe.

AMM is also compatible with COP for AMI, Demand Optimizer, DLCA, FWU, FSU-SAM, HCM, JMS Bridge, KeySafe, MPC, NEC, NEM, ODS, Power Monitor, and SSNAgent.

AMM WS-Route

AMM WS-Route is a Silver Spring ESB application installed on ESB Server that is the basic AMM Web services routing application. ESB Server is discussed in [Mule ESB and ESB Server](#) on page 32.

AMM WS-Route requires AMM and all products required to run AMM and an SSL certificate.

Global Meter Reader

The Global Meter Reader (GMR) component of AMM manages meter reading jobs, ping jobs, meter program processing, and the generation of XML and HHF export files. For large deployments (those exceeding 2 million endpoints) multiple GMR instances can be installed on multiple servers. Multiple GMR instances balance meter reading loads and improve performance.

C12.19 Electricity Meter Plug-ins

AMM supports ANSI C12.19 electricity meters through Java plugins. A plugin is an easily installed software component that adds a specific set of functions to a larger software application.

Silver Spring provides one plugin for each C12.19 meter manufacturer. Each plugin, therefore, can support more than one meter. For example, the General Electric plugin supports both I-210+c and kV2c meters.

Meter plugins require that you install AMM.

UtilityIQ Demand Optimizer

Demand Optimizer is a full-featured DRMS that can act as a UtilityIQ head-end application for creating and managing utility DR programs, forecasting load and load shedding potential, and providing actionable analytics following events with information about load shed and customer participation. Demand Optimizer also incorporates advanced capabilities for managing large ecosystems of HAN devices, OpenADR devices, and building management systems over multiple networks (such as AMI, broadband, and cellular).

Figure 8 shows how Demand Optimizer integrates with HCM and other Silver Spring applications and services.

Figure 7. Demand Optimizer integration in the Silver Spring mesh network



Demand Optimizer uses web services to communicate with other Silver Spring applications, such as HCM and AMM. These web services are routed through SSNAgent, so you need SSNAgent installed to use this functionality.

In addition to products discussed elsewhere in this section, Demand Optimizer is compatible with CAAS, DMS, FWU, NEC, and Trap Receiver.

UtilityIQ Firmware Upgrader

Firmware Upgrader (FWU) performs audits and upgrades for UtilOS on NICs and Gas IMUs, and meter firmware on third-party electricity meters.

Audits can be run as network jobs that query a set of devices in the mesh network for their currently running version of UtilOS (for Silver Spring NICs) or meter firmware (for meters). Queries include a specific UtilOS or meter firmware version number. Each device responds to the audit query indicating a version match or mismatch. When configuring an audit job, you can optionally generate an upgrade list for all those devices that indicated mismatches.

Upgrades consist of a firmware image, the *upgrade list* (all devices to be upgraded), configuration options, and tracking data. The upgrade list is based on a dynamic or static device group, imported MAC addresses, or devices that indicated mismatches during an audit job.

FWU requires AMM and all products required to run AMM, an SSL certificate, and PKI key material in a keystore or in KeySafe, and is compatible with Demand Optimizer, HCM, KeySafe, and Power Monitor.

UtilOS Upgrades on Silver Spring NICs

For UtilOS firmware on Silver Spring NICs, the upgrade procedure includes a *code push*, where a server pushes a NIC firmware *image* (an executable file) to a relatively few *seed* NICs. After the code push, UtilOS upgrades also include a *code float*, where all non-seed NICs acquire the image from any directly neighboring NIC (one that can be reached without going through any intervening hops) that has it.

UtilOS Upgrades on Silver Spring Gas IMUs

Unlike other Silver Spring devices, Gas IMUs rely entirely on battery power. All Gas IMU functionality must therefore be designed to minimize battery usage.

To minimize battery usage on the Gas IMU, FWU loads UtilOS images onto continuously powered devices (CPDs) that act as proxies for Gas IMUs. Used in the context of Gas IMUs, a CPD can be an electricity meter, an AP, a Relay, or a Bridge, all of which are powered up on a continuous basis. UtilOS on the Gas IMU transfers its data to the CPD, checks the CPD's persistent memory for new UtilOS images and, if present, downloads the image and performs the upgrade locally.

Firmware Upgrades on Electricity Meters

For meter firmware, each upgrade is a code push or point-to-point transfer, meaning that the FWU server pushes the meter firmware image to each individual meter. A code float is not possible for meter firmware upgrades as it is for NIC firmware upgrades.

UtilityIQ HAN Communications Manager

HAN Communications Manager (HCM) enables utilities to create and manage DR programs. A DR program is a contract between a customer and a utility company under which customers can elect to participate in or opt out of DR events that the company sends out during critical peak periods.

Note: HCM functionality was previously provided by UtilityIQ Demand Response Manager (DRM).

HCM enables utility companies to do the following:

- Create and manage DR programs
- Enroll customers in DR programs
- Associate rate plans with customers
- Create and manage DR events
- Provision and diagnose issues with HAN devices in customer locations, so they can participate in DR events
- Analyze results and impacts of DR events

In a typical scenario, HCM sends DR events during critical peak periods. These messages route through the mesh NAN in the same way that AMM sends requests for metering data. However, the destination of the message extends beyond the Communications Module. The message is relayed over the 2.4 GHz radio on the Communications Module to the HAN inside the home. The event message displays on the In-Home Display (IHD) or similar device, where the utility customer can read it.

As [Figure 8](#) shows, HCM functionality depends on several other components and services:

- HCM can receive HAN device installation data from the Installer Portal by installer personnel in the field for provisioning through web services. For more details about Installer Portal, see [Installer Portal](#) on page 38. For information about HCM web services, see the *UtilityIQ HAN Communications Manager Integration Guide*.
- HCM single sign-on and customer authentication is provided through a CAAS deployment. Interactions between HCM and CAAS use HTTPS. For more details about CAAS, see [Central Authentication and Authorization Service](#) on page 32.
- Device Management Service (DMS) is a component that is used for sharing information between applications. The central repository of critical device data, DMS enables deployment of non-metering applications without having to rely on the AMM database. For more details about DMS, see [Device Management Service](#) on page 32.

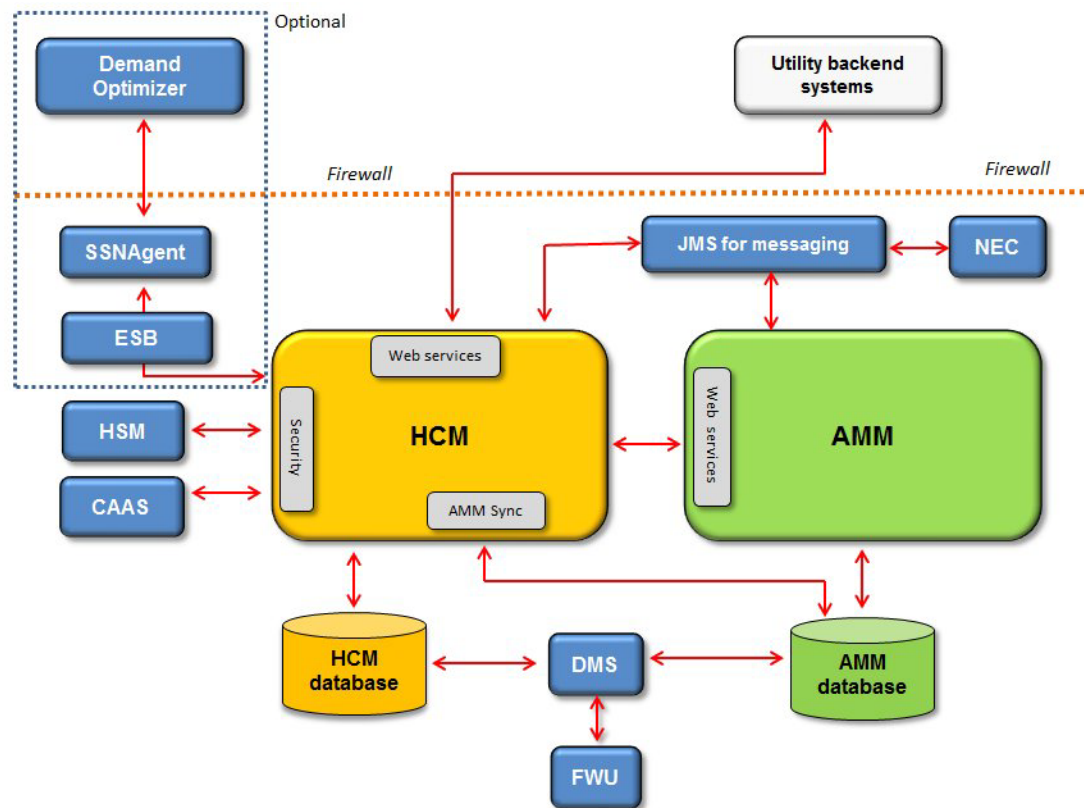
Advanced Metering Manager (AMM) maintains its own database but copies Energy Services Interface (ESI) location information to DMS for use by other applications—such as Firmware Upgrader (FWU)—through DMS. In addition, HCM is configured to copy ESI, NIC, and Service Point information directly from the AMM database for meter NICs managed by AMM. For more details about AMM, see [UtilityIQ Advanced Metering Manager](#) on page 17.

Note: HCM also can import location, devices, and customer data through data import files. For information about importing data into HCM, see the *UtilityIQ HAN Communications Manager User Guide*.

- Critical operations can be protected using demand response Critical Operations Protector (COP for DR), which is administered through hardware security modules (HSMs). For more details about COP for DR, see [Critical Operations Protector for AMI and DR](#) on page 29.
- AMM Sync enables HCM to read NIC and Service Point-related data from AMM for NICs that function as ESIs for ZigBee HAN devices managed by HCM.
- Firmware Upgrader (FWU) integration with HCM allows upgrading of DtG LCS devices and ZigBee HAN devices. DMS pulls relevant data from the HCM and AMM databases on a regular basis, and FWU is able to use this DMS data to upgrade the firmware on DtG LCS and ZigBee HAN devices. For more details about FWU, see [UtilityIQ Firmware Upgrader](#) on page 19.
- NIC Event Collector (NEC) is a centralized NIC and application event collection and repository for Silver Spring and third-party applications. NEC reads new events from NICs and LCS devices at a scheduled interval or on demand and sends them to applications through a JMS queue. For more details about NEC, see [NIC Event Collector](#) on page 33.
- SSNAgent and enterprise service bus (ESB) applications are included with HCM for customers who need to communicate with Silver Spring applications inside the firewall. SSNAgent clients are applications such as Demand Optimizer that face the utility's customers, installers, and other users. Silver Spring provides a packaged version of a third-party product called Mule ESB. ESB is an external integration layer for UtilityIQ that provides web service routing and extended services and APIs. It is required for

SSNAgent. The ESB Server is an installation and configuration wrapper for Mule ESB. For more details about SSNAgent, see [SSNAgent](#) on page 35. For more details about Demand Optimizer, see [UtilityIQ Demand Optimizer](#) on page 18. For more details about ESB applications used in the Silver Spring environment, see [Mule ESB and ESB Server](#) on page 32.

Figure 8. HCM and UtilityIQ integration in the Silver Spring mesh network



HCM requires that participating customer locations are equipped with HAN supported devices, such as In-Home Displays (IHDs), and that the associated electricity meter Communications Modules are enabled for the HAN.

HCM requires the following Silver Spring products:

- CAAS
- DMS
- FWU
- NEC
- Registrar
- Trap Forwarder

the following third-party products:

- Apache Tomcat
- Oracle 11g database

- Oracle JDK
- Red Hat Enterprise Linux
- TIBCO EMS and conf files, which you obtain from Silver Spring

and an SSL certificate, and PKI key material in a keystore or in KeySafe.

In addition to products discussed elsewhere in this section, HCM is also compatible with AMM, COP for DR, Demand Optimizer, DMS, FSU-SAM, FWU, KeySafe, NEC, Power Monitor, SSNAgent, Trap Forwarder, and Trap Router.

UtilityIQ Meter Program Configurator

Meter Program Configurator (MPC) enables wireless, remote audits and upgrades of meter programs. Specifically, it performs the following functions:

- Audits and upgrades of American National Standards Institute (ANSI) C12.19 electricity meter programs. Meter programs are provided by the meter manufacturers.
- Audits and upgrades of International Electrotechnical Commission (IEC) electricity meter tariffs provided by the meter manufacturer.
- Audits, configuration, and upgrades of GMI electricity meter programs. GMI programs can be saved to disk, transferred, and used in future upgrades.

Note: Configurable program attributes include channels, registers, and interval widths.

- Configuration and upgrades of Silver Spring Gas IMU programs. Gas IMU programs are very similar to electricity meter programs but reflect the limited functionality of Gas IMUs.

Audits are network jobs that query meters for their currently running meter program. The query includes a specific meter program identifier. Each meter responds to the audit query indicating an identifier match or mismatch. When configuring an audit job, you can optionally generate an upgrade list for all those devices that respond with mismatches.

An upgrade consists of a the meter program, the *upgrade list* (all meters to be upgraded), configuration options, and tracking data. The upgrade list is based on a dynamic or static device group, imported MAC addresses, or devices that indicated negative results in an audit job.

MPC employs the *code push* or *point-to-point* method to deploy programs to meters. MPC sends the program individually to each meter in the upgrade list. However, meter programs are fairly small (less than 10 KB), and MPC can update many meters simultaneously by sending the program out in parallel across multiple APs.

MPC requires AMM and all products required to run AMM, an SSL certificate, and PKI key material in a keystore or in KeySafe, and is compatible with COP for AMI and KeySafe.

UtilityIQ Network Element Manager

Network Element Manager (NEM) provides advanced network management capabilities based on industry standards, including:

- Fault management to detect problems, alert operators, and provide tools to identify the root cause

- Performance management to measure performance characteristics and, if necessary, alert operators

NEM requires AMM and all products required to run AMM, an SSL certificate, and PKI key material in a keystore or in KeySafe for nmsui and nmsspoller, and is compatible with KeySafe.

Fault Management

NEM provides fault management through asynchronous notifications to alert operators of potential issues at a remote node without waiting for a polling schedule to request status.

NEM receives notifications, including electricity meter last gasps, forwarded by neighbor nodes acting as proxies for the node emitting the last gasp. When an electricity meter loses power, its Communications Module can emit a last gasp message. Neighbor nodes forward all last gasps they receive.

NEM compares performance and capacity metrics against baseline and operational thresholds. Performance metrics that violate thresholds generate events or alerts that can be configured to be sent to Syslog, JMS Export, or SNMP Trap.

Performance Management

NEM enables utilities to monitor the performance of all field-deployed devices such as the following:

- Periodically poll performance and capacity related metrics
- Configure performance baselines
- View time-aligned data across all devices for aggregate performance evaluation

NEM provides several performance metrics, including but not limited to:

- Device metrics such as uptime, boot count, memory, and CPU usage
- Interface metrics, including interface status, bytes in and out, packets in and out, input errors, and transmit retries
- Protocol metrics such as routing protocol activity and errors, neighbor tables, and neighbor stability
- Availability metrics such as ping response and round trip times

UtilityIQ Outage Detection System

Outage Detection System (ODS) is a Silver Spring application that manages outage-related messages from electricity meters, including last gasp and power restoration messages. Unlike an outage management system (OMS), ODS does not include a work order management system.

ODS enables utilities to do the following:

- Configure the duration to distinguish momentaries from sustained outages
- Automatically identify and monitor outages and restorations
- Display maps showing sustained, momentary, or restored meters
- Display notifications sent to an integrated outage management system (OMS)

ODS reads power fail and power restore *trap* (asynchronous event) data from the AMM database. Users can then manage this data in the ODS user interface.

ODS can integrate with an OMS through JMS and web services.

ODS requires AMM and all products required to run AMM, an SSL certificate, and PKI key material in a keystore or in KeySafe, and is compatible with KeySafe.

UtilityIQ Power Monitor

Power Monitor is an application that provides real-time alerts for voltage sags and swells on monitored endpoints.

Power Monitor provides the following features:

- Grid-side energy efficiency applications such as Volt-VAR Optimization (VVO) and Conservation Voltage Reduction (CVR). VVO and CVR are techniques for reducing the amount of energy waste or overprovisioning on the distribution grid.
- Power Quality Monitoring (PQM), to monitor sags and swells in real-time and take action before they result in power quality violations or equipment overload.

To enable monitored endpoints, utilities create voltage profiles. A voltage profile establishes high and low thresholds for line voltage that, if violated, sends a trap to AMM that is forwarded through JMS to external applications, including voltage optimization systems.

Utilities can create one or more voltage profiles, but at least one profile is used specifically for end-of-line meters, which are the most likely candidates to fall below preset thresholds.

Once voltage profiles are created, utilities can assign these to multiple electricity meters included in the Silver Spring mesh network, but each meter can have only one profile applied at a time. However, single voltage profile can be assigned to multiple meters.

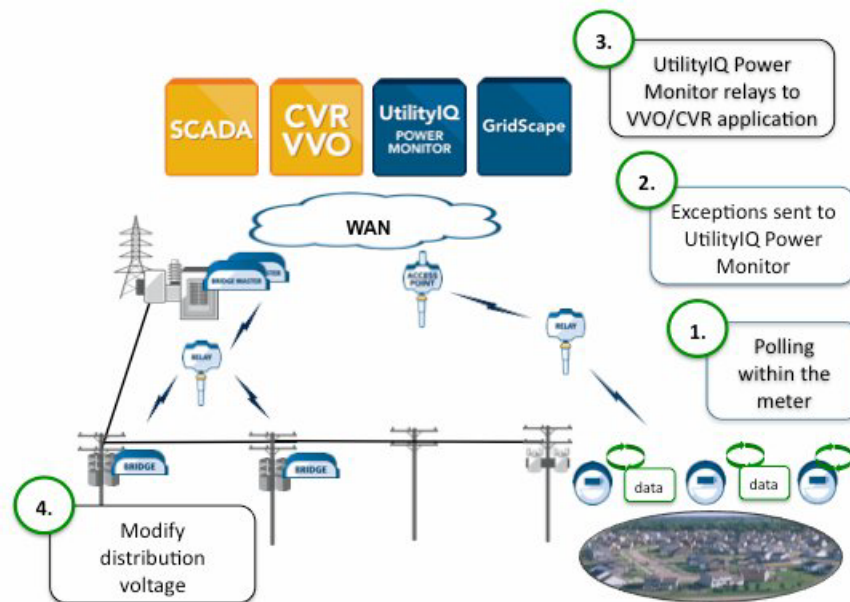
After meters are provisioned with voltage profiles, violations of the voltage thresholds set in the profile generate traps that the Communications Module sends immediately to Power Monitor. In turn, Power Monitor forwards messages to JMS, which can then integrate with voltage optimization applications.

AMM can be configured to perform scheduled voltage reads—for example, every four hours. Electricity meters can be configured to capture voltage readings at each interval, typically every 15 or 60 minutes. In contrast, once a meter's Communications Module receives a voltage profile from Power Monitor, it can monitor sags and swells as frequently as every five seconds with no network overhead. If sag/swell thresholds are violated, the trap is sent immediately without waiting for the next scheduled voltage read, and with little or no network overhead.

You can use Power Monitor with Voltage Optimizer to create a holistic understanding of voltage levels throughout the distribution network. A third-party product (EDGE from Dominion Voltage Inc.) then analyzes that data, looking for areas where it can tune DA device settings to optimize voltage levels.

Figure 9 shows how Power Monitor integrates with other Silver Spring applications and services.

Figure 9. Power Monitor functionality in the Silver Spring mesh network



Power Monitor requires AMM and all products required to run AMM, SSN Services, an SSL certificate, and PKI key material in a keystore or in KeySafe, and is compatible with FWU, HCM, and KeySafe.

UtilityIQ Voltage Optimizer

Voltage Optimizer provides utilities with a turnkey solution for maximizing voltage savings based on sophisticated EPRI-validated methods while maintaining compliance with regulatory settings. The software combines voltage alerts, polling, and sophisticated algorithms to provide up-to-date voltage optimization.

The solution leverages real-time alerts from Power Monitor and polled data from AMM to create a holistic understanding of voltage levels throughout the distribution network. A third-party product (EDGE from Dominion Voltage Inc.) then analyzes that data, looking for areas where it can tune DA device settings to optimize voltage levels.

Voltage Optimizer requires AMM and all products required to run AMM, and Power Monitor.

GridScape for the DA Solution

GridScape is a web-based network management application that operates from a utility's back-office to enable remote, secure configuration and management of Silver Spring-based DA communication networks. GridScape works as the management layer of the DA communication network, which consists of Silver Spring radio frequency (RF) devices such as master Bridges and remote Bridges connected to remote terminal units (RTUs) and intelligent electronic devices (IEDs), as well as APs and Relays.

GridScape communicates over the WAN through APs in much the same way as AMM or HCM. However, unlike these other applications, GridScape communicates with Bridges that connect to remote devices typically found in substations. GridScape also runs network jobs that audit and analyze these devices for faults and security events.

[Figure 20](#) on page 46 shows how GridScape functions with Bridges in the Silver Spring mesh network.

GridScape requires the following Silver Spring products:

- CAAS
- DMS
- Registrar
- Trap Receiver

the following third-party products:

- Apache Tomcat
- Greenplum and binaries
- Oracle 11g database
- Oracle JDK
- Red Hat Enterprise Linux
- TIBCO EMS and conf files, which you obtain from Silver Spring

and SSL certificates for GridScape, TIBCO EMS, and CAAS, and PKI key material in a keystore.

GridScape is also compatible with DLCA and KeySafe.

For more requirements and compatibility information, see *Requirements and Compatibility Matrix for GridScape*.

Bridge Configurator, which is a tool used for creating DA networks of Bridges and RTUs, is discussed in [Bridge Configurator](#) on page 36.

Smart Street Lighting Solution Software

Silver Spring provides the following software products to support its Smart Street Lighting solution:

- Street Light Adapter, which provides an interface between the central management software (CMS) used for controlling street lights and AMM.

Street Light Adapter requires TALQ Bridge, AMM, PAPI, and an SSL certificate for TALQ Bridge

- Streetlight.Vision, which is the Silver Spring CMS product.

For more details, see [Smart Street Lighting Solution](#) on page 14.

UtilOS for All Solutions

UtilOS is the firmware operating system for Silver Spring NICs, and provides the following functions and features:

- NAN mesh networking logic
- Security
- Time management
- Communications interface to the electricity meter, including:
 - Generic Meter Interface (GMI)
 - RSM for electricity meters that support Remote Disconnect (or Service Disconnect) and LCS devices

GMI

GMI provides the metering interface to electricity meters operating in energy-only mode and Gas IMUs. GMI provides the following features:

- Load profile metering for energy-only electricity meters and Gas IMUs
- Management of meter data stored on the Communications Module including:
 - Data logs
 - Event logs

For ANSI C12.19-compliant electricity meters, GMI reads data from standard tables (ST) and stores the data in appropriate structures. For energy-only electricity meters and Gas IMUs, GMI provides many of the same functions as C12.19 meters by recording much of the same data in its logs.

Security-Related Components for All Solutions

End-to-end security is critical to utilities, and security is built into all Silver Spring products. The components discussed in this section are optional and can be added to existing deployments to provide additional security or to comply with certifications programs such as North American Electric Reliability Corporation-Critical Infrastructure Protection (NERC-CIP). Silver Spring security-related components include the following:

- [Certificate Authority Tools](#) on page 28
- [Critical Operations Protector for AMI and DR](#) on page 29
- [Driver's License Certificate Authority](#) on page 29
- [Field Service Unit-Secure Access Manager](#) on page 29
- [KeySafe](#) on page 30

Certificate Authority Tools

Certificate Authority Tools (CA Tools) is a suite of tools that allow Silver Spring Operations to perform the following Network Operator tasks within the Silver Spring Networks public key infrastructure (PKI) hierarchy, and which provides the following features:

- Certificate monitoring, auditing, and renewal
- Certificate debugging
- Utility Operator certificate requests to the Silver Spring Networks root
- Key material generation for private keys and certificates for entities under the Operator certificate
- Import of key material external to the hardware security module (HSM), such as an Operator certificate file or a keystore file, to an HSM slot
- Administration of HSM-based databases of public and private keys used by Silver Spring back-office applications to communicate securely with NICs in the field
- Certificate revocation list (CRL) generation

CA Tools requires Oracle JDK, Red Hat Enterprise Linux, and the Windows OS, and is compatible with KeySafe.

Critical Operations Protector for AMI and DR

Critical Operations Protector (COP) consists of both Silver Spring firmware and a command line interface that are added to an HSM supplied by a third-party vendor.

Critical Operations Protector (COP) is available as COP for AMI and COP for DR:

- **COP for AMI**—Restricts the rate at which potentially grid-destabilizing critical commands, such as remote disconnects or connects, can be issued through AMM to meters in the mesh network.
- **COP for DR**—Restricts the rate of load shed that can be scheduled for subscribing devices managed by HCM through issuance or restriction of permits signed by a key in the HSM. Each permit corresponds to a certain load.

COP for AMI requires KeySafe and Oracle JDK, and is compatible with AMM, CA Tools, DLCA, and MPC.

COP for DR requires CA Tools, HCM, KeySafe, and Oracle JDK, and is compatible with the COP for AMI CLI and DLCA.

Driver's License Certificate Authority

Drivers License Certificate Authority (DLCA) is a Certificate Authority that issues and signs a certificate (called a Driver's License) to allow a field device to become a fully operational member of a utility network.

DLCA is a requirement for supporting link layer (or Layer 2) security. Link layer security protects a wireless network by denying access to the network before a device is successfully authenticated and authorized.

DLCA requires Oracle JDK and PKI key material in a keystore or in KeySafe, and is compatible with AMM, COP for AMI, and COP for DR.

Field Service Unit-Secure Access Manager

FSU-Secure Access Manager (FSU-SAM), enables an administrator to limit the number of secure maintenance links each Field Service Unit (FSU) can establish with the NIC of a targeted endpoint within a configured duration.

These secure maintenance links allow critical commands, such as remote disconnects, to be issued from an FSU in the field to the meter firmware securely. This capability protects the FSU from misuse and protects the network from sabotage.

The FSU with smart card (FSU 2.1 and above) represents a significant security upgrade, with the FSU:

- Operating in a secure mode, in which it exchanges appropriate cryptographic certificates for authentication and authorization
- Establishing secure maintenance links for communications with these endpoints
- Limiting the number of secure maintenance links that can be established

FSU-SAM requires CAAS, Oracle JDK, an SSL certificate, PKI key material in a keystore or in KeySafe, the Oracle Java 1.7 plug-in for any browser running FSU-SAM, and is compatible with AMM, HCM, and KeySafe.

KeySafe

KeySafe is the key storage and management solution offered by Silver Spring for its data center applications. Its essential component is a third-party sourced HSM with special Silver Spring firmware that makes it “KeySafe.” Its protected memory stores private keys and certificates under the PKI Operator Certificate Authority (CA) hierarchy, which chains to the Silver Spring root.

In addition to the Operator private key and certificate, KeySafe also stores the following for the purpose of certificate signing requests of different types:

- Network Manager (NM) Entity used by UtilityIQ applications
- Broadcast CA used for secure broadcasts in the Australian market
- Driver's License CA (DLCA) used to support link-layer security
- FSU-CA used by FSU-SAM to contact meters in the field that are otherwise unreachable
- Privilege Manager CA used for network troubleshooting and remediation tasks, such as broadcasting certificate revocation list to meters

KeySafe provides the following cryptographic operations through secure access to private keys:

- Signing
- Encryption
- Decryption
- HMAC functions

KeySafe requires CA Tools and Oracle JDK, and is compatible with AMM, CA Tools, CertWeb, COP for AMI, COP for DR, DLCA, FSU-SAM, FWU, HCM, MPC, NEC, NEM, ODS, Power Monitor, and the Robot Tool Set.

Shared Services Components for All Solutions

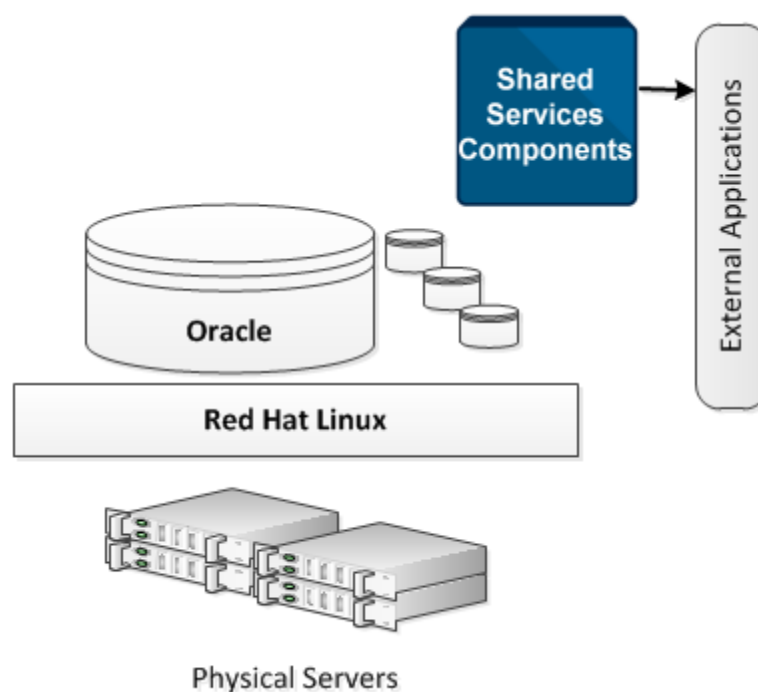
Shared services components constitute a common set of components required by application suites such as UtilityIQ and GridScape. It includes the following components:

- [Central Authentication and Authorization Service](#) on page 32
- [Device Management Service](#) on page 32
- [JMS Bridge](#) on page 32
- [Mule ESB and ESB Server](#) on page 32
- [NIC Event Collector](#) on page 33
- [Registrar](#) on page 33
- [SSN Services](#) on page 33
- [TIBCO EMS and TIBCO Configuration Files](#) on page 33
- [Trap Forwarder](#) on page 33
- [Trap Receiver](#) on page 34
- [Trap Router](#) on page 34

DLCA and FSU-SAM are also included in shared services components. DLCA is discussed in [Driver's License Certificate Authority](#) on page 29, and FSU-SAM is discussed in [Field Service Unit-Secure Access Manager](#) on page 29.

Figure 10 shows how shared services components are situated in a Silver Spring operating environment.

Figure 10. Shared services components in a Silver Spring operating environment



Central Authentication and Authorization Service

Central Authentication and Authorization Service (CAAS) supports single sign-on, and stores user credentials in a local database, an LDAP data store, or both, as needed by customers.

Users log into all applications and access application screens for which they have access privileges by means of a single, initial authentication of their credentials during a session.

If CAAS is deployed with LDAP, CAAS passes authentication requests from a client application to LDAP without visibility to the user. When LDAP group users log into a Silver Spring application, the CAAS Login page appears, and they are prompted to enter their LDAP group credentials to log in.

If a local CAAS database is in use, CAAS authenticates the entered username and password locally and authorizes access to applications and views based on the user role and privileges. After successful login to an application during a single session, users can access any other application they have privileges for without needing to present credentials again.

If CAAS is configured to run with an LDAP data store, CAAS sends the request for authentication to the LDAP data store. LDAP authenticates the credentials and authorizes use of views and privileges for those Silver Spring applications for which the user or LDAP group has access.

CAAS requires Oracle JDK and at least one of the following:

- AMM
- HCM

and an SSL certificate, and is compatible with Demand Optimizer, FSU-SAM, FWU, GridScape, HCM, MPC, NEM, ODS, and Power Monitor.

Device Management Service

Device Management Service (DMS) is a component of UtilityIQ used for sharing information between applications, such as AMM, HCM, and GridScape. DMS is the central repository and source of truth for critical device data, including device locations, and it enables deployment of non-metering applications without having to rely on the AMM database. This data is periodically and automatically synchronized to ensure that associated applications have accurate data.

DMS requires Oracle JDK and an SSL certificate, and is compatible with AMM, Demand Optimizer, FWU, GridScape, HCM, Power Monitor, and Registrar.

JMS Bridge

JMS Bridge is a stand-alone Java application that forwards messages from Silver Spring internal message queues to customer message queues.

JMS Bridge requires Oracle JDK and is compatible with AMM.

Mule ESB and ESB Server

Silver Spring provides a packaged version of a third-party product called Mule ESB. ESB is an external integration layer for UtilityIQ that provides web service routing and extended

services and APIs, and Mule ESB is required for AMM, Power Monitor, and SSNAgent. ESB Server is an installation and configuration wrapper for Mule ESB.

Mule ESB requires ESB Server and Oracle JDK, and is compatible with AMM, Power Monitor, SSNAgent, SSN Services, Trap Forwarder, and Trap Router.

ESB Server requires Mule ESB, Oracle JDK, and is compatible with AMM, Power Monitor, SSNAgent, SSN Services, Trap Forwarder, and Trap Router.

NIC Event Collector

NIC Event Collector (NEC) is a centralized NIC and application event collection and repository for Silver Spring and third-party applications. NEC reads new events from NICs and LCS devices at a scheduled interval or on demand and sends them to applications through a JMS queue.

NEC requires Oracle JDK, an SSL certificate, and PKI key material in a keystore or in KeySafe (for NEC version 1.0.5 or later), and is compatible with Demand Optimizer, HCM, and KeySafe (for NEC version 1.0.5 or later).

Registrar

Registrar is the Silver Spring implementation of a Dynamic Domain Name System (DDNS). Its primary purpose is to collect network registration and update notices from the NICs sent using the DDNS protocol and to serve look-up requests as specified by the DNS RFC (RFC1035). Its secondary purpose is to collect statistics of device activity and display those statistics through a Representational State Transfer (REST) web service interface.

Registrar requires Oracle JDK and is compatible with AMM, DMS, GridScape, and HCM.

SSN Services

SSN Services is a Silver Spring ESB application installed on ESB Server that helps with web services and is used by applications such as Advanced Metering Manager (AMM), Provisioning API (PAPI), and Power Monitor.

SSN Services requires ESB Server, Mule ESB, and an SSL certificate, and is compatible with AMM, Power Monitor, Street Light Adapter, Trap Forwarder, and Trap Router.

TIBCO EMS and TIBCO Configuration Files

TIBCO Enterprise Message Service™ (EMS) provides JMS functions for a number of Silver Spring applications. TIBCO EMS publishes messages to queues managed by other message services, such as JBoss, through a bridge.

TIBCO EMS and the associated configuration files are available from Silver Spring.

TIBCO EMS requires its associate configuration files and an SSL certificate, and is compatible with AMM, GridScape, and HCM.

Trap Forwarder

Trap Forwarder asynchronously captures, displays, and logs traps from network devices and allowing users to instantaneously view alert notifications from any network device that supports SNMP. The Trap Forwarder contains an NMR_Listener feature to capture and

forward all communication between applications and the neighborhood area network (NAN) through the Access Point (AP). Trap Forwarder was previously called Trap Receiver.

Trap Forwarder requires ESB Server, Mule ESB, SSN Services, and Trap Router, and is compatible with AMM, GridScape, HCM, ODS, Power Monitor, and Street Light Adapter.

Trap Receiver

Trap Receiver (now replaced by Trap Forwarder) processes traps (asynchronous events) and, depending on how it is configured, forwards them to various components. For example, when used with UtilityIQ, Trap Receiver forwards power loss traps to GMR. If ODS is installed, ODS also receives the traps and can be configured to forward them to the configured JMS, such as TIBCO EMS.

Trap Receiver process running on a Linux operating system is the NMR_listener daemon.

Trap Receiver requires Oracle JDK and is compatible with AMM, Demand Optimizer, GridScape, HCM, ODS, and Power Monitor.

Trap Router

Trap Router is a Silver Spring ESB application installed on ESB Server that is used by Trap Forwarder and enables routing configuration for traps.

Trap Router requires ESB Server, Mule ESB, SSN Services, Trap Forwarder, and an SSL certificate, and is compatible with AMM, Power Monitor, and Street Light Adapter.

CustomerIQ

CustomerIQ is the Silver Spring interactive online portal for utility company customers to help them monitor their energy usage, receive important rate and system alerts, compare their energy use with similar neighbors, and learn how they might reduce their energy use and save money through energy efficiency, more appropriate rate plans, and by shifting energy use to low-cost time periods.

HCM is related to [CustomerIQ](#), but HCM is intended for use by utility companies, and CustomerIQ is intended for utility company customers. However, you can use HCM and CustomerIQ together in your operations environment to optimize your overall energy management solution.

CustomerIQ is designed for use by residential, small and medium business (SMB), and Commercial & Industrial (C&I) customers. CustomerIQ Backroom Portal is the administration interface for CustomerIQ.

[Figure 11](#) shows how CustomerIQ integrates with other applications and services.

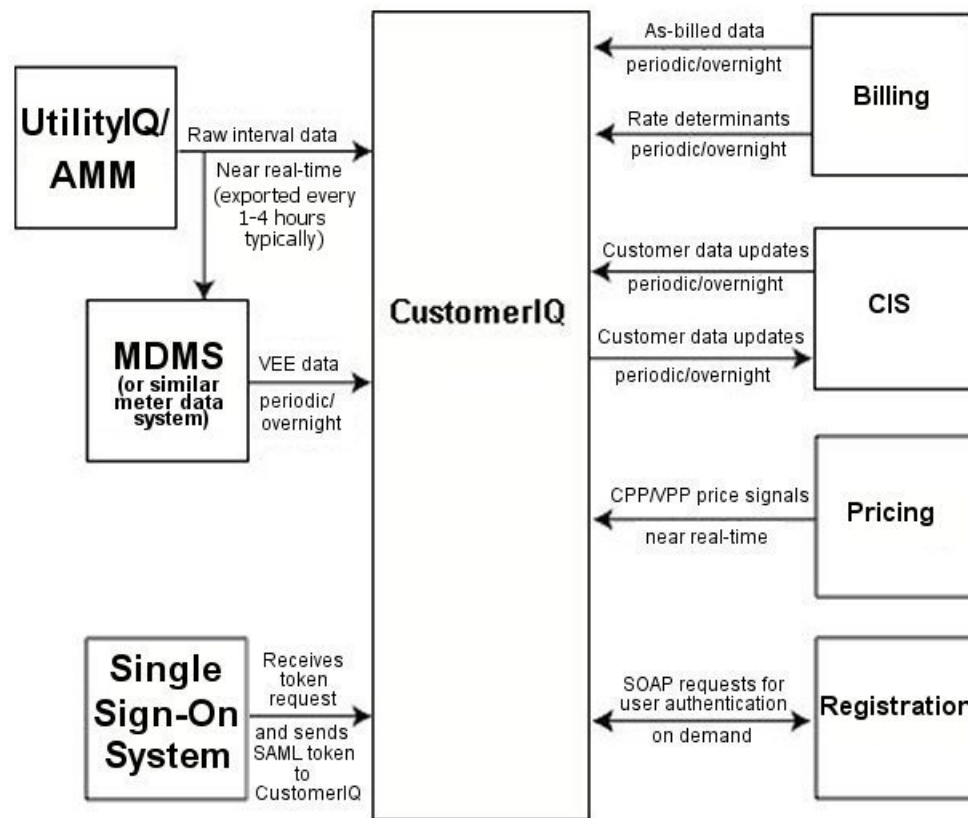
You can deploy CustomerIQ using one or both of the following interfaces:

- UtilityIQ- AMM to CustomerIQ
- MDMS to CustomerIQ

If you use UtilityIQ- AMM to CustomerIQ, the benefit is of more timely or near real-time data in CustomerIQ versus day-delayed data of option 2.

If you use MDMS to CustomerIQ, the benefit is that all historical data is available from MDMS system. The Data from MDMS is VEE corrected as well.

Figure 11. Typical Interface Architecture for CustomerIQ



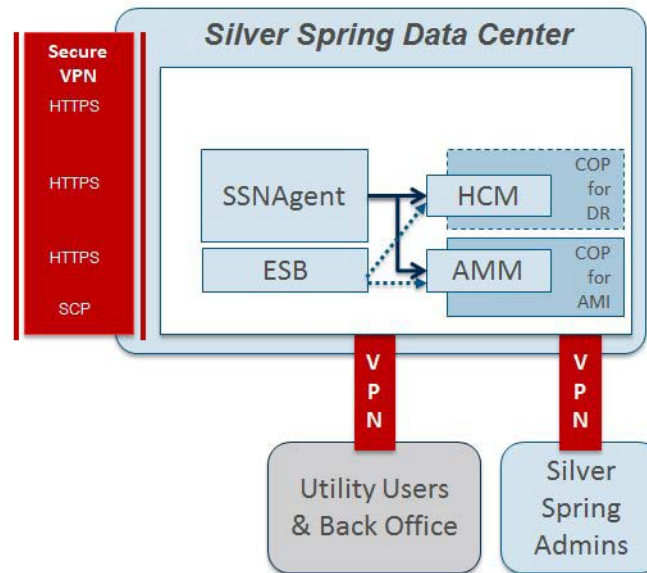
CustomerIQ is compatible with AMM.

SSNAgent

SSNAgent is a small application that runs as a daemon and provides a secure gateway to a subset of web services for UtilityIQ applications such as AMM and HCM from applications such as CustomerIQ and Demand Optimizer. For details about Mule ESB and ESB Server, see [Mule ESB and ESB Server](#) on page 32.

Figure 12 shows how SSNAgent integrates with other applications and services.

Figure 12. SSNAgent integration



SSNAgent requires ESB Server, Mule ESB, an SSL certificate, and is compatible with AMM, Demand Optimizer, and HCM.

Field Tools

Silver Spring field tools are applications used for testing, diagnostics, and configuration. These included the following:

- [Bridge Configurator](#) on page 36
- [Communications Module Utility](#) on page 37
- [Communications Tester for All Solutions](#) on page 37
- [Electricity Communications Module Tester](#) on page 37
- [Gas IMU Configurator](#) on page 37
- [HAN Test Kit](#) on page 38
- [IMU Accuracy Tester for the AMI Solution](#) on page 38
- [Installer Portal](#) on page 38
- [Load Control Configurator](#) on page 39

Bridge Configurator

Bridge Configurator is a PC-based application used in conjunction with the Silver Spring FSU that allows you to create DA networks of Bridges and RTUs. The Bridge Configurator interface guides you through a logical process of creating networks. Additionally, Bridge Configurator performs validation checks as you work through the process.

The network configuration feature simplifies the process of choosing a supported network topology and adding the appropriate mix of master and remote Bridges. At the device level, utilities can create a firewall on the individual devices—master and remote—in the network.

Communications Module Utility

Communications Module Utility (CMU) is a PC-based application used in conjunction with the Silver Spring FSU that reads meter data from Silver Spring enabled meters outside of AMM and uploads that data to AMM. CMU allows utilities to do the following:

- Read meters loaded into AMM but never registered on the network or meters that are unreachable on the Silver Spring mesh network
- Swap Communications Modules in meters
- Complete resets using demand reset functions

Communications Module Utility was formerly known as Contingency Reader.

Communications Module Utility is compatible with AMM.

Communications Tester for All Solutions

Communications Tester is a PC-based application used in conjunction with the Silver Spring FSU for field and lab testing of Silver Spring Communications Modules, Access Points, Relays, Bridges, and Gas IMUs. Communications Tester enables engineers and technicians to transmit and receive messages to and from these devices, log the data, and analyze the results. For example, operators can perform register reads, firmware upgrades, and they can read meter tables, check configuration options, collect radio frequency statistics data, and exercise other troubleshooting features. Communications Tester also supports user-created compound commands, session logging, and results export.

Electricity Communications Module Tester

Electricity Communications Module Tester (ECMT) is a PC-based application used in conjunction with the Silver Spring FSU for testing the operational status of electricity meters equipped with Communications Modules. Specifically, ECMT runs pre-defined test scripts to test electricity meters. When combined with any method of powering an electricity meter, such as a meter test board, ECMT enables utility company meter shops to conduct quality sample testing of inbound meters and to assess field returned meters.

Gas IMU Configurator

Gas IMU Configurator is a PC-based application used in conjunction with the Silver Spring FSU that automates gas meter reads and controls the basic functionality of Gas IMUs with Silver Spring RF wireless NICs installed.

The Gas IMU Configurator performs the following basic tasks and generates results files for each of them:

- Joins Gas IMUs to host meters
- Unjoins Gas IMUs from host meters
- Checks Gas IMU read operations

HAN Test Kit

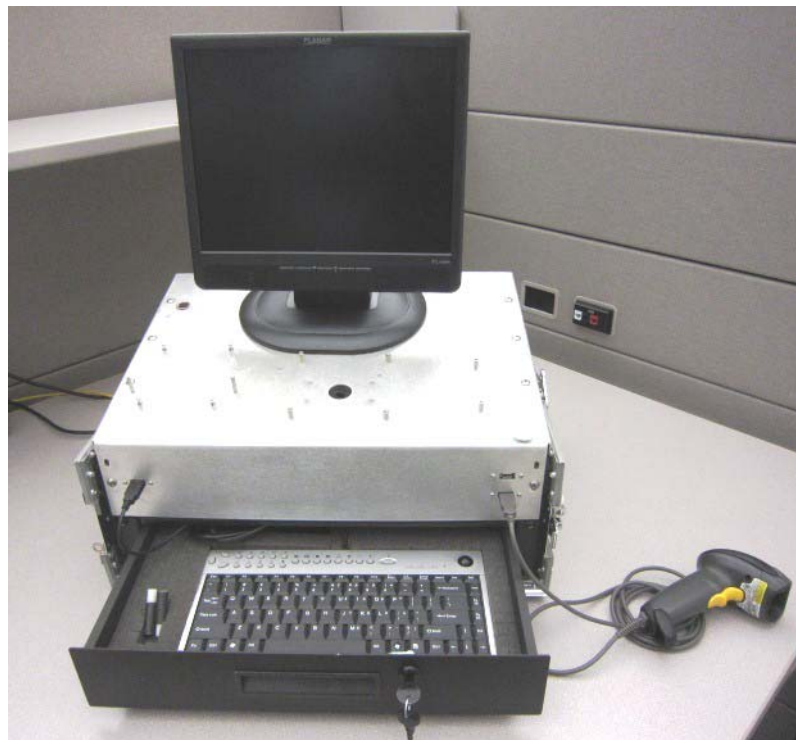
HAN Test Kit is a PC-based application used in conjunction with the Silver Spring FSU that enables HAN device vendors to test their HAN devices with Silver Spring equipment and the ZigBee Smart Energy Profile (SEP) implementation to confirm correct interoperation. The tests go beyond what the base ZigBee SEP standards specify, as ZigBee allows room for interpretation in a number of areas.

You can also upgrade HAN device firmware over the air with HAN Test Kit version 2.1 and later.

IMU Accuracy Tester for the AMI Solution

IMU Accuracy Tester is a PC-based application used in conjunction with the Silver Spring FSU (installed inside the IMU Accuracy Tester hardware) and is used for lab testing, partner OEM manufacturing, and in-field testing needs for testing and analyzing the metrology (counting accuracy), radio link, and event logging of Silver Spring residential and commercial Gas IMUs. Interchangeable adapter plates enable you to test the functionality of any supported Silver Spring residential or commercial Gas IMU.

Figure 13. IMU Accuracy Tester



Installer Portal

Installer Portal is a PC-based application used by field installers to provision HAN devices as one process for deploying HCM in utility operations environments. For information about the Installer Portal, see the *Installer Portal User and Troubleshooting Guide*.

Installer Portal is compatible with HCM.

Load Control Configurator

Load Control Configurator (LCC) is a PC-based application used in conjunction with the Silver Spring FSU that works with supported DtG LCS devices, and it is intended for verifying switch installation, configuration, upgrades, and field troubleshooting and repair.

3 Silver Spring Hardware Products

This chapter describes Silver Spring hardware products. These products are used throughout the network environment to support functionality provided by Silver Spring software, firmware, and end devices. Included in this chapter are the following:

- [Communications Modules and Network Interface Cards](#) on page 40
- [Access Point](#) on page 42
- [Relay](#) on page 43
- [Bridge](#) on page 44
- [Faulted Circuit Indicator](#) on page 46
- [Field Service Unit](#) on page 48
- [Gas Interface Management Units](#) on page 48
- [NIC Reminting Station](#) on page 50
- [Silver Spring Street Light Control Devices](#) on page 51
- [Silver Spring Support for Electricity Meters](#) on page 51
- [Silver Spring Support for Third-Party Gas and Water Modules](#) on page 52
- [Silver Spring Support for Third-Party Load Control Switches](#) on page 52

Communications Modules and Network Interface Cards

Silver Spring Communications Modules and Network Interface Cards (NICs) are installed in devices that need to communicate across the Silver Spring mesh network.

- Communications Modules are used in devices manufactured outside of Silver Spring (for example, electricity meters, LCS devices, and street light control devices).
- NICs are used in APs, Relays, and other devices manufactured by Silver Spring.

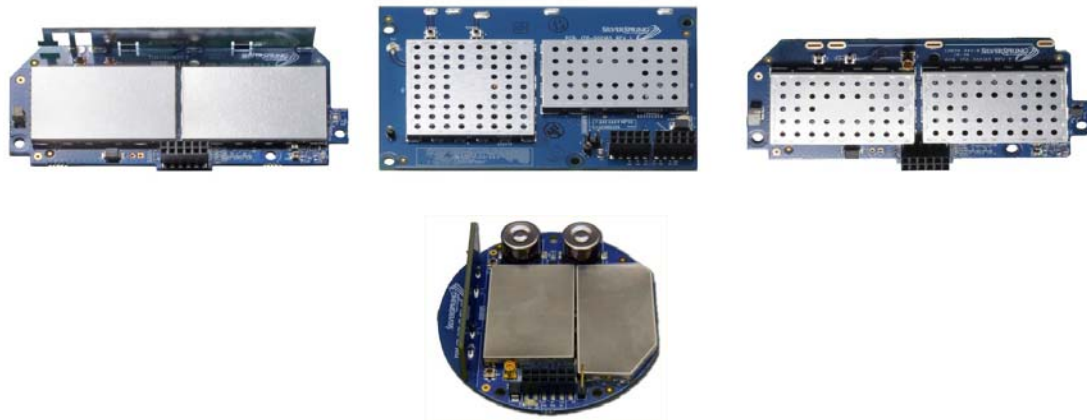
Installed in devices that support them, the Communications Module or NIC leverages Silver Spring network devices to form a mesh network for the utility, providing wireless networking back to the utility's back office and into the customer's premises.

Note: Where discussion in this document covers both Communications Modules and NICs, the term NIC is used.

All infrastructure devices use the same type of wireless Communications Module or NIC from Silver Spring, although the model or version can vary depending on the device. For

example, meter Communications Modules are rectangular while the Street Light Communications Module for photocells is round to best fit the space.

Figure 14. Silver Spring Communications Module and NIC designs



Communications Modules and NICs include the following wireless technologies:

- A 902–928 MHz—and 865–880 MHz for EU, Dubai, and other locations—communications interface. This interface is used in the mesh NAN environment.
- A 2.4 GHz communications interface that complies with the Institute of Electrical and Electronics Engineers (IEEE) 802.15.4 standard, and it is used in the HAN environment through the ZigBee protocol.
- A Generation 4 (Gen4) communications interface that provides cellular WAN connectivity directly to the data center. This is primarily used to provide connectivity for isolated endpoints.

MicroAP

The MicroAP™ is a Gen4 Communications Module that can be configured to act as a self-contained Access Point (AP). This is especially useful to connect isolated or hard-to-reach devices.

MicroAPs can simultaneously support cellular, HAN, and radio frequency (RF) mesh communications. The MicroAP is outfitted with a cellular modem and two radios—a 900 MHz NAN radio and a 2.4 GHz HAN radio. The MicroAP is designed for the edges of networks, hard to reach meters, high-rise buildings, and other specific use cases.

The MicroAP leverages cellular communications for backhaul connectivity and can use the Radio Frequency (RF) mesh communications to connect with other nearby Silver Spring devices using Silver Spring Micromesh technology.

A MicroAP supports a combination of 2G or 3G technologies, carriers, and RF mesh communications.

Each MicroAP can provide backhaul connectivity on behalf of up to 50 Silver Spring-enabled meters, connected in a Micromesh deployment.

Access Point

Access Points (APs) link endpoint devices with utility back-office systems, and they provide communications to and from NICs in the devices. APs transport information through multiple Silver Spring Relays, Bridges, or through Silver Spring-connected electricity meters. APs can communicate directly with endpoint devices when they are in range. For those endpoints that are out of range, an AP can communicate indirectly by using one or more Relays.

The connection between the UtilityIQ suite along with other Silver Spring applications and APs forms a WAN. Within the service area, APs serve as the apex of field-deployed endpoints and form NANs.

APs connect to Silver Spring applications through Code Division Multiple Access (CDMA, either 1xRTT or EV-DO), General Packet Radio Service (GPRS, EDGE), or Ethernet. This flexibility enables utilities to take advantage of existing infrastructures.

Figure 15. Access Point with backup battery



In Silver Spring DA communications networks, APs can also serve a variety of functions. If network traffic is not allowed to traverse through the master Bridge into the substation and utility network, then an AP can serve as the take-out point for the network traffic in a stand-alone DA communication network. You can use GridScape to manage APs and other devices in a DA communications network.

APs are available in cellular or Ethernet versions. AP 4.5 is used with Silver Spring Gen4 products, such as Bridge 4.0 and Relay 4.5. AP 1.5 is used with older products, such as Bridge 2.0 and Relay 1.5.

APs are engineered to withstand harsh weather, including wind, rain, snow, and temperature extremes.

Each AP performs the following functions:

- Routes all inbound network traffic from devices in the NAN to the UtilityIQ suite, including:
 - Usage data
 - Network performance metrics
 - Alarms
 - Last gasp and power restore messages
- Routes all outbound network traffic from the UtilityIQ suite to devices in the NAN including:
 - Scheduled and on-demand requests for metering data
 - Scheduled and on-demand network polling
 - Firmware updates
- Acts as the time server for all NAN devices

Relay

The Relay is a repeater device that extends the range of the network. RF signal strength can decrease between transmitter and receiver due to interference or obstructions such as foliage, buildings, and terrain. The Relay receives signals from other network devices, including APs, meters, Gas IMUs, other Relays, and Bridges, and retransmits signals at full strength.

Relays use essentially the same heavy duty enclosure as the AP and are engineered to withstand harsh weather. Like APs, Relay 4.5 is used with Silver Spring Gen4 products, such as Bridge 4.0 and Relay 4.5. Relay 1.5 is used with Bridge 2.0 and AP 1.5.

Figure 16. Relay with backup battery



Bridge

The Silver Spring Bridge family—consisting of Bridge 4.0, eBridge 2.0, and sBridge 2.0—provide high-performance, reliable, and secure DNP3 protocol functionality. The RF interface connects all Bridges together in a mesh RF wireless network for DA communications. You can manage the Bridge in AMM just as you would any other supported device. In DA, you can use GridScape to configure and manage Bridges.

Bridges are designed to perform one of two roles: *master* or *remote*. Master Bridges provide the connection or take-out point for remote Bridges to the SCADA system. Remote Bridges connect to RTUs to provide connectivity to the master.

Bridge 4.0 has one Ethernet and two serial ports; eBridge 2.0 has one Ethernet and one serial port. This enables both to perform as either a master Bridge or remote Bridge. However, sBridge 2.0 has two serial ports but no Ethernet port, so it can perform only as a remote Bridge.

For Bridge 4.0: The master Bridge Ethernet port typically connects to the network leading to the back office or the electrical substation SCADA system. Remote Bridges can use their Ethernet port to connect to one or more RTUs. Serial ports can be used for RTU connections or for raw data connections.

For sBridge: Serial port 1 is designated as a remote communication port, allowing Telnet access to the RTU's serial network management or craft port. Serial port 2 connects to the RTU and passes DNP3/IP traffic.

Figure 17 illustrates the front and back of Bridge 4.0.

Figure 17. Bridge 4.0 front and back panels

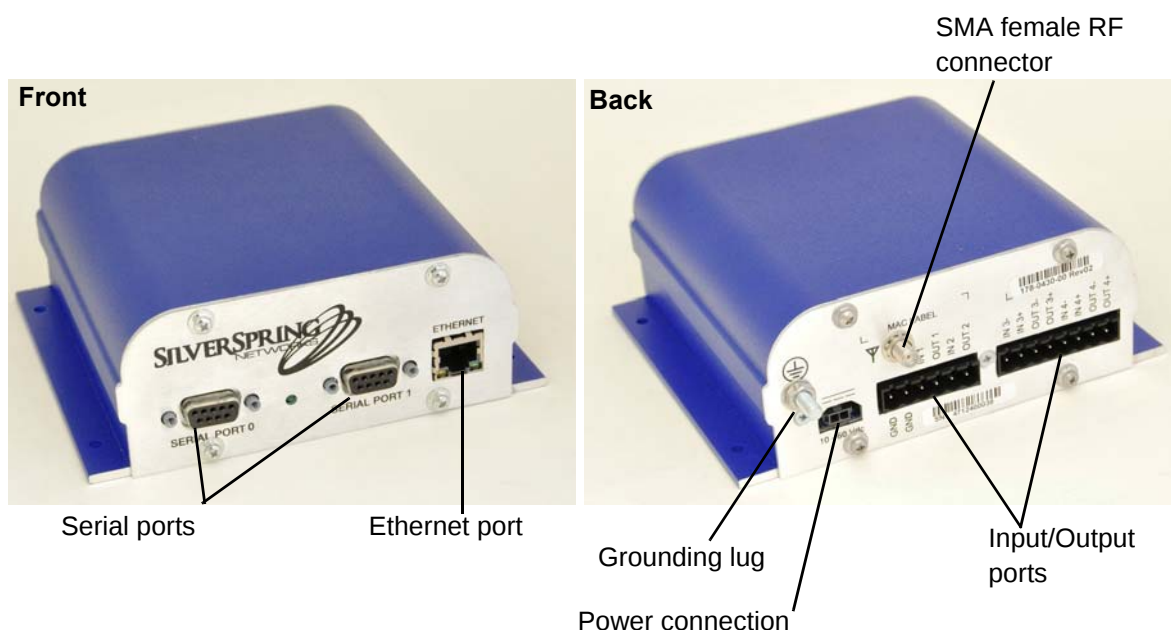


Figure 18 illustrates the front and back of the sBridge.

Figure 18. eBridge 2.0 front and back panels

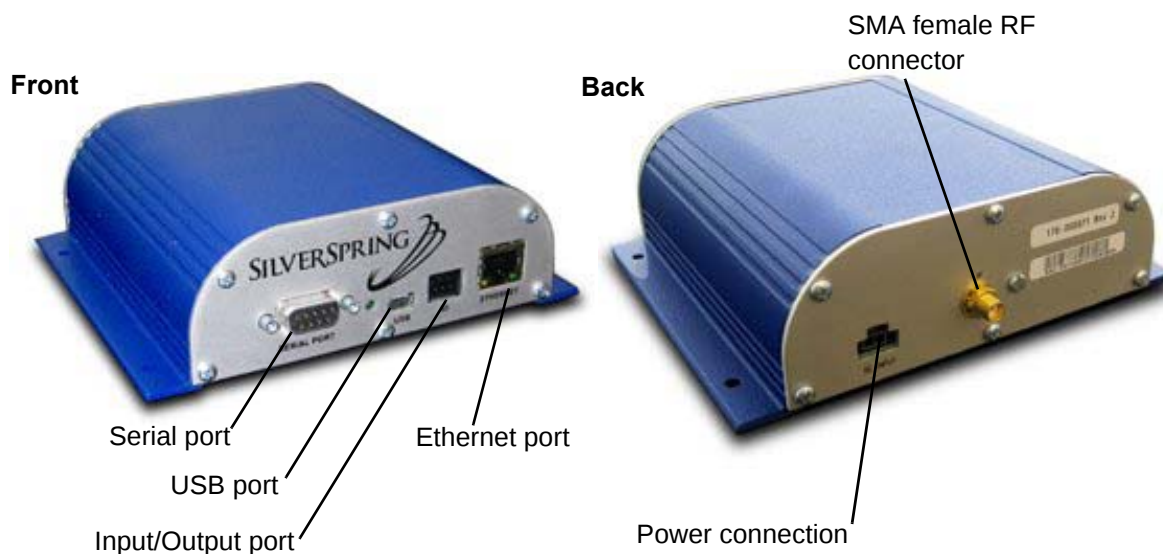


Figure 19 illustrates the front and back of the sBridge.

Figure 19. sBridge front and back panels

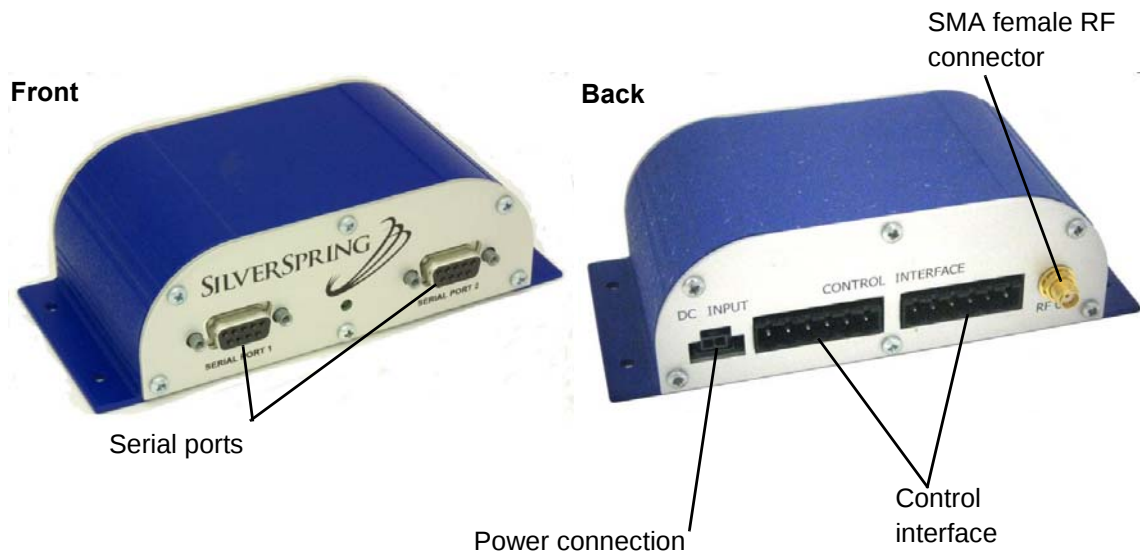
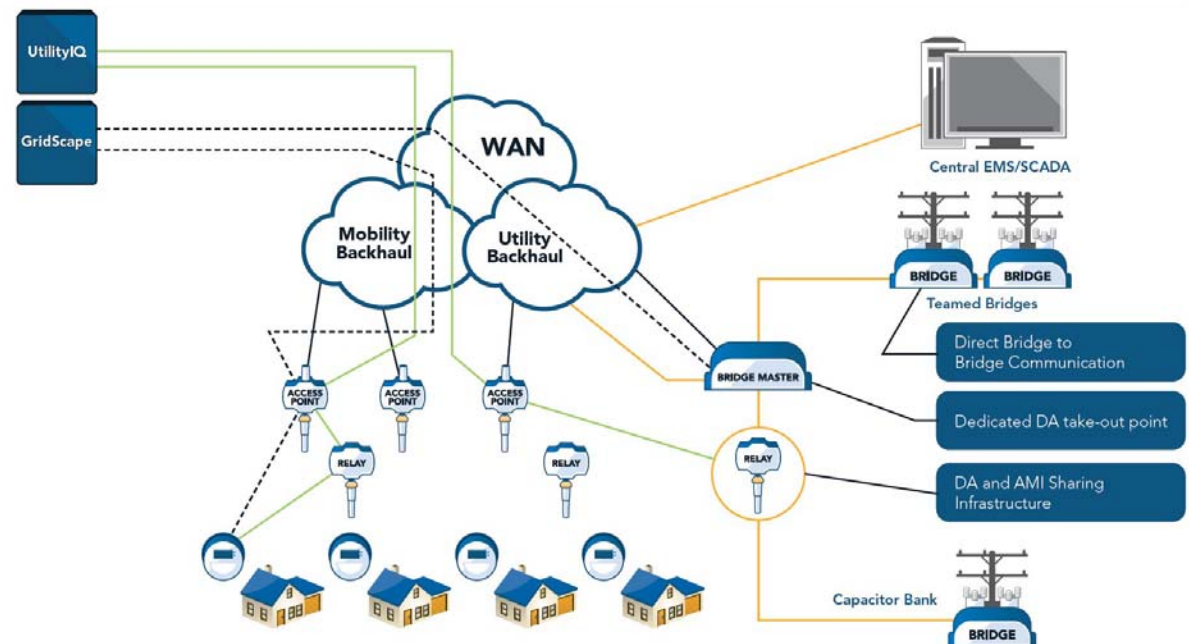


Figure 20 shows how Bridges function in the Silver Spring mesh network.

Figure 20. Bridges integration in the Silver Spring mesh network



Faulted Circuit Indicator

Faulted circuit indicators (FCIs) provide real-time reporting of fault locations to a utility's SCADA system. Connected to a distribution line and powered inductively, FCIs monitor

primary circuit current and temperatures and provide instantaneous DNP3-based alerts when problems occurs.

Such continuous information not only delivers rapid fault location but also enables you to proactively identify other line problems such as overloading and primary circuit imbalances.

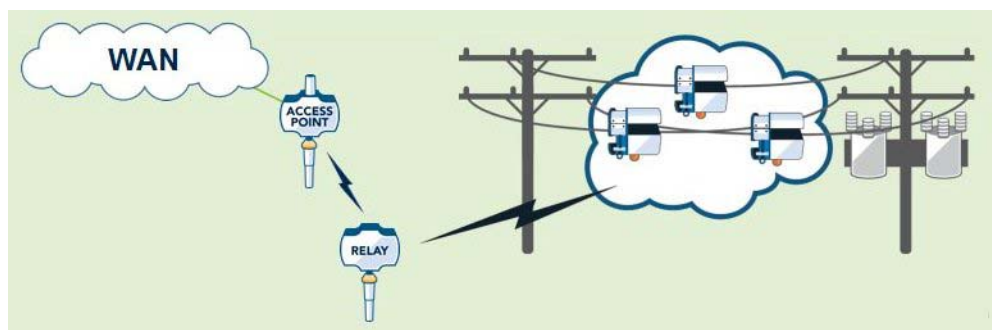
FCIs reduce operating costs by:

- Pinpointing and resolving outages immediately without waiting for customer calls
- Improving customer satisfaction by shortening outage duration
- Improving a utility's recorded reliability performance metrics
- Reducing field-service truck rolls. FCIs can also help utilities determine if other problems in the vicinity are contributing to the problem and to confirm that service work has resolved the problem completely
- Enabling utilities to proactively identify other line problems such as overloading and primary circuit imbalances

Figure 21. Faulted circuit indicator



Figure 22. FCIs in a Silver Spring mesh network



Field Service Unit

The Silver Spring Field Service Unit (FSU) is a portable device that uses RF to communicate with any Silver Spring device. FSUs are used by field technicians to perform installations, testing, and troubleshooting field-deployed NICs, regardless of how they are deployed as part of an AMI, DR, or DA solution. FSUs allow technicians in the field to issue commands in the field without connectivity with the back office.

When used with Silver Spring Bridge Configurator, Communications Module Utility, Communications Tester, Electricity Communications Module Tester, Gas IMU Configurator, HAN Test Kit, IMU Accuracy Tester for the AMI Solution, Installer Portal, and Load Control Configurator field tool applications, the FSU can perform a full range of RF, configuration, and network diagnostic tests, including register reads, firmware upgrades, and Gas IMU joins.

Figure 23. Field Service Unit and communications with Silver Spring device



Gas Interface Management Units

The Silver Spring Gas Interface Management Unit (IMU) interfaces with mechanical gas meter indexes for residential and commercial gas meters to provide RF communication across the Silver Spring mesh network. Gas IMUs are typically mounted just above ground, although this depends on climate and local building codes that determine where gas lines are located. In some locations that present space or signal propagation issues, Gas IMUs require external hardware to communicate across the mesh network.

Unlike electricity meters, APs, and Relays, Gas IMUs are entirely dependent on battery power, which places a premium on battery usage to transmit data. To conserve battery power, Gas IMUs only wake up infrequently (once or twice per day) to communicate with other devices. Due to their dependence on battery power, limited range, and because they are usually off, Gas IMUs do not act as relays.

UtilOS firmware on the NIC enables Gas IMUs to record interval data similar to electricity meters. UtilOS receives raw pulses from the meter's index and can store up to two months of usage data in persistent memory. UtilOS allocates this data into record intervals.

At scheduled times (based on their internal clock), Gas IMUs wake up and discover a neighboring continuously powered device (CPD) such as an electricity meter, Relay, or AP. Once a neighboring CPD is discovered, the Gas IMU:

- Transmits its data log, event log, and other data to the CPD.

The CPD then acts as a proxy for the Gas IMU and stores the data until it is retrieved by a Gas IMU proxy read schedule. When these schedules run at their configured times, they *collect data from CPD proxy devices*, not the Gas IMUs. The use of CPDs as data storage proxies helps to conserve Gas IMU battery power.

- CPDs also store program changes for Gas IMUs. When a Gas IMU transfers data to a CPD, the CPD pushes program changes to Gas IMUs.

Note: CPDs can act as proxies for more than one Gas IMU. The proxy CPD must be a direct neighbor to the Gas IMU. There can be no intervening hops through other devices.

Figure 24. Example gas meter with Gas IMU components and as installed

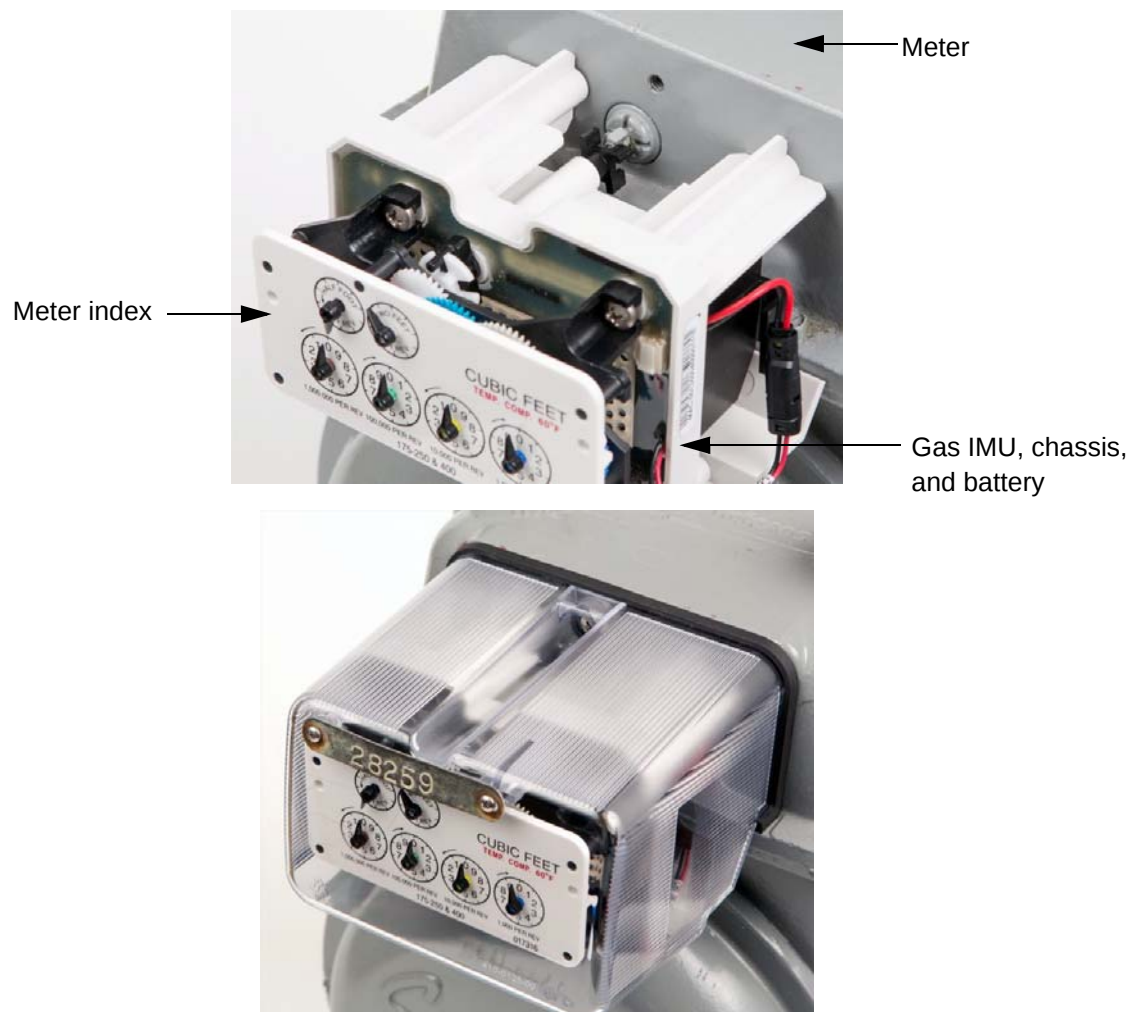


Figure 25. Gas meter with remote IMU hardware



NIC Reminting Station

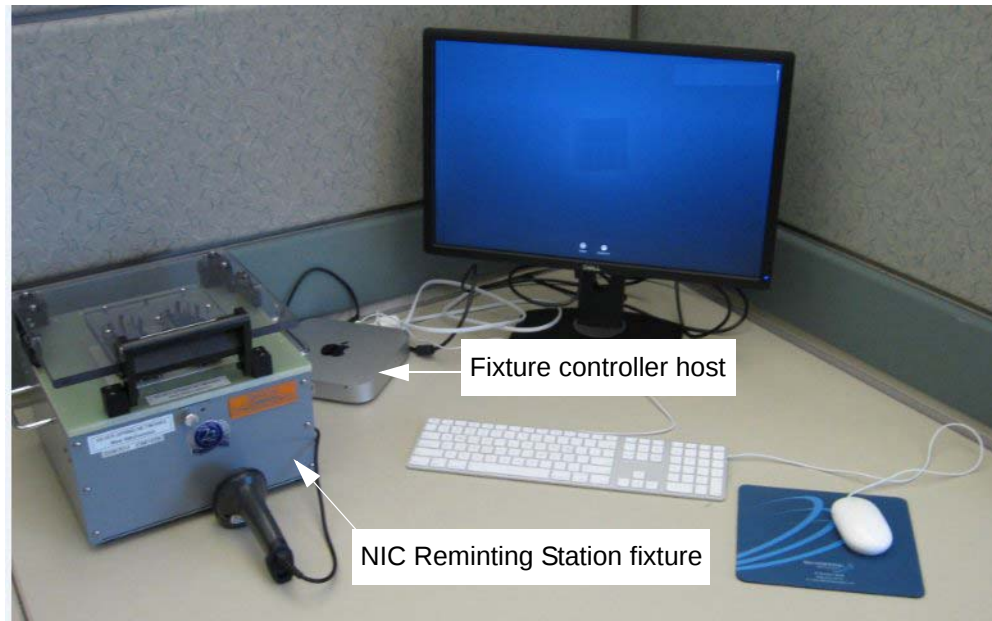
The Silver Spring NIC Reminting Station is a set of hardware software tools that integration partners can use to identify non-functioning device NICs and restore functioning NICs for redeployment. The NIC Reminting Station is used in coordination with the Silver Spring Return Merchandise Authorization (RMA) process. For information about the Silver Spring RMA process, see the *Meter Life Cycle* document.

These are NICs that might have been functioning in the customer environment, although the meter vendor does not have the credentials needed for communicating with the device. The reminting station's primary function is to put the NICs into a known state, which allows the integration partner to communicate with and test them.

With the reminting station, NICs can be restored with new firmware, and NIC firmware can be upgraded or restored to previous firmware versions (depending on the requirements of the meter customer).

Note: The Silver Spring RMA program for integration partners requires that all functional NICs in returned Silver Spring hardware are reminted.

Figure 26. NIC Reminting Station



Silver Spring Street Light Control Devices

Street light control devices equipped with Communications Modules allow utilities and municipalities to manage, control, and monitor, and provide analysis for street lights across the Silver Spring mesh network.

The Communications Modules can be installed in street light control devices (such as in control nodes in photocells and controllers in cabinets), and they can communicate across the network through a TALQ Bridge to the Streetlight.Vision central management software (CMS) and UtilityIQ for integration with other Silver Spring applications.

Silver Spring Support for Electricity Meters

Silver Spring supports American National Standards Institute (ANSI) and International Electrotechnical Commission (IEC) meters. In addition to recording electricity usage data, electricity meters capable of communicating across the Silver Spring mesh network contain essentially the same NIC as Relays and can perform the same function of extending the range of the network. They often act as a Relays in meter rooms, where one meter is equipped with an antenna that leads outside.

However, because electricity meters are installed at low height and usually on the side of or inside buildings, their RF range is less than that for Relays, as Relays are mounted high and in clear line of sight for optimum transmission and reception.

Electricity meters also function as Energy Services Interfaces (ESIs) for the HAN. Each electricity meter's Communications Module contains two radios: one for the 902–928

MHz—and 865–880 MHz for EU, Dubai, and other locations—NAN and one for the 2.4 GHz HAN. The IC chip (radio in a chip) for 2.4 GHz supports the Institute of Electrical and Electronics Engineers (IEEE) 802.15.4 standard and the ZigBee protocol for HAN communications. This enables transmission of asynchronous load and price control signals, temperature set points, and other messages through the WAN, the NAN, and finally the HAN.

Silver Spring Support for Third-Party Gas and Water Modules

Silver Spring supports a variety of third-party gas and water modules such as those used with Aquiba, Itron, and Landis+Gyr meters. For information about supported modules and related communications information, see the *UtilityIQ Integration Guide*.

Similar to Silver Spring Gas IMUs, third party water and gas modules are also entirely dependent upon battery power. However, there are several differences between these modules and Gas IMUs:

- ZigBee-based water modules, which operate at 2.4 GHz, must communicate only with the electricity meter at the same customer location. 802.15.4-based devices, which operate in the 902–928 MHz range—and 865–880 MHz for EU, Dubai, and other locations—can communicate with any nearby 802.15.4 device.
- Scheduled AMM ZigBee Proxy Meter Read jobs retrieve all usage data stored in the water module NIC's flash memory.

Silver Spring Support for Third-Party Load Control Switches

Load control switch (LCS) devices allow utilities or consumers to remotely to temporarily turn off devices that are connected to the network. Silver Spring supports both ZigBee and DtG implementations for these devices.

DtG describes a communications method that allows DR solutions through a Communications Module integrated into these devices and enables them to communicate directly through the mesh network without communicating through an Energy Services Interface (ESI) at the customer location.



A Silver Spring Product Documentation

This chapter provides information about other documentation you can reference to learn more about Silver Spring products. All documentation can be found on Springboard: <https://springboard.silverspringnet.com> under Documentation & Release Notes. Each document title included in this chapter is linked to its location on SpringBoard. Where multiple versions of a title are available, the link points to the latest available version.

Categories in this chapter are as follows:

- How Things Work and other Reference Documentation
- Advanced Metering Infrastructure
- Demand Response
- Distribution Automation
- Field Tools
- Gas IMUs
- Hardware
- Networking
- Security
- Release Notes
- For Customers Who Install and Manage Their Own Services

How Things Work and other Reference Documentation

- *Communications Module Flash Memory Utilization*
- *HAN Theory of Operations and Reference Guide*
- *The Life of Smart Street Lighting Devices: From Manufacturing Through Retirement*
- *Meter Programs and Programs Seals Application Note*
- *Networking in the Silver Spring Environment*
- *Power Loss Detection and Processing Application Note*
- *Silver Spring Glossary*
- *Solution and Product Overview* (this document)
- *Understanding Access Points*
- *UtilityIQ/UtilOS Meter Support in UtilityIQ and UtilOS Application Note*
- *UtilOS Theory of Operations*

Advanced Metering Infrastructure

- *Central Authentication and Authorization Service Administrator's Guide*
- *Communications Module data sheet*
- *Communications Modules for Electricity Meters data sheet*
- *Silver Spring Solution Brief—AMI whitepaper*
- *UtilityIQ Advanced Metering Manager User Guide*
- *UtilityIQ Advanced Metering Manager data sheet*
- *UtilityIQ Firmware Upgrader User Guide*
- *UtilityIQ Firmware Upgrader data sheet*
- *UtilityIQ Integration Guide*
- *UtilityIQ Meter Program Configurator User Guide*
- *UtilityIQ Meter Program Configurator data sheet*
- *UtilityIQ Network Element Manager User Guide*
- *UtilityIQ Network Element Manager data sheet*
- *UtilityIQ Outage Detection System Integration Guide*
- *UtilityIQ Outage Detection System User Guide*
- *UtilityIQ Outage Detection System data sheet*
- *UtilityIQ Power Monitor User Guide*
- *UtilityIQ Power Monitor data sheet*
- *UtilityIQ Voltage Optimizer data sheet*

Demand Response

- *CustomerIQ Backroom Administration Guide*
- *CustomerIQ data sheet*
- *CustomerIQ Integration Guide*
- *Demand Optimizer User Guide*
- *Demand Optimizer data sheet*
- *HAN Theory of Operations and Reference Guide*
- *Home Area Network Test Kit data sheet*
- *Installer Portal User and Troubleshooting Guide*
- *UtilityIQ HAN Communications Manager User Guide*
- *UtilityIQ HAN Communications Manager Integration Guide*
- *UtilityIQ HAN Communications Manager data sheet*

Distribution Automation

- *Bridge Configurator User Guide*
- *Bridge Configurator data sheet*
- *Bridge data sheet*
- *Bridges Installation Guide*
- *DA Design and Implementation Guide*
- *GridScape User Guide*
- *GridScape data sheet*

Field Tools

- *Bridge Configurator User Guide*
- *Bridge Configurator data sheet*
- *Communications Module Utility User Guide*
- *Communications Tester User Guide*
- *Communications Tester data sheet*
- *Electricity Communications Module Tester User Guide*
- *Electricity Communications Module Tester data sheet*
- *Field Tools and FSU Installation Guide*
- *Field Service Unit data sheet*
- *FSU User Guide*
- *Gas IMU Configurator User Guide*
- *Gas Interface Management Unit (IMU) Configurator data sheet*
- *Home Area Network Test Kit data sheet*
- *IMU Accuracy Tester User Guide*
- *Gas Interface Management Unit (IMU) Accuracy Tester data sheet*
- *Load Control Configurator User Guide*

Gas IMUs

- *Gas Interface Management Unit (IMU) data sheet*

Hardware

- *APs and Relays Installation Guide*
- *Bridges Installation Guide*
- *Communications Module data sheet*
- *Communications Module for Electricity Meters data sheet*

- *Infrastructure Hardware Guide*
- *Meter Patch Antenna Coupler Installation Guide*
- *NIC User Guide*

Networking

- *Access Point data sheet*
- *APs and Relays Installation Guide*
- *MicroAP data sheet*
- *Network Optimization Guide*
- *Network Deployment Guide*
- *Networking in the Silver Spring Environment*
- *Relay data sheet*
- *Silver Spring—Network Overview in Brief*
- *Understanding Access Points*
- *UtilOS Theory of Operations*

Security

- *Central Authentication and Authorization Service Administrator's Guide*
- *Component Roles and Privileges for UtilityIQ*
- *Critical Operations Protector data sheet*
- *FSU-Secure Access Manager User Guide*
- *HSM Quick Reference*
- *KeySafe and Critical Operations Protector Administration and Monitoring Guide*
- *KeySafe and Critical Operations Protector Primer*
- *KeySafe data sheet*
- *Planning for Security*
- *Security Overview in Brief*
- *Silver Spring Security Myths and Reality white paper*

Release Notes

Release notes are published for every major and minor release of each product. See the specific product categories in SpringBoard under Documentation & Release Notes.

For Customers Who Install and Manage Their Own Services

- *Critical Operations Protector for Demand Response Installation Guide*
- *DLCA Installation Guide*

- *FSU-Secure Access Manager Installation Guide*
- *GridScape Installation Guide*
- *GridScape Ports and Protocols*
- *KeySafe and Critical Operations Protector (COP) Installation and Upgrade Guide*
- *MicroAP Installation Guide*
- *MicroAPs for Managed and SaaS Customers*
- *Planning for Security*
- *Outage Detection System (ODS) Installation Guide*
- *SSNAgent Installation Guide*
- *Street Light Adapter Installation Guide*

Note: The *Street Light Adapter Installation Guide* also includes installation information for Provisioning API (PAPI).

- *UtilityIQ HAN Communications Manager Installation Guide*
- *UtilityIQ Installation Guide*

Note: The *UtilityIQ Installation Guide* includes the majority of installation information for Silver Spring applications unless specific guides exist for them.

- *UtilityIQ Network Element Manager (NEM) Installation Guide*
- *UtilityIQ Outage Detection System (ODS) Installation Guide*
- *UtilityIQ Operations Guide*
- *UtilityIQ Planning and Implementation Guide*
- *UtilityIQ Ports and Protocols*
- *UtilityIQ Power Monitor Installation Guide*
- *UtilityIQ Upgrade Guide*
- *UtilityIQ Requirements and Compatibility Matrix* (available for each supported version of UtilityIQ)
- *Requirements and Compatibility Matrix for GridScape*

B Silver Spring Software and Firmware Version Numbering and Processes

This appendix provides information about Silver Spring software and firmware product version numbering and related processes.

Software Releases

Currently, Silver Spring offers major releases of UtilityIQ every 9 to 12 months and patch releases on an as-needed basis. All interfaces are expected to remain compatible for at least one major release of UtilityIQ products so that customers can upgrade easily to a new version of UtilityIQ without incurring significant integration expenses caused by the upgrade.

Major, Minor, Patch, and Hot Fix Releases

Depending on the extent of the features provided by a product release, it is considered Major, Minor, Patch, or Hot Fix. Only fixes that are low risk and do not require regression are allowed in patch releases and hot fixes.

The following table describes Major, Minor, Patch and Hot Fix product releases and details related to each of them.

Table 2. Silver Spring product release types

Convention	Major	Minor	Patch	Hot Fix (Customer Specific)
Numbering	x.0.0 For example, UtilityIQ 4.0.0	x.x.0 For example, UtilityIQ 4.10.0	x.x.x For example, UtilityIQ 4.10.1	x.x.x.x For example, UtilityIQ 4.9.0.1

Table 2. Silver Spring product release types (*Continued*)

Convention	Major	Minor	Patch	Hot Fix (Customer Specific)
Typical content	- Architectural changes - New features - Enhancements - Bug fixes	- New Features - Enhancements - Bug fixes	- Low risk minor improvements that do not require regression testing - Bug fixes	Critical and low risk bug fixes that do not require regression testing
Product documentation	- User guide (if needed) - Installation/ Upgrade guide (if needed) - Integration guide - Release notes	- User guide (if needed) - Installation/ Upgrade guide (if needed) - Integration guide - Release notes	- User guide (if needed) - Installation/ Upgrade guide (if needed) - Release notes	- Installation/ Upgrade guide (if needed) - Release notes

General Availability and Limited Availability Releases

In most cases, software products are released and made available to all Silver Spring customers. These are called General Availability releases. However, some releases are intended for only one or a few customers. These are called Limited Availability releases.

Typically, features that are included in a Limited Availability release are later included in the product's General Releases.

How Software Bundles Are Named

Software files from Silver Spring are named for the product using either the full name or a short name. For example, `UIQ_4.10.2_Release` for UtilityIQ version 4.10.2 software and `SSC_2.3.4` for shared services components version 2.3.4 software.

Note that any UtilityIQ version includes multiple software products, and a change to any one of them results in a version change for the complete package. For example, UtilityIQ version 4.10.2 was released to include the new AMM WS-Route version 2.0.1, while other applications in the release, such as AMM, did not change version numbers (in this case, the AMM version remained 4.10.1).

Also, the numbering for individual software products that change do not necessarily follow the UtilityIQ numbering (as is the case with AMM WS-Route version 2.0.1), and no product in the release might actually carry the updated UtilityIQ number.

Requirements and Compatibility Matrix documentation provides software file names for listed products.

About Skipped Version Numbers

In cases where a version number appears to have been skipped, this typically occurs in the following cases:

- In order to apply the same version number to closely related components. For example, AMM database (db), AMM Global Meter Reader (gmr), and AMM Middle Tier (mt) together comprise AMM. And, while one of these components might not have changed with a new release, the version number is set the same for all three.
- When a version is intended for internal use only and has never been released to customers.

You can refer to the release notes for the product to determine why a number was skipped in each case.

Firmware Releases

UtilOS firmware releases are designated as Major, Minor, and Patch.

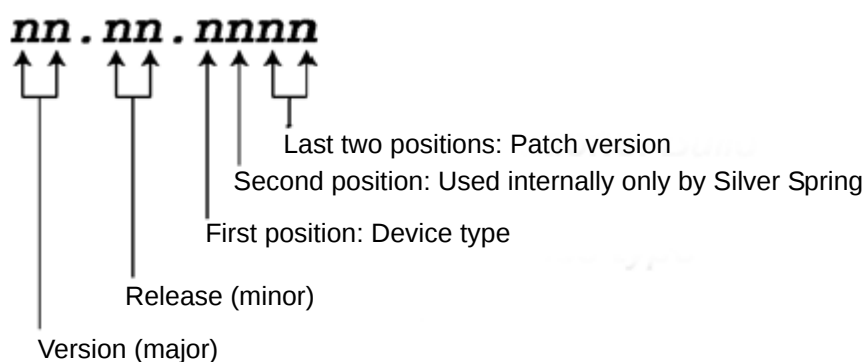
Major releases generally apply when platform changes have occurred.

Minor releases include features, and large and small and bug fixes.

Patch releases are intended for bug fixes or small changes introduced in a major or minor release.

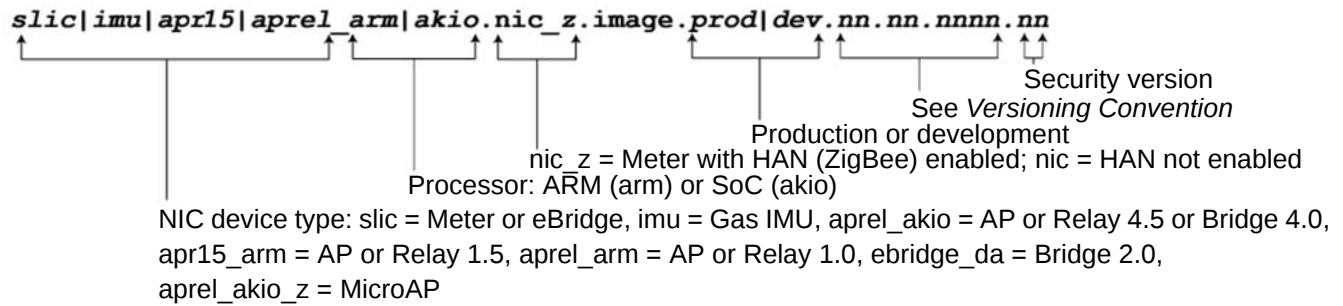
The following conventions apply to UtilOS firmware releases:

Figure 27. UtilOS Versioning Convention



For a given firmware release, the following conventions apply to firmware image names:

Figure 28. Image Naming



Example:

`slic_arm.nic_z.image.prod.02.10.0001.03`

means Meter with HAN enabled, in production, version 2.10.1, security version 3, and the 1 in 0001 indicates this is a patch release.

Further details are provided in *UtilOS Release Notes* for any firmware version.

Index

Numerics

- 2.4 GHz communications 20, 41, 52
- 802.15.4 standard
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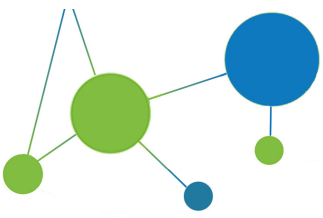
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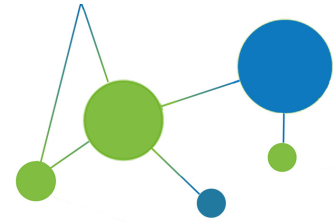
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SILVERLINK PRODUCTS

Silver Spring Networks SilverLink is the leading critical infrastructure solution suite.

This chapter provides a complete list of Silver Spring SilverLink products. For more product information and terminology, refer to the *Silver Spring Glossary*, which is available—along with other Silver Spring documentation—at <http://springboard.silverspringnet.com>.

SilverLink is comprised of the following five categories:

- [SilverLink Applications](#)
- [SilverLink Control Platform](#)
- [SilverLink Data Platform](#)
- [SilverLink Network Platform](#)
- [SilverLink Services](#)

SilverLink Applications

SilverLink Applications include consumer, grid, city, and other applications built by Silver Spring, its partners, and customers. All of these applications are available from Silver Spring.

SilverLink applications are applied as follows:

- **Customer care and outreach:** Save money on operations through automation, program management, prepaid, and customer marketing tools.
- **Customer engagement:** Present near-real-time usage and itemized bills to customers with personalized, targeted, and accurate tips and budgeting tools.
- **Demand side management (DSM):** For utilities, provide means to shape electricity demand and improve program effectiveness. For customers, provide ways to manage energy use and increase participation in efficiency, demand response, and variable pricing programs.
- **Grid management:** Improve utility operations with tools to manage assets, outages, losses, loads, and power quality. For distribution automation (DA) systems, resilience, reliability, optimization, efficiency, monitoring and analysis metrics can be evaluated.
- **Network management:** Optimize network operations with solutions to provision, test, manage, and troubleshoot network devices.
- **Smart cities:** Improve city services and safety and with solutions for street lights, parking, traffic, and environmental sensors.

[SilverLink Applications from Silver Spring Networks](#) on page 5 lists applications produced by Silver Spring, and [SilverLink Applications from Partners](#) on page 7 lists applications produced by Silver Spring partners. [Sensor Applications](#) on page 9 list all sensor applications available from Silver Spring.

SilverLink Applications from Silver Spring Networks

Advanced Metering Manager (AMM)

A grid management application that provides meter device lifecycle management. AMM's web-based interface allows utilities to configure groups, schedules, and exports across a variety of electricity and gas devices, which enables the collection, management, and analysis of consumption, time of use, interval data, power quality measures, and status logs.

CustomerIQ®

A customer engagement application that includes an interactive web portal intended for utility consumers to monitor and analyze their energy usage, receive important rate and system alerts, compare their energy use with similar neighbors, and learn how to reduce their energy use and costs.

CustomerIQ® Energy Reports

Printed and mailed reports that extend the value of online tools and encourage smart meter customers to use their web portal and provide ongoing energy insights and tips. Effective customer engagement programs demand multi-channel communication options. While many customers adopt desktop and mobile tools for energy management, some are accustomed to more traditional means of communication.

CustomerIQ® Gas

A customer engagement application that provides natural gas and multi-service utilities with a suite of customer engagement features for residential, commercial and industrial customers. The CustomerIQ Gas interactive dashboard delivers near-real-time usage insights along with weekly email reports and messaging to in-home devices to help customers reduce consumption, save money and minimize their environmental impact. The dashboard is highly configurable, so utilities can customize the portal with rate plan information and other details to better tailor to your customer programs. Utilities providing both electricity and gas service can deliver energy management insights on a unified dashboard. Customers use a single login to learn about natural gas and electricity consumption, increasing their engagement and providing added incentive to return to the portal.

CustomerIQ® Solar

A customer engagement application that provides comprehensive tools for residential, commercial and industrial solar customers to help them understand their solar production, electricity usage and estimate their net energy bills.

Demand Optimizer

A demand side management (DSM) application for optimizing load shed, managing peak load by precisely estimating potential load shed, accurately measuring and verifying load shed events, and optimizing a portfolio of demand response (DR) programs and target load-reduction strategies.

HAN Communications Manager (HCM)

(formerly Demand Response Manager or DRM)

A demand side management (DSM) application that enables utility companies to manage demand response (DR) programs and customer engagement.

Meter Program Configurator (MPC)

A grid management application that remotely programs and configures energy-only and advanced digital electricity meters on a mass scale.

Operations Optimizer

(formerly branded as Detectent products)

A customer care and outreach, grid management, and network management application that includes the following modules:

- **AMI Operations:** An analytics module that identifies and diagnoses meter data collection and delivery problems, monitors for meter safety issues, and manages AMI deployments and network performance. For example, it can identify failed, unreachable, and high-temperature meters, and AP/Relay health issues.
- **Customer Programs:** An analytics module that enables utilities to better plan, deliver and measure demand-side management programs. The module includes smart meter disaggregation analytics that operate on hourly consumption data to predict the type and number of appliances in a residential account in order to improve customer segmentation and targeting.
- **Grid Operations:** An analytics module that aggregates and analyzes metering loads across the distribution system to identify asset risks and connectivity mismatches, support load planning, and estimate technical losses.
- **Revenue Assurance:** An analytics module that identifies theft and other non-technical losses by analyzing feeder imbalances and identifying tampered or bypassed meters. It also provides workflow, field investigation, and billing capacities.

OpsIQ™

A network management application that includes the following modules:

- **Meter Center**, which provides meter status and performance information for each meter including read time, meter status, and meter rooms. The module can help to reduce the time and number of physical visits to troubleshoot meter problems. The module also monitors meter temperature for an entire service territory, enabling proactive remediation of meter temperature issues. And it can be used to identify meters with temperatures that fall outside of a customizable threshold.
- **Network Center**, which provides mesh network performance data, allowing customers to see the hop count and device state of every meter in their network. The module also enables improved network remediation.
- **Operations Center**, which monitors [Access Point \(AP\) 5](#) and [Relay 5](#) status for advanced metering infrastructure (AMI) customers, and tracks and displays all alerts in a single view. The module enables easy integration with existing management tools used in network operations centers (NOCs) and can reduce troubleshooting time for APs and Relays.

- **SilverLink Console**, which provides back-office network monitor status, including application and infrastructure monitors for hosted and managed advanced metering infrastructure (AMI) customers. The module also delivers improved visibility into business metrics for AMI through real-time monitors and dashboards.

Outage Detection System (ODS)

A grid management application that manages outage-related messages from electricity meters—including last gasp and power restore messages—and makes them available to the outage management system.

Street Light Adapter (SLA)

A smart cities application that provides a standard interface for central management software (CMS) to interact with street light devices on Silver Spring mesh networks. Using Street Light Adapter, a CMS can perform configuration management, lighting control, and monitoring of street light devices.

Streetlight.Vision™

A smart cities central management software (CMS) application that interacts with street light devices on Silver Spring mesh networks.

SilverLink Applications from Partners

AutoGrid DROMS

A demand side management (DSM) application for optimizing load shed, managing peak load by precisely estimating potential load shed, accurately measuring and verifying load shed events, and optimizing a portfolio of demand response (DR) programs and target load-reduction strategies.

Bidgely HomeBeat Web & Mobile

A customer engagement application that is built on Bidgely's HomeBeat energy disaggregation platform. Using either low or high resolution data, Bidgely positively identifies and tracks the major appliances in the home—including air-conditioning, electric heating, pool pumps, refrigerators, electric water heaters—to provide consumers with personalized tips for saving energy and money.

Bidgely HomeBeat ActionDR

A demand side management behavioral demand response mobile solution that combines social incentive with appliance-specific queues to help utilities shift peak load through demand and peak shift efficiency programs.

Bidgely HomeBeat Agent

A customer care and outreach application that provides customer service representatives with insights that reduce the impact of high-bill disputes through lowering call volume, increasing first-call resolutions, decreasing average call-handling times, bringing off-line consumers on-board, and increasing customer satisfaction.

Bidgely HomeBeat Marketer

A customer care and outreach application that enables marketing and outreach groups inside the utility to precisely segment and target residential participants for energy efficiency, demand response, and other incentive programs.

DVI Edge

A grid management application developed by Dominion Voltage Inc. that utilizes AMI data to optimize voltage levels across the grid.

EnergySavvy Optix Engage

A customer care and outreach and demand side management (DSM) application that provides online energy audits.

EnergySavvy Optix Quantify

A customer care and outreach savings-measurement application that continuously monitors utility program performance and energy savings in real time.

Exceleron MyUsage Prepaid

A customer care and outreach application that provides a hosted solution for managing prepaid accounts for electricity, gas, water, and/or other utility services. MyUsage Prepaid benefits the utility industry by reducing write-offs and bad debt, improving customer service, and encouraging conservation.

Gridium Billcast

A customer engagement application that provides rate modeling, budget projections, scenario analysis, and drift reporting.

Gridium Snapmeter

A demand side management (DSM) application that tracks efficiency improvements, building drift, efficiency opportunities, remote building energy-use screening, load management, and peak demand management.

Nexant Grid360 Distribution Analytics

A grid management application that provides an advanced network modeling, simulation and analysis platform that enables transmission and distribution system planners and operators to build, monitor, analyze, and optimize grid operation.

Onzo Personalized Customer Engagement

A customer engagement application designed to help utilities develop relationships with their customers; for example, by providing consumption data, peer group comparison, actionable recommendations, and goal setting.

Onzo Personalized Customer Insight

A customer care and outreach application that develops an accurate household profile that can inform targeted marketing, more efficient field based operations, and personalized customer services engagement. This product set is designed to enable utilities to deliver real outcomes including energy efficiency, reduced cost to serve, new valued added services, and increased customer trust and satisfaction.

PlotWatt Residential Dashboard

A customer engagement application that provides load disaggregation, comparison to similar homes, appliance usage feedback, and mobile browsers.

Retroefficiency Virtual Energy Assessment

A demand side management (DSM) application that enables utilities and program administrators to effectively target, engage, and convert efficiency projects among commercial customers.

Sentient Ample Analytics Platform

A grid management application that provides a scalable solution for the management of Sentient's MM3 line monitors, and that supports viewing and analysis of massive amounts of remote sensor data. The application serves both as the data repository and analytics platform, and as the integration platform for supervisory control and data acquisition (SCADA) and Distribution Management System (DMS) applications.

SmartGridCIS GridLink Prepaid

A customer care and outreach application that makes managing a prepaid program easier. It is designed for utilities to manage and automate the full customer-account lifecycle, including enrollment, billing and rating, payment processing, customer communication, and meter control (through AMM). Gridlink Prepaid can be deployed as a fully integrated adapter to a legacy customer information system (CIS) or as a stand-alone billing and CIS application.

Sensor Applications

A Sensor is a feature available to be enabled on the Silver Spring network interface card (NIC) to monitor one or multiple data points on the attached device (for example, a meter or load control switch) to facilitate the collection of data.

The supported Sensors may vary depending on the device vendor or model. Available sensor bundles are:

- **Rapid DR Telemetry:** Supports demand response at all times of the year with up-to-the-minute data collected on DR event performance for all DR customers, and facilitates integration of distributed energy resources
- **Electricity Bundle:** Includes voltage, temperature, current, usage, power, and power factor Sensors

SilverLink Control Platform

The SilverLink Control Platform provides the back office software required to provision, operate, and troubleshoot a Silver Spring network. This section is divided between software that supports Silver Spring Applications and other platforms and tools used in the field and other environments.

Software that Supports Silver Spring Applications and Other Platforms

Certificate Authority Tools (CA Tools)

A suite of tools that allow Silver Spring Operations to perform the following Network Operator tasks within the Silver Spring Networks public key infrastructure (PKI) hierarchy:

- Certificate monitoring, auditing, and renewal
- Certificate debugging
- Utility Operator certificate requests to the Silver Spring Networks root
- Key material generation for private keys and certificates for entities under the Operator certificate
- Import of key material external to the hardware security module (HSM), such as an Operator certificate file or a keystore file, to an HSM slot
- Administration of HSM-based databases of public and private keys used by Silver Spring back-office applications to communicate securely with NICs in the field
- Certificate revocation list (CRL) generation

Central Authentication and Authorization Service (CAAS)

(included in Silver Spring shared services components)

An application that provides authentication and authorization services and supports single sign-on for all applications in the Silver Spring back office.

CertWeb

Software used in connection with [KeySafe](#) for monitoring certificate expiration dates and creating certificate revocation lists (CRLs).

Critical Operations Protector (COP)

A hardware and software-based security platform that applies limits to critical operations.

COP for AMI limits the number of critical commands that users can issue within a given period of time.

COP for DR places hardware-based limits on the maximum load shed allowed in the power grid based on permit issuance and multi-party control of critical commands.

CryptKeeper

(included in Silver Spring shared services components)

A grid management application that enables multiple operator certificates to be used in a single environment.

Device Management Service (DMS)

(included in Silver Spring shared services components)

A central repository of critical device data that is used for sharing information between applications.

Driver's License Certificate Authority (DLCA)

(included in Silver Spring shared services components)

A program that issues a certificate (called a “driver’s license”), which allows a network node to become a member of that network. DLCA is a requirement for link layer and Master Meter security.

ESB Server

(included in Silver Spring shared services components)

An application that is an installation and configuration wrapper for a packaged version of a third-party product called Mule ESB that Silver Spring provides in shared services components. Mule ESB is an external integration layer that provides web service routing and extended services and APIs. Supported ESB applications are:

- **AMM WS-Route**, which is the basic [Advanced Metering Manager \(AMM\)](#) web services routing application.
- **Job Execution Framework (JEF)**, which is used by Power Monitor and [SensorIQ™](#). JEF provides quartz job scheduling, job monitoring, and persistence.
- **Field Pairing Service (FPS)**, which is a service that allows customers to install or swap Silver Spring NICs into meters in the field without any field tools.
- **Provisioning API (PAPI)**, which is a simple web service interface used by [Street Light Adapter \(SLA\)](#) that enables device provisioning to support additions, moves, and changes to devices in the field through the central management software (CMS).
- **SSNIAgent** (*formerly SSNAgent*), which is a small application that runs as a daemon and provides a secure gateway to a subset of web services for Silver Spring applications such as [Advanced Metering Manager \(AMM\)](#) and [HAN Communications Manager \(HCM\)](#) from applications such as [CustomerIQ®](#) and [Demand Optimizer](#). The application also provides fast and secure data transfer from a customer environment to the [SilverLink Data Platform](#) when used with related applications SSNIAgentForwarder and TransferAgent.
- **SSNI Services** (*formerly SSN Services*), which helps create the infrastructure for all applications that use web services. SSNI Services is available in Silver Spring shared services components.
- **SSNIAgentForwarder**, which forwards files to SSNIAgent.
- **TransferAgent**, which runs on the SilverLink Data Platform and monitors and responds to data transfer API calls from SSNIAgent.
- **Trap Router**, which is used by [Trap Forwarder \(TMB\)](#) and enables routing configuration for traps. Trap Router is available in Silver Spring shared services components.

Firmware Upgrader (FWU)

An application used to manage the delivery and activation of firmware over the wireless mesh network and to provide image management, audits of upgrades, project management, and alerts related to the firmware update process.

FSU-Secure Access Manager (FSU-SAM)

(included in Silver Spring shared services components)

An application used to protect a [Field Service Unit \(FSU\)](#) from misuse by allowing an administrator to limit the number of secure maintenance links an FSU can issue within a configured amount of time based on role-based credentials and available credits.

Gateway

A proxy and API service that authenticates applications and manages mesh-bound traffic, providing a common interface to the Silver Spring mesh network.

GridScape® Configuration Server

An application used for configuring Access Points (APs) and MicroAPs in Silver Spring mesh networks. See also [Access Point \(AP\) 5](#) and [MicroAP™ 5](#).

GridScape® Network Manager

An application that supports out-of-band and in-band management for polling, event management, diagnostics, real-time visualization, auditing, and security measures in a distribution automation (DA) network. Key functions include enabling IPv4 addressing, static routing, and peer-to-peer communications.

JMS Bridge

(included in Silver Spring shared services components)

A Java application that forwards messages from Silver Spring applications' internal message queues to customer message queues.

KeySafe

A shared repository in the head end or back office that uses a Hardware Security Module (HSM) to securely store credentials (private keys) required for authenticating and authorizing entities in the Silver Spring system. It is also used to securely store negotiated symmetric keys used for protecting data exchanged between back office applications and the field endpoints.

Meter Plugins

Software that Silver Spring provides for each meter manufacturer and standard and that adds a specific set of functions to a larger software application. For example, there is one Plugin for Itron C12.19 meters and another for all Itron DLMS/COSEM meters. All metering functionality particular to the meter is contained in its Plugin.

Network Center

(formerly CEP NMS)

A network management application that provides advanced network management capabilities such as fault management and performance management.

Network Center ES is a customized version of Elasticsearch search server software used by Network Center.

Network Event Collector (NEC)

A centralized [network interface card \(NIC\) 5](#) and application event collection and repository for [HAN Communications Manager \(HCM\)](#) and third-party applications. NEC reads new

events from NICs and load control switch (LCS) devices at a scheduled interval or on-demand and sends them to applications through a Java Message Service (JMS) queue.

Registrar (REG)

(included in Silver Spring shared services components)

A Dynamic DNS (DDNS) server with a primary purpose to collect network registration and update notices from the NIC devices sent using the Dynamic Domain Name System (DDNS) protocol and to service look-up requests. Its secondary purpose is to collect statistics from the activity of the devices and to serve up those statistics through a web service interface.

SensorIQ™

(formerly Power Monitor)

A back-office application used for collecting data from Silver Spring Network-enabled devices. A SensorIQ profile on the [network interface card \(NIC\) 5](#) defines the device data to be sampled, how often to record that data, and any alarming conditions. The SensorIQ server can collect the sampled data from the NIC at regular intervals and provide real-time alerts for data threshold violations.

SensorIQ uses Sensor bundles for data collection. See [Sensor Applications](#) for information about Sensor bundles available from Silver Spring.

TIBCO Conf files

(included in Silver Spring shared services components)

Configuration files used with [TIBCO EMS](#) that contain a list of all Silver Spring queues. When [TIBCO EMS](#) is started, it reads these files and initializes the queues.

TIBCO EMS

(included in Silver Spring shared services components)

A Silver Spring shared services component that provides JMS functions for a number of Silver Spring applications. TIBCO EMS publishes messages to queues managed by other message services, such as JBoss, through a bridge. TIBCO EMS uses associated [TIBCO Conf files](#), also available from Silver Spring as a shared services component.

Trap Forwarder (TMB)

(included in Silver Spring shared services components)

(formerly Trap Receiver)

An application that asynchronously captures, displays, and logs traps from network devices and allows users to instantaneously view alert notifications from any network device that supports Simple Network Time Protocol (SNTP).

Tools

Bridge Configurator

A software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), creates networks of Bridges, Remote Terminal Units (RTUs), and intelligent electronic devices (IEDs). A number of distribution automation (DA) deployment scenarios and network configurations are supported by this tool.

Communications Configurator

An application that remotely configures devices by automatically downloading configuration parameters when the device is powered up.

Communications Module Utility (CMU)

(formerly Contingency Reader and CROC)

A grid management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), reads meter data from Silver Spring-enabled meters and uploads the meter read data to [Advanced Metering Manager \(AMM\)](#). The application can be used to read meters loaded into AMM—but never registered on the network—or meters that are unreachable on the Silver Spring mesh network.

Communications Tester

(formerly CATT)

A grid management and network management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used for field and lab testing of devices equipped with a Silver Spring [network interface card \(NIC\) 5](#) that communicate across the mesh network. Communications Tester enables engineers and technicians to transmit and receive messages to and from these devices, log the data, and analyze the results.

Electricity Communications Module Tester (ECMT)

A network management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used for testing the status of electricity meters equipped with a Silver Spring [network interface card \(NIC\) 5](#). The tool is used in combination with any method of powering an electricity meter, such as a meter test board.

Electricity OEM Configurator

(formerly MUTT)

A software tool that programs, tests, and stores programmatic information used in device provisioning for Silver Spring NICs, electricity meter original equipment manufacturer (OEM) models specified for a given Silver Spring NIC, and supported Load Control Switch (LCS) devices.

Field Installation and Support Handheld (FISH)

A network management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), runs on a portable handheld computer and is used to pair Gas IMUs with gas meters and configure the IMUs for operation over the Silver Spring mesh network. See also [Gas Interface Management Unit \(Gas IMU\)](#).

Gas IMU Configurator

(formerly GECKO)

A network management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), allows users to configure and test Silver Spring Gas IMUs. Supported tasks allow joining and unjoining Gas IMUs to gas meters, validating meter reading values with a check read, and generating configuration reports for specified Gas IMUs. After executing tasks, the Gas IMU Configurator produces results files that describe in detail what was loaded by the Gas IMU Configurator and the processing results. The primary use for this tool is provisioning Gas

IMUs in a utility's gas meter shop or in a gas meter OEM facility. See also [Gas Interface Management Unit \(Gas IMU\)](#).

HAN Test Kit

A demand side management software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used to enable home area network (HAN) device vendors to test their HAN devices with Silver Spring equipment and the ZigBee Smart Energy Profile (SEP) implementation to confirm correct interoperation.

IMU Accuracy Tester

A demand side management hardware and software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used in meter manufacturers for testing the basic functionality of new and field-returned Gas IMUs and to log test results. Testing covers counting accuracy, radio frequency links, and event logging. See also [Gas Interface Management Unit \(Gas IMU\)](#),

Installer Portal

A demand side management software tool used by utilities and third-party installers for installing HAN devices. With the tool, installers can provision HAN devices in the field, and administrators can set and manage application user permissions.

Load Control Configurator (LCC)

A software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), verifies Direct-to-Grid load control switch installation, configuration, and upgrades, and can be used for field troubleshooting and repair.

NodeSim

An application for simulating meter endpoints on the network for use in development and test environments. Supported device types include GMI/C12.19/PRI meters, Gas IMUs, Access Points, and Bridges. The application receives typical meter requests from Silver Spring applications—such as interval reads and replies—with data responses in the same structure as provided by non-simulated NICs. NodeSim also tests the SilverLinkOS firmware update process.

SilverLink Data Platform

The SilverLink™ Data Platform is an application enablement solution that ingests, organizes, and visualizes data from multiple internal and external systems.

SilverLink Data Platform

The SilverLink Data Platform enables an open ecosystem of applications. The platform automatically ingests device data, normalizes and enriches the data, and makes it secure and accessible to utilities and third parties through standard APIs. The SilverLink Data Platform includes the following:

- **Data Archive:** An application that enables long-term retention of data. Longer data history supports deeper analysis and new use-cases and analytics.
- **Data Visualizations:** An application that provides custom data visualizations through native integration with Tableau and support for other business intelligence tools.
- **Time Series API:** An API that presents time-series data from devices.

- **Device Metadata API:** An API that presents metadata on devices including device types and locations.
- **Events API:** An API that delivers events from [SensorIQ™](#) or [Advanced Metering Manager \(AMM\)](#).
- **Streaming API:** An API that supports streaming of real-time data from [SensorIQ™](#).

SilverLink Network Platform

The SilverLink Network Platform provides intelligent devices and embedded firmware that connect critical infrastructure.

Access Point (AP) 5

A gateway that performs the function of communicating over both a Wide Area Network (WAN) and the Neighborhood Area Network (NAN) and that provides advanced networking services, including addressing, routing/switching, health information, network time, security, and encryption.

Battery Backup

A hardware option that allows Access Points and Relays to operate during outages. See also [Access Point \(AP\) 5](#) and [Relay 5](#).

Bridge 5

A communications device that provides high-performance, reliable, and secure Distributed Network Protocol 3 (DNP3) transport between remote terminal units (RTUs) and data centers. Bridges are manufactured to perform one of two roles: Master or Remote.

Each Master Bridges provides the connection or take-out point for any DA device it communicates with to the SCADA system.

Remote Bridges connect to the RTUs to provide connectivity back to the Master.

Field Service Unit (FSU)

A portable tool used by field technicians to communicate with devices equipped with a Silver Spring [network interface card \(NIC\) 5](#) for configuration, troubleshooting, and other operations. It can also be used in a laboratory or meter shop to test and pre-configure devices before installation at customer sites.

Gas Interface Management Unit (Gas IMU)

A two-way radio with metrology capabilities that can be installed on diaphragm, rotary, and turbine gas meters. The Gas IMU allows remote meter reading, and provides asynchronous alerts for leaks, meter tampering, and other critical events, and it can be remotely configured.

Gen™5 technology

A networking technology integrated into Silver Spring devices that supports the network with data rates up to 1.2 Mbps, low latency, transmission range to more than 50 miles, power optimization, decreased size, and distributed intelligence. Products that support this technology are the [Access Point \(AP\) 5](#), [Bridge 5](#), [MicroAP™ 5](#), [Milli™ 5](#), Silver Spring [network interface card \(NIC\) 5](#), [Relay 5](#) and [SocketAP 5](#).

IoT Edge Router

A communications hardware device that enables customers to securely connect a variety of city and utility devices—including those that require legacy-protocol support — across a common RF mesh network infrastructure using proven open standards and interfaces and networking protocol support. This support includes a secure and standards-based architecture for both IPv4 and IPv6 communications with Linux-based network-edge computing capability.

Whether connected devices are new or legacy, the IoT Edge Router provides the processing horsepower and new data sources customers need to more efficiently and effectively apply existing city-wide resources.

Meter Patch Antenna Coupler

A passive microstrip antenna and coaxial cable for connecting a meter equipped with a Silver Spring [network interface card \(NIC\) 5](#) to a remotely mounted antenna. This hardware is intended for meters that are located in hard-to-reach locations.

MicroAP™ 5

A [network interface card \(NIC\) 5](#) that includes a cellular modem that can be configured to act as a self-contained [Access Point \(AP\) 5](#). This is especially useful to connect isolated or hard-to-reach devices.

Milli™ 5

(formerly Milli 5 Communications Module)

The Silver Spring Networks' Milli 5, formerly known as Milli 5 Communications Module, is a cost-effective, energy-efficient sub-GHz wireless communications device.

The Milli 5 is the first in the family of such devices and can be integrated with both battery-powered devices such as water meters and constantly powered devices such as voltage monitoring relays and photocells.

mounting equipment

Hardware equipment for mounting an [Access Point \(AP\) 5](#), [Relay 5](#), [Battery Backup](#), or antenna at the installation location.

network interface card (NIC) 5

(formerly Communications Module)

The Silver Spring network interface card (NIC) used in devices that communicate across the Silver Spring mesh network.

Relay 5

A device on a network used to extend the reach of a network.

Satellite Access Point

An alternative to cellular technology in areas where cellular coverage does not exist or is unreliable. The Satellite Access Point enables Silver Spring to read smart meters in areas where cellular service is unavailable.

Silver Spring Appliance

An all-in-one stack of hardware for hosting SilverLink product family applications. The Appliance contains all of the computing, storage, and networking infrastructure needed for a standard Silver Spring deployment.

Silver Spring Interpreter

A two-way radio integrated with Master Meter water meters that allows remote meter reading, and provides asynchronous alerts for leaks, meter tampering, and other critical events, and can be remotely configured.

SilverLinkOS

(formerly UtilOS)

The open standards-based network operating system and firmware for devices equipped with a Silver Spring [network interface card \(NIC\) 5](#). SilverLinkOS provides a suite of networking services, including network discovery, addressing, routing and switching, health, network time, security, and encryption.

SocketAP 5

A Silver Spring [Access Point \(AP\) 5](#) that provides the central network resource for delivering data generated by endpoint devices at the network edge and IT/OT systems—enabling high performance applications, network control and monitoring. Its flexible communication features extend the reach and coverage of the network to hundreds of customer sites, and its support for up to 250 endpoints per SocketAP dramatically lowers costs. The SocketAP 5 offers multiple paths to each endpoint device through sophisticated mesh network routing that ensures greater reliability and redundancy.

Street Light NIC

A Silver Spring network interface card (NIC) that is used in street light control devices (such as in control nodes in luminaires and controllers in cabinets) to enable communication across the mesh network.

Underground AP and Relay

An [Access Point \(AP\) 5](#) and [Relay 5](#) optimized for use in subterranean utility vaults in dense urban areas where pole top or pad mount infrastructure is not available.

Water Module

A two-way radio integrated with water meters that provides consumption reads and that can be remotely configured. ZigBee-based water modules are typically installed above ground to enable transmission on the 2.4 GHz frequency.

SilverLink Services

SilverLink Services support organizations in managing and operating their Silver Spring mesh network.

Software as a Service (SaaS)

The service model where Silver Spring hosts and operates Silver Spring or third-party applications at a Silver Spring data center.

Logistics

A combination of Network as a Service (NaaS), and SilverLink Control Platform and SilverLink Applications offerings

Network as a Service (NaaS)

A service model where Silver Spring deploys and owns the network infrastructure and manages the networking solution while customers can be responsible only for the endpoints that connect to the network. When combined with Silver Spring's Software as a Service (SaaS) offerings for endpoint management and control, Silver Spring can deliver a turnkey solution to its customers.

Managed Services

A service model where customers own and host back-end applications at their own data centers.



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GLOSSARY

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Glossary

A

abnormal peak day (APD)

A statistical planning standard defined as the coldest temperature that will be exceeded every 90 years, on average.

access control

Maps the identity of a user to a set of access rules to enforce the appropriate access rights. Silver Spring prefers the RBAC access control mechanism (role based access control) because it tends to reduce the complexity and cost of security administration in large network applications.

Access Point (AP)

A gateway that performs the function of communicating over both a Wide Area Network (WAN) and the Neighborhood Area Network (NAN) and that provides advanced utility networking services, including addressing, routing/switching, health information, network time, security, and encryption. See also [primary Access Point](#), [secondary Access Point](#), [wide area network \(WAN\)](#), and [neighborhood area network \(NAN\)](#).

actual peak load reductions

The actual reduction in annual peak load (in kilowatts) achieved by consumers in a utility demand side management program such as CustomerIQ. See also [CustomerIQ®](#).

advanced metering

Devices for recording or communicating actual electric use during minutes, hours, days, or weeks. This is useful for calculating time-of-day, on-peak/off peak, or other billing rates.

advanced metering infrastructure (AMI)

The integration of advanced metering data from the meter all the way through to back office systems. See also [advanced metering](#) and [back office](#).

Advanced Metering Manager (AMM)

An [advanced metering infrastructure \(AMI\)](#) application that provides meter device lifecycle management, which enables the collection of advanced metering information. AMM's web-based interface allows utility

operators to configure groups, schedules, and exports across a variety of electricity and gas devices, which enables the collection, management, and analysis of consumption, time of use, interval data, power quality measures, and status logs.

aggressive discovery

How nodes first discover neighboring nodes. After selecting a time slot and channel, each node goes into aggressive discovery by sending a neighbor discovery packet as it cycles through its epoch. See also [neighbor table](#), [NMEntity \(Network Manager Entity\)](#), and [epoch](#).

alternate Access Point

Other reliable Access Points that can be used by the endpoint device. See also [secondary Access Point](#).

AMI

See [advanced metering infrastructure \(AMI\)](#).

AMM

See [Advanced Metering Manager \(AMM\)](#).

AMM-DMS Sync

AMM-DMS synchronization package enables users, who have not yet upgraded to AMM 4.7 to integrate meter data into DMS. See also [Device Management Service \(DMS\)](#).

AMM WS-Route

A Silver Spring ESB application installed on [ESB Server](#) that is the basic AMM web services routing application.

AMR

See [automated meter reading \(AMR\)](#).

ANSI

American National Standards Institute. A standards organization that administers the standardization and conformity assessment system used in the U.S. and around the world. When ANSI adopts a standard, it disseminates a code to identify the standard. For example, ANSI Standard C12.19.

antenna

Antennas improve the capacity of the mesh network. Silver Spring has antenna models optimized to work in

a variety of indoor or outdoor installations include: [rubber duck antenna](#), [dual-band antenna \(oil filter\)](#), [dual-band body mount antenna](#), [dual-band dipole antenna](#), [high gain fiberglass \(stick antenna\)](#), [low-profile disc antenna \(hockey puck\)](#), and [salt shaker antenna](#).

AP

See [Access Point \(AP\)](#).

APD

See [abnormal peak day \(APD\)](#).

API

See [application programming interface \(API\)](#).

application layer security

The protection of the application layer by means of a secure association between the applications and field devices, allowing the applications to access data or execute a command against the device. Sometimes called V2 security at Silver Spring because of the first version of Silver Spring firmware that incorporated the keykeep.store files for application layer security.

application programming interface (API)

A set of methods by which a software developer can request the services of an application. A typical example is one application loading data into another application through an API.

associate

In [HAN Communications Manager \(HCM\)](#), associate means to link a device with an [Energy Services Interface \(ESI\)](#) but without joining it. A device can become associated also if it is unjoined from an ESI or if a permit join has failed for the device. See also [join](#).

asynchronous

In networking communications, an asynchronous signal occurs without a corresponding request for that signal. A last gasp from an electricity meter is an example of an asynchronous signal.

attenuation

The decrease in amplitude of a signal during its transmission from one point to another.

auto associate

To have the FSU automatically initiate a Secure Association with the meters that it discovers. See also [Field Service Unit \(FSU\)](#) and [secure association \(SA\)](#).

auto teardown

To have the FSU automatically terminate the secure associations after a meter finishes testing. To improve network performance between the Secure FSU and tested meters, Silver Spring recommends automatically tearing down the Secure Associations with each device after testing is completed. See also [Field Service Unit \(FSU\)](#) and [secure association \(SA\)](#).

automated meter reading (AMR)

A form of advanced metering that uses communications devices to send data from the meter to the utility. This includes simple energy consumption data to outage detection and over-the-air meter programming.

average revenue per kilowatt hour

Calculated as the total monthly revenue divided by the total monthly sales for each sector (residential, commercial, or industrial) and geographic area (state, census division, or national).

B**back office**

The internal business operations of an company that are not accessible or visible to the general public.

back office certificate authority (BOCA)

A certificate issued by the back office of a utility, which chains back to the root certificate in a X.509 digital certificate hierarchy. Also known as EBOCA.

Multiple BOCAs are used within the Silver Spring system, including: Network Management Entity CA, which signs the network management entity certificates, and may be multiple CAs with different privileges depending on operator requirements. See also [conditioning equipment \(CE\)](#).

backbone device

A device that is required to communicate with parts of the network. These are typically APs and Relays, but could be electricity meters in special circumstances. See also [Access Point \(AP\)](#) and [Relay](#).

backhaul

To transmit data to a point from which it can be sent over a network (hauled back) to the data center. The backhaul link provides the connection between the [Access Point \(AP\)](#) and Silver Spring applications and is typically the highest capacity data link in a network.

ballast

a device used to control current in a street light. The two types are magnetic and electronic. Magnetic ballast technology predate electronic, and the electronic type provide more functional options over the magnetic type.

bandwidth

The amount of data transmitted in a given amount of time, usually measured in bits per second, kilobits per second, or megabits per second.

base load capacity

The generating equipment normally operated to serve loads on an around-the-clock basis.

base load plant

A plant, usually housing high-efficiency steam-electric units, which is normally operated to take all or part of the minimum load of a system, and which consequently produces electricity at a constant rate as it runs continuously. These units are operated to maximize system mechanical and thermal efficiency and minimize system-operating costs.

base station

A land station in the land mobile service. For example, in cellular and personal communications uses, each cell has its own base station. Each base station is interconnected with other base stations and with the public switched network.

baseload

Sometimes referred to as demand, baseload is the average amount of electricity a homeowner uses just to “run” the home. The usage comes from appliances that are always on, like refrigerators or electric clocks, and items that are not turned on but are plugged in, like a computer or television. See also [demand](#).

battery backup

An option that allows Access Points and Relays to operate during outages. The Infrastructure Battery Pack (IBP) uses sealed lead-acid battery technology, which delivers energy over the -40 to +85° C temperature range. Silver Spring operates the Infrastructure Battery Pack on a “float” (that is, the usage model is defined as long periods of topped-off charge states followed by sporadic deep discharge events (outage events).

battery electric vehicle (BEV)

A vehicle that runs exclusively from on-board batteries.

BEV

See [battery electric vehicle \(BEV\)](#).

billing cycle

Determines how often bills are sent to utility customers. In [Advanced Metering Manager \(AMM\)](#), a billing cycle is a convenient way to verify that meters are being read with enough lead time to generate bills. Unlike a schedule, a billing cycle in Advanced Metering Manager does not cause any meters to be read. See also [Secure Copy \(SCP\)](#).

billing read window

Determines the period when a meter can be successfully read for billing purposes. This is the period in hours before and after midnight of the bill generation date.

billing success rate (BSR)

The percentage of meters for which a successful read occurred between midnight and midnight. BSR is a metric for how well the data necessary to generate bills can be gathered during off hours. Unlike RSR, BSR records the percentage of *meters read* during a given period, whereas RSR records the percentage of successful *meter reads* per schedule run. See also [message success rate \(MSR\)](#) and [read success rate \(RSR\)](#).

binary large object (blob)

A blob is similar to a file in most respects, except that it will execute upon successful load to a device. It is often used to send a set of configuration commands to a device.

birth certificate

A digital identification, conforming to the X.509 security standard, given to a Silver Spring NIC at the time of its manufacture. See also [Driver's License certificate](#) and [Operator certificate](#).

blob

See [binary large object \(blob\)](#).

block rate

See [declining block rate](#) and [inclining block rate](#).

BOCA

See [back office certificate authority \(BOCA\)](#)

BPL

See [broadband over powerlines \(BPL\)](#).

Bridge

A communications device that provides high-performance, reliable, and secure DNP3 transport between [remote terminal unit \(RTU\)](#) and data centers. Bridges are manufactured to perform one of two roles: Master or Remote. A Master Bridge provides the connection or take-out point for the Remote Bridges to the SCADA system. The Remote Bridges connect to the RTUs to provide connectivity back to the Master.

The Bridge is so named because it connects (bridges) two networks. For example, Bridges deployed in a Distribution Automation solution bridge the Silver Spring RF network and the utility DNP3 network.

Bridge 4 supports the Silver Spring GenTM4 network and Bridge 5 supports the Silver Spring GenTM5 network. Both provide Ethernet and serial connectivity for simultaneous support of DNP3 and management traffic. Bridge 5 also provides APIs for maximum flexibility.

See also [remote terminal unit \(RTU\)](#), [eBridge](#), and [sBridge](#).

Bridge Configurator

A Silver Spring software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used for creating networks of Bridges, Remote Terminal Units (RTUs), and intelligent electronic devices (IEDs). A number of DA deployment scenarios and network configurations are supported by this tool. See also [Bridge](#), [remote terminal unit \(RTU\)](#), and [intelligent electronic device \(IED\)](#).

British thermal unit (BTU)

A standard unit for measuring the quantity of heat energy equal to the quantity of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit.

broadband over powerlines (BPL)

Broadband is a type of data transmission in which a single wire can carry high speed packet (internet) data. Cable TV, for example, uses broadband transmission. Electricity providers can use BPL technology to transmit data over the power lines that they already have in place by using a system of signal injectors, repeaters, and extractors that bypass the distribution

transformer. The frequency of BPL signals is much higher than that of traditional Power Line Carrier systems. See also [power line carrier \(PLC\)](#).

broadcast

The mode of sending packets over a network so that all devices receive them. Each device NIC then evaluates the event and decides if it can run it. The broadcast mode in [Advanced Metering Manager \(AMM\)](#) is used for some ESCC and LC jobs. See also [emergency supply capacity control \(ESCC\)](#), [load control](#), and [unicast](#).

broker

A firm that acts as an agent in the sale and purchases of electricity, but never owns the electricity and typically does not own generating facilities.

BSR

See [billing success rate \(BSR\)](#).

BTU

See [British thermal unit \(BTU\)](#).

C**C&I**

See [commercial & industrial \(C&I\)](#).

C12.19

An ANSI standard that applies to electricity meters. This standard defines a table structure for utility application data to be passed between electricity meters and a computer.

CA

See [Certificate Authority \(CA\)](#).

CA Tools

See [Certificate Authority Tools \(CA Tools\)](#).

CAAS

See [Central Authentication and Authorization Service \(CAAS\)](#).

CAIDI

See [Customer Average Interruption Duration Index \(CAIDI\)](#).

CAIFI

See [Customer Average Interruption Frequency Index \(CAIFI\)](#).

calculation delay

With demand limiting, the time after a connect that a meter waits to begin calculating demand. See also [calculation period](#) and [demand limiting period](#).

calculation period

With demand limiting, the interval between demand measurements during the demand limiting period. See also [demand limiting period](#).

canary polling

See [exception polling](#).

capability

The maximum load that a generating unit, generating station, or other electrical apparatus can carry under specified conditions for a given period without exceeding approved limits of temperature and stress.

Capacitor Voltage Register (CVR)

A register that provides a value that represents the Remote Disconnect switch capacitor's voltage.

capacity

The amount of electric power delivered or required for which a generator, turbine, transformer, transmission circuit, station, or system is rated by the manufacturer.

capacity charge

An element in a two-part pricing method used in capacity transactions (energy charge is the other element). The capacity charge, sometimes called Demand Charge, is assessed on the amount of capacity being purchased and expressed in \$/kWmonth or \$/MW-day. See also [energy charge](#).

CATT

Internal name no longer associated with [Communications Tester](#).

Ccf

100 cubic feet of natural gas, approximately equal to one therm.

CDMA

See [code-division multiple access \(CDMA\)](#).

CE

See [conditioning equipment \(CE\)](#).

CellINIC

See [MicroAP™](#).

Central Authentication and Authorization Service (CAAS)

A shared service component that supports single sign-on for all applications in the Silver Spring Networks back office. When users log into an application such as Secure Access Manager, [Advanced Metering Manager \(AMM\)](#), or Network Element Manager, users initially log into a CAAS screen. CAAS authenticates their login credentials against the user role information stored in the CAAS local database for the application in question. If the credentials match a user name with access, CAAS reviews the user privileges for specific application pages, then forwards that information to the application. The application then enforces the user privileges to access particular web pages or to see certain UI objects.

central management software (CMS)

Software used for management, control, and monitoring of systems and devices (such as street lights, traffic signals, parking meters, and so on) by municipalities and utilities. See also [Streetlight.Vision](#).

Certificate Authority (CA)

The collection of hardware, software, and operating personnel that create, sign, and issue public key certificates to subscribers. The CA is responsible for issuing and managing certificates.

Each certificate authority has essentially the same security requirements for its protection, but each is capable of issuing certificates for a different purpose, and is operated according to its own separate security (issuance) policy. See also [certificate roles](#).

Certificate Authority Tools (CA Tools)

A suite of tools that allow Silver Spring Operations to perform the following Network Operator tasks within the Silver Spring Networks public key infrastructure (PKI) hierarchy:

- Certificate monitoring, auditing, and renewal
- Certificate debugging
- Utility Operator certificate requests to the Silver Spring Networks root
- Key material generation for private keys and certificates for entities under the Operator certificate
- Import of key material external to the hardware security module (HSM), such as an Operator certificate file or a keystore file, to an HSM slot

- Administration of HSM-based databases of public and private keys used by Silver Spring back-office applications to communicate securely with NICs in the field
- Certificate revocation list (CRL) generation

Certificate Revocation List (CRL) Distribution Tool

Allows revocation of the private key and certificate of any device that suspected or known to have been compromised through theft or loss. Requires a Certificate Revocation List generated by the KeySafe administrator using [CertWeb](#).

certificate roles

Roles assigned to individuals dealing with the life cycle or use of a certificate, and which are dictated by a certificate policy. See also [policy](#).

CertWeb

Used in connection with KeySafe for monitoring certificate expiration dates and creation of certificate revocation lists (CRLs). See also [Certificate Revocation List \(CRL\) Distribution Tool](#).

CFL

See [compact fluorescent light \(CFL\)](#).

Challenge Handshake Authentication Protocol (CHAP)

A protocol that enables secure, encrypted authentication between local and remote workstations. The local workstation has a local CHAP password and the remote workstation has a remote CHAP password.

channel

On electricity meters, each channel is associated with a specific measurement. For example, Channel 1 may measure kWh and Channel 2 may measure voltage. This should not be confused with radio frequency channels.

CHAP

See [Challenge Handshake Authentication Protocol \(CHAP\)](#).

child

A meter that is associated with a Relay is a child of that Relay. Similarly, a Relay is a child of the Access Point to which it is associated. A meter can also be a child of another meter. In this case, the parent meter is acting as a Relay. See also [Relay](#).

churn

Refers to endpoint devices recalculating the egress route to their preferred Access Point on a frequent basis. This is a sign of network instability because an endpoint's IP address may become stale, resulting in missed reads. See also [endpoint](#).

CIQ

See [CustomerIQ®](#).

circuit

A conductor or a system of conductors through which electric current flows. Also, a two-way communications path for the transmission of signals.

CIS

See [customer information system \(CIS\)](#).

CLO

See [constant light output \(CLO\)](#).

clutter

Surface features, such as structures and foliage, that impact on radio wave propagation.

CMS

See [central management software \(CMS\)](#).

CMU

See [Communications Module Utility \(CMU\)](#).

code float

Refers to the process when all non-seed NICs acquire a [UtilOS®](#) image from the NIC (seed or non-seed) of a close network neighbor that has it. "Close" is defined as reachable without going through any intervening hops. See also [firmware](#), [image](#), and [code push](#).

code-division multiple access (CDMA)

A digital wireless technology that uses spread spectrum technology to send its signals over a wider bandwidth than the original signal.

code push

Refers to pushing code to a limited number of seed NICs. Pushing the image to a few seeds (3%) and instructing the vast bulk of non-seeds (97%) to acquire the image from their direct neighbors is much more resource-efficient than pushing the image to all NICs. This way, network traffic associated with a firmware upgrade takes place between direct neighbors and not along mission-critical routes between the data center and endpoints. Disruption of normal network traffic,

such as metering schedules and events, is reduced as much as possible. See also [code float](#).

cogenerator

A generating facility that produces electricity and another form of useful thermal energy (such as heat or steam) used for industrial, commercial, heating, or cooling purposes.

coincidental demand

Two or more demands that occur at the same time or coincidentally.

coincidental peak load

The sum of two or more peak loads that occur in the same time interval.

commercial & industrial (C&I)

Refers to commercial and industrial energy and water customers. C&I customers typically have over 500 employees, demand of over 75-kW, are demand metered, and most likely use building management systems.

Examples of commercial customers are schools, hospitals, hotels, and strip malls.

Examples of industrial customers are manufacturing plants, mills, and heavy industry.

Communications Configurator

A Silver Spring software application that remotely configures devices by automatically downloading configuration parameters when the device is powered up.

Communications Module Utility (CMU)

A Silver Spring software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), reads meter data from Silver Spring enabled meters and uploads the meter read data to [Advanced Metering Manager \(AMM\)](#). The application can be used to read meters loaded into AMM but never registered on the network or meters that are unreachable on the Silver Spring network. Additionally, CMU can be used for swapping Silver Spring NICs in meters and performing Demand Resets.

Communications Module Utility was formerly known as Contingency Reader.

Communications Tester

A Silver Spring software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used for field and lab testing of devices equipped with Silver Spring NICs that communicate across the mesh network. Communications Tester enables engineers and technicians to transmit and receive messages to and from these devices, log the data, and analyze the results. For example, operators can perform register reads, firmware upgrades, and they can read meter tables, check configuration options, collect radio frequency statistics data, and exercise other troubleshooting features. Communications Tester also supports user-created compound commands, session logging, and results export.

compact fluorescent light (CFL)

A fluorescent light bulb that uses less power than a traditional light bulb and has a longer rated life.

Companion Specification for Energy Metering (COSEM)

A data model that provides an interface to model the functionality of an electricity meter. Used with the messaging and transport capabilities of [Device Language Message Specification \(DLMS\)](#) as the standard for utility meter data exchange for Silver Spring DLMS/COSEM meters.

compensated cuFt

Unit of measure for measuring gas consumption in multichannel IMUs where a Mercury rotary corrector is installed. See also [Gas Interface Management Unit \(IMU\)](#).

conditioning equipment (CE)

Equipment modifications or adjustments necessary to match transmission levels and impedances, and which equalize transmission and delay to bring circuit losses, levels, and distortion within established standards,

conservation pricing

Pricing that provides an incentive to reduce average or peak use, or both.

Conservation Voltage Reduction (CVR)

A technique for reducing the amount of energy waste or over provisioning on the distribution grid, and which reduces energy consumption resulting from a reduction of feeder voltage. This functionality is provided through [Power Monitor](#) or [SensorIQ™](#).

constant light output (CLO)

In street light [central management software \(CMS\)](#) systems, CLO is used to adjust the light to allow for degradation in brightness due to the age of the lamp.

The adjustment takes place using a lumen depreciation curve, which specifies how much the lamp should be dimmed. This is calculated in hours as a percentage of the dimming level set by configuration or by the schedule based on the lamp age.

The CLO algorithm takes into account the age of the bulb or lighting element. As the element ages, it deteriorates, emitting less light for a given input level. When the element is brand new, the NIC firmware sends a lower value to the control board. As the light ages, the value sent gradually increases. When the light is fully depreciated, firmware does not reduce the CMS requested value. The amount of reduction is defined by a depreciation curve, which defines the reduction factor at various ages of the bulb.

consumption (fuel)

The amount of fuel used for gross generation, providing standby service, start-up, and/or flame stabilization.

consumption

The amount of electricity, gas, or water used by a customer during a specified period. Electric consumption is usually expressed in kilowatt-hours (kWh), gas in cubic feet or therms, and water in cubic feet.

consumption read

A meter functioning in consumption mode records a usage value to a single-register memory space. Reading this value is referred to as a consumption read. See also [interval read](#).

Contingency Reader

Replaced by [Communications Module Utility \(CMU\)](#).

continuously cumulative max demand

The previous billing period's continuous max demand plus the current max demand.

The sum of [cumulative max demand](#) and the present period [maximum demand \(peak demand\)](#). See also [demand](#).

continuously powered device (CPD)

Used in the context of IMUs, a CPD can be an electricity meter, an AP, a Relay, or a Bridge, all of

which are powered up on a continuous basis. IMUs use CPDs to store their data to conserve battery power. See also [in-band interferers](#), [Gas Interface Management Unit \(IMU\)](#), [Access Point \(AP\)](#), [Relay](#), and [Bridge](#).

control node

An [outdoor lighting controller \(OLC\)](#) device that resides in a street light used to control lights across the Silver Spring network. See also [Silver Spring Smart Street Lighting](#).

cooling degree day

A measure of the need for air conditioning (cooling) based on temperature and humidity.

COP

See [Critical Operations Protector for Advanced Metering Infrastructure \(COP for AMI\)](#).

COSEM

See [Companion Specification for Energy Metering \(COSEM\)](#).

cost-based pricing

A method of setting rates so that a utility can recover the costs of providing that particular service.

coverage area

The geographical reach of a radio network or system.

CPD

See [continuously powered device \(CPD\)](#).

CPP

See [critical peak pricing \(CPP\)](#).

credits

Used to allow a predefined number of operations by the FSU before the unit must be returned to an administrator for reactivation with a new set of credits. Once the credits allocation is exhausted, the FSU must be configured with a new set of credits by the administrator. See also [Field Service Unit \(FSU\)](#).

critical commands

Typically, a command that can potentially affect energy supply or demand. For example, this might be a load control event, in the case of COP for DR, or a remote disconnect command, in the case of COP for AMI. A large number of such load-affecting commands in a short period of time can potentially destabilize the grid.

Critical Operations Protector for Advanced Metering Infrastructure (COP for AMI)

Previously called GridScape COP or just COP. A hardware-based security platform that ensures the stability of the power grid by limiting the number of critical commands that users can issue within a given period of time. See also [critical commands](#), [hardware security module \(HSM\)](#), and [Critical Operations Protector for Demand Response \(COP for DR\)](#).

Critical Operations Protector for Demand Response (COP for DR)

Places hardware-based limits on the maximum load shed allowed in the power grid based on Permit issuance and multi-party control of critical commands. See also [critical commands](#) and [hardware security module \(HSM\)](#).

Critical Operations Protector Permit CA

A Certificate Authority (CA) that generates a key pair randomly and imports it to the [hardware security module \(HSM\)](#).

critical peak pricing (CPP)

A hybrid of time of use and real-time pricing. Utilities charge fixed time of use rates for preset periods but might charge higher rates during extreme supply conditions. Customers are notified in advance of the price change, allowing them time to curtail demand. See also [real time pricing \(RTP\)](#) and [time of use \(TOU\)](#).

CROC

Internal name no longer associated with [Contingency Reader](#) or [Communications Module Utility \(CMU\)](#).

CryptKeeper

A grid management application that enables multiple operator certificates to be used in a single environment.

CTAIDI

See [Customer Total Average Interruption Duration Index \(CTAIDI\)](#).

cuFt

Cubic feet. This unit of measure is used by gas meters to measure gas consumption.

cumulative max demand

The sum of the previous billing period's max demands. At the time of demand reset, the [maximum demand \(peak demand\)](#) of the previous billing period is added

to the previous accumulated total of all max demands. See also [demand](#) and [continuously cumulative max demand](#).

current

A flow of electrons in an electrical conductor. The strength or rate of movement of the electricity is measured in amperes.

curtailment

A reduction in the scheduled capacity or energy delivery to a customer, usually due to unusually high demand or peak load.

Customer Average Interruption Duration Index (CAIDI)

Calculated by: sum of all customer interruption durations / total customer interruptions. See also [Customer Total Average Interruption Duration Index \(CTAIDI\)](#) and [Customer Average Interruption Frequency Index \(CAIFI\)](#).

Customer Average Interruption Frequency Index (CAIFI)

Calculated by: number of customer interruptions / number of customers who have had at least one interruption. See also [Customer Average Interruption Duration Index \(CAIDI\)](#) and [Customer Total Average Interruption Duration Index \(CTAIDI\)](#).

customer class

The differentiation between users of energy or water. The class is determined by usage patterns, usage levels, type of customer (commercial or residential), or the conditions of service.

customer information system (CIS)

An application system. From the perspective of [Advanced Metering Manager \(AMM\)](#), the CIS system stores meter and customer data.

customer premises equipment

All telecommunications terminal equipment located on the customer premises, such as a cable modem, router, or [Access Point \(AP\)](#).

customer record

A record in the utility customer information system (CIS) that contains pertinent customer account information such as name, address, billing address, telephone number, meter ID, and so on. See also [customer information system \(CIS\)](#).

Customer Total Average Interruption Duration Index (CTAIDI)

Calculated by: sum of durations of all customer interruptions / customers who had at least one interruption. See also [Customer Average Interruption Duration Index \(CAIDI\)](#) and [Customer Average Interruption Frequency Index \(CAIFI\)](#).

CustomerIQ®

A Silver Spring interactive web portal intended for utility company customers to help them monitor and analyze their energy usage, receive important rate and system alerts, compare their energy use with similar neighbors, and learn how they might be able to reduce energy use and save money through energy efficiency, more appropriate rate plans, and shifting energy use to low-cost time periods. CustomerIQ is designed for use by residential, [small and medium business \(SMB\)](#), and [commercial & industrial \(C&I\)](#) customers.

CustomerIQ® Backroom

The administration interface for [CustomerIQ®](#).

CustomerIQ® Energy Reports

Printed and mailed reports that extend the value of online tools and encourage smart meter customers to use their web portal and provide ongoing energy insights and tips. Effective customer engagement programs demand multi-channel communication options. While many customers adopt desktop and mobile tools for energy management, some are accustomed to more traditional means of communication.

CustomerIQ® Gas

A customer engagement application that provides natural gas and multi-service utilities with a suite of customer engagement features for residential, commercial and industrial customers. The CustomerIQ Gas interactive dashboard delivers near-real-time usage insights along with weekly email reports and messaging to in-home devices to help customers reduce consumption, save money and minimize their environmental impact. The dashboard is highly configurable, so utilities can customize the portal with rate plan information and other details to better tailor to your customer programs. Utilities providing both electricity and gas service can deliver energy management insights on a unified dashboard. Customers use a single login to learn about natural gas

and electricity consumption, increasing their engagement and providing added incentive to return to the portal.

CustomerIQ® Solar

A customer engagement application that provides comprehensive tools for residential, commercial and industrial solar customers to help them understand their solar production, electricity usage and estimate their net energy bills.

CVR

See [Capacitor Voltage Register \(CVR\)](#) or [Conservation Voltage Reduction \(CVR\)](#).

cycle billing

The process of reading only part of a system's meters each day and then billing that portion of its customers. By the end of the cycle (usually a month) the customer is billed.

D**daily peak**

The greatest amount of electricity used during a certain period in a day, such as an hour, half-hour, or quarter hour.

DALI

See [Digital Addressable Lighting Interface \(DALI\)](#).

Data Encryption Standard (DES)

A block cipher.

day of flow

The day in which electricity deliveries are made, measured as the period beginning at midnight for the hour ending 0100 and ending at exactly the end of the 2400 hour day.

dB

Decibels. A logarithmic unit of measurement that expresses the magnitude of radio power.

dBi

Decibels isotropic. The forward gain of an antenna compared with the hypothetical isotropic antenna, which uniformly distributes energy in all directions.

dBm

The power ratio in decibels (dB) of radio power relative to one milliwatt (mW).

dead area

Locations from which effective transmission cannot be established because the transmitted signal is blocked by clutter. Also known as shadow.

decimal degrees

A numerical way of expressing degrees, minutes, and seconds longitude from Greenwich, England and latitude from the equator:

decimal degrees = degrees + (minutes / 60) + (seconds / 3600)

Positive numbers indicate East longitude or North latitude. Negative numbers indicate West longitude or South latitude. For example, W 122° 28', 39.3" longitude by N 37° 49', 11.2 latitude expressed in decimal degrees is:

-122.477583 longitude by 37.819778 latitude

declining block rate

An electricity billing rate that decreases across tiers with the customer's energy use.

delivery pressure

The gas pressure provided to the customer which determines the customer's piping and equipment sizes.

demand

The highest requirement for power; that is, the amount of power required to satisfy the demand. There is no time element involved, and the highest requirement for power can occur in an instant. In practice, most demand meters measure the average peak demand over the 15 or 30 minute period. This definition of demand differs from the definition of energy in that energy is the usage of power over time whereas there is no time element in measuring demand. Demand is measured in kilowatts (kW) and energy is measured in kilowatt-hours (kWh).

For example, a demand for 100 kW continuous for an hour equals 100 kWh. If the demand rose to 400 kW continuously for the next hour, the demand for that hour equals 400 kWh. For the two hour period, the demand is 400 kW because that is the highest requirement for power. The energy used is 500 kWh because that is the actual usage of power over time.

See also [continuously cumulative max demand](#), [cumulative max demand](#), [energy](#), [maximum demand \(peak demand\)](#), [minimum demand](#), [previous demand](#),

and [projected demand](#).

demand limiting period

A configurable period during which demand for a specified electricity meter is limited to using a configurable amount of electricity. See also [calculation delay](#) and [calculation period](#).

Demand Optimizer

A Silver Spring [demand response management system \(DRMS\)](#) application for optimizing [load shedding](#), managing peak load by precisely estimating potential load shedding, accurately measuring and verifying load shed events, and optimizing a portfolio of [demand response \(DR\)](#) programs and target load-reduction strategies.

Demand Optimizer also incorporates advanced capabilities for managing large ecosystems of [HAN devices](#), OpenADR devices, and building management systems over multiple networks (such as [advanced metering infrastructure \(AMI\)](#), broadband, and cellular).

demand reset

The process of setting demand electricity meter peak demand registers to 0 (zero). Normally, a button on the meter is used for resetting. Silver Spring customers can also use [Advanced Metering Manager \(AMM\)](#) or [Communications Module Utility \(CMU\)](#) with a [Field Service Unit \(FSU\)](#) to reset the meters wirelessly.

demand response (DR)

A set of time-dependent activities that reduce electricity use to improve grid reliability, manage costs, and encourage load shedding during times when the electric grid is near capacity or prices are high.

Fully automated demand response is initiated at a home, building, or facility through receipt of an external signal. The receipt of the signal initiates pre-programmed shedding strategies. Facility staff at each site pre-program the control systems to receive the signals.

Demand Response Enrollment (DRE) Portal

A web-based enrollment portal for utilities to enroll their customers in Demand Response programs. The site checks customers' eligibility, schedules installation appointments (when required), and synchronizes with the utility [customer information system \(CIS\)](#) application.

demand response event

A specific period when the demand response program administrator (ISO, utility) calls for load curtailment from its program participants.

demand response management system (DRMS)

A system used by utility companies to manage their [demand response \(DR\)](#) programs including communications with smart meters, demand-side smart devices (such as [HAN devices](#)), [Direct-to-Grid](#) load control switches, and so on.

Demand Response Manager (DRM)

A software application that allows utilities to monitor and manage power consumption with the goal of reducing demand, particularly during peak periods. This application has been replaced by [HAN Communications Manager \(HCM\)](#).

demand response/load control (DRLC)

Refers to specific load reduction actions that utilities can take to reduce demand during peak periods. Demand response can also use pricing incentives to accomplish these goals.

demand shedding

Any means to reduce energy consumption during critical peak periods or to reschedule demand to alternative non-peak times, such as during the night. When demand is moved to non-peak times, this is also known as [demand shifting](#).

demand shifting

See [demand shedding](#).

demand side management (DSM)

Refers to any means for electricity consumers to reduce their use, particularly during peak-load periods. Examples of DSM include communications with utility-company customers (such as those recommending that they offset use during upcoming peak-price events to save money) and enabling hardware and software. Silver Spring supports, for example, [programmable communicating thermostat \(PCT\)](#), [electric vehicle supply equipment \(EVSE\)](#), [load control switch \(LCS\)](#) products that utility company customers can use as part of their DSM solutions.

demand threshold

The number of kW used as a threshold in demand limiting.

deprovision

See [unjoin](#).

DES

See [Data Encryption Standard \(DES\)](#).

device

Access Point, Relay, meter, or HAN device. Meters can be electric, gas, or water. See also [Access Point \(AP\)](#), [Relay](#), [HAN devices](#), and [in-band interferers](#).

Device Language Message Specification (DLMS)

An application layer protocol for a messaging and transportation method that communicates between the meter and Silver Spring applications. Used with the data modeling provided by [COSEM](#) as a standard for utility meter data exchange for Silver Spring DLMS/COSEM meters.

Device Management Service (DMS)

A shared services component used for sharing information between applications. The central repository of critical device data, DMS enables deployment of non-metering applications without having to rely on the AMM database.

device states

Device status. The states that apply to devices in a Silver Spring Network are of two types: administrative states and operational states. Administrative states result from user or system input, including provisioning device data, installing new devices on the network, removing a device, or editing device details in Silver Spring applications. Advanced Metering Manager determines operational states from data gathered from the device and stored in the [RDBMS](#).

diffraction

The radio path between transmitter and receiver, obstructed by surfaces with sharp irregular edges. Waves bend around the obstacle. See also [reflection](#).

Digital Addressable Lighting Interface (DALI)

A lighting technology protocol managed under IEC standard 62386. DALI enables intelligent management of lighting equipment and is incorporated into [Silver Spring Smart Street Lighting](#) technologies.

direct access

The ability of a retail customer to purchase commodity electricity directly from the wholesale market rather than through a local distribution utility.

direct load control (DLC)

The ability of a utility to turn off appliances (such as air conditioners) in a [HAN Communications Manager \(HCM\)](#) network remotely to reduce load during peak periods. See also [HAN Communications Manager \(HCM\)](#).

direct sequence spread spectrum (DSSS)

Direct sequence spread spectrum systems transmit on a single selected frequency but on a very wide band. Only a small portion of that band is used for specially encoded information. Direct sequence spread spectrum offers an increase of processing gain for significant improvements in range. See also [frequency-hopping spread spectrum \(FHSS\)](#).

Direct-to-Grid

Method of communications that provides [demand response \(DR\)](#) solutions through a [Silver Spring network interface card \(NIC\)](#) integrated into devices such as a [load control switch \(LCS\)](#) or [electric vehicle supply equipment \(EVSE\)](#). This allows these devices to communicate directly through the mesh network without going through an [Energy Services Interface \(ESI\)](#).

disaster recovery

The process, policies, and procedures related to preparing for recovery or continuation of technology infrastructure critical to an organization after a disaster.

distributed generation

A distributed generation system that involves small amounts of generation or pieces of generation equipment applied to a utility's distribution system for the purpose of meeting local peak loads and/or displacing the need to build additional infrastructure. Distributed generation may be in the form of gas or propane generators, fuel cells, or solar.

Distributed Network Protocol (DNP)

A protocol widely used in SCADA networks for communications between a master station and RTUs or IEDs. DNP3 is the version currently supported. See also [remote terminal unit \(RTU\)](#), [intelligent electronic device \(IED\)](#), and [supervisory control and data acquisition \(SCADA\)](#).

distribution automation (DA)

The intelligent control and monitoring of the electrical power grid down to the distribution and substation

level. See also [supervisory control and data acquisition \(SCADA\)](#).

distribution power

A packaged power unit located at the point of demand. While the technology is still evolving, examples include fuel cells and photovoltaic cells.

DLC

See [direct load control \(DLC\)](#).

DLCA

See [Driver's License Certificate Authority \(DLCA\)](#).

DLMS

See [Device Language Message Specification \(DLMS\)](#).

DMS

See [Device Management Service \(DMS\)](#).

DNP3

See [Distributed Network Protocol \(DNP\)](#).

DNS

See [domain name system \(DNS\)](#).

domain name system (DNS)

An Internet service that translates alphanumeric domain names into numeric IP addresses. For example, the alphanumeric domain [www.silverspringnet.com](#) translated to its IP address through DNS is 64.207.187.4.

downstream / upstream

Refers to the relationship between devices along the route. Downstream refers to moving toward a meter. Upstream means moving toward an Access Point. See also [child](#) and [path](#).

DR

See [demand response \(DR\)](#).

DRE

See [Demand Response Enrollment \(DRE\) Portal](#).

Driver's License certificate

A digital identification given to a Silver Spring NIC that identifies which utility company the device belongs to. See also [birth certificate](#) and [Operator certificate](#).

Driver's License Certificate Authority (DLCA)

A shared service component, Driver's License Certificate Authority is a program located in the back office of a utility that issues a certificate (called a "driver's license"), allowing a network node to become

a member of that network. DLCA is a requirement for link layer and Master Meter security.

DRLC

See [demand response/load control \(DRLC\)](#).

DRM

See [Demand Response Manager \(DRM\)](#).

DRMS

See [demand response management system \(DRMS\)](#).

DSM

See [demand side management \(DSM\)](#).

DSSS

See [direct sequence spread spectrum \(DSSS\)](#).

dual-band antenna (oil filter)

A low profile omnidirectional antenna that can be used as a NAN or WAN antenna. The dual-band antenna is designed for outdoor wireless networks operating in either the cellular band or 2.4 GHz frequency range.

dual-band body mount antenna

An external, wireless antenna that operates in both 900 MHz and 2.4 GHz.

dual-band dipole antenna

A 3 dBi omnidirectional antenna that can be used in ISM bands to maximize the coverage radius.

duty cycle

The ratio of active time to total time in electrical systems (such as motors, refrigerators, and air conditioners). Modifications to heating, ventilating, and air conditioning (HVAC) system duty cycles can be made through demand response applications such as [HAN Communications Manager \(HCM\)](#) to reduce load at one or more customer premises.

dW

Deciwatt. A unit of power equal to 10000 watts.

dWh

Deciwatt-hours. A unit of energy equivalent to one Deciwatt (1 dW) of power expended for one hour.

Dynamic Host Configuration Protocol (DHCP)

An automatic configuration protocol used on IP networks.

E**EAI**

See [Enterprise Application Integration \(EAI\)](#).

eBridge

A device that uses [Ethernet](#) and serial connectivity to provide robust, two-way RF standards-based communications to support Distribution Automation applications such as asset management, Volt/VAR control, self-healing circuits, FCI communications, and distributed generation. See also [Bridge](#).

ECBOCA

See [back office certificate authority \(BOCA\)](#).

ECMT

See [Electricity Communications Module Tester \(ECMT\)](#).

effective isotropic radiated power (EIRP)

The output power when a signal is concentrated into a smaller area by the antenna.

EIRP

See [effective isotropic radiated power \(EIRP\)](#).

electric vehicle (EV)

A battery-powered automotive vehicle.

electric vehicle supply equipment (EVSE)

Charging devices designed specifically for recharging electric vehicles.

Electricity Communications Module Tester (ECMT)

A Silver Spring software tool that, in conjunction with the Silver Spring [Field Service Unit \(FSU\)](#), is used for testing the operational status of electricity meters equipped with Silver Spring NICs. The tool is used in combination with any method of powering an electricity meter, such as a meter test board. Tests include those for on-demand meter reads, secure maintenance link functions for ensuring device and network security, and meter/NIC verifications.

Electricity OEM Configurator

The Electricity OEM Configurator (formerly known as MUTT) programs, tests, and stores programmatic information used in device provisioning for Silver Spring NICs, electricity meter original equipment manufacturer (OEM) models specified for a given Silver Spring NIC, and supported Load Control Switch (LCS) devices.

electronic serial number (ESN)

A unique identifier embedded on every cellular phone device by the manufacturer. The ESN is transmitted with each cell phone call and is used to authenticate the phone with the cellular service the phone is attempting to use.

emergency supply capacity control (ESCC)

A function reserved for use during supply emergencies to ration power and avoid or minimize power outages.

end gap

A gap in the usage data existing between the last time the meter was read and the time usage data was last collected for the same meter. This is not problematic. See also [gap](#) and [unfillable gap](#).

endpoint

Meters, [electric vehicle supply equipment \(EVSE\)](#), FCIs, and HAN devices (such as load control switches, and street light controllers), distribution controls, cap bank switches, and other specialized network devices. Many endpoints are assigned to nodes.

energized

See [set](#).

energy

The use of power over time, expressed in kilowatt-hours (kWh). See also [demand](#) and [time of use \(TOU\)](#).

energy charge

An element in a two-part pricing method used in capacity transactions (capacity charge is the other element). This is the charge for the electricity used by an electric customer during the billing period, measured in kilowatt-hours (kWh). See also [capacity charge](#).

energy only meters

Meters that do not have their own programs (including meters running in EO mode) and rely on GMI (a generic meter interface software component of UtilOS) to provide load profile functionality.

Energy Services Interface (ESI)

The meter [Silver Spring network interface card \(NIC\)](#) when the HAN radio is activated. An active ESI enables communication to and from HAN devices in the

customer location. The ESI can support [ZigBee®](#), in which case it functions as a portal and communicates with ZigBee HAN devices. The ESI can also support a custom [direct load control \(DLC\)](#) protocol; in this case, the ESI is embedded inside a device — such as a [load control switch \(LCS\)](#) or [electric vehicle supply equipment \(EVSE\)](#) — and can control some of its functions.

Enterprise Application Integration (EAI)

A framework consisting of services and technologies the enterprise uses, and which acts as middleware enabling system and application integration across the enterprise.

enterprise service bus (ESB)

See [ESB Server](#).

EO

See [energy only meters](#).

ephemeral key

A relatively short-lived public or private key generated for each execution of a key establishment process. See also [public keys](#) and [private keys](#).

epoch

The time it takes a node to traverse all the channel time slots in its hopping sequence. See also [hopping sequence](#).

ESB Server

An shared services component used with Silver Spring applications. ESB Server functions as an external integration layer for Silver Spring applications that provides web service routing and services. It is required for [Advanced Metering Manager \(AMM\)](#), [AMM WS-Route](#), [Power Monitor](#), [SensorIQ™](#), and [Job Execution Framework \(JEF\)](#), [Provisioning API \(PAPI\)](#), [SSNI Services](#), [Trap Forwarder](#), [Trap Router](#), and [SSNI Agent](#)—which runs with [HAN Communications Manager \(HCM\)](#) and is used by [Demand Optimizer](#).

ESCC

See [emergency supply capacity control \(ESCC\)](#).

ESN

See [electronic serial number \(ESN\)](#).

ESP

See [Energy Services Interface \(ESI\)](#).

Ethernet

A specification for local communication networks that interconnects different kinds of computers, information processing products, and office equipment.

EV

See [electric vehicle \(EV\)](#).

event

In [Advanced Metering Manager \(AMM\)](#) and other Silver Spring applications, an action that occurs on any device in the network, including device configuration changes, schedule deployments, and errors. In meters and Access Points, events can be associated both with the device and with the Silver Spring NIC. All events have a severity level: Informational, Warning, or Error.

EVSE

See [electric vehicle supply equipment \(EVSE\)](#).

exception polling

A proactive outage detection technique where pings are sent to devices to see if they are still alive. Devices that do not respond may signify an outage.

export

Meter read data, for a specific date and time, contained in XML, OUSM (Ontario Utility Smart Metering), IEE (Institution of Electrical Engineers), Loadstar, or HHF (hand held format) files for integration with business systems.

external token

Refers to an external hardware device, such as a smart card or [hardware security module \(HSM\)](#), that the Certificate System uses to generate and store its key pairs and certificates. The Certificate System supports any hardware tokens that are compliant with PKCS #11. See also [PKCS #11](#).

F**faulted circuit indicator (FCI)**

A device that, if tripped, indicates a failed utility condition such as a power failure.

FCI

See [faulted circuit indicator \(FCI\)](#).

FHSS

See [frequency-hopping spread spectrum \(FHSS\)](#).

Field Installation and Support Handheld

A software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), runs on a portable handheld computer and is used to pair Gas IMUs with gas meters and configure the IMUs for operation over the Silver Spring mesh network.

Field Pairing Service (FPS)

A service that allows customers to install or swap Silver Spring NICs into meters in the field without any field tools. The back office manages the processes required to complete the provisioning with minimal user intervention.

Field Service Unit (FSU)

A portable tool used by field technicians to communicate with devices equipped with a Silver Spring [Silver Spring network interface card \(NIC\)](#) or NIC for configuration, troubleshooting, and other operations. It can also be used in a laboratory or meter shop to test and pre-configure devices before installation at customer sites.

filter

A band-pass filter, used to minimize out-of-band interference issues.

firewall

A system designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware and software or a combination of both.

firmware

A computer program embedded in a hardware device. See also [image](#) and [code float](#). See [UtilOS®](#).

Firmware Upgrader (FWU)

A Silver Spring application that manages the delivery, float, and activation of firmware over the wireless mesh network and provides image management, audits of upgrades, project management, and alerts related to the firmware update process. FWU can also perform audit jobs to make sure devices are running a specified firmware image and automatically run an upgrade job based on audit results.

FISH

Internal name no longer associated with [Field Installation and Support Handheld](#).

flat rate

A fixed billing rate for power consumers that does not vary during the day.

FQDN

See [fully qualified domain name \(FQDN\)](#).

frequency

Electromagnetic waves used to carry information over radio. For example, the selected radio station in your car is a frequency, which brings in the information you want.

frequency-hopping spread spectrum (FHSS)

Originally developed during the Second World War to avoid jamming, FHSS is a method of sending radio signals over several frequency channels. Unlike DSSS, FHSS switches between channels in a pattern known to both sender and receiver, thereby avoiding interference in any one channel. See also [direct sequence spread spectrum \(DSSS\)](#).

Fresnel zone

The elliptically shaped area formed by radio frequency waves between a transmitter and a receiver.

fronthaul

Contains utility-specific customer information and billing systems that are integrated into the Silver Spring application. The fronthaul link provides the connection between the utility data center and Silver Spring applications.

FSU

See [Field Service Unit \(FSU\)](#).

FSU Certificate Authority

A certificate authority that signs the FSU Smart Card certificates. See also [Field Service Unit \(FSU\)](#).

FSU-Secure Access Manager (FSU-SAM)

A shared services component that provides a web service used in conjunction with the [FSU](#) that protects an FSU from misuse by allowing an administrator to limit the number of secure maintenance links an FSU can issue within a configured amount of time based on role-based credentials and available credits. These secure maintenance links allow a user to issue critical commands (such as remote disconnects) from the FSU to the endpoint firmware. This protects the FSU and the network from misuse. See also [secure maintenance link](#) and [Field Service Unit \(FSU\)](#).

FTP

File Transfer Protocol. A protocol for transferring files over any network that supports TCP/IP. See also [Secure Copy \(SCP\)](#).

fully qualified domain name (FQDN)

Sometimes referred to as an absolute domain name. A domain name that specifies its exact location in the tree hierarchy of the DNP3. An FQDN is specified with a trailing dot, for example: somehost.example.com. See also [Distributed Network Protocol \(DNP\)](#).

FWU

See [Firmware Upgrader \(FWU\)](#).

G**gap**

Refers to a gap in the usage data collected from a meter. [Advanced Metering Manager \(AMM\)](#) automatically detects and fills such gaps. See also [end gap](#) and [unfillable gap](#).

gas day

A specific time of day when a gas meter begins its 24-hour day. For many utilities, the gas day is 9:00 AM, but this is not always the case.

Gas IMU Configurator

A software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), allows users to configure and test Silver Spring Gas IMUs. Supported tasks allow joining and unjoining Gas IMUs to gas meters, validating meter reading values with a check read, and generating configuration reports for specified Gas IMUs. After executing tasks, the Gas IMU Configurator produces results files which describe in detail what was loaded by the Gas IMU Configurator and the processing results. The primary use case for this tool is provisioning Gas IMUs in a utility's gas meter shop or in a gas meter OEM facility. See also [join](#), and [unjoin](#).

Gas Interface Management Unit (IMU)

A two-way radio with an integrated gas meter register that can be installed on diaphragm, rotary, and turbine gas meters. The IMU allows remote meter reading, and provides asynchronous alerts for leaks, meter tampering, and other critical events, and it can be remotely configured.

Gateway

A proxy and API service that authenticates applications and manages mesh-bound traffic, providing a common interface to the Silver Spring mesh network.

Gaussian frequency shift keying

A type of frequency shift keying modulation that utilizes a Gaussian filter to smooth positive / negative frequency deviations.

gear shifting

An innovation within the GenTM4 networking technology that lets a 300 kbps-capable device not only adjust data rates for backward compatibility but also to dynamically optimize between performance and range. See also [GenTM4 technology](#).

GECKO

Internal name no longer associated with [Gas IMU Configurator](#).

GenTM4 technology

A networking technology integrated into Silver Spring devices that provides support for new transports, our innovative Micromesh[®] technology, faster data rates, gear shifting, and increased memory. For coverage in any type of territory, the modular architecture of Gen4 enables customers to add support for cellular/mobile transport along with RF mesh and support for other transports in the future. The increased data rates support up to 300 kbps performance with lower latency, and the ability to gear shift to lower data rates supports not only backward compatibility with earlier generations of Silver Spring devices but also dynamic optimization between performance and range. Increased memory enables Gen4 to support the broadening range of new device types coming onto the smart grid. See also [Micromesh[®] technology](#) and [gear shifting](#).

GenTM5 technology

A networking technology integrated into Silver Spring devices that builds on [GenTM4 technology](#) with higher data capacity and increased and cost-effective coverage and dynamically optimized performance. Gen5 technology provides support for the [Access Point \(AP\)](#), [Bridge](#), [MicroAP[™]](#), [Milli[™]](#), [Silver Spring network interface card \(NIC\)](#), [Relay](#), and [SocketAP 5](#), which support the high data capacity of the network with data rates up to 1.2 Mbps.

general packet radio service (GPRS)

A wireless communications standard used most commonly in telephony for sending or receiving relatively small amounts of data.

generation capacity

The maximum output (MW) that generating equipment can supply to a system load.

Generic Meter Interface (GMI)

A software component of UtilOS. GMI is the metering interface to electricity meters operating in energy-only mode and IMUs. GMI provides meter reads and data logs and event logs of the meter data stored on the Silver Spring NIC. See also [Silver Spring network interface card \(NIC\)](#).

geographic information system (GIS)

A system that locates, manages, analyzes, and presents geographical information.

GFSK

See [Gaussian frequency shift keying](#).

GHz

See [gigahertz](#).

gigahertz

A unit of frequency equal to one billion hertz (one billion cycles per second).

GIS

See [geographic information system \(GIS\)](#).

Global Meter Reader (GMR)

The GMR component manages meter reading jobs, ping jobs, meter program processing, and generating export files. To balance meter reading loads and improve performance, GMR can be loaded on multiple servers each configured to manage discrete meter networks.

Global System for Mobile Communications (GSM)

A standard set developed by the European Telecommunications Standards Institute to describe protocols for second generation digital cellular networks used by mobile phones.

GMI

See [Generic Meter Interface \(GMI\)](#).

GMR

See [Global Meter Reader \(GMR\)](#).

GPRS

See [general packet radio service \(GPRS\)](#).

grid operator

The entity that oversees the delivery of electricity over the grid to the customer, while assuring consistently high levels of reliability and public and worker safety. The grid operator potentially could be independent of the utilities and suppliers.

GridScape® Configuration Server

An application used for configuring Access Points (APs) and MicroAPs in Silver Spring networks. Unlike the [GridScape® Network Manager](#), the GridScape Configuration Server does not collect statistical data.

GridScape® Network Manager

An application that supports out-of-band management (through an [Access Point \(AP\)](#) as well as in-band management through an [eBridge](#)) for polling, event management, diagnostics, real-time visualization, auditing, and security measures in a [distribution automation \(DA\)](#) network.

gross generation

The total amount of electric energy produced by the generating units at a generating station or stations, measured at the generator terminals.

GSM

See [Global System for Mobile Communications \(GSM\)](#).

GWh Gigawatt-hours

One billion watt-hours.

H**HA**

See [high availability \(HA\)](#).

HAN

See [home area network \(HAN\)](#).

HAN Communications Manager (HCM)

A Silver Spring application that enables utility companies to manage [home area network \(HAN\)](#) devices (including [ZigBee®](#) and [Direct-to-Grid](#) devices) and [electric vehicle supply equipment \(EVSE\)](#), utility company rate plans, and create and manage [demand response \(DR\)](#) programs.

HAN devices

Devices that are used in the home or [small and medium business \(SMB\)](#) to help customers control and monitor their electricity use and, in some cases, to respond to [demand response \(DR\) price signals](#). Examples of HAN devices are the [programmable communicating thermostat \(PCT\)](#), [load control switch \(LCS\)](#) and similar devices, and [in-premises display](#).

HAN Test Kit

A Silver Spring application that, in conjunction with the Silver Spring [Field Service Unit \(FSU\)](#), enables home area network (HAN) device vendors to test their HAN devices with Silver Spring equipment and the [ZigBee® Smart Energy Profile \(SEP\)](#) implementation to confirm correct interoperation. The tests go beyond what the base ZigBee SEP standards specify, as ZigBee allows room for interpretation in a number of areas.

hand held format (HHF) files

Files that contain meter interval read data.

hardware security module (HSM)

An appliance that stores sensitive credentials or private keys in hardware protected memory. It is FIPS-140-2 level 3-compliant, with provisions for tamper evidence and tamper prevention. It also provides hardware-based acceleration for cryptographic operations such as signing, and encryption. It is used in Silver Spring Networks products such as COP for AMI, COP for DR, and KeySafe.

hash value

A block of data represented as a string of bits. See also [program seal](#).

HCM

See [HAN Communications Manager \(HCM\)](#).

hertz

A unit of frequency equal to one cycle per second (cps). One kilohertz equals 1,000 cps; one megahertz equals 1 million cps; one gigahertz equals 1 billion cps.

HHF files

See [hand held format \(HHF\) files](#).

HID

See [high-intensity discharge \(HID\)](#).

high availability (HA)

A system design approach and associated service implementation that ensures that a prearranged level of operational performance will be met during a contractual measurement period.

high gain fiberglass (stick antenna)

An omnidirectional stick antenna designed for 800 MHz and 900 MHz ISM bands. It is suited for multipoint, non line of sight (NLOS), and mobile applications where high gain and wide coverage is required.

high-intensity discharge (HID)

A type of lighting technology commonly used for street lights where light is produced by an electric arc generated between tungsten electrodes that are contained within a fused alumina or quartz tube.

high-pressure sodium (HPS)

a type of street light technology, very common, and predates [light-emitting diode \(LED\)](#) development for street lights.

home area network (HAN)

A data communications system contained within the home or [small and medium business \(SMB\)](#) location that provides communication to and from [HAN devices](#).

hop

When data is transmitted across a network, the packet hops from device to device. A hop is a point along a network route between the [Access Point \(AP\)](#) and the meter. Though technically not a device, a hop is always associated with a device, usually a Relay or meter acting as a Relay. See also [link](#) and [route](#).

hopping sequence

When a node selects a random start channel and seed to reduce the amount of interference with other nodes within range. See also [channel](#).

hosting location

The physical location of an Access Point or Relay.

HPS

See [high-pressure sodium \(HPS\)](#).

HSM

See [hardware security module \(HSM\)](#).

Hz

See [hertz](#).

I**IDR**

See [interval data recorder \(IDR\)](#).

IEC

See [International Electrotechnical Commission \(IEC\)](#).

IED

See [intelligent electronic device \(IED\)](#).

IEEE

Institute of Electrical and Electronics Engineers. A very prominent standards body for the electrical, telecommunications, aerospace, and engineering industries.

IHD

See [in-home display \(IHD\)](#).

IKE

See [Internet Key Exchange \(IKE\)](#).

image

Firmware or software programming code that can be copied to multiple programmable chips in one or more devices, such as Silver Spring NICs or electricity meters. See also [firmware](#) and [code float](#).

IMU

See [Gas Interface Management Unit \(IMU\)](#).

IMU Accuracy Tester

Hardware and software that, in conjunction with a [Field Service Unit \(FSU\)](#), is used in OEM and meter shops for testing the basic functionality of new and field-returned Gas IMUs and to log test results. Testing covers counting accuracy, radio frequency links, and event logging. See also [Gas Interface Management Unit \(IMU\)](#).

in-band interferers

Transmitters in the same ISM band that are not part of Silver Spring' transmitters. See also [ISM band](#).

inclining block rate

An electricity billing rate that increases across tiers with the customer's energy use.

info success rate

The percentage of data packets that succeed when a process sends a poll to a specific node and receives an acknowledgment. Calculated by:
$$(\text{successes} / (\text{successes} + \text{failures})) * 100$$

in-home display (IHD)

See [in-premises display](#).

in-premises display

A device that shows consumers their electricity usage. Often, the in-premise display and smart thermostat are housed in the same physical unit. Also referred to as [in-home display \(IHD\)](#).

Installer Portal

A Silver Spring software tool used by utilities and third-party installers for installing HAN devices. With the Installer Portal, installers can provision HAN devices in the field, and administrators can set and manage application user permissions.

instantaneous voltage

The voltage between two points at a particular moment in time.

intelligent electronic device (IED)

Any of the remote controller units that function as part of the utility network and which can be managed in the smart grid. Capacitor banks, reclosers, and switches are types of IEDs. Transformers are typically not IEDs because they are not intelligent devices.

Silver Spring smart grid infrastructure devices (such as eBridges) communicate with IEDs. The generic term IED is preferred to the specific term [RTU](#) because RTUs are not typically intelligent devices.

Utility companies also refer to IEDs as DA devices, Field Device Controller (FDC), [programmable communicating thermostat \(PCT\)](#), or [supervisory control and data acquisition \(SCADA\)](#) device.

See also [remote terminal unit \(RTU\)](#), [distribution automation \(DA\)](#), and [supervisory control and data acquisition \(SCADA\)](#).

interferers

See [in-band interferers](#) and [out-of-band interferers](#).

internal token

A pair of files, usually called the certificate database and key database, that the Certificate System uses to generate and store its key pairs and certificates. The Certificate System automatically generates these files in the file system of its host machine when first using the internal token.

International Electrotechnical Commission (IEC)

An international standards body that prepares and

publishes International Standards for all electrical, electronic and related technologies. Also defines a type of Silver Spring meter.

Internet Key Exchange (IKE)

A protocol used to set up a secure association between the network and the NIC. See also [secure association \(SA\)](#).

Internet of Things (IoT)

A term that applies to any software, hardware, or firmware that enables communications to and from a variety of end devices across an Internet-connected network. Devices can be, for example, traffic signals, parking meters, bicycle-rental kiosks, digital signs, video cameras, and motion and environmental sensors.

Internet Protocol Security (IPsec)

A security protocol suite developed and maintained by the Internet Engineering Task Force (IETF) to protect Internet Protocol (IP) traffic by encrypting packets and by providing end-to-end authentication. [GridScape® Configuration Server](#) and [Bridge Configurator](#) support IPsec tunnels as a firewall feature.

interruptible capacity

An interstate pipeline, with backbone transmission or storage capacity, which may be available from time to time, but cannot be assured under all operating conditions.

interruptible load

Refers to program activities that, in accordance with contractual arrangements, can interrupt consumer load at times of seasonal peak load by direct control of the utility system operator or by action of the consumer at the direct request of the system operator. Interruptible load activities usually involve commercial and industrial consumers.

interruptible power

Power that can be interrupted or curtailed by the supplier, usually under the agreed-upon guidelines of the parties involved.

interruptible rate

A special utility rate given to certain industrial customers who have a agreement with their electric provider to have their service reduced or temporarily stopped.

interval data recorder (IDR)

A solid-state electronic device that measures consumption among high-usage commercial and industrial accounts. The data collected is used by a utility to determine peak demand times and adjust its distribution system accordingly.

interval read

A meter recording usage data on a periodic basis (for example, every 15 or 60 minutes) is known as an interval or *load-profile meter*. An interval read is the act of reading the interval values stored in the meter. The interval values are stored in channels. See also [consumption read](#) and [load-profile meter](#).

IoT

See [Internet of Things \(IoT\)](#).

IoT Edge Router

A hardware device that enables customers to securely connect a variety of city and utility devices—including those that require legacy-protocol support—across a common RF mesh network infrastructure using proven open standards and interfaces and networking protocol support. This support includes a secure and standards-based architecture for both IPv4 and IPv6 communications with Linux-based network-edge computing capability.

Whether connected devices are new or legacy, the IoT Edge Router provides the processing horsepower and new data sources customers need to more efficiently and effectively apply existing city-wide resources.

IPARM

Internet Protocol Address Resolution Map. Specifies how IPv4 addresses on Remote Bridges are advertised to the Master Bridge for routing purposes. See also [Bridge](#).

IPv6

Internet Protocol Version 6. A network layer standard that enables devices to communicate over a packet-switched network.

ISM band

Industrial, Scientific, and Medical band. ISM bands are defined by the ITU-R in 5.138, 5.150, and 5.280 of the Radio Regulations. For the United States, the 902-928 MHz band is an unlicensed frequency band governed by FCC, Part 15. For the European Union, Dubai, and other locations, 865–880 MHz is used, and in Europe

and some countries outside of Europe, ETSI is responsible for ISM band regulation.

J**JEF**

See [Job Execution Framework \(JEF\)](#).

JMS Bridge

A shared services component and stand-alone Java application that forwards messages from Silver Spring internal message queues to customer message queues.

job

In [Advanced Metering Manager \(AMM\)](#) and other Silver Spring applications, a job is a running or scheduled process, including but not limited to metering schedules, imports, exports, and reports. In common usage, the term *schedule* is reserved for jobs that read meters over the network. See also [Secure Copy \(SCP\)](#) and [schedule](#).

Job Execution Framework (JEF)

A Silver Spring ESB application installed on [ESB Server](#) that is used by [Power Monitor](#) and [SensorIQ™](#). JEF provides quartz job scheduling, job monitoring, and persistence. Job management and monitoring are accomplished with a set of web service calls between JEF and the Power Monitor or SensorIQ task framework.

jobs interface

The web services API used to run and manage jobs. See also [application programming interface \(API\)](#).

join

A Silver Spring NIC and its meter are said to be joined when they have been assembled, configured, tested, and communicating together as designed. See also [Silver Spring network interface card \(NIC\)](#), [Gas Interface Management Unit \(IMU\)](#), and [unjoin](#).

With [Gas IMU Configurator](#), *join* means connecting a gas IMU to a gas meter so it wakes up and transmits read results to a proxy device on the network. The proxy device sends the read results on to the back office.

With [HAN Communications Manager \(HCM\)](#), *join* means that a device has been associated with an [Energy Services Interface \(ESI\)](#), and an authorization has successfully completed or a joined device

deprovision has failed. Join is also referred to as provision. See also [associate](#).

J-pole antenna

An end-fed omnidirectional, half-wave dipole antenna. Used in conjunction with Silver Spring Relays and Access Points.

K**kbits**

Kilobyte per second.

KeySafe

A shared repository in the headend or back office that uses a Hardware Security Module (HSM) to securely store credentials (private keys) required for authenticating and authorizing entities in the Silver Spring system. It is also used to securely store negotiated symmetric keys used for protecting (encrypting, validating the authenticity of) data exchanged between back office applications and the field endpoints. See also [hardware security module \(HSM\)](#), [Critical Operations Protector for Advanced Metering Infrastructure \(COP for AMI\)](#), and [Critical Operations Protector for Demand Response \(COP for DR\)](#).

keystore

A location where the most sensitive private keys and certificates are stored in the Silver Spring back office. Two options exist for this purpose: one or more designated slots in a hardware security module (HSM), preloaded with private keys and certificates or a text file containing the same content and installed to a server. See also [private keys](#) and [hardware security module \(HSM\)](#).

KHz

See [Kilohertz](#).

Kilohertz

A measure of frequency equal to 1,000 cycles per second.

kVA

Kilo Volt Ampere.

kVAh

Kilo Volt Ampere Hours.

kVAR

Kilo Volt Ampere Reactive. A measure of reactive energy usage. See also [Vrms](#), and [reactive power](#).

kVAR lag

The inductive reactance, or how much the voltage lags the current, of the circuit. See also [reactive power](#).

kVAR lead

The capacitive reactance, or how much the voltage leads the current, of the circuit. See also [reactive power](#).

kVARh

Kilo Volt Ampere Reactive Hours. A unit of energy equivalent to one kVAR of power expended for one hour. See also [V](#) and [reactive energy](#).

kW

Kilowatt. A unit of power equal to 1000 watts.

kWh

Kilowatt-hour. A unit of energy equivalent to one kilowatt (1 kW) of power expended for one hour.

L**lag**

See [kVAR lag](#).

LAN

See [local area network \(LAN\)](#).

last gasp (LG)

An asynchronous message from an electricity meter that indicates the meter has lost power. Also known as a power out message. Last gasps can result when the loss-of-power PIN becomes active, when zero crossing events are missed, or when a transition from utility power to battery power occurs. There is no guarantee that a last gasp will be received by any other device in the network. See also [power out message](#), [zero crossing](#), and [ZigBee®](#).

last known good (LKG)

Last known good image. If a new image is not compatible with a device, Communications Tester commands can be used to revert to a previous image that was known to work.

last read pointer (LRP)

A sequence number that indicates reads that have already been recorded in Silver Spring applications.

For interval reads, reads can start at the LRP so only the data available since the last time the meter was successfully read is included in the read and read report. See also [interval read](#).

LC

Load Control. See also [load management](#).

LCC

See [Load Control Configurator \(LCC\)](#).

LCS

See [load control switch \(LCS\)](#).

LDAP

Lightweight Directory Access Protocol. An application protocol for reading and editing directories over an IP network.

lead

See [kVAR lead](#).

LED

See [light-emitting diode \(LED\)](#).

Legacy Port Off (LPO)

The Legacy-Port-Off tool shuts off the legacy port (also called the clear-text port), and forces any data source, including an FSU, to instead send data through the secure port 648 to reach the Silver Spring NIC in an end point. After four days, the Silver Spring NIC in the end point redirects traffic back through the legacy port if neither of the following have taken place: no successfully completed secure associations were detected; no legally credentialed commands were executed.

Application-layer security must be enabled in the back office before this internal use-only tool can be used.

LG

See [last gasp \(LG\)](#).

light-emitting diode (LED)

A type of lighting technology increasingly used for street lights, in particular to replace existing [high-pressure sodium \(HPS\)](#) street lights.

line of sight (LOS)

A direct path, free of clutter, between a transmitter and a receiver.

link

A connection between devices in a network. See also [hop](#) and [route](#).

link budget

The total amount of radio frequency power available to establish a link between the transmitter and receiver, expressed mathematically:

$$\text{PLinkBudget} = \text{PTx} - \text{PTxLoss} + \text{PTxAntenna} + \text{PRxAntenna} - \text{PRxLoss} - \text{PRxSensitivity}$$

link layer

A physical and logical network component that connects devices in a network. Sometimes called the data link layer or L2. See also [mesh network](#).

link layer security

As implemented for Silver Spring, a security solution that protects RF mesh traffic and reduces the threat of denial-of-service attacks by preventing a device's access to a network unless that device can be authenticated.

link quality

The overall radio frequency quality of a link between a transmitter and receiver. Often expressed in terms of message success rate and signal strength. See also [message success rate \(MSR\)](#) and [received signal strength indicator \(RSSI\)](#).

LKG

See [last known good \(LKG\)](#).

load

The electric power used by devices connected to an electrical generating system. This encompasses the amount of electric power required to meet customers' use in a given period and the amount of electric power delivered or required at any specific point or points on a system. The power requirement originates at the customers' energy-consuming equipment.

load aggregation

An aggregation of energy consumption from facilities that are geographically separate from each other. Used for acquiring and billing utility services.

load control

Having and exercising direct control over appliances or equipment at a customer's premise to lower peak demand.

Load Control Configurator (LCC)

A software tool that, in conjunction with a [Field Service Unit \(FSU\)](#), is used for verifying Direct-to-Grid load control switch installation, configuration, upgrades, and for field troubleshooting and repair. The tool provides the core functionality for configuring the switch, validates network connectivity to the switch, tests its ability to shed load, and troubleshoots potential issues during or after initial installation.

Direct-to-Grid [load control switch \(LCS\)](#) installers can use LCC to: Apply a configuration profile to a switch based on how it was installed and the types of devices connected (for example, conventional AC versus heat pump systems), verify switch operations (for example, ensuring that it can turn load on and off), and record additional information about loads connected to the switch (such as type and size of the HVAC compressor).

load control event

A [HAN Communications Manager \(HCM\)](#) event that is generated if the total load is above a certain threshold. See also [HAN Communications Manager \(HCM\)](#).

load control switch (LCS)

A switch that utilities or consumers can use remotely to temporarily turn off devices that are connected to the network. Silver Spring supports both [ZigBee®](#) and [Direct-to-Grid](#) LCS implementations for these devices. See also [physical relays](#) and [virtual relays](#).

load factor

The average power divided by the peak power for some period of time.

load forecast

The estimation of electricity or natural gas demand, or energy consumption, for a future time.

load management

Shifting use of electricity from periods of high demand to periods of lower demand, when the cost of electricity usually is lower. Also known as Load Control (LC.)

load profile (LP)

A graphical representation of electricity load over time. A measurement of a customer's electricity usage over a period shows how much and when a customer uses electricity. Load profiles can be used by transmission system operators to forecast electricity supply.

load-profile meter

A load-profile electricity meter records load (electricity usage) in hourly, 15-minute, or other intervals. See also [interval read](#).

load shedding

The process of deliberately removing preselected customer demand from a power system in response to an abnormal condition to maintain the integrity of the system and minimize overall customer outages.

local area network (LAN)

Computers and other devices that share a common link within a geographic area. See also [neighborhood area network \(NAN\)](#) and [wide area network \(WAN\)](#).

local CHAP password

See [Challenge Handshake Authentication Protocol \(CHAP\)](#).

logical unit number (LUN)

In computer storage, a logical unit number or LUN is a number used to identify a logical unit, which is a device addressed by the SCSI (Small Computer System Interface) protocol or similar protocols such as Fibre Channel or iSCSI. LUNs are most often used to refer to a logical disk as created on a [SAN](#).

LOS

See [line of sight \(LOS\)](#).

low-profile disc antenna (hockey puck)

A flat "hockey puck" style antenna for use with pad-mounted transformers and other applications that need a flat antenna.

LP

See [load profile \(LP\)](#).

LPO

See Legacy Port Off (LPO).

LRP

See [last read pointer \(LRP\)](#).

luminaire

Any apparatus that distributes, filters, or transforms light transmitted from one or more lamps and which includes, besides the lamps themselves, all parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply.

LUN

See [logical unit number \(LUN\)](#).

M**MAC**

Media Access Controller. A unique hardware identifier for network equipment.

Mandatory Access Control. An access control mechanism that defines user access rights.

MAIFI

See [Momentary Average Interruption Frequency Index \(MAIFI\)](#).

maintenance factor

In street light [central management software \(CMS\)](#) systems, maintenance factor is used to take into account how long it has been since the fixture has been cleaned. When the light has just been cleaned, the NIC firmware reduces the value by a maximum amount. The value sent to the control board gradually increases until the maintenance period has passed, at which point there is no reduction by the firmware.

Managed Appliance

See [Silver Spring Appliance](#).

MANTIS

Internal name no longer associated with [Electricity Communications Module Tester \(ECMT\)](#).

manufacturing station certificate

One of three credentials embedded in NIC firmware at the time of manufacture. This is the certificate in the chain between the birth certificate and the root.

master device

A device that controls a remote device. A master device is typically deployed as a core device and a remote device is typically deployed as an edge network device. See also [remote device](#).

Master Failover Protocol (MFP)

Enables High Availability and load balancing of Distribution Automation connections through multiple Master Bridges. See also [high availability \(HA\)](#), [distribution automation \(DA\)](#), and [Bridge](#).

maximum demand (peak demand)

The highest [demand](#) measured over a selected period of time (typically within a billing period). See also [cumulative max demand](#).

Mcf

A measure of volume of natural gas equal to 1,000 cubic feet or approximately one decatherm.

MD5

Message-Digest algorithm 5. A 128bit cryptographic hash function widely used for file integrity. See also [Secure Copy \(SCP\)](#).

MDMA

Meter Data Management Agent. In a deregulated energy market, an MDMA is an entity that is certified to collect and distribute metering information on behalf of utilities, energy service providers, or end customers.

MDMS

See [meter data management system \(MDMS\)](#).

measurable outage or measurable duration

An outage that can be measured, that is, one that has a duration of longer than n , where n is configurable in UtilOS (NIC firmware), but defaults to 100 milliseconds. See also [momentary outage](#).

megahertz

A unit of frequency equal to one million cycles per second.

mesh network

A LAN of continuously connected meter end nodes, Access Points, and Relays that connect to and communicate with adjacent nodes via multiple hops. In a mesh network, devices collaborate to propagate the data in the network. See also [local area network \(LAN\)](#).

message success rate (MSR)

The percentage of packets that are transmitted (by the Access Point) and also acknowledged (by the meter).

The MSR is derived from successful packet transmission during scheduled reads, on-demand reads, and segment retries. MSR is a metric for packet transmission and how well the Access Point communicates with a meter. See also [billing success rate \(BSR\)](#), [read \(meter read\)](#), [one-time schedule](#), and [on-demand read \(ODR\)](#).

meter badge

A label on a gas meter that includes the meter ID and

meter capacity.

meter capacity

Electricity meters: The class rating of the meter. A typical residential meter may have a class value of 200, meaning it can pass 200 amps.

Gas meters: The nominal rating of the meter volume. Meter manufacturers typically size this in terms of cubic feet per hour. For example, a 250 cfh meter has a capacity of 250 cubic ft per hr.

Water meters: Water meters typically measure and display total usage in cubic feet (ft.3), cubic meters (m3), or US gallons.

meter data management system (MDMS)

A system that performs long term data storage and management for the large quantity of data delivered by smart metering systems. The MDMS imports the meter data and validates and processes it so it can be used for billing and analysis.

meter index

The dials or LCD on the front of a meter which indicate the volume of gas that has passed through the meter.

Meter Patch Antenna Coupler (MPAC)

A passive microstrip antenna and coaxial cable for connecting a meter equipped with a Silver Spring NIC to a remotely mounted antenna. This hardware is intended for meters that are located in hard-to-reach locations, such as meter rooms and metal enclosures. The antenna coupler boosts the RF signal, so the signal can get to the hard-to-reach meters. The kit includes the antenna coupler, a template to help position the antenna on the meter, and other components to assist the process.

Meter Plugins

Software that Silver Spring provides for each meter manufacturer and standard and that adds a specific set of functions to a larger software application. For example, there is one Plugin for Itron [C12.19](#) meters and another for all Itron [DLMS/COSEM](#) meters. All metering functionality particular to the meter is contained in its Plugin.

meter program

A program utilities deploy on the meter that specifies how the meter functions.

Meter Program Configurator (MPC)

A Silver Spring application that remotely programs and configures both energy-only and advanced digital electricity meters on a mass scale.

meter program mode

The electricity meter program mode can be Demand (measures demand only), Demand/LP (measures demand and uses a load profile), or TOU. See also [demand](#), [load profile \(LP\)](#), and [time of use \(TOU\)](#).

meter record

A record that is associated with a customer record and that contains meter reading and billing data, high / low checks, and survey information.

MFP

See [Master Failover Protocol \(MFP\)](#).

MicroAP™

A Silver Spring NIC that includes a cellular modem that can be configured to act as a self-contained Access Point (AP). This is especially useful to connect isolated or hard-to-reach devices. See also [Micromesh® technology](#) and [Silver Spring network interface card \(NIC\)](#).

Micromesh® technology

The Silver Spring technology used when a WAN-enabled Silver Spring NIC connects to nearby grid devices via an RF mesh and acts as their take-out point for the WAN. This option allows utilities to adapt the number of cellular connections needed based on such factors as topology, coverage, density, bandwidth requirements, and the pace of deployment.

Milli™

A Silver Spring Networks NIC used for monitoring and managing battery-powered meters.

minimum demand

The lowest [demand](#) measured over a selected period of time.

mirroring

Mirroring meter data allows the NIC to support battery-backed and [ZigBee®](#)-enabled gas and water meters that only activate for short periods to conserve energy.

Momentary Average Interruption Frequency Index (MAIFI)

Calculated by: momentary customer interruptions / total customers in system. See also [System Average Interruption Duration Index \(SAIDI\)](#) and [System Average Interruption Frequency Index \(SAIFI\)](#).

momentary outage

An outage that cannot be measured, that is, one that has a duration of less than n , where n is configurable in UtilOS (NIC firmware), but defaults to 100 milliseconds. See also [measurable outage](#) or [measurable duration](#).

morning of adjustment factor

The ratio of the average load for the first three of four hours before a demand response event to the average load for the same hours from the previous ten similar days.

morphology

The combination of terrain and surface clutter.

mounting equipment

Hardware equipment for mounting Access Points and Battery Backups to a range of utility assets. Mounting kits are offered in several formats including:

- Utility pole kits (wood/concrete)
- Light-pole/lamp-arm kits
- Wall kits
- Pad-mounted enclosure kits

MPAC

See [Meter Patch Antenna Coupler \(MPAC\)](#).

MPC

See [Meter Program Configurator \(MPC\)](#).

MSR

See [message success rate \(MSR\)](#).

Mule ESB

A shared services component that functions as an external integration layer that provides web service routing and extended services and APIs.

multihomed

For Silver Spring devices, describes IP addresses that are assigned to multiple port interfaces.

multi-role certificate

In UtilOS v2.0.2 and later, certificates can have multiple roles encoded in them. Each role is mapped to

a set of commands that the authorized certificate holder can perform.

MUTT

See [Electricity OEM Configurator](#).

MW

Megawatt. One million watts.

mW

Milliwatt. One thousandth of a watt.

N**NAN**

See [neighborhood area network \(NAN\)](#).

NDR

See new data read (NDR)

NEC

See [Network Event Collector \(NEC\)](#).

neighbor table

A memory structure within each Silver Spring NIC to store data about its neighboring Silver Spring NIC-enabled devices. See also [Silver Spring network interface card \(NIC\)](#).

neighborhood area network (NAN)

A wireless network for a small geographic area.

NEM

See [Network Element Manager \(NEM\)](#).

net metering

Net metering applies to energy customers, such as commercial and industrial users, who both generate and purchase power. Utilities need to meter the power generated by customers to determine the credit the customer should receive. A net register calculates energy to be billed by subtracting power received from the customer from the power delivered to the customer.

Network Center

A network management application (formerly CEP NMS) that provides advanced network management capabilities such as fault management and performance management.

Network Center ES is a customized version of Elasticsearch search server software used by Network Center.

network discovery

When a new node is first energized, it broadcasts a discovery message. The discovery message is received by all Silver Spring NICs that share the same Network ID and are in range. Each node collects basic health data from its neighboring nodes and calculates an egress route to either an Access Point or to a Bridge Master. See also [route](#).

Network Element Manager (NEM)

A Silver Spring application that provides fault management through asynchronous notifications to alert operators of potential issues at a remote node without waiting for a polling schedule to request status.

NEM receives notifications, including electricity meter last gasps, forwarded by neighbor nodes acting as proxies for the node emitting the last gasp. When an electricity meter loses power, its NIC can emit a last gasp message. Neighbor nodes forward all last gasps they receive.

Network Library

A library of commands for running jobs on the network. Also referred to as NIC NAC.

Network Manager Entity Certificate Authority

Signs the Network Manager (NM) entity certificates; may be multiple Certificate Authorities with different privileges depending on operator requirements. See also [NMEntity \(Network Manager Entity\)](#).

network operations center (NOC)

Location where monitoring and control devices manage a communications network.

NIC

See [Silver Spring network interface card \(NIC\)](#).

Network Event Collector (NEC)

NEC is a centralized NIC and application event collection and repository for Silver Spring and third-party applications. NEC reads new events from NICs and [load control switch \(LCS\)](#) devices at a scheduled interval or on demand and sends them to applications through a JMS queue. You can use the JMX console to schedule the job with a cron expression. An application may also schedule an on-demand job through a web service API.

NICNAC

The secure communications library Silver Spring Networks uses to communicate securely with devices.

NMEntity (Network Manager Entity)

PKI entity used in the certificate signing chain, based on the Net Manager protocol proprietary to Silver Spring. Also refers to a slot (KeySafe slot) within an HSM, used to securely store the private keys and certificates of some Silver Spring [advanced metering infrastructure \(AMI\)](#) and [distribution automation \(DA\)](#) applications. See also [Network Manager Entity Certificate Authority](#).

NOC

See [network operations center \(NOC\)](#).

node

A network device. Examples include electricity meters, Relays, and IMUs.

nodeq

A list of all neighboring nodes which are currently in the active state – meaning that links to each have been established and are currently being maintained. Also known as Node Queue. See also [neighbor table](#).

Node Queue

See [nodeq](#).

NodeSim

An application for simulating meter endpoints on the network for use in development and test environments. Supported device types include GMI/C12.19/PRI meters, Gas IMUs, Access Points, and Bridges. The application receives typical meter requests from Advanced Metering Manager (AMM)—such as interval reads and replies—with data responses in the same structure as provided by non-simulated NICs. NodeSim supports the simulation of meter data, as well as testing of the UtilOS firmware update process

NodeSim is used primarily for large scale testing (hundreds to millions of Silver Spring smart devices), testing features that cannot easily be reproduced on real meters, such as generating certain event logs or setting status flags, and for development and troubleshooting in a controlled and reproducible environment.

non line of sight (NLOS)

When the path between a transmitter and a receiver is completely or partially obscured by houses, trees, and other objects.

non-technical loss

Power system losses attributed to factors external to power transmission and distribution that are not naturally occurring or expected. Common causes for these losses are deliberate tampering with the system, component malfunctions or misconfigurations, billing errors. Non-technical losses between 1 and 2% are typical, but these losses can be much higher depending on the region and other factors. See also [technical losses](#).

O**ODR**

See [on-demand read \(ODR\)](#).

ODS

See [Outage Detection System \(ODS\)](#).

off-peak

Related to electricity use during periods of time when prices tend to be lowest due to decreased demand.

OLC

See [outdoor lighting controller \(OLC\)](#).

OMS (OM)

See [outage management system \(OMS or OM\)](#).

on-demand read (ODR)

An ODR functions much like a one-time schedule performed for one meter. However, a crucial difference is that an ODR occurs immediately in real time with high priority. See also [one-time schedule](#).

on-peak

Related to electricity use during periods of time when prices tend to be highest due to increased demand.

one-time schedule

A schedule with a frequency of one-time. See also [Secure Copy \(SCP\)](#).

Open Systems Interconnection (OSI)

A standard reference model for how messages are transferred between any two points in a network. The OSI reference model defines seven layers of function that take place at each end of a communication. It serves as a standard by which diverse applications can communicate with one another.

Operations Optimizer

A customer care and outreach, grid management, and network management application (formerly branded as Detectent products) that includes the following modules:

- **AMI Operations:** An analytics module that identifies and diagnoses meter data collection and delivery problems, monitors for meter safety issues, and manages [advanced metering infrastructure \(AMI\)](#) deployments and network performance. For example, it can identify failed, unreachable, and high-temperature meters, and [Access Point \(AP\)](#) and [Relay](#) health issues.
- **Customer Programs:** An analytics module that enables utilities to better plan, deliver and measure demand-side management programs. The module includes smart meter disaggregation analytics that operate on hourly consumption data to predict the type and number of appliances in a residential account in order to improve customer segmentation and targeting.
- **Grid Operations:** An analytics module that aggregates and analyzes metering loads across the distribution system to identify asset risks and connectivity mismatches, support load planning, and estimate technical losses.
- **Revenue Assurance:** An analytics module that identifies theft and other non-technical losses by analyzing feeder imbalances and identifying tampered or bypassed meters. It also provides workflow, field investigation, and billing capacities.

Operator certificate

A digital identification that associates a meter with a specific utility. See also [birth certificate](#) and [Driver's License certificate](#).

OpsGuard

A service provided to Silver Spring licensed customers that allows them to better monitor their system, and also allows Silver Spring to view the system for troubleshooting purposes.

OpsIQ™

A network management application that includes the following modules:

- **Meter Center:** A module that provides meter status and performance information for each meter including read time, meter status, and meter rooms. The module can help to reduce the time and number of physical visits to troubleshoot meter problems. The module also monitors meter

temperature for an entire service territory, enabling proactive remediation of meter temperature issues. And it can be used to identify meters with temperatures that fall outside of a customizable threshold.

- **Network Center:** A module that provides mesh network performance data, allowing customers to see the hop count and device state of every meter in their network. The module also enables improved network remediation.
- **Operations Center:** A module that monitors [Access Point \(AP\)](#) and [Relay](#) status for [advanced metering infrastructure \(AMI\)](#) customers, and tracks and displays all alerts in a single view. The module enables easy integration with existing management tools used in network operations centers (NOCs) and can reduce troubleshooting time for APs and Relays.
- **SilverLink Console:** A module that provides back-office network monitor status, including application and infrastructure monitors for hosted and managed [advanced metering infrastructure \(AMI\)](#) customers. The module also delivers improved visibility into business metrics for AMI through real-time monitors and dashboards.

optical port

An infrared port on some types of electricity meters that allows network access for meter reads, meter program changes, and other communication.

OSI

See [Open Systems Interconnection \(OSI\)](#).

OTA

See [over-the-air](#) on page 34.

Outage Detection System (ODS)

A Silver Spring application that manages outage-related messages from electricity meters, including /last gasp and power restore messages. Unlike an OMS, ODS does not include a work order management system. See also [outage management system \(OMS or OM\)](#) and [work order management system \(WOMS\)](#).

outage management system (OMS or OM)

A centralized system that manages the identification of all outage events and the restoration of service in a utility grid. An OMS system usually is tightly integrated with a work order management system. See also [work order management system \(WOMS\)](#).

out-of-band interferers

Transmissions operating below 902 MHz or above 928 MHz that may interfere with transmissions between 902 and 928 MHz. See also [in-band interferers](#).

outdoor lighting controller (OLC)

Any device used to control street lights. Can be either a [control node](#), [photocell](#), or [street light controller](#). See also [Silver Spring Smart Street Lighting](#).

oversampling

The process of increasing the sampling frequency by generating new digital samples based on the values of known samples. In cases where power is restored after an outage but the [Silver Spring network interface card \(NIC\)](#) is temporarily unable to reach an AP to synchronize its clock, UtilOS begins oversampling data and storing it in temporary flash memory. Once the Silver Spring NIC is able to synchronize its clock, it allocates the stored data into the appropriate intervals and flags those intervals as CONVERTED_INTERVAL.

over-the-air

Wireless communications between devices. Sometimes used to refer to the programming of devices through wireless communications.

P

packets

A unit of data that consists of a header, which contains data such as destination address, and a payload, which contains application data such as interval read results. See also [payload](#) and [ping](#).

packets in flight

The number of simultaneous packets being transferred between a sender and a receiver. A packet in flight is a packet that the sender has sent but the receiver has not yet acknowledged as received. See also [packets](#).

Pad Mount AP/Relays

A mounting kit for installing APs and Relays with a remotely mounted NAN antenna in a secure, fiberglass or plastic, pedestal-type enclosure. See also [Access Point \(AP\)](#), [Relay](#), and [neighborhood area network \(NAN\)](#).

PAPI

See [Provisioning API \(PAPI\)](#).

parent

A network device to which other devices are registered.

path

Refers to how cells, nodes, and endpoints are connected together. For example, the path from cell A to endpoint Z runs through node B. See also [route](#).

path loss

Total amount of power lost in the propagation of the RF signal from the transmitter to the receiver.

payload

The part of a packet that is not the header. Payloads consist of application data such as interval read results. In the case of an On Demand ping, the user can set the payload size to increase or decrease the size of the packet. In RF networks, small packets can traverse the network more successfully than larger packets. When performing an On Demand ping, users can configure the payload up to 255 bytes. See also [packets](#), [ping](#), and [on-demand read \(ODR\)](#).

PCA

See [Permit Certificate Authority \(PCA\)](#).

PCT

See [programmable communicating thermostat \(PCT\)](#).

peak demand

The maximum level of use by customers of a system during a specified period.

peaking capacity

Capacity of generating equipment normally reserved for operation during the hours of highest daily, weekly, or seasonal loads.

peaking plant

A power plant that normally operates only during peak load periods.

permit

In Silver Spring cryptographic practice, the permit is an additional security check within the X.509 digital certificate hierarchy that is used to implement rate limitation on so-called critical commands. A permit must be signed by the private key of the certificate authority with privileges associated with the issued command. See also [conditioning equipment \(CE\)](#), [private keys](#), [public keys](#), [X.509](#) and [critical commands](#).

Permit Certificate Authority (PCA)

The authority that signs Silver Spring application permit certificates. See also [conditioning equipment \(CE\)](#).

permit signer

The Silver Spring application Critical Operations Protector private key/public key pair. The permit signer private key signs any permit generated for a critical command. See also [private keys](#), [public keys](#), and [critical commands](#).

PEV

See [plug-in electric vehicle \(PEV\)](#).

PHEV

See [plug-in hybrid electric vehicle \(PHEV\)](#).

photocell

An [outdoor lighting controller \(OLC\)](#) device mounted to a street light luminaire that detects how much sunlight is available, and switches the light on or off in response. The Silver Spring NIC used for communications across the mesh network can be installed in street light photocells. See also [Silver Spring Smart Street Lighting](#).

physical relays

Used to physically control and connect one or more assets through a [Direct-to-Grid load control switch \(LCS\)](#). Typical assets are HVACs, water heaters, and pool pumps. Each relay allows control signals to turn the asset behind the switch on or off.

An HVAC, for example, could include multiple components (such as a first stage compressor, second stage compressor, fan, and heat strip), each of which is connected to and controlled by a separate physical relay.

When sending a DRLC event, you might want to control only certain components. For example, the utility might want to turn off the compressors but keep the fan on. The switches accomplish this through [virtual relays](#), each of which is associated with multiple physical relays. See also [load control switch \(LCS\)](#) and [virtual relays](#).

ping

A program to test the reachability of devices on a network. The ping program sends a packet to the named device and returns data indicating how long, in milliseconds, the packet took to reach the device and

return (also known as round trip time). See also [packets](#), [reachable](#), and [traceroute](#).

PKCS #11

A standard set of APIs and shared libraries that isolate an application from the details of the cryptographic device. This enables the application to provide a unified interface for PKCS #11-compliant cryptographic devices. See also [Public Key Infrastructure \(PKI\)](#) and [application programming interface \(API\)](#).

PKI

See [Public Key Infrastructure \(PKI\)](#).

PLC

See [power line carrier \(PLC\)](#).

PLG

See [power light gradient \(PLG\)](#).

plug sensor

See [smart plug](#).

plug-in electric vehicle (PEV)

Generally, any type of vehicle that can be plugged in for electricity.

plug-in hybrid electric vehicle (PHEV)

Any vehicle that includes both a battery driven motor and gas powered engine, and that can be plugged in for battery recharging.

PoE

See [Power over Ethernet \(PoE\)](#)

policy

The rules regarding what types of commands are rate-limited, including what privileges certificates possess. See also [rate limitation](#).

port

In networking, a port is used in conjunction with a computer address that specifies a process running on the destination computer.

power

The energy transfer rate, typically measured in watts.

power factor

The ratio of real power (kW) actually used in an electrical circuit to apparent power (kVA), that is, the power being drawn from the power source.

power light gradient (PLG)

A factor used to address the fact that a 50% dimming level on a light does not necessarily correspond to a 50% lamp power output. In Communications Tester, this is expressed as an attribute for the lamp type and calculated as the ratio of change in light level divided by change in power level. The value is likely to vary for each light manufacturer/model. If the value is not known, it is assumed to be 1.

power line carrier (PLC)

A communication system that transmits data between devices over power lines.

Power Monitor

A Silver Spring application that provides real-time alerts for voltage sags and swells on monitored endpoints. To enable monitored endpoints, you create voltage profiles. A voltage profile establishes high and low thresholds for line voltage that, if violated, sends a trap to [Advanced Metering Manager \(AMM\)](#) which is forwarded through Java Messaging Service (JMS) to external applications, including voltage optimization systems.

power out message

See [last gasp \(LG\)](#).

Power over Ethernet (PoE)

An IEEE 802.3af standard that allows [Ethernet](#) cables to supply the power for network devices while they are transmitting data.

power pool

An arrangement between two or more interconnected electric utilities to coordinate the operation of their generating or transmission facilities.

Power Quality Monitoring (PQM)

A technique to monitor sags and swells in real-time and take action before they result in power quality violations or equipment overload. This functionality is provided through [Power Monitor](#) or [SensorIQ™](#).

PQM

See [Power Quality Monitoring \(PQM\)](#).

preferred Access Point

See [primary Access Point](#).

premise ID

A unique numeric service address identifier, including the apartment or suite.

prepaid metering

Where customers prepurchase energy much like they would a prepaid phone card. The meter must provide the interface and communications technology that enables customers to redeem the card for energy on a pay-as-you-go basis.

previous demand

The [maximum demand \(peak demand\)](#) from the most recently completed interval. See also [demand](#).

price cap

A level above which regulated prices may not rise.

price response

The reduction of electrical consumption at the customer level in response to wholesale electricity price signals.

price signals

As managed by Silver Spring through the [HAN Communications Manager \(HCM\)](#) application, price signals indicate to customers, typically through [HAN devices](#), changes in their utility's rates for electricity. This helps customers to know about or respond to rate changes, so they can limit expenses by reducing or shifting their use during high-cost periods.

price transparency

Market prices to generate and transmit service to the public. This allows customers to know how much they will pay for power supply and transportation in a deregulated market.

pricelist

A message used to send price and other information to thermostats, which allows utilities to call special pricing events and have thermostats react in an automated fashion to help save customers money, and reduce peak usage for the utility. Customers are offered lower off peak rates in exchange for installing these connected thermostats. Pricelist runs at least once daily throughout the year, as prices can change even during peak/winter seasons due to [block rate](#) plans. For pricelists, [price signals](#) are used to declare peak pricing events for a given day, and they are sent to the utility the day before a price event will take place. The price event can be either a critical event, where customers on either [critical peak pricing \(CPP\)](#) or [variable peak pricing \(VPP\)](#) rate plans are affected, or VPP event, which affects only customers on VPP rate plans. VPP events indicate periods of the day that do

not have off-peak pricing set, and they can be Low, Standard, High, or Critical.

primary Access Point

The best performing, most reliable Access Point as determined by the endpoint device. Also known as the preferred Access Point. See also [secondary Access Point](#).

private keys

The unpublished key in a cryptographic system that uses two keys for encryption and decryption. In Critical Operations Protector, private keys are used only for signing. For example, a private key signs the permits attached to each critical command issued. When encryption keys must be negotiated, key agreement takes place by combining one public key with a private key from another key pair over a secure association between the back office and a Silver Spring NIC. See also [public keys](#), [root key](#), and [Critical Operations Protector for Advanced Metering Infrastructure \(COP for AMI\)](#).

program seal

A hash value of the meter program used to uniquely identify meter programs. Any change detected in the seal indicates a legitimate re-programming of the meter, tampering, or damage. See also [hash value](#).

programmable communicating thermostat (PCT)

A thermostat that can receive information wirelessly.

projected demand

The estimated [maximum demand \(peak demand\)](#) that a meter will accumulate by the end of the current interval. See also [demand](#).

promiscuous network ID

A network node that uses the promiscuous network ID can join any other network and accept packets from any other node. Similarly, any node can accept packets from a node using the promiscuous network ID.

propagation

The motion of waves through or along a medium.

protocol

An agreed upon format for transmitting data between two devices. Protocols have rules that govern the syntax, semantics, and synchronization of communication. Protocols may be implemented by hardware, software, or a combination of both.

Protocol for Access, Configuration and Transfer (PACT)

A specification for transporting data between different electricity meter types and the host tariff (billing) system.

Protocol Specification for Electricity Meters (PSEM)

A protocol commonly used with North American meters as the interface between the meter and AMR communications add-ons. PSEM is part of the C12.18 ANSI standard for electricity meters. See also [automated meter reading \(AMR\)](#).

Protocol Specification for Electricity Meters X (PSEM X)

A variation of the PSEM protocol that allows for the logon, security, and read/write services to be encrypted and authenticated to removing the possibility of simple packet tampering and replay. This authentication allows the meter to verify that highly important messages such as service disconnect originate from the back office. See also [Protocol Specification for Electricity Meters \(PSEM\)](#).

provision

See [join](#).

Provisioning API (PAPI)

A simple web service interface that enables device provisioning to support additions, moves, and changes to devices in the field through the [central management software \(CMS\)](#). See also [Street Light Adapter](#).

PSEM

See [Protocol Specification for Electricity Meters \(PSEM\)](#).

PSEM X

See [Protocol Specification for Electricity Meters X \(PSEM X\)](#).

Public Key Infrastructure (PKI)

A framework for creating a secure method for exchanging information based on public key cryptography. The foundation of PKI is the certificate authority (CA), which issues digital certificates that authenticate the identity of organizations and individuals over a public system.

The certificates are also used to sign messages, which ensures that messages have not been tampered with. See also [conditioning equipment \(CE\)](#) and [Certificate](#)

[Authority \(CA\)](#).

public keys

The public key is bound into a digital certificate or other digitally signed object with appropriate roles and policies. It can be shared with anyone and is used for the public operations of encryption and verification. Public keys are bound into X.509 digital certificates in a predefined hierarchy. The public key certificate is signed by the [Permit Certificate Authority \(PCA\)](#). See also [private keys](#).

publishing

The method that [HAN Communications Manager \(HCM\)](#) uses to push new energy rates to Energy Services Interfaces (ESIs). See also [Energy Services Interface \(ESI\)](#).

pulse

The raw units electricity meters record. Pulses are converted into watthours.

pulse multiplication factor

See [Secure Copy \(SCP\)](#).

pulse weight

The number of cubic feet of gas per rotation of the gas meter wriggler, or per signal from the pulser.

Q**queue**

A list. In [Advanced Metering Manager \(AMM\)](#), a list of meters associated with a schedule is referred to as a queue. In general computing, a queue can be a list of commands to execute one by one. See also [remote terminal unit \(RTU\)](#).

R**radio frequency (RF)**

The frequency of transmitting waves of a given radio message or broadcast. RF is the electromagnetic field generated by AC current that is suitable for wireless communications.

RAID

See [redundant array of independent disks \(RAID\)](#)

rate limitation

Refers to a limitation of the number of critical commands that can be issued within a configured length of time to protect the security of the power grid.

Disconnect and connect are examples of critical commands that can only be issued by individuals authorized to do so. See also [critical commands](#).

rate plan

See [regulated price plan \(RPP\)](#).

rate structure

The various rates charged by a utility for its services.

rate threshold

A sliding window of time during which permits can be issued and, correspondingly, users can issue a valid critical command, such as a disconnection of service. After this time limit has expired, no permits can be granted and no critical commands issued. See also [permit](#) and [critical commands](#).

RBAC

See [role based access control \(RBAC\)](#).

RDBMS

Relational Database Management System. A database management system that maintains data records and indexes in tables. Relationships can be created and maintained across and among the data and tables. Oracle is an example of an RDBMS.

reachable

The ability to send and receive data to and from a meter. A reachable meter is usually readable. However, a meter may be reachable with small packet sizes, but may not be readable with the larger packet sizes necessary for a successful read.

reactive energy

Energy measured by [kVARh](#). See also [reactive power](#).

reactive power

Power measured as volt-amperes reactive (VAR). By convention, lagging (inductive) loads, such as motors, have positive reactive power, while leading (capacitive) loads have negative reactive power. See also [kVAR](#), [kVAR lag](#), and [kVAR lead](#).

read (meter read)

The collection of usage data from a meter. Collections of meter reads are referred to as read data.

read success rate (RSR)

Percentage of meter reads saved to the [RDBMS](#) during a 24 hour period. For example, the default interval

schedule reads meters every two hours or 12 times per day. If a meter is read 11 times, the RSR is 92%.

The RSR is a useful metric for determining the reachability of a meter during various times of day. This data determines at what times of day meter reachability declines so administrators can plan schedules accordingly. Unlike BSR, which is a metric for successfully completed, intact meter reads that correspond to a business rule (completed reads from midnight to midnight), RSR is a metric for meter reads per schedule. See also [billing success rate \(BSR\)](#) and [message success rate \(MSR\)](#).

real time pricing (RTP)

Enables frequent price adjustments based on real-time market conditions. Prices may change hourly, with one-hour or one-day notice, and are based on actual wholesale prices or on statistical models that forecast wholesale prices. Customers are notified in advance of the price change, allowing them time to curtail demand. See also [critical peak pricing \(CPP\)](#) and [time of use \(TOU\)](#).

reboot counter

This counter, which resides within the [Silver Spring network interface card \(NIC\)](#) or NIC, keeps track of the number of times the Silver Spring NIC has rebooted. This information is used by the [Outage Detection System \(ODS\)](#) for example, to infer that an electricity meter has lost power or that power was restored when a restore (RS) [trap](#) is received without a [last gasp \(LG\)](#) trap having preceded it, due to the LG trap having been lost.

received signal strength indicator (RSSI)

A method of measuring the strength of a received radio signal.

redundant array of independent disks (RAID)

A method of storing the same data in different places (thus, redundantly) on multiple hard disks.

reflection

When a propagating wave impinges on an object which is large compared to its wavelength and bounces off.

register

A readable device within a meter. For example, the demand or usage register read to calculate billing.

register read

Refers to a meter's register information being transmitted across the network for use in the utility back office. For example, for billing purposes.

Registrar

A shared services component and Dynamic [DNS](#) (DDNS) server with a primary purpose to collect network registration and update notices from the NIC devices sent using the DDNS protocol and to serve up look-up requests as per the DNS RFC (RFC1035). Its secondary purpose is to collect statistics from the activity of the devices and to serve up those statistics through a Representational State Transfer (REST) web service interface. See also [Representational State Transfer \(REST\)](#).

regulated price plan (RPP)

An electricity pricing plan that provides stable and predictable electricity pricing, encourages conservation and ensures that the price consumers pay for electricity best reflects the price paid to generators.

Relay

A device on a network used to extend the reach of a network. Relays are typically placed high for best line-of-sight to meters, and can be plugged into photocell sockets on light poles. Normally, several meters are associated with each Relay and several Relays are associated with an Access Point. Meters can also act as a Relay. Referred to as repeaters in utility and other networks. See also [reachable](#) and [Access Point \(AP\)](#).

remote CHAP password

See [Challenge Handshake Authentication Protocol \(CHAP\)](#).

remote device

A device controlled by a master device. A remote device is typically deployed as an edge network device, while a master device is typically deployed as a core device. Previously known as a slave device. See also [master device](#).

remote disconnect

Disconnecting a device from the [back office](#).

remote provisioning

See [remote service management \(RSM\)](#).

remote service management (RSM)

Refers to any job that acts on the remote disconnect, remote service, load control, or auxiliary switches. See also [job](#).

remote terminal unit (RTU)

A device that interfaces objects in the physical world to a distributed control system or SCADA by transmitting telemetry data to the system and/or altering the state of connected objects based on control messages received from the system. See also [supervisory control and data acquisition \(SCADA\)](#) and [intelligent electronic device \(IED\)](#).

Representational State Transfer (REST)

A style of software architecture for distributed hypermedia systems such as the World Wide Web.

re-queue

When [Advanced Metering Manager \(AMM\)](#) reads meters, it polls all meters associated with the schedule in order. If it does not receive a response for a meter after a certain number of attempts, it puts the meter it was unable to read to the end of the queue, or requeues it, and polls the next meter in the queue. When the schedule reaches the end of the queue, it starts again with re-queued meters. See also [queue](#), [retries](#), and [unread meter](#).

reserve margin

The amount of unused available capability of an electric power system at [peak demand](#) for a utility system, expressed as a percentage of total capability.

REST

See [Representational State Transfer \(REST\)](#).

restore time objective (RTO)

During a period when data is being recovered, measures the amount of time that an organization will not have access to a category of data.

result set

Data in tabular form displayed on the screen. For example, if a user performs a search for all meters of a particular model, all the meters that display constitute the result set.

retries

When a schedule is unable to read a meter on the first try, all subsequent attempts to read the meter are retries. See also [remote terminal unit \(RTU\)](#).

RF

See [radio frequency \(RF\)](#).

RMS

See [root mean square](#).

Robot Toolkit

A Java-based framework that offers scripts that remediate a variety of application-layer network problems by examining and acting on the Communication Module (NIC) of an endpoint. Robot allows users to run batches of network library commands against a list of meters.

role based access control (RBAC)

An access control mechanism where access permissions apply to groups of individuals that have been assigned the same role. Typical roles are administrator, user, and operator. See also [access control](#).

root key

The public/private key pair of the certificate authority. If the private part of the root key is ever discovered, all the certificates issued under that key pair are compromised. See also [private keys](#) and [Certificate Authority \(CA\)](#).

root mean square

A statistical measure of the magnitude of an AC signal or peak modulation.

rotations per minute

For gas meters, the number of rotations per minute of the wriggler, or per signal from the pulser.

route

The route from an [endpoint](#) to an egress device, usually an [Access Point \(AP\)](#) or a [Bridge Master](#). Routes are discovered dynamically. However, when performing an On Demand ping in [Advanced Metering Manager \(AMM\)](#), users can specify a one-time route that is discarded after use.

rpm

See [rotations per minute](#).

RPP

See [regulated price plan \(RPP\)](#).

RSM

See [remote service management \(RSM\)](#).

RSR

See [read success rate \(RSR\)](#).

RSSI

See [received signal strength indicator \(RSSI\)](#).

RTO

See [restore time objective \(RTO\)](#).

RTP

See [real time pricing \(RTP\)](#).

RTU

See [remote terminal unit \(RTU\)](#).

rubber duck antenna

An antenna designed for indoor use and testing purposes only in conjunction with a Silver Spring Bridge. It is suited for 900MHz ISM band applications, as well as 900MHz cellular applications. This rubber duck antenna has a tilt-and-swivel SMA-male connector, allowing it to be aligned at any angle.

rule

A user-defined limit that allows or denies permits for load shed events and critical commands. See also [load shedding](#) and [critical commands](#).

run

A schedule run consists of the initial attempt and all retries of all meters associated with the schedule, plus the initial attempt and all retries of queued meters. See also [Secure Copy \(SCP\)](#) and [schedule](#).

S**SA**

See [secure association \(SA\)](#).

sag and swell

When voltage increases or decreases.

salt shaker antenna

An antenna that works with APs and Meter Antenna Couplers for both GSM and CDMA networks to ensure uninterrupted video and data transmissions in urban canyons and rural drop-off areas. See also [Access Point \(AP\)](#), [Meter Patch Antenna Coupler \(MPAC\)](#), [Global System for Mobile Communications \(GSM\)](#), and [code-division multiple access \(CDMA\)](#)

SAM

See [FSU-Secure Access Manager \(FSU-SAM\)](#).

SAN

See [storage area network \(SAN\)](#).

Satellite Access Point (AP)

The Satellite Access Point (AP) is an alternative to cellular technology in areas where cellular coverage does not exist or is unreliable. The Satellite Access Point enables Silver Spring to read smart meters in areas where cellular service is unavailable.

sBridge

A device that uses multiple serial connections to provide robust, two-way RF standards-based communications to support Distribution Automation applications such as asset management, Volt/VAR control, self-healing circuits, FCI communications, and distributed generation. See also [Bridge](#) and [distribution automation \(DA\)](#).

SCADA

See [supervisory control and data acquisition \(SCADA\)](#).

scale factor

In [Advanced Metering Manager \(AMM\)](#), converts the value read from the meter (such as deciwatt hours) to engineering units (such as kWh).

schedule

Determines what meters are read and when. A schedule consists of a start date and time, an optional end date and time, and a list of devices that will be read when the schedule executes. See also [run](#) and [billing cycle](#).

SCP

See [Secure Copy \(SCP\)](#).

secondary Access Point

The next best performing, most reliable Access Point as determined by the endpoint device. See also [Access Point \(AP\)](#) and [primary Access Point](#).

seconds since last reboot (SSLR)

Seconds since last reboot. This is how long the NIC had been running at the time of the event that caused it to reboot.

Secure Access Manager

See [FSU-Secure Access Manager \(FSU-SAM\)](#).

secure association (SA)

A session that conveys a so-called critical command from the back office over the Secure Network Manager

port of the NIC firmware in a meter. The firmware performs a verification that the command has a signed permit and meets other criteria. Secure associations use Elliptical Curve (EC) keys for authentication. They typically expire in 60 days, but this is configurable in the back office. See also [secure maintenance link](#), [permit](#), and [critical commands](#).

Secure Copy (SCP)

Transfers files between local and remote hosts using the Secure Shell Protocol. See also [FTP](#).

secure maintenance link

Similar to a secure association, but, it differs in the following ways: a) used to send a command from the FSU to an endpoint; b) the FSU cannot issue a command to an endpoint not in the immediate vicinity (for instance, an FSU in Sacramento cannot send a command to an endpoint in Bakersfield); c) a secure maintenance link expires in one hour unless the FSU is idle, in which case, it expires in 5 minutes; d) they use RSA keys, not Elliptical Curve (EC) keys, for authentication. See also [secure association \(SA\)](#).

Secure Transmission of Remediation Certificates (STORC)

The STORC tool remotely regenerates birth certificates and replaces anomalous manufacturing certificates loaded onto devices. Specifically, STORC re-mints malformed birth certificates; repairs system-on-chip (SoC) devices that have lost their private key; and replaces birth certificates that have been dated in the future.

Security Hash Algorithm (SHA)

A cryptographic hash function often used to secure government agencies. The most commonly used version is SHA-1, which is a Federal Information Processing Standard. See also [Mcf](#) and [hash value](#).

Security Monitoring Tool (SMT)

Monitors the application layer of the network for problems with secure associations and configuration settings. System administrators monitoring for security anomalies can monitor for things like the status of sensitive ports; privileges for hard coding devices; and device security levels.

seed NIC

See [code float](#) and [code push](#).

self-read

In electricity meters, when the meter performs a self read and transfers usage data from ST23 to ST25.

Sensor

A feature available to be enabled on the Silver Spring [NIC](#) to monitor one or multiple data points on the attached device (for example, a meter or load control switch) to facilitate the collection of data. This feature is used by [SensorIQ™](#). The supported Sensors may vary depending on the device vendor or model.

Available sensor bundles are:

- **Rapid DR Telemetry:** Supports demand response at all times of the year with up-to-the-minute data collected on [demand response \(DR\)](#) event performance for all DR customers, and facilitates integration of distributed energy resources
- **Electricity Bundle:** Includes voltage, temperature, current, usage, power, and power factor Sensors

SensorIQ™

A back-office application for collection of data from Silver Spring Network-enabled electricity meters. A SensorIQ profile on the Silver Spring NIC defines the meter data to be sampled, how often to record that data, and any alarming condition. The SensorIQ server can collect the sampled data from the Silver Spring NIC at regular intervals and provide real-time alerts for data threshold violations.

SEP

See [Smart Energy Profile \(SEP\)](#).

service address

The mailing address of a meter location.

service point

A unique identifier associated with a premise ID. There can be multiple service points associated with a premise ID. See also [premise ID](#).

service point ID

See [service point](#).

set

When a device is physically installed and connected to electricity. Also known as energized. See also [energized](#).

SHA

See [Security Hash Algorithm \(SHA\)](#).

Shared service components

A set of packaged applications and utilities that provide common services such as single sign-on, sending and receiving traps, and others to Silver Spring applications.

Silver Spring Appliance

An all-in-one stack of hardware for hosting Silver Spring applications. The Appliance contains all of the computing, storage, and networking infrastructure needed for standard Silver Spring applications deployments.

Silver Spring Interpreter

A two-way radio integrated with Master Meter water meters that allows remote meter reading, and provides asynchronous alerts for leaks, meter tampering, and other critical events, and can be remotely configured.

Silver Spring Networks Services

Services Silver Spring provides to customers, including business system integration, customer support, hosting choices, installation support, mesh design, and training.

Silver Spring network interface card (NIC)

The Silver Spring network interface card (NIC) used in devices that communicate across the Silver Spring mesh network.

Silver Spring Smart Street Lighting

A solution that allows utilities and municipalities to manage, control, and monitor, and provide analysis for street lights across the Silver Spring mesh network. Silver Spring NICs are installed in street light control devices (such as in control nodes in luminaires and controllers in cabinets) and communicate through [Street Light Adapter](#) to the [central management software \(CMS\)](#) and [Advanced Metering Manager \(AMM\)](#) for integration with other Silver Spring applications. See also [control node](#), [photocell](#), and [street light controller](#).

SilverLink™ Data Platform

The SilverLink Data Platform enables an open ecosystem of applications. The platform automatically ingests device data, normalizes and enriches the data, and makes it secure and accessible to utilities and third parties through standard APIs. The SilverLink Data Platform includes the following:

- **Data Archive:** An application that enables long-term retention of data. Longer data history

supports deeper analysis and new use-cases and analytics.

- **Data Visualizations:** An application that provides custom data visualizations through native integration with Tableau and support for other business intelligence tools.
- **Time Series API:** An API that presents time-series data from devices.
- **Device Metadata API:** An API that presents metadata on devices including device types and locations.
- **Events API:** An API that delivers events from [SensorIQ™](#) or [Advanced Metering Manager \(AMM\)](#).
- **Streaming API:** An API that supports streaming of real-time data from [SensorIQ™](#).

SilverLink™ Sensor Network

A Silver Spring open-standards software solution designed to collect and use data from networked sensor devices such as usage, voltage, theft, and energy-audit sensors. The solution enables utilities to aggregate and organize these devices, and to analyze smart grid data quickly and cost effectively, which is particularly applicable for mission-critical operations and for customer engagement. The solution can be configured for broad integration and access by utility and consumer applications, utility business systems (such as [meter data management system \(MDMS\)](#), [customer information system \(CIS\)](#), and billing and operations systems), and through Silver Spring networks, home area networks, third-party networks, and legacy systems.

simple metering cluster

Provides a means to retrieve energy use information for individual HAN devices (for example, HAN-enabled meters and load control switches) through ZigBee-based communications. This is used, for example, by [HAN Communications Manager \(HCM\)](#) to obtain information not provided through standard meter reads. See also [home area network \(HAN\)](#) and [ZigBee®](#).

Simple Object Access Protocol (SOAP)

A protocol for exchanging XML-based messages over a computer network. SOAP provides a basic messaging framework for web services.

small and medium business (SMB)

Refers to small and medium business energy and water customers. SMB customers typically have fewer than 500 employees, demand of less than 75-kW, are energy-only metered, and do not use building management systems.

Examples of SMB customers are restaurants, coffee shops, and start-up companies.

Smart Energy Platform

The Silver Spring platform based on open Internet Protocol (IP) standards, allowing continuous, two-way communication between the utility and devices on the grid.

Smart Energy Profile (SEP)

Various protocols and specifications that support ZigBee® devices. See also [ZigBee®](#).

smart grid

Refers to technologies that enable a highly communicative, predictive, and self-healing utility grid.

smart plug

An electrical outlet that can be plugged into a standard wall outlet to turn off or on any connected electrical appliance or device. When used in conjunction with a power monitoring software application, utility consumption of the connected devices can be viewed and managed.

SMB

See [small and medium business \(SMB\)](#).

SMT

See Security Monitoring Tool (SMT).x

SOAP

See [Simple Object Access Protocol \(SOAP\)](#).

SoC

See [State of Charge \(SoC\)](#).

SOC

See [System On a Chip \(SOC\)](#).

SocketAP 5

A Silver Spring [Access Point \(AP\)](#) that provides the central network resource for delivering data generated by endpoint devices at the network edge and IT/OT systems—enabling high performance applications, network control and monitoring. Its flexible communication features extend the reach and

coverage of the network to hundreds of customer sites, and its support for up to 250 endpoints per SocketAP dramatically lowers costs. The SocketAP 5 offers multiple paths to each endpoint device through sophisticated mesh network routing that ensures greater reliability and redundancy.

source select

Corresponds to a measurement channel configured on an electricity meter. Each channel measures a particular source, such as energy delivered in dWh.

sparse deployment

A range-limited deployment where relatively few endpoints operate at minimum signal strength. See also [spot deployment](#).

spectral inspection

A spectrum analyzer can be used to determine potential sources for out-of-band interferers. See also [out-of-band interferers](#).

spot deployment

Deployments to read a small number of relatively contained endpoints, such as in an office park. See also [sparse deployment](#).

SQL

See [Structured Query Language \(SQL\)](#).

SRT RAL

Silver Spring Routing Route Accept List. The Silver Spring routing table's list of accepted routes.

SSLR

See [seconds since last reboot \(SSLR\)](#).

SSNIAgent

A small application that runs as a daemon and provides a secure gateway to a subset of web services for Silver Spring applications such as [Advanced Metering Manager \(AMM\)](#) and [HAN Communications Manager \(HCM\)](#) from applications such as [CustomerIQ®](#) and [Demand Optimizer](#).

SSNI Services

A Silver Spring ESB shared services component installed on [ESB Server](#) that helps create the infrastructure for all applications that use web services.

SSP

See [Shared service components](#).

standard tables

Tables in electricity meters that conform to ANSI Standard C12.19. See also [C12.19](#).

standby facility

A facility that supports a utility system and is generally running under no-load. It is available to replace or supplement a facility normally in service.

standby service

Support service that is available as needed to supplement a consumer, a utility system, or to another utility if a schedule or an agreement authorizes the transaction. The service is not regularly used.

State of Charge (SoC)

The percentage of usable battery power available from an electric vehicle battery. For example, 75% SoC describes a battery that has 3/4 of its power remaining.

storage area network (SAN)

Storage devices such as disk arrays, tape libraries and optical jukeboxes which are accessible to servers so the devices appear as locally attached to the operating system.

Street Light Adapter

A Silver Spring application that provides a standard interface for [central management software \(CMS\)](#) to interact with street light devices on the Silver Spring mesh networks. Using the [Street Light Adapter](#), a CMS can perform configuration management, lighting control, and monitoring of street light devices. The Street Light Adapter application contains two modules: [TALQ Bridge](#) and the [Provisioning API \(PAPI\)](#).

street light controller

An [outdoor lighting controller \(OLC\)](#) device that resides in a street light control cabinet or other location separate from the street light luminaire and used to control lights across the Silver Spring mesh network. See also [Silver Spring Smart Street Lighting](#).

Street Lights

See [Silver Spring Smart Street Lighting](#).

Streetlight.Vision

Silver Spring [central management software \(CMS\)](#) used to interact with street light devices on the Silver Spring mesh networks. See also [Street Light Adapter](#).

Structured Query Language (SQL)

A standard syntax which allows most [RDBMS](#) users to extract and manipulate data.

submetering

Individually metering all the apartments in an apartment complex or strip mall rather than using one master meter to determine usage for the entire complex.

substation

A facility in an electricity distribution system used for switching and / or changing or regulating the voltage of electricity. A substation is the location where high voltage transmission lines connect to switchgear and step-down transformers to produce lower voltages at lower power levels for local distribution networks.

supervisory control and data acquisition (SCADA)

Computer systems designed to control and monitor industrial, manufacturing, or facility-based operations such as the electric utility distribution system. See also [distribution automation \(DA\)](#).

switching station

Facility equipment used to tie together two or more electric circuits through switches. The switches are selectively arranged to permit a circuit to be disconnected, or to change the electric connection between the circuits.

System Average Interruption Duration Index (SAIDI)

Calculated by: sum of durations of all customer interruptions / total customers in system. See also [System Average Interruption Frequency Index \(SAIFI\)](#).

System Average Interruption Frequency Index (SAIFI)

Calculated by: customer interruptions / total customers in system. See also [System Average Interruption Duration Index \(SAIDI\)](#).

system of record

The authoritative or master data storage system for a given entity that overrides other sources for the same data. [Advanced Metering Manager \(AMM\)](#) can be configured as the system of record for the utility.

System On a Chip (SOC)

The SOC (Intelligent Processor System On a Chip) is the part of the [Silver Spring network interface card](#)

([NIC](#)) that includes an embedded security engine for key management, link layer authentication, and packet encryption.

The SOC supports network communications, GE I-210+, I-210+c, and kV2c electricity meters, and other Silver Spring field tools such as [Electricity Communications Module Tester \(ECMT\)](#) and [Communications Tester](#).

T**TALQ**

An interoperability standard for the control and management of outdoor lighting and for interfacing outdoor lighting networks (OLN) with [central management software \(CMS\)](#). TALQ is used by Silver Spring [Street Light Adapter](#) for street light communications between the CMS and Silver Spring applications.

TALQ Bridge

An implementation of the [TALQ](#) Specification enabling TALQ-based messages to be passed between [central management software \(CMS\)](#) applications and Outdoor Lighting Networks (OLNs) such as the solution Silver Spring provides. See also [Street Light Adapter](#).

tariff

Meter programs on Secure Meters, Ltd meters. See also [meter program](#).

TCP/IP

See [Transmission Control Protocol / Internet Protocol \(TCP/IP\)](#).

technical losses

Electricity losses due to expected loss between the generation source and the customer location meter. These can be due to normal losses through transmission and distribution, equipment failures, and non-optimized transmission loads and voltage. Technical losses between 6 to 8% are considered normal. See also [non-technical loss](#).

Th

See [therm](#).

therm

The metered unit of natural gas energy. 1 therm equals 100,000 BTUs.

TIBCO Conf files

Configuration files used with [TIBCO EMS](#) that contain a list of all Silver Spring queues. When [TIBCO EMS](#) is started, it reads these files and initializes the queues.

TIBCO EMS

A Silver Spring shared services component that provides JMS functions for a number of Silver Spring applications. TIBCO EMS publishes messages to queues managed by other message services, such as JBoss, through a bridge. TIBCO EMS uses associated [TIBCO Conf files](#), also available from Silver Spring as a shared services component.

tier

Under tiered rate plans, the customer's cost per kilowatt hour (kWh) changes as more electricity is used within a billing period. Depending on your price plan, this cost can either go up or down at higher tiers.

time of use (TOU)

An electricity billing rate where the rate varies by time. TOU metering divides the day into periods, such as 8:00 AM to 12:00 PM, 12:00 PM to 4:00 PM, and 4:00 PM to 8:00 AM. Each period has a corresponding rate, expressed in terms of \$/kWh, where \$ is the currency type configured for your rate plans (for example, \$0.05/kWh). The rate is usually based on expected average cost (where prices are usually higher during peak periods) and is generally fixed for several months in advance. Rates can also change seasonally. [HAN Communications Manager \(HCM\)](#) supports twenty four tiers per day. See also [HAN Communications Manager \(HCM\)](#).

time synchronization

To assure the proper operation of network devices, the calculation and storage of usage data, utility customer service, and accurate billing calculations, the meter clock synchronizes to the NIC clock and reports discrepancies to the [Advanced Metering Manager \(AMM\)](#). Endpoint NICs in turn synchronize with APs which act as a [neighborhood area network \(NAN\)](#) time server and synchronize with a Network Time Protocol server on the Internet. Discrepancies between the [endpoint](#) NIC and the [Access Point \(AP\)](#) resolve to the time on the Access Point.

TMB

See [Trap Forwarder](#).

token

A hardware or software device that performs cryptographic functions and stores public-key certificates, cryptographic keys, and other data. The Certificate System defines two types of tokens, internal and external, for storing key pairs and certificates that belong to the Certificate System subsystems. See also [private keys](#) and [public keys](#).

topology

The physical layout of a distribution network infrastructure with specific hierarchical identification of all components.

TOU

See [time of use \(TOU\)](#).

traceroute

A networking utility to track the routes taken by packets across a network. See also [ping](#).

Transmission Control Protocol / Internet Protocol (TCP/IP)

A suite of communications protocols used to connect hosts on the Internet. TCP/IP is the accepted standard for transmitting data over networks.

trap

An asynchronous event, often in a managed subsystem. Examples include Last Gasp and Power Restore. See also [asynchronous](#).

Trap Forwarder

A Silver Spring shared services component that asynchronously captures, displays, and logs traps from network devices and allows users to instantaneously view alert notifications from any network device that supports SNMP. Trap Forwarder contains an NMR_Listener feature to capture and forward all communication between applications and the [neighborhood area network \(NAN\)](#) through the [Access Point \(AP\)](#). Trap Forwarder was previously called [Trap Receiver](#). See also [Trap Router](#).

Trap Receiver

Currently called [Trap Forwarder](#).

Trap Router

A Silver Spring ESB shared services component installed on an [ESB Server](#) host that is used by [Trap Forwarder](#) and enables routing configuration for traps.

tunnel

In networking, a tunnel allows the encapsulation of the data of one protocol within another protocol. By using a tunnel, the system passes the encapsulated data over an incompatible network or provides security for transferring data over an untrusted network.

U**UART**

See [universal asynchronous receiver/transmitter \(UART\)](#).

UDP

See [User Datagram Protocol \(UDP\)](#).

unassociated

With [HAN Communications Manager \(HCM\)](#), unassociated refers to a new device that has been imported into HCM but is not associated with an [Energy Services Interface \(ESI\)](#). The unassociated state is established by importing a new device through device import or by removing a device from an ESI. See also [associate](#).

Underground AP and Relay

An [Access Point \(AP\)](#) and [Relay](#) optimized for use in subterranean utility vaults in dense urban areas where pole top or pad mount infrastructure is not available.

unfillable gap

An instance of discontinuous meter data that cannot be filled. Unfillable gaps can occur for several reasons: the meter never recorded the data, the meter was reprogrammed, the meter's flash memory was corrupted, time shifts, physical damage, and so on. See also [gap](#) and [end gap](#).

unicast

The sending of packets over a network to a single device. The bulk of packets in [Advanced Metering Manager \(AMM\)](#), for example, are sent in unicast mode. See also [broadcast](#).

unit under test (UUT)

Used in the [IMU Accuracy Tester](#) software to refer to the gas IMU being tested.

universal asynchronous receiver/transmitter (UART)

An interface for serial communication between devices. Silver Spring [Communications Tester](#) UART

commands set and show serial communication information.

Universal Transverse Mercator (UTM)

A system that divides the globe into 60 North-South zones, each measuring six degrees wide in longitude. Zones are numbered consecutively from West to East.

Positions on the globe are given by zone coordinates, then the number of meters East (easting) or West (westing) from the center of the zone, and finally by the number of meters North (northing) or South (southing) from the center of the zone. UTM coordinates for the Golden Gate Bridge are zone 10 S, 545980m E. 4185742m N.

unjoin

To remove or separate a Silver Spring NIC from its meter as part of a troubleshooting operation. IMUs that are to be retrofitted in the field to their corresponding gas and water meters are said to be unjoined up until the time they are joined. See also [join](#) and [Gas Interface Management Unit \(IMU\)](#).

With [HAN Communications Manager \(HCM\)](#), unjoin means to move a device from the join to the associated state. Also known as deprovision. See also [join](#).

unreachable meter

A meter transitions to this state if a route exists but if the device has not been read for a configurable period. See also [reachable](#) and [device states](#).

unread meter

Schedules attempt to read meters in two passes. Each pass consists of several read attempts. After the first round of attempts, the schedule places the meter in a requeue list and makes another, later pass. After the second set of retries, the meter is flagged for inclusion in the recovery schedule. Depending on the context, it may appear in the UI as an unread meter. See also [remote terminal unit \(RTU\)](#), [re-queue](#), and [retries](#).

User Datagram Protocol (UDP)

A protocol that allows computer applications to send messages (datagrams) to other hosts on an Internet Protocol network without previously setting up transmission channels or data paths.

utility enrollment group

Defined groups within [HAN Communications Manager \(HCM\)](#) that can be selected to participate in demand reduction programs a utility provides.

UtilOS®

The open standards-based network operating system for devices equipped with Silver Spring NICs.

SilverLinkOS provides a suite of utility networking services, including network discovery, addressing, routing and switching, health, network time, security, and encryption.

UtilOS includes a metering interface that provides load profile functionality for electricity meters and Water and Gas IMUs. It records usage data and allocates it to the appropriate intervals so that it can be processed by back-end systems.

UTM

See [Universal Transverse Mercator \(UTM\)](#).

UUT

See [unit under test \(UUT\)](#).

V**V**

Volts or voltage. See also [Kilohertz](#), [kVAh](#), [kVAR](#), and [kVARh](#).

V2 security

See [application layer security](#).

vampire

Electronic devices that, when turned off, can remain on in “standby mode” and can represent as much as 10% of a consumer’s total electricity consumption.

variable peak pricing (VPP)

A power billing structure whereby rates can vary throughout the day depending on system load conditions.

VEE

Validation, Estimation, and Editing. Software tools that manage data collected from endpoints. See also [endpoint](#).

verified single outage (VSO)

A last gasp followed by a measurable duration. See also [last gasp \(LG\)](#) and [measurable outage or measurable duration](#).

virtual light output (VLO)

VLO allows a user to set the light output percentage that will be considered to be 100%. For example, if a 100-watt light is deployed in the field, and the user

wants it to run at a maximum of 80 watts, they would set the VLO value to 80%. As an example application, with this value set, a calendar or program that indicates the light should turn on at 100% at 7 PM will actually turn the light on at 80% after applying the VLO value. If the program indicates that the light should dim to 50% at midnight, the light will actually be set to 40% after the VLO value is applied.

virtual local area network (VLAN)

A VLAN enables devices on different physical LAN segments to communicate as if they are on the same LAN segment. See also [local area network \(LAN\)](#).

virtual private network (VPN)

A computer network that uses a public telecommunication infrastructure such as the Internet to provide remote offices or individual users with secure access to their organization’s network. VPNs aim to avoid expensive systems of owned or leased lines that can only be used by a single organization.

virtual relays

Used through [physical relays](#) in a [Direct-to-Grid load control switch \(LCS\)](#) to physically control and connect one or more assets, which can be, for example, HVACs, water heaters, and pool pumps. Each physical relay allows control signals to turn the asset behind the switch on or off.

An HVAC, for example, could include multiple components (such as a first stage compressor, second stage compressor, fan, and heat strip), each of which is connected to and controlled by a separate physical relay.

When sending a DRLC event, you might want to control only certain components. For example, the utility might want to turn off the compressors but keep the fan on. The switches accomplish this through the [virtual relays](#), each of which is associated with multiple physical relays. See also [physical relays](#) and [load control switch \(LCS\)](#).

VLAN

See [virtual local area network \(VLAN\)](#).

VLO

See [virtual light output \(VLO\)](#).

Volt-VAR Optimization (VVO)

A technique for reducing the amount of energy waste or over provisioning on the distribution grid. VVO is a

process used to actively manage voltage levels and reactive power on distribution circuits in order to reduce energy losses, improve reliability, and power quality. VVO is typically achieved through the use of real-time information and controls that activate capacitor banks, voltage regulators, and transformer load-tap changers, and, in some cases, distributed generation to adjust voltage and VAR levels on the primary and secondary distribution circuits.

Voltage Optimizer

A Silver Spring application that provides utilities with a turnkey solution for maximizing voltage savings based on sophisticated EPRI-validated methods while maintaining compliance with regulatory settings. The software combines voltage alerts, polling, and sophisticated algorithms to provide up-to-date voltage optimization.

The solution leverages real-time alerts from [Power Monitor](#) and polled data from [Advanced Metering Manager \(AMM\)](#) to create a holistic understanding of voltage levels throughout the distribution network. A third-party product (EDGE from Dominion Voltage Inc.) then analyzes that data, looking for areas where it can tune DA device settings to optimize voltage levels.

voltage standing wave ratio (VSWR)

The ratio of maximum to minimum voltage. When a transmission line is terminated by an impedance that does not match the characteristic impedance of the transmission line, not all of the power is absorbed by the termination. Part of the power is reflected back down the transmission line. The forward (or incident) signal mixes with the reverse (or reflected) signal to cause a voltage standing wave pattern on the transmission line.

VPN

See [virtual private network \(VPN\)](#).

VPP

See [variable peak pricing \(VPP\)](#).

Vrms

Volts Root Mean Squared. A measurement of the magnitude of an AC signal or peak modulation. See also [Kilohertz](#), [kVAh](#), [kVAR](#), and [kVARh](#).

VSO

See [verified single outage \(VSO\)](#).

VSWR

See [voltage standing wave ratio \(VSWR\)](#).

VVO

See [Volt-VAR Optimization \(VVO\)](#).

W**WAN**

See [wide area network \(WAN\)](#).

WAN-enabled Silver Spring NIC

See [MicroAP™](#).

Water Module

A two-way radio integrated with water meters that provides consumption reads and that can be remotely configured. [ZigBee®](#)-based water modules are typically installed above ground to enable transmission on the 2.4 GHz frequency.

Wi-SUN Alliance

An association of companies working together to enable reliable, cost-effective, low-power, wireless utility products based on the open global standard [IEEE 802.15.4g](#). The Wi-SUN Alliance certification regimen helps ensure conformance of and interoperability between IEEE 802.15.4g implementations. Silver Spring has completed certification starting with the [Gen™4 technology](#) portfolio.

wide area network (WAN)

A dispersed telecommunications network. In contrast to a local area network (LAN) or neighborhood area network (NAN), a WAN often includes public networks. See also [local area network \(LAN\)](#) and [neighborhood area network \(NAN\)](#).

wireless

Communications service transmitted via cellular, PCS, satellite, or other means.

WOMS

See [work order management system \(WOMS\)](#).

work order management system (WOMS)

In the utility industry, a software application used to dispatch work crews to perform repairs. Such systems are often integrated with outage management systems. See also [outage management system \(OMS or OM\)](#).

X**X.509**

A cryptographic ITU-T standard for a public key infrastructure (PKI) for single sign-on (SSO) and Privilege Management Infrastructure (PMI). X.509 specifies, among other things, standard formats for public key certificates, certificate revocation lists, attribute certificates, and a certification path validation algorithm. See also [Public Key Infrastructure \(PKI\)](#).

XML

Extensible Markup Language. An standard, structured file format for exchanging business data over networks. Silver Spring exports interval data to XML files, which can then be imported into back-end business systems.

Z**zero crossing**

The event of standard AC line voltage crossing the zero volt, or reference level, from positive to negative or negative to positive. An electricity meter monitors its zero crossings and interprets their absence as a loss of power.

ZigBee®

A specification for a suite of high-level communication protocols using small, low-power digital radios. A wireless network used for home, building and industrial control. It operates in the 2.4 GHz (ISM) radio band. The specification supports data transmission rates of up to 250 kbps at a range of up to 30 meters.