Integrating your BAS with Cooper Lighting Solution's WaveLinx/Trellix system

Overview

Intelligent buildings are buildings that leverage their physical design, IT infrastructure and systems to become responsive, flexible and adaptive to the building's occupants changing needs. The buildings intelligent systems will provide impactful insights and services to the buildings occupants including its administration and operation & maintenance teams.

Most of the large real-estate management companies are developing applications that allow them to transition better manage their real-estate assets as well as offer new value-added services to their tenants. For instance many of them offer web portal that allows tenants to find new spaces offered by the real-estate company and be able to analyze how their current spaces are being used. These applications typically rely on data gathered from the various systems operating the buildings, i.e.HVAC systems, lighting systems, elevator systems, security systems, waste water management systems, etc…

With the rapid adoption of connected lighting systems within the market, the real-estate management will have much more granular data at their disposal. Cooper Lighting Solutions is expanding its BACnet object model to empower third party systems to easily access the data available on its connected lighting system. This white paper describes how BACnet system integrator should integrated Cooper's WaveLinx system with the building automation.

WaveLinx Connected Lighting System

WaveLinx is a digital lighting controls system that easily connect IoT enabled luminaires, i.e. luminaire with integrated sensors, standard luminaires, ceiling, corner wall sensors, wallstations and other control devices to create a digital lighting network that is easy to specify, install, and own. In addition to meet local energy codes, the system allow users to be ready for IoT applications that would leverage the data generated by the sensors.

Trellix Smart Spaces IoT Platform

The Trellix Smart Spaces IoT platform is the platform that unlocks the value gathered the WaveLinx connected lighting system. The platform hosts , i.e. IoT sensors, digital ballasts and LED drivers, lighting controls, centralized management under one system/software umbrella.

In a typical building, you will typically have at least one Trellix Core and multiple area controllers per floor connected over the building network or a dedicated network for the lighting system.

The Trellix can seamlessly and reliably integrate with other building systems via BACnet/IP protocol and REST APIs.

BACnet is embedded or native in Trellix Core, which means no external interfaces or gateways are required in order to communicate with other systems. Only a single point of connection is needed on the network for total and complete communication to the entire system. The diagram above shows a Trellix Core connected to WaveLinx Area Controllers and third-party building automation system.

Communication Protocol

Communication between third party Building Automation System and Cooper WaveLinx system is BACnet/IP. The BACnet/IP uses Broadcast UDP and Peer-to-Peer UDP on any standard Ethernet network system.

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Lighting System Data Structure

Prior to reviewing the BACnet objects offered by WaveLinx/Trellix system, let's review the WaveLinx/Trellix data structure.

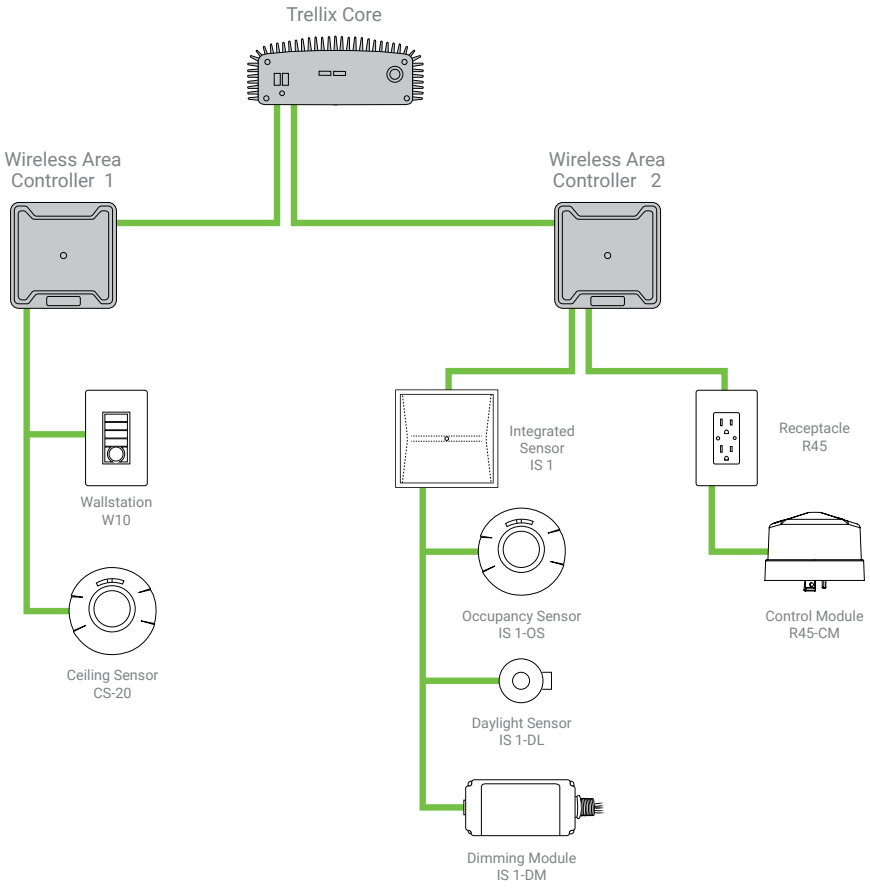
When a WaveLinx lighting system is configured, wireless devices are grouped into a logical device hierarchy and spatial/building hierarchy. These groupings are used to control the lights according to strategies defined by the specialist who configured the system.

As a system integrator, you will most likely deal with the spatial/building aspects of the data model. However, it will be valuable to have a good understanding of both WaveLinx logical and spatial/geographical hierarchies.

Device Hierarchy

A lighting system is composed of wireless devices (wallstations, ceiling sensors, wireless receptacles, switchpacks, integrated sensors, drivers) connected to Wireless Area Controllers (WAC). The WACs are connected to a Trellix Core that acts as a data repository and hosts interfaces such as BACnet/IP and Public (REST) API used by third-party systems.

The logical or device hierarchy is as follows: **Trellix Core > Wireless Area Controllers > Devices > Endpoints.** An example of as device hierarchy is shown below.



Devices

A Device is a physical component of a lighting system. When connected to a network, each device has a unique ID (address) on that network that is used to route network communication to the device. The object structure is flexible enough to describe current and future devices in a general way but with an appropriate level of detail. A device is associated to an area.

Endpoints

An Endpoint represents a function available on a Device, including controllers, inputs and outputs. Each device can have one or more endpoints. For example, a ceiling sensor contains an occupancy sensor endpoint and a daylight sensor endpoint, while an integrated sensor contains an occupancy sensor endpoint, a daylight sensor endpoint, and a dimming module endpoint.

Endpoints are represented as a list in a Device object, which in turn is presented to the network. An Endpoint may represent a physical component of a Device (e.g., a daylight sensor or occupancy sensor), a logical function of a Device (e.g., firmware update capability), or a link to a controlled device. Most system interactions take place directly through Endpoints, not the Device object that contains them.

When a device is associated to an area, the endpoints associated to the device are automatically moved to the appropriate grouping. As such when an integrated sensor is moved into an area, the dimming module endpoint is automatically moved to the default light dimming zone while the occupancy sensor endpoint is moved to the occupancy set and the daylight sensor endpoint is moved to the daylight set.

Building Hierarchy

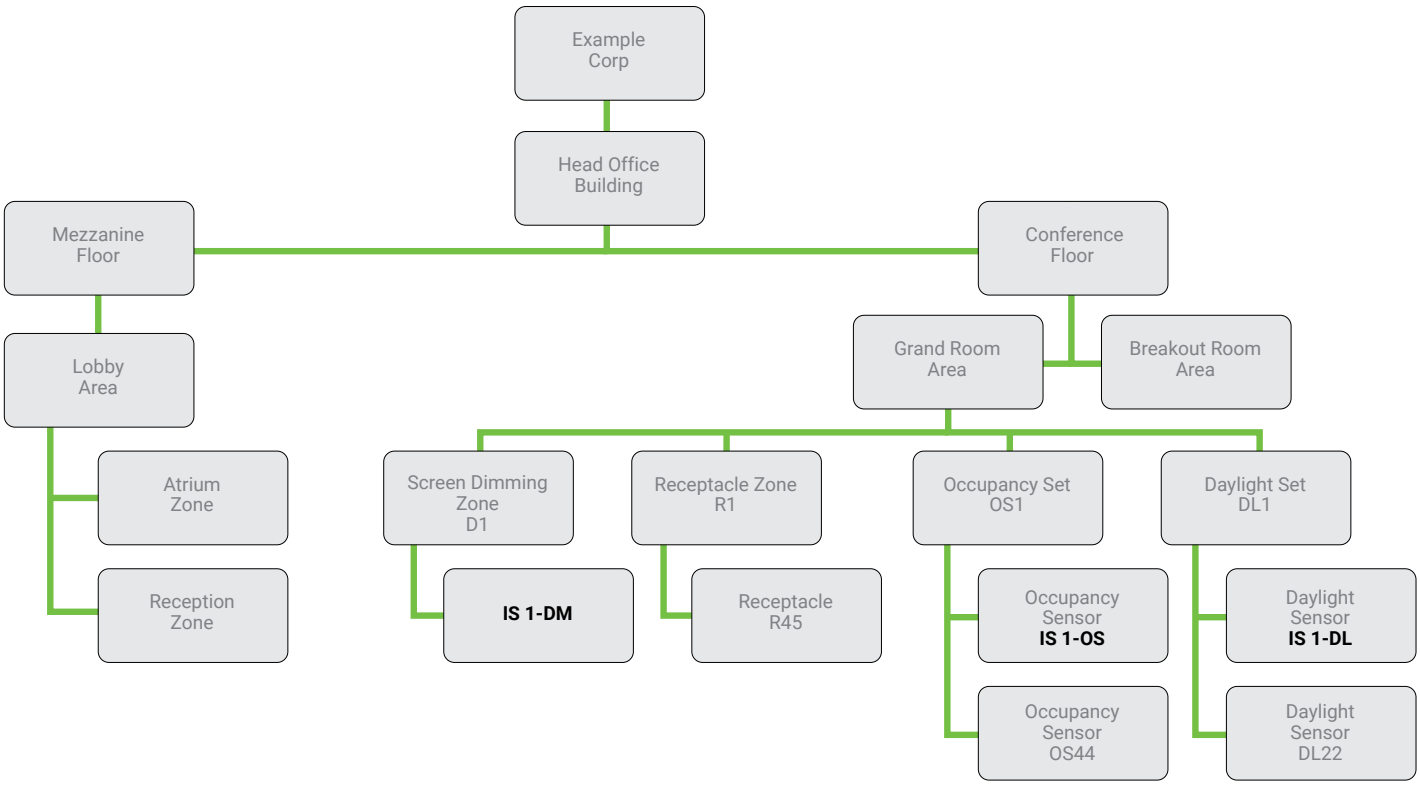
The geographical or building hierarchy is as follows: **Client > Building > Floor > Area > [Zones / Occupancy Sets / Daylight Sets / Devices].**

A building hierarchy reflects a physical relationship but also certain logical relationships that group endpoints into Occupancy Sets, Daylight Sets and Zones.

An **occupancy set** is a group of occupancy sensor endpoints. These endpoints are physically located within ceiling or integrated sensor devices. The occupancy sets are associated to lighting zones. The controller sends occupied and unoccupied command (scene or light level) to the associated zones based on the occupancy set status (occupied or unoccupied).

A **daylight set** is a group of daylight sensor endpoints. These endpoints are also physically located within ceiling or integrated sensor devices. The daylight sets are associated to lighting zones. The controller controls the light level of the zones according to how much daylight is present in a space.

An example of a building hierarchy is shown below.



Integrated Sensor IS 1 installed in a light fixture and has an occupancy sensor endpoint, a daylight sensor endpoint, and a dimming module endpoint. The blue labels in the diagram highlights how the IS 1 dimming module appears in Screen Dimming Zone D1 while its occupancy set endpoint appears in Occupancy Set OS1, and its daylight sensor appears in Daylight Set DL1.

Components of a Building Hierarchy

The components of a building hierarchy are as follows:

A **Client** is a collection of Buildings.

A **Building** is a collection of Floors.

A **Floor** is a collection of Areas.

An **Area** is a collection of Zones and is typically a private space such as a personal office, washroom or open space. An Area can have multiple Occupancy Sets and Daylight Sets associated with it, but each Occupancy Set or Daylight Set can only be associated with one Area.

A **Zone** is a group of dimming or on/off output endpoints that are used to control the light level or receptacles. There are three types of zones: dimming zones for dimmable light fixtures, on/off for on/off light fixtures and receptacle zones for receptacles. These dimming or on/off endpoints can be found in a wireless integrated sensor, a wireless switchpack, and a wireless receptacle.

An **Occupancy Set** is a group of occupancy sensor endpoints that are used to turn the lights on and off based on occupancy state. Occupancy Sets are associated to a single Area.

A **Daylight Set** is a groups of daylight sensor endpoints that are used to dim the light according to amount of daylight sensed. Daylight Sets are associated with a single Area.

What needs to be done in the WaveLinx system

1. BACnet is native to the Trellix Core. However, in order to enable this capability, a BACnet software license must be purchased for the job.
2. With the BACnet software license, the Cooper Service representative will turn on the BACnet capability during setup. Only one Trellix Core per building is needed. The Trellix Core will act as the master for all BACnet communications for the subsystem.
3. If the Trellix and Building automation systems are not on the same subnet, a BACnet Broadcast Management Device (BBMD) is required by the integrator. The Trellix Core supports foreign device registration of BBMD. The IP address and port of the BBMD should be given to the Cooper field service representative during setup (if required).
4. The Trellix system will show as a single device instance number. All lighting objects will be listed under the Trellix Device.

What to Integrate

Trellix BACnet Interface is a BACnet Application Specific Controller (B-ASC) device type as such it does data sharing and device management. Scheduling and Trending Logs are not supported.

Data Sharing

Trellix BACnet interface exposes lighting objects as Analog inputs, Analog outputs, Binary inputs, Binary outputs. This allows third party applications to use BACnet services to monitor and command the lighting objects.

The WaveLinx Area Controller is a two-priority based system. Manual actions commands are sent at a normal priority. Override commands are sent at a high priority. WaveLinx system maps

Trellix exposes area's attributes, zone attributes, occupancy sets attributes, daylight sets attributes and endpoints attributes as objects. Below tables lists all the objects exposed via BACnet and what users can do with these objects.

Objects	Description
System Data	
Trellix_{MACID}	This a Device ID for the Trellix system. It is used to connect your building automation system and your Trellix/WaveLinx system
cDemandResponse	Allows you to send demand response command to the entire lighting system. 0: cancel demand response 1: initiate demand response The light level % reduction is defined within the WaveLinx area controller.
Override Duration	Allows you to define the duration for the high priority/override command sent by the BAS system.
Area Data	
Area_{AreaName}_Actual Scene	Allows you to read the scene of an area.
Area_{AreaName}_Selected Scene	Allows you to set the scene for an area.
Area_{AreaName}_Total Energy	Allows you to read the energy usage of an area (real-time). The energy usage is updated every 15 minutes and increases continuously.
Area_{AreaName}_Is Occupied Physical	Allows you to get information about the occupancy status of an area.
Zone Data	
Zone_{ZoneName}_Actual Level	Allows you to read the light level for a lighting zone, i.e. group of light fixtures. Note: The daylight sensors changes are not reflected in the light level.
Read_{ZoneName}_Is On	Allows you to read the light level for a receptacle zone, i.e. group of receptacles.
Zone_{ZoneName}_Requested Level	Allows you to set the light level for a lighting zone, i.e. group of light fixtures. Note: The requested level commands are sent as manual actions.
Occupancy Set Data	
OccupancySet_{OccupancySetName}_Is OccupiedPhysical	Allows you to get the status of an occupancy set, i.e. occupied or not.
OccupancySet_{OccupancySetName}_Enable	Allows you to enable/disable an occupancy set.
Daylight Set Data	
DaylightSet_{CL Daylight Set Name}_Enable	Allows you to enable/disable the closed loop daylight set.
DaylightSet_{OL Daylight Set Name}_Enable	Allow you to enable/disable the open loop daylight set.
Endpoint (occupancy sensors, drivers, ballasts, daylight sensors, wallstations)	
Output_{OutputDeviceName}_Actual Level	Allows you to read the light level of an output device, i.e. fixture controlled by an integrated sensor or relay switchpack.
Output_{OutputDeviceName}_Actual Level	Allows you to read the status of a receptacle, i.e. on or off.
Input_{OccupancysensorName}_Daylight Sensor Name_Daylight Sensor Reading	Allows you to read the value captured by the photocell within the occupancy sensor. You can use this number if you are looking at optimizing your space light level.
Input_{DeviceName}_Status	Allows you to get the status of the device, i.e. communicating with the controller or not. You can use this object to generate alarms on the BAS console.
Input_{Sensor ID}_{Sensor Name}_Is OccupiedPhysical	Allows you to get the status of an individual ceiling or integrated sensor status.

To simplify the integration process, it is recommended that the integrator and WaveLinx / Trellix representative coordinate on area, zone, occupancy sets, daylight sets and endpoint sets naming conventions.

For a summary of WaveLinx / Trellix BACnet objects, naming conventions, and functionality, reference the additional tables located in the WaveLinx/Trellix BACnet PICS statement. To get the latest PIC statement with object list that corresponds to the Trellix version you are running, go to the Trellix BACnet Interface web page and look for PICS.

BACnet Scheduling

Trellix does not currently support the BACnet Schedule Object. There are two methods that can be employed to control the lights based on time-based events.

Method 1: You can have the BAS scheduling object manage the light levels by having the BAS system send command to the Trellix system using the data sharing objects. The user will manage the schedule using the BAS console.

Method 2: Trellix can support the schedule and Trellix Lighting application can be used to view and modify events. Note: Trellix system supports the setup of schedules via the Trellix application but they are not accessible via BACnet objects. Approach 1 should be taken if BACnet Scheduling is required for the project.

BACnet Trend Log

Trellix does not support the BACnet Trend Log object. However, the Trellix system does share information (energy usage, occupancy status, etc.) through Binary output, Analog output objects which can be used for trending. BAS systems can read real-time data via the data sharing objects and then use the Trend Log object to aggregate and archive the data. The BAS system can then trend the real-time and aggregate data using its own trend log object.

Trellix provides energy and occupancy dashboards that can be used to view aggregated/historical data.

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