Torana: Cisco and Schneider Electric Business Energy Management

Introduction

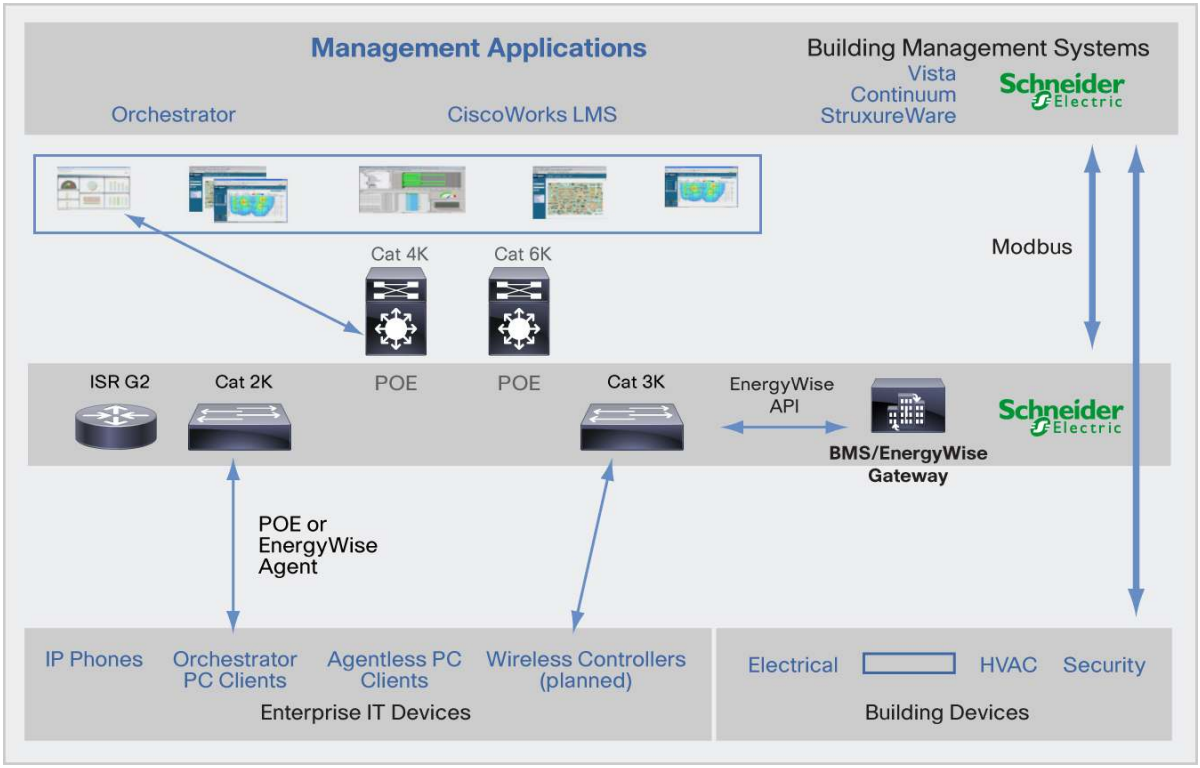
This white paper describes a joint solution from Cisco and Schneider Electric for building energy management. It represents an industry first: the convergence of information and communications technology (ICT) and facilities management using Cisco® EnergyWise as an IP energy control plane.

The target audience includes networking professionals with an interest in or responsibility for energy reduction, facility managers, sustainability teams, and energy managers.

Solution Overview

The Cisco/Schneider Electric iBMS solution is based on a gateway called **Torana**, illustrated in Figure 1.

Figure 1: System Architecture

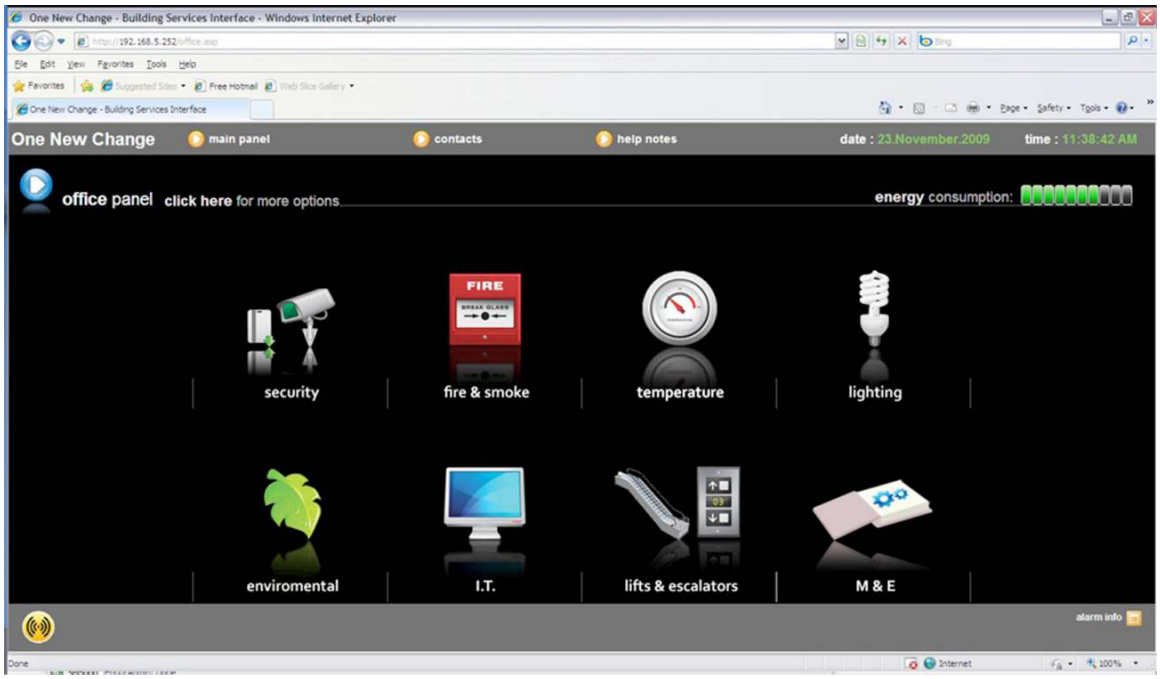


The strategy behind the solution is to provide Schneider Electric buildings management systems (BMSs) with access to energy data from a Cisco Borderless Network. This solution is achieved using the EnergyWise protocol, which Torana converts from EnergyWise into Modbus/IP and then into the Schneider Electric environment. This approach is used, because it allows the existing Schneider Electric BMSs to access the new data and provide support for EnergyWise with minimal overhead. The BMSs compatible with Torana are Vista, Continuum, and the next-generation StuxureWare.

Torana provides two-way control, allowing a BMS to extract data for measurement, monitoring, and reporting purposes, and also to control EnergyWise devices, such as powering down a group of IP phones.

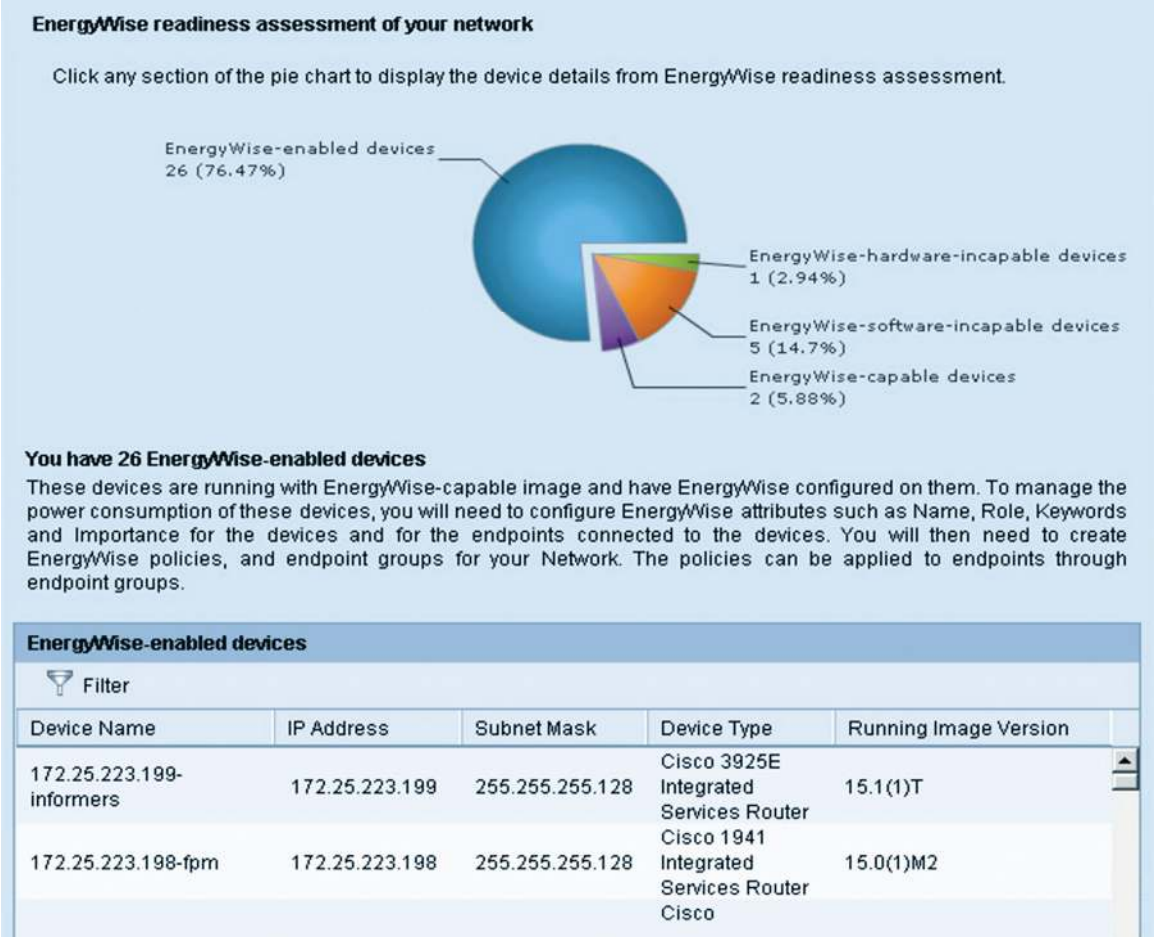
Functionality is exposed to the user via the BMS interface and is smoothly integrated into the existing BMS GUI environment. This arrangement allows ICT energy data and controls to be integrated into the main energy center in the BMS. An example is shown in Figure 2.

Figure 2: Example BMS Dashboard



Another key component is the network management application. Torana assumes that EnergyWise is already configured in the network; therefore, the customer or service provider should use another tool to perform this task. Any EnergyWise-compatible application can be used for this purpose. A good candidate is CiscoWorks LMS, because it provides full lifecycle support from auditing the network through to full EnergyWise commissioning and control. This capability makes CiscoWorks LMS ideal as a complement to Torana, providing a customer-owned solution or a partner-managed service. An example of the LMS EnergyWise WorkCenter is shown in Figure 3.

Figure 3: LMS EnergyWise WorkCenter



Applications

The integration provided by Torana, combined with the functionality in both EnergyWise and the BMS platforms, enables a whole range of applications.

Monitoring and Reporting

The first step in any energy management strategy is to enable data collection. Only once energy data is available can analysis be performed and policy decisions be made. This activity is very common for traditional BMS systems, but for the first time, it will now be possible to integrate ICT data into this process. At a minimum, this integration will provide facilities managers with the ability to associate a consumption figure to ICT equipment. However, of more value, are the additional questions that can now be answered:

What is the ICT consumption over time, for example, for a day, week, or month?

Which devices are consuming the most power?

What buildings/floors are consuming the most power?

How is consumption varying per business function, for example, human resources, accounts, sales, etc.?

Analysis and Correlation

The real value of the converged solution is the ability to perform analysis of the data and correlation between different sources.

Even the relatively simple reports described previously provide a pivotal starting point for facility managers to begin making recommendations for energy reduction.

For example, ICT reports may show that PC and IP phone consumption is not reducing significantly at nighttime or weekends and hence is underoptimized.

Another useful exercise is to evaluate when equipment is being used and for how often, because this evaluation may identify redundant devices such as PCs, phones, and servers.

ICT equipment produces heat, which must be cooled and represents on average 18 percent of the total cooling load. This load is a significant cost for facility managers and occurs in the office, wiring closet, and data center. Often, however, cooling systems are not optimized and are set too high, because they are configured using outdated or static nameplate values for heat produced by ICT equipment. Correlating the actual power consumed against cooling loads could result in significant savings. A good example is in the data center, where it is estimated that raising the temperature by a single degree can result in 4-5 percent energy savings[1].

Smart Buildings

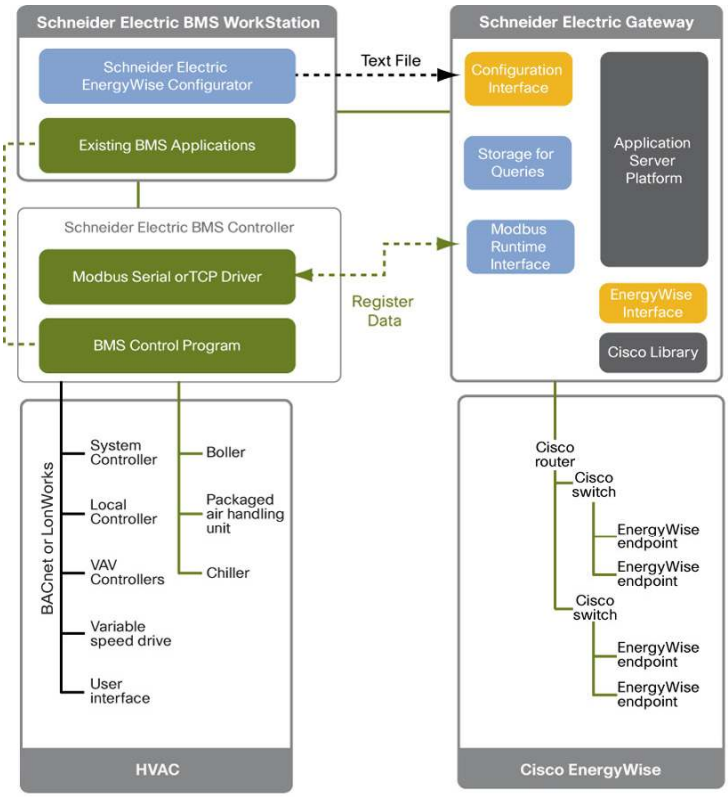
Schneider Electric BMSs have the ability to integrate different systems to provide so-called cause-and-effect services. For example, the security system can be integrated with video surveillance to capture images and raise alarms to operators and air conditioning systems can be switched off when external doors are left open.

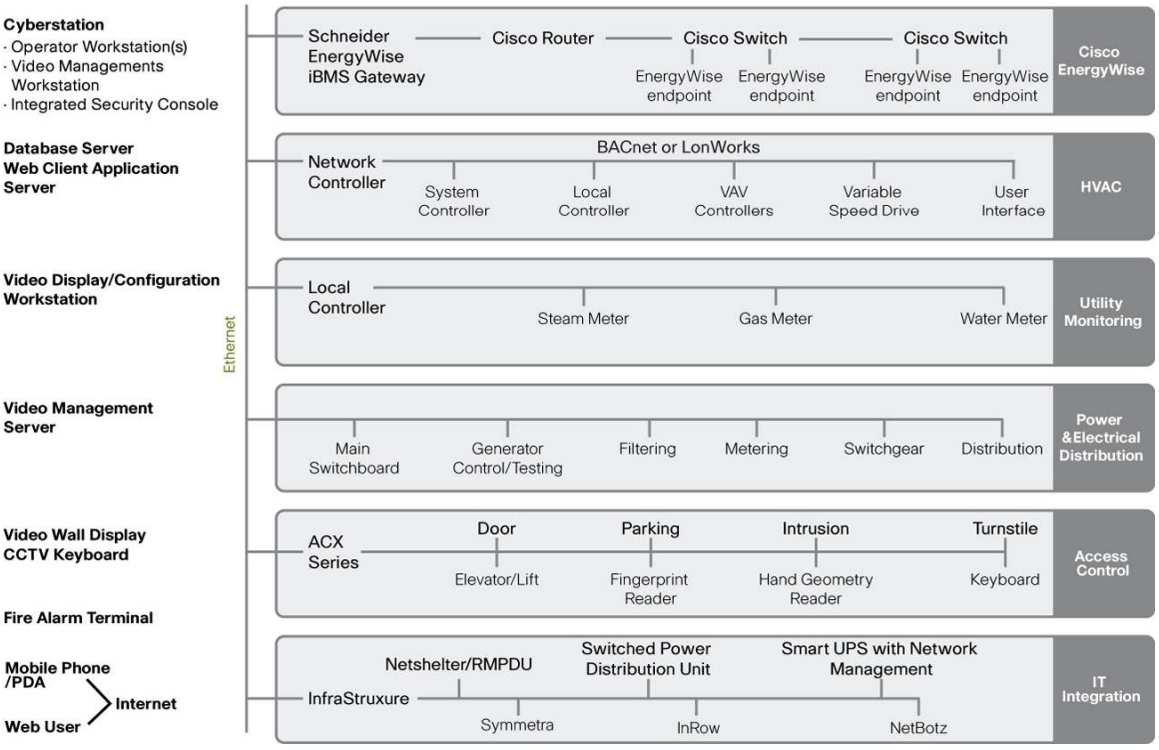
Such BMSs support the notion of a smart building that can adapt automatically to environmental circumstances or user requests.

This ability to integrate different systems and apply actions based on events is a critical feature. The architecture of such a system is illustrated in Figure 4 and shows how Schneider Electric controllers are used to provide northbound integration to the Cisco IP network and southbound integration to the native building systems such as heating, ventilating, and air conditioning (HVAC) and security. Torana is shown furthest left, connecting the BMS clients to ICT equipment. The logic for providing cause and effect would be contained within the application server, which is able to send and receive events to all systems.

[1] http://www.datacenterresources.com/index.cfm/resources/press-releases/increasing-crac-set-points-to-save-data-center-energy-costs/

Figure 4: Schneider BMS Integration





This arrangement allows new energy management services to be created. For example, parts of a building can be powered up/down based on who is entering or leaving. In the optimal case, where a company supports hot-desking, upper floors can be powered down and only activated when lower floors are at capacity.

Similarly, ICT systems can support the idea of a smart office, where digital signage screens welcome employees or visitors, power up an appropriate desk, and display a map of how to get there.

Individuals can also be granted certain autonomy over the local climate control and modify ambient temperature and lighting through a web portal or an IP phone.

Underpinning all of this is the Cisco Borderless Network, which provides an integration platform to transport the data securely over IP. Furthermore, Cisco EnergyWise provides a control plane to enable the BMS to communicate energy commands to ICT equipment.

Deployment

The deployment process consists of the following stages:

1. Auditing
2. Sizing
3. Commissioning
4. Verification

Auditing

Torana is designed to scale from small buildings up to multisite deployments, potentially over different geographical regions.

Each customer environment would be audited to determine compatibility and how many Torana systems would be required and where they would be placed. The purpose of the audit is to determine (a) if any existing BMSs are compatible, (b) what ICT equipment can be managed, and (c) whether any hardware or software upgrades are recommended. The first task is typically done by inspection and discussion with the facility management team. The latter two tasks can also be performed manually or using a tool such as CiscoWorks LMS. If a Cisco partner is involved, it may be able to support these tasks using tools within the Cisco Transformative Networks Program.

Compatible equipment comprises:

- Switches
- Routers
- PCs/laptops
- Thin clients
- IP phones
- Wireless access points
- IP cameras

- Power distribution units (PDUs)
- Printers/multifunction devices (MFDs)

and potentially other equipment typically found in office environments, such as vending machines, appliances, kiosks, etc.

It is important to note that coverage is not limited to devices that have native EnergyWise support (in the form of an agent). EnergyWise-capable PDUs act as proxies for the devices that they are powering through each plug and hence can be used to monitor (and control) a wide variety of equipment.

Sizing

Each customer environment would be audited to determine how many Torana systems would be required. Factors that influence this number are:

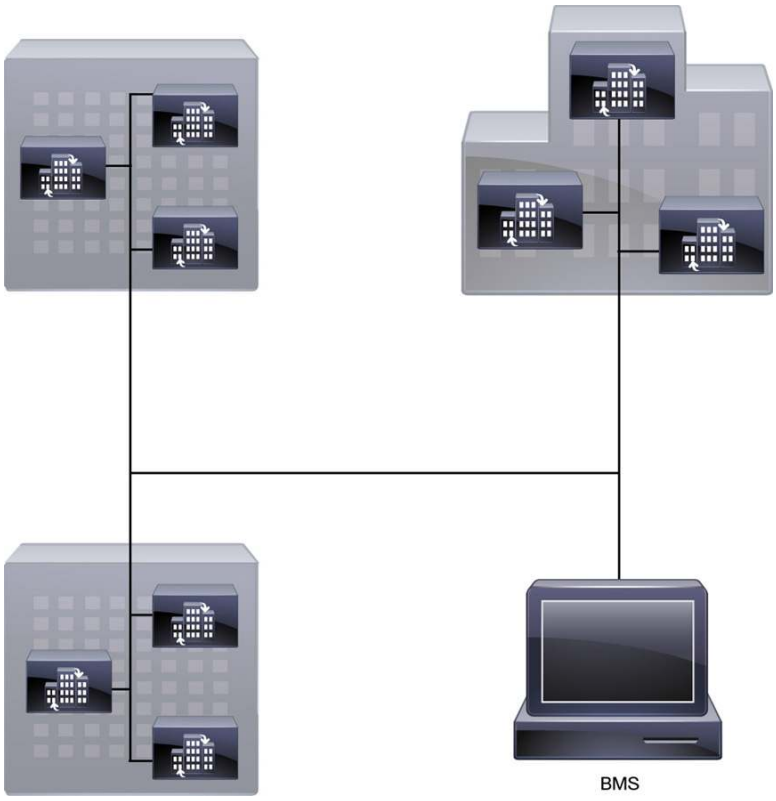
Query operations and frequency

Number of Modbus clients

If the Torana needs to bridge between separate networks; for example, the primary switch in one of the EnergyWise domains is in a separate network and requires additional routing to connect them.

It is, therefore, possible that a single building may have multiple physical Toranas. Consequently, a multisite organization may have tens or potentially hundreds of Toranas. There is no inter-Torana protocol, and each one needs to be connected to the main backbone of the central BMS, as shown in Figure 5.

Figure 5: Multi-Torana Deployments



Note that this figure is showing only the connection to the BMS, not the connection to the EnergyWise network. Each Torana has two connectors: a northbound one for connection on a separate management network and a southbound one to the main data network.

Commissioning

Each Torana is configured individually from the BMS, using the EnergyWise configuration shown in Figure 6. This configuration interface allows the administrator to connect to each Torana, to enable the interface to the EnergyWise network and begin the process of discovering what domains, devices, and attributes can be managed. The administrator would then define the EnergyWise queries that they wish to be supported, for example, all IP phones in a specific Building.

Once this initial specification had been performed, the configurator creates a mapping from an EnergyWise entity (such as a phone, domain, or query) to a corresponding Modbus Register. These registers are then read by existing Schneider Electric controllers, which are essentially Modbus clients. Therefore the Modbus registers serve a dual purpose: they allow the BMS GUI to present EnergyWise data and send messages to the controllers, and allow existing controllers to communicate to the Torana using native Modbus commands. This latter process is illustrated in Figure 7.

Figure 6: Torana Deployment Architecture

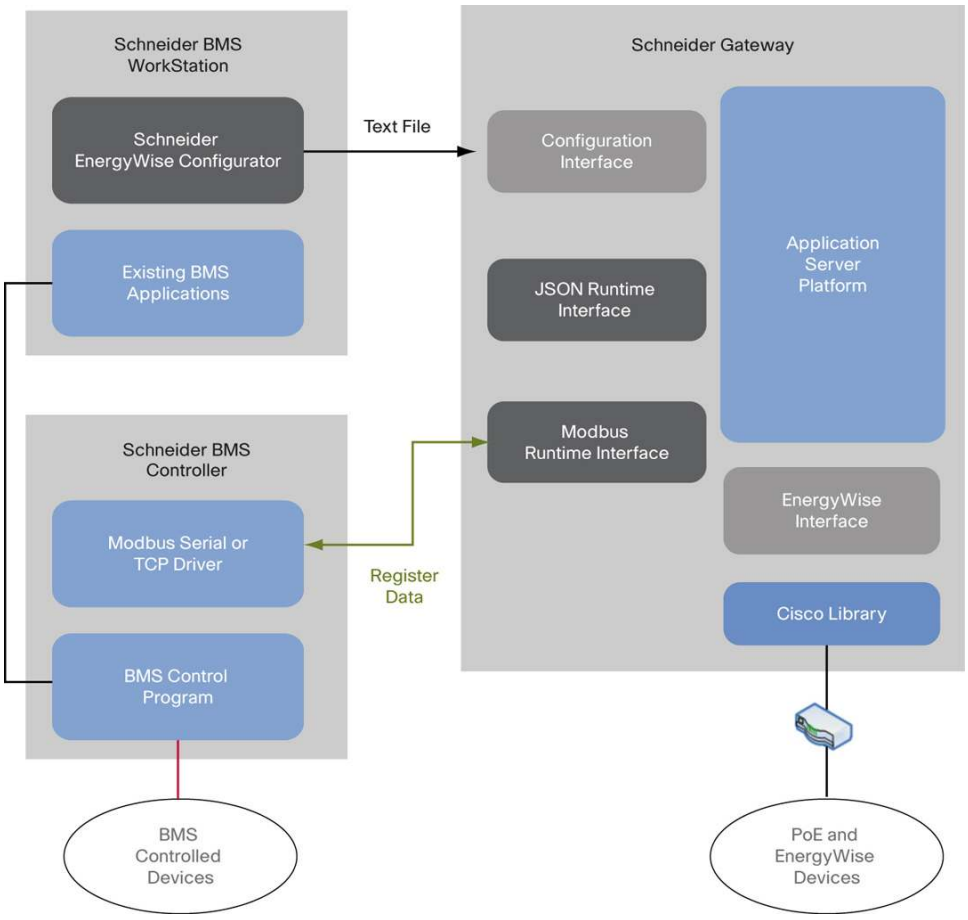
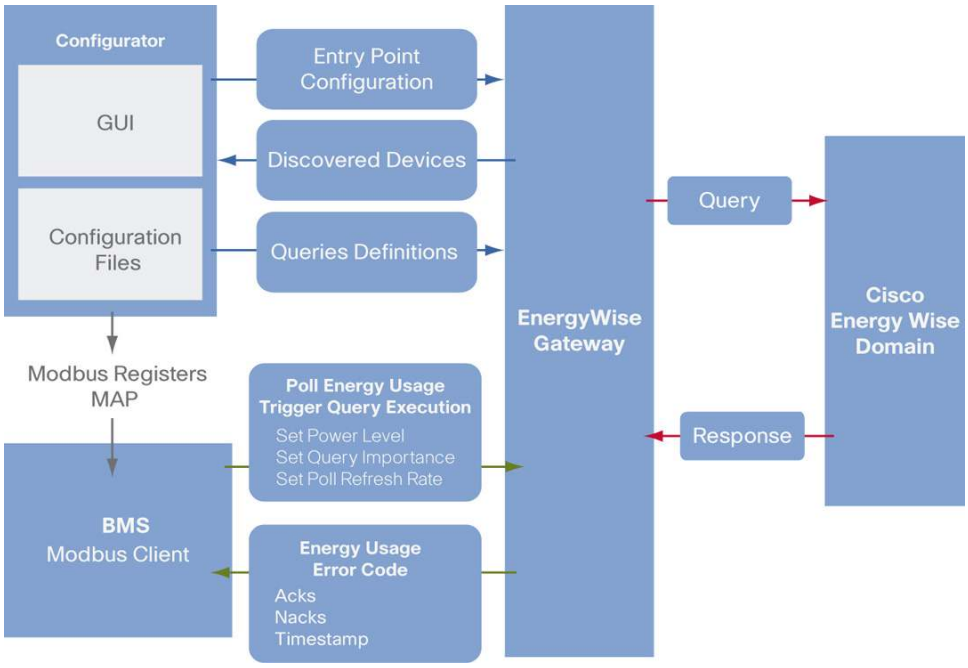


Figure 7: Torana Commissioning



Verification

The final stage in the deployment process is verification. This primarily requires the administrator to check that EnergyWise data is being captured into the BMS, and that the devices can be queried and controlled. The starting point for this would be the GUI by manual inspection.

Security

Security is paramount for Torana, because it can access ICT equipment. Two main connections require protection: northbound to the BMS, the configurator is password protected and encrypted. It supports role-based access, for example, the administrator and engineer.

The Modbus Server component of Torana will accept connections only from a set of allowed IP addresses.

Southbound to the EW network is protected by an encrypted TCP session from Torana to the primary switch within each target domain.

The fact that these two Gigabit Ethernet connections exist also provides a default firewall in the sense that no direct communication between the two networks is possible without administrator configuration.

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