This specification was updated in March 2025 and supersedes all previous WaveLinx hybrid specifications.
This Section includes editing notes. These notes are hidden and can be viewed by Microsoft Word. To do this, go to the FILE menu, select OPTIONS, and then DISPLAY. Under the DISPLAY VIEW, select or deselect the HIDDEN TEXT option and click OK.

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wireless Lighting Control Devices
2. System Software Interfaces
3. System Backbone and Integration Equipment

B. Related Sections:

1. Section 260010 – Supplemental Requirements for Electrical – for abbreviations, definitions, submittals, qualifications, testing agencies and other requirements applicable to work specified in this Section.
2. Section 262726 - Wiring Devices/Lighting Controls for wired switches, dimmers and receptacles requirement applicable to work specified in this section.
3. Division 250000 – Integrated Automation – for requirements to integrate the lighting control system with Building Automation Systems

1.2 DEFINITIONS

A. Communication Bus: A wired interface a device uses to communicate with other control devices.

B. Device: A wired wireless equipment that controls the light emitted by a lighting source, including fluorescent ballasts, LED drivers, incandescent lamps, manual switches, switching relays, dimming modules and sensors.

C. Group: A set of devices that communicate together

D. Scene: Digital light level associated with a preset

E. Supervisory System: A set of tools to acquire, process, communicate and display equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

F. System Backbone: Devices used to connect separate spaces via TCP/IP, including bridging devices, gateways, and area controllers.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at [**Project Site**]

B. Pre-installation Coordination Meeting(s): For networked systems, conduct meeting(s) via videoconference or in person at the project site before construction activities.

    1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify the architect, construction manager and owner's commissioning authority of scheduled meeting dates.

    2. Scope: Review the submittal drawing, sequence of operation, IT requirements, and wiring best practices, including wiring testing, device installation best practices and lighting control integration requirements with other systems with the project team.

1.4 ACTION SUBMITTALS

A. Product data:

    1. Bill of Materials necessary to install the networked lighting control system.

    2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.

    3. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.

    4. General and system notes define system characteristics the installer should know before installing.

    5. Other diagrams and operational descriptions as needed to indicate system operation or interaction with other system(s).

B. Shop drawings:

    1. Riser diagram showing device wiring or wireless connections and typical per room/area type.

    2. IT system drawing showing how IP devices are connected (especially for higher-level networking devices).

C. The Sequence of operations:

    1. Description of how each component operates and how any building-wide functionality is achieved to exceed local energy code (California Title 24 , ASHRAE 90.1, IECC).

D. Commissioning forms:

    1. Forms are to be completed by the installer before requesting the system start-up.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor Start-up/Commissioning Worksheet.

B. Service Specification Sheets indicating general service descriptions, including start-up, training, post-startup support, and service contract terms.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Contracts.

B. Hardware and Software Operation Manuals

C. Maintenance service agreement.

D. Warranty documentation.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications

B. Phone Support: Toll-free technical support shall be available from the manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.

C. Remote Support: The manufacturer shall be able to provide remote support and virtually connect with customers to address issues with visual guidance overlaid on images of real-world objects.

D. On-Site Support: The manufacturer shall be capable of providing a 72-hour, on-site response time within the continental United States and Canada.

E. Service Contracts: The manufacturer shall be capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion, including:

F. Remote and on-site emergency response.

G. Remote system performance checks.

H. Remote diagnostics.

I. Replacement parts.

1.8 WARRANTY

A. Warranty: The manufacturer and Installer warrant that installed lighting control devices perform per specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within the extended warranty period.

B. Failures include, but are not limited to, the following:

   1. Faulty operation of lighting control hardware.
   2. Faulty operation of lighting control firmware.
   3. <Insert failure modes>.

C. Minium Warranty Period

D. Five years for lighting control devices from the date of shipment.

E. One year for the supervisory controller from the date of shipment

F. One year for lighting management software application from the date of shipment

G. Recommended spare parts:

   1. Ceiling sensors: one (1) spare for every 200 installed to be used for maintenance.
   2. Wallstations: one (1) spare for every 200 installed for maintenance.
   3. Receptacle: one (1) spare for every 100 installed for maintenance.
   4. Relay Switchpack: one (1) spare for every 200 installed for maintenance.
   5. Area Controller: one (1) spare for every 100 installed for maintenance.
   6. Area Hub: One (1) spare for every 100 installed for maintenance.
   7. Panel Controller: one (1) spare for every 100 installed for maintenance.
   8. Panel Keypad: one (1) spare for every 100 installed for maintenance.
   9. Panel Relay: one (1) spare for every 100 installed for maintenance.
   10. Panel Dimming module: one (1) spare for every 100 installed for maintenance.
   11. Low-Voltage Power Module: one (1) spare for every 100 installed for maintenance
   12. Touchscreens: one (1) spare for every 50 installed for maintenance.

PART 2 - PRODUCTS

2.1 SYSTEM COMPLIANCE

A. Components manufactured in accordance with UL 916 and UL 924 standards where applicable.

B. Components manufactured in accordance with CFR Title 47, Part 15 standards where applicable.

C. Components manufactured in accordance with ISED Canada RSS-247 standards where applicable.

D. Components manufactured in accordance with IFT-008-2015 and NOM-208-SCFI-2016 standards where applicable.

E. The system shall be listed as a qualified system under Design Lights Consortium Networked Lighting Control System Specification v5.0 or higher.

F. Performance Criteria:

G. Listed and labelled in accordance with NFPA 70 by a qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. System Characteristics

    1. The system is composed of the following interconnected digital control devices:

        a. Wallstations
        b. Occupancy/Vacancy Ceiling and tile mount Sensors.
        c. Fixture mount sensors for indoor, industrial, and outdoor fixtures
        d. Dimming Switchpack
        e. Dimming emergency switchpack
        f. Receptacle -
        g. Contact Closure Input
        h. Touchscreen.
        i. Area controller for networked spaces.
        j. Outdoor Area Controller
        k. Area hub to network multiple control areas to an area controller.
        l. Supervisory server.
        m. Lighting Management Software applications
        n. BACnet/IP, API, OpenADR and Shades interfaces.
        o. The system shall be able to support the following topologies:
        a. Interconnected digital control devices to control the lights in a standalone room/a space with one or multiple zones.
        b. Interconnected digital control devices, area hubs and area controllers to control the lights in networked rooms/spaces with one or multiple zones per room.
        c. Hybrid lighting control with the integration devices like area hubs and area controllers to control wireless lights, including connected luminaires seamlessly. The wireless system should be able to control the wired system as well.
        d. In a single room/space topology, the lighting control system shall provide the following capabilities:
        e. wireless communication – The devices shall be able to exchange data with each other via wireless communication.
        f. Occupancy sensing – The ability to automatically turn the lights on and off based upon detecting the presence or absence of people in an indoor or outdoor space.
        g. Daylight harvesting - The capability of automatically affecting the operation of luminaires based on the amount of daylight present in a space.

h. Zoning - The capability of grouping luminaires to form unique lighting control zones for a control strategy via software or electrical installation details (e.g. wiring).

i. High-end trim - The ability to set the maximum light output to a less-than-maximum state of an individual or group of luminaires/lamps using the software application.

j. Individual Addressability - The ability to uniquely identify and address each control device, allowing for configuration and re-configuration of devices and control zones independent of electrical circuiting.

k. Continuous dimming – The ability to offer smooth light level changes by providing high resolution in light output control.

l. Personal Control – The capability for individual users to adjust the lights to their personal preferences using a control interface.

m. Scenes control – The capability of providing two or more pre-programmed light level settings for a group or multiple groups of luminaires.

n. Zone control – The capability of controlling a zone based on the last affected zone or last active scene that was controlled by a control device like a Wallstation.

o. Plug load control – The capability to control the power delivered to receptacles through scheduling or occupancy sensing.

p. Emergency lighting – The capability of having emergency lighting to full on upon loss of normal power.

q. Luminaire Level Lighting Control (connected luminaires) - The capability to have an occupancy sensor and ambient light sensor installed for each luminaire for luminaire level control as well as the ability of individual luminaires to exchange data with other luminaires and control devices on the system (Note: for wireless luminaires and control devices only).

r. Programming – The capability of allowing installers and system owners to configure the system to meet their specifications using an application running on a mobile device.

s. System devices support firmware updates from a mobile app or controller.

t. Out-of-box control – For spaces within connected wireless the lights shall be able to go to 50% light level once powered and automatically turn on/off based on the occupancy status of the space with no programming.

u. Out-of-box zone control – The ability to order various digital control devices like wallstations and dimming swithpacks pre-configured with a zone number from the manufacturer allowing for out-of-box zone control of the space with no programming.

v. Standalone Control – The capability for digital lighting control devices within the same space to provide automatic control from sensors (occupancy and/or photosensor) without requiring connection to a higher-level system component.

w. Contact Closure Inputs – The capability of the wireless system to react to the input from an Alarm, Demand response, KeySwitch/Master switch, timeclock without requiring connection to a higher-level system component.

2. In a networked rooms/spaces topology, the system shall provide the following capabilities in addition to the capabilities available in a single room/space application:

a. 7-Days / Astronomic scheduling – The ability to automatically affect the operation of lighting equipment based on the time of day. The system shall offer time-based scheduling and "astronomical" scheduling functionality for sunrise and sunset programming based on geographical location and time of year.

b. Demand Response (Load Shedding) - The capability to temporarily reduce the energy consumption of a lighting system, in a pre-defined way, in response to a demand response signal without manual intervention.

c. OpenADR – The capability to receive demand response commands from a utility company using the OpenADR standard.

d. Floorplan – The capability to manage the lighting system via a floorplan, i.e., change the light of a single fixture or group of fixtures from the floorplan and view the health status of a fixture or a group of fixtures.

e. Programming – The capability of programming and managing all spaces from a mobile app running on a mobile device and a web browser accessing a computing device. The supervisory server, area controller, and area hub serve the web pages.

f. Energy reporting – The capability to report energy consumption (calculated or measured) of a connected luminaire or a group of luminaires for up to 13 months.

g. Occupancy reporting – The capability to report occupancy usage of areas for up to 13 months.

h. Integration with third-party systems via BACnet/IP and Public (REST) API

i. Firmware update – The capability to update the firmware of multiple area controllers

j. System health monitoring - The ability to monitor, diagnose, and report operational performance, including system and/or component failures.

k. Ability to make central changes via a local area controller when there are multiple area controllers at a location connected to a central hub (CORE).

B. Wireless Control System Characteristics

1. Multiple wireless networking protocols supported:

   a. A 2.4 GHz IEEE 02.15.1 Bluetooth Sig Mesh network is used when the system is deployed in a standalone topology. The devices use this protocol to communicate directly with each other and with the mobile device used to program the system.

   b. A 2.4 GHz IEEE 802.15.4 wireless mesh network is used when the system is deployed in a networked topology. The devices use this protocol to communicate with each other and an area controller.

   c. A 2.4 GHz Wi-Fi IEEE 802.11 b/g/n protocol is used when the system is deployed in a networked topology. The area controller uses this protocol to communicate with the mobile device used to program the system.

2. No wired connections shall be required between networked control. Wired connections shall only be required to connect area controllers, supervisory controllers, and Touchscreen. The wired connection is used to allow for central management of the system.

3. The wireless mesh network shall self-configure, self-organize and self-heal.

4. Wireless network communication must support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.

5. The wireless lighting control system shall provide a visible indication on all wireless devices as each wireless device joins the wireless network.

6. Wireless devices shall have a line-of-sight communication range of 150 ft and 75 ft under typical site conditions accounting for typical environment conditions and building construction materials.

7. The wireless lighting control system shall allow addressed wireless light fixtures with integrated sensors to be identified (reverse-identified) by the sensor with laser, flashlight, IR remote, etc. Identified light fixtures shall provide a visible indication on the mobile application. Systems that do not permit reverse identification methods shall not be acceptable.

8. The wireless lighting control system shall allow wireless wallstations, receptacles, wireless Switchpack with 0-10V dimming and battery-powered wireless sensors to be identified (reverse-identified) by a simple pushbutton method on each device. Identified devices shall provide visible indications on the mobile application. Systems that do not permit reverse identification methods shall not be acceptable.

9. The wireless lighting control system shall support standalone and networked topologies. The WaveLinx Area Controllers both indoor and outdoor shall not be connected to an IP network in a standalone topology. The user shall program the standalone area controller via a mobile app. In a networked topology, the WaveLinx Area Controllers are connected to an IP network and bi-directionally communicate with a supervisory system.In networked, the WaveLinx Area Controller can be configured to have static IP address or obtain an IP address via Dynamic Host Configuration Protocol (DHCP).

C. System Integration Capabilities

1. The system shall provide the necessary interfaces to integrate with third-party systems such as building management systems (BMS) and smart building platforms.
2. Holistic control and integration of the system independent of technology.
3. The system shall offer the following interfaces:

   a. BACnet/IP protocol to integrate with the building automation system and other BACnet/IP supporting systems.
   b. RESTful API includes the following system integration capabilities:
      1) "Write" messages to control individual devices, including relay and dimming output.
      2) "Write" messages to control groups of devices through a single command, including control of relay and dimming output of all devices.
      3) "Read" messages for individual device status information. The available status will vary based on device type and capabilities, including relay state, dimming output, power measurement, occupancy sensor status, and photosensor light measurement.
      4) "Read" messages for group status information for occupancy, relay state, and dimming output.
   c. OpenADR 2.0b to active demand response requests from utility companies' Demand Response Automation Servers (DRAS).

D. Supported Sequence of Operations

1. Control Zones

   a. Standalone topology: A group of lighting control devices (ceiling sensor, wallstations, Switchpacks) installed in a single area that communicate with each other and adjust the lights within the space based on the space's occupancy status, daylight levels coming into the room as well as occupants' actions. The lights can be grouped together up to 16 unique control zones to support different and reconfigurable sequences of operation within the area.
   b. Networked topology: A group of connected luminaires and lighting control devices (ceiling sensors, wallstations, swithpacks), including a hybrid topology, installed in different areas that communicate to an area controller. The devices communicate with each and adjust the lights within the space based on the space's occupancy status, daylight levels coming into the rooms as well as occupants' actions. The lights can be grouped together up to 30 control zones per area and up to 49 areas to support different and reconfigurable sequences of operation within those areas.

2. Wallstation Capabilities

   a. Wall stations support the following capabilities:
      1) On/Off control of one or many zones.
      2) Continuous dimming control of the light level of one or many zones.
      3) Multi-Way Control: Multiple wallstations capable of controlling the same zones to support "multi-way" switching and dimming control
      4) Minimum actions supported: Specific light level, specific scene, raise, lower, toggle (available in networked topology only)
      5) Mechoshades® integration: In a networked topology with a supervisory controller, a wallstation can control a shade controlled by a Mechoshades® control system.

3. Occupancy Sensing Capabilities

   a. Occupancy sensors configurable to control one or multiple zones.
   b. Multiple occupancy sensors controlling one or multiple zones.
   c. Occupancy sensing sequence of operation modes:
      1) On/Off Occupancy Sensing.

2)   Partial-On Occupancy Sensing.(including Associated occupancy sets(
3)   Partial-Off Occupancy Sensing.
4)   Vacancy Sensing (Manual-On / Automatic-Off).

d.   On/Off, Partial-On, and Partial-Off Occupancy Sensing Modes Sequence of Operation:

1)   When occupancy is detected, occupancy automatically turns lights on to a designated level or scene (0 to 100%).

2)   When occupancy is detected in an associated occupancy set, that associated occupancy automatically turns lights on to a designated level or scene (0 to 100%)

3)   Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when a vacancy occurs or if sufficient daylight is detected.

4)   A system capable of combining Partial-Off and Full-Off operations by dimming lights to a designated level when vacant and turning the lights off entirely after an additional time delay.

5)   If enabled in the occupancy sensing control zone, photosensor readings automatically adjust light levels during occupied or unoccupied conditions as necessary.

6)   Wall station activation changes the dimming level or turns the lights off as the occupant selects. Lights optionally remain in this manually specified light level until the zone becomes vacant. Upon vacancy, the normal sequence of operation resumes.

e.   Vacancy Sensing or Manual-On/Automatic-Off Mode Sequence of Operation:

1)   Activation of a wall station is required to turn lights on. A system capable of programming the area to turn on to a designated light level. Initially occupying the space without using a wall station must not result in lights turning on.

2)   Occupancy sensors automatically turn lights off or to a dimmed state (Partial-Off) when a vacancy occurs or if sufficient daylight is detected. Users can change the default unoccupied light level (0%) to another light level.

3)   Photosensor readings, if enabled in the Occupancy Sensing control set, can automatically adjust the light level during occupied or unoccupied conditions as necessary.

4)   Wall station interaction changes the dimming level or turns lights off as the occupant selects. Lights remain at the manually specified light level until the zone becomes vacant; the normal sequence of operation resumes upon vacancy.

f.   Occupancy time delays before dimming or shutting off lights separately programmable for all control zones from 15 seconds to 2 hours.

g.   Energy mode sequence of operation:

1)   The system shall be capable of dimming the lights when vacant and then turning the lights off entirely after an additional time delay.

2)   Associated occupancy sets: Networked control devices can track occupancy broadcasts from adjacent zones. When this feature is enabled, luminaire output for a vacant zone will reduce to a configurable dimmed state if one or more adjacent zones are occupied. Luminaires will turn off when both primary and adjacent zones are vacant.

4.   Daylighting Sensing Capabilities

a.   Photosensor devices configurable to control a local zone.

b.   Photosensor-Based Control: The photosensor will automatically adjusts dimming output in response to photometric readings, to maintain a minimum light level consisting of both electric light and daylight sources. Photosensor response can be adjusted using the programming application.

5.   Time-based Events Capabilities in networked operation

a. The system shall be able to trigger actions at user-defined time.
b. The following actions can be defined with a time-based event:
   1) Enable/Disable Wallstations
   2) Select Occupancy Actions
   3) Select Scene for one or multiple areas/zones.
   4) Set White Tuning Level for one or multiple areas/zones.
   5) Set Zone Level for one or multiple zones.
   6) Enable/Disable Occupancy Detection
   7) Enable/Disable Manual Timer
c. The system shall allow user to define recurring actions. The user can define daily, weekly, yearly and a specific date. The system shall support definition of start date, end date, end after "n" recurrences, or never ending.
d. The system shall be able to allow users to schedule events based on sunrise and sunset. The Sunrise/sunset times automatically derived from location of the building using an astronomical clock. The system shall be able to support buildings located in different geographies. The system shall also allow the definition of timed offsets relative to sunrise or sunset.
e. The lighting management software application shall offer a graphical calendar view of scheduled event. profile schedules for each control zone. The system shall support daily, weekly and monthly calendar views.

6. General Characteristics

   a. System capable of providing a visible "blink warning" prior to a light turning off if required by the sequence of operations.

2.3 SYSTEM SOFTWARE INTERFACES

A. The system shall allow users to program and manage the system via a mobile app and/or latest web browser from Apple, Googe and Microsoft.

B. Programming

   1. The system shall support the following features:

      a. Programming via an auxiliary device or via an interface already embedded in all or certain control devices. Once programming is done the auxiliary programming device may be removed and the control devices should remember its programming. Similarly when the auxiliary device is connected to the programmed wired system, it should be able read in the systems configured/programmed parameters.
      b. Creating, editing and deleting the building elements, i.e. building, floor, areas and zones, occupancy groups and daylight groups.
      c. Discovery of the control devices.
      d. Blink identification of control devices, by blinking them or devices connected to them.
      e. Ability to add one or many devices to a defined area.
      f. Switch, occupancy sensor, and photosensor zone configuration.
      g. Defining high- and low-end trim levels
      h. Ability to adjust an occupancy sensor hold time and PIR sensitivity.
      i. Ability to define the sensor occupancy mode (occupancy or vacancy)
      j. Ability to enable or disable an occupancy sensor or group of occupancy sensors.
      k. Ability to enable/disable a daylight sensor or group of daylight sensors
      l. Ability to adjust the photocell setpoints and transition time delays.
      m. Ability to calibrate the photocell and auto-setpoint.
      n. Defining the Demand Response values for each area.
      o. Definition of scene values for each area.
      p. Definition of time-based events to turn the lights on/off for one or many areas.
      q. The system shall display live status of control devices and connected luminaires:

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1) Luminaire on/off status.
2) Dim level.
3) Occupancy sensor status.
4) Photosensor reading.
5) Device health status

r. The system shall allow users to easily identify the devices using its attributes:
1) Device Type
2) Device Description
3) Model description.
4) Serial number or network ID.
5) Device Name that can be edited

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C. Lighting Management

1. The system shall allow users to monitor and control the lights:

   a. Area lights can be monitored for on/off status.
   b. Area lights can be modified to a pre-defined scene or defined light level.
   c. Zone lights can be monitored for on/off status.
   d. Zone lights can be modified to define the light level.
   e. Individual control devices can be monitored for on/off status.
   f. Individual control devices can be modified to define light levels or on/off status.

2. When higher level network devices are used, the system shall offer a graphical floorplan:

   a. The user shall be to create a floorplan for each floor within the building with areas, zones and devices. No additional services from manufacturers are required to create and manage the floorplan.
   b. The floorplan shall offer the following features:
   1) Pan and zoom commands supported to allow smaller areas to be displayed on a larger scale simply by panning and zooming each floor's master graphic.
   2) When selecting an area/zone or a device from the floorplan shall, the system shall display a property display that would allow users to monitor the selected element and perform specific actions:
      a) Element Name.
      b) Total Alarms
      c) Current light level (scene or light level)
      d) Manual Actions including manual override.
      e) Device diagnostic information.

D. Alarms/Events Management

1. The system shall display the system's fault in near real-time. System faults include loss of communication and low battery alarms for battery powered devices (wireless wallstations and wireless ceiling sensors).
2. When higher level network interfaces are used, such as the Area Hub and area controller:
3. The system shall allow users to view current and past system faults to provide better insight into the system's health.
4. The system shall offer context-sensitive troubleshooting tips for each alarm.
5. The system shall offer a floorplan locator for each alarm. When selected, the system shall automatically launch the floorplan and zoom in on the selected device.
6. The system shall send e-mail notifications to subscribe users for each fault. The user shall provide the SMTP server information to allow the supervisory software application to send out e-mail notifications.

E. User Management

1. The system shall include user management module allowing users to:

   a. Create user accounts.
   b. Assign the user account to a specific role.

c. Create custom roles based on pre-determined permissions.
d. Restrict access for user accounts to specific areas within the system.

F. System Energy Analysis and Reporting

1. When higher-level network devices are used, such as an Area Hub and Area Controller:

a. The system shall offer an intuitive graphical interface allowing the building owner to view the energy usage for the buildings controlled by the system.
b. The interface shall allow users to analyze the data based on the building hierarchy, i.e. building, floors, areas and zones, as well as the source type, i.e. lighting and/or receptacles.
c. The system shall collect energy usage data for 13 consecutive months.
d. The system shall allow users to select the period for the energy usage, i.e. last 24 hours, last 7 days, last 30 days, last 3 months, last 12 months.
e. The system shall provide the energy savings generated by the lighting system in kWh for the selected period.
f. The system shall allow users to export the report as a pdf or an excel.

2.4 CYBERSECURITY

A. The IP network connectable products within the networked, wireless, and hybrid Lighting Control system can comply with the IEC 62443-4-2 cybersecurity standard. A letter of compliance by an IEC authorized certification lab shall be provided for all IP connectable products. Self-certification to the standard will not be accepted.

B. All wireless communication between lighting control components supports the following five tiers of security measures:

1. Data encryption.
2. Firmware protection.
3. Tamper-proof hardware.
4. Authenticated user access.
5. Mutual device authentication

C. Wireless devices use AES encryption to secure communication with a unique encryption key generated for each programmed site.

D. Wireless devices use signed firmware to ensure that unmodified, authentic software is always installed.

2.5 WIRELESS DEVICES

A. Wireless Dimming Switchpack

1. Basis-of-design Product: WaveLinx PRO Universal Dimming Switchpack with one 0-10V Dimming channel [RSP-P-010-347]
2. Communication: Wireless IEEE 802.15.4
3. Plenum-rated
4. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low-voltage power].
5. Input Voltage: 120/277/347 VAC
6. Relay Output:

a. 20amp 120/277/347VAC General Purpose
b. 16amp 120/277/347VAC electronic ballast (LED load)

7. Dimming Output: Single Class 2 0-10V dimming output
8. Sink Current: 120mA at 0-10 VDC.
9. Mounting: Integral 1/2 inch chase nipple.
10. Calculated energy consumption data available through the WaveLinx CORE

11. Shall be compatible with electronic ballast, LED, incandescent, magnetic, or electronic low-voltage, magnetic or electronic fluorescent, and motor loads.
12. Shall be capable of controlling up to 20-amp receptacle or plug loads.
13. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.
14. Environmental regulations:

    a. FCC certified.

B. Wireless Dimming Switchpack with Dry Contact Closure

1. Basis-of-design Product: WaveLinx PRO Universal Dimming Switchpack with Dry Contact Closure [WSP-CA-010]
2. Communication: Wireless IEEE 802.15.4
3. Plenum-rated
4. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low-voltage power].
5. Relay Output:

    a. 20amp 347VAC General Purpose
    b. 16amp 347VAC electronic ballast (LED load)

6. Dimming Output: Single Class 2 0-10V dimming output
7. Sink Current: 30mA at 0-10 VDC.
8. Contact Closure Input: 1 input interface to support wired low-voltage sensor or maintained contact closure signal.
9. Mounting: Integral 1/2 in chase nipple
10. Calculated energy consumption data based on maximum connected power available through the WaveLinx CORE
11. Shall be compatible with electronic ballast, LED, incandescent, magnetic, or electronic low-voltage, magnetic or electronic fluorescent, and motor loads.
12. Shall be capable of controlling up to 20Amp receptacle or plug loads.
13. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.
14. Standards/Environmental regulations:

    a. FCC certified.
    b. cULus Listed.
    c. RoHS

C. Wireless Emergency Dimming Switchpack

1. Basis-of-design Product: WaveLinx PRO Emergency Dimming Switchpack with one 0-10V Dimming channel [ESP-P-010]
2. Communication: Wireless IEEE 802.15.4
3. Plenum-rated
4. Integrated, self-contained unit consisting internally of an isolated load switching control relay [and a power supply to provide low-voltage power].
5. Input Voltage: 120/277/347 VAC
6. Only one source of input voltage from them emergency panel to the ESP-P.
7. Normal power loss sense detection over the network signal (communication bus).
8. Relay Output:

    a. 20amp 347VAC General Purpose
    b. 16amp 347VAC electronic ballast (LED load)

9. Dimming Output: Single Class 2 0-10V dimming output
10. Sink Current: 120mA at 0-10 VDC.
11. Power Output: 24VDC; 350 mA
12. Mounting: Integral 1/2-inch chase nipple.

13. Calculated energy consumption data available through the WaveLinx CORE or higher-level networking appliances.
14. Shall automatically override emergency fixture to full brightness upon normal power loss
15. Shall be compatible with electronic ballast, LED, incandescent, magnetic, or electronic low-voltage, magnetic or electronic fluorescent, and motor loads.
16. Shall be capable of controlling up to 20Amp receptacle or plug loads.
17. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored
18. Standards/Environmental regulations:

    a. FCC certified.
    b. cULus Listed
    c. UL924 Listed (Emergency Lighting and Power Equipment)

D. Wireless Ceiling Occupancy Sensor

1. Basis-of-design Product: WaveLinx PRO Ceiling Occupancy Sensor [CWPD-1500
2. Communication: Wireless IEEE 802.15.4
3. Input power: Two (2) AA standard alkaline batteries.
4. Sensing technologies:
5. Motion sensing:

    a. PIR multiple-segmented lens, with internal grooves to eliminate dust and residue build-up.
    b. Products tested in identical manner, compliant with NEMA WD 7 -2011 Occupancy Motion Sensors Standards
    c. Sensor shall have time delays from 10 to 20 min.
    d. Sensor battery life shall be ten years based on approximately 30 daily activations and wireless signals.

6. Daylight Sensing:

    a. Open-loop daylight sensor
    b. 0-10,000lux
    c. Light input within 60° cone

7. Power failure memory: Device shall incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored. Programming is stored in each sensor in addition to the Area Controller.
8. Sensor reports the following data to the area controller:

    a. Battery life
    b. Occupancy status
    c. Ambient light level

9. LED indicators: LED indicators always provides a visual means to verify that motion is being detected during both testing and normal operation.
10. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
11. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
12. Sensors may remotely adjust the light output to reduced levels and remain at that reduced level for an adjustable period before turning off when the space is unoccupied.
13. Standards/Environmental regulations:

    a. FCC certified.
    b. cULus Listed
    c. RoHS

E. Wireless Tile Mount Sensor

1. Basis-of-design Product: WaveLinx PRO Tilemount Sensor Kit [WTA]
2. Sensing mechanism:

    a. [Infrared]: Utilize multiple-segmented lens with internal grooves to eliminate dust and residue build-up.
    b. Daylight]: Utilize integrated daylight sensor to provide closed-loop daylight dimming control. Each WaveLinx PRO Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
    c. Location]: Utilize additional internal Bluetooth radio capable of offering Real-Time Location Services (RTLS) – IoT Software Upgrade Required

3. Power failure memory:

    a. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

4. Tilemount sensor connects to a control module which supports up to 3 amps of connected fixtures.
5. Tilemount is designed to be installed in a ½" or ¾" ceiling tile within 54" (137cm) of the control modules and connected fixtures.
6. Sensor shall provide unique daylight calibration considering the light level at the sensors, work surface and integrated luminaire light output.
7. All sensors shall provide an LED as a visual means of indication and diagnostics.
8. Control Module:

    a. Sensor shall connect to a 0-10V dimmable ballast or driver via a control module or connect to a WaveLinx enabled driver without using the WaveLinx control module.
    b. The sensor shall connect to a controller via a low-voltage cable for interior applications.
    c. If power dropouts in the event of a brown-out or black-out, when power is restored, the lighting system should recover quickly and automatically return to the last lighting levels. A momentary interruption (1 or 2 seconds) of power should not cause extended periods (20 seconds or more) without lighting while the system reboots and all other electrical equipment is back on.
    d. The luminaire manufacturer shall install the Control Module within the luminaire before shipping it.

9. The sensor shall be a Class 2 device.
10. The system shall support user-initiated manual demand response and utility, or BMS initiated automatic demand response.
11. Standards/Environmental regulations:

    a. FCC certified
    b. cULus Listed
    c. RoHS

F. Wireless Receptacle

1. Basis-of-design Product: WaveLinx PRO Receptacle [WR-15]
2. Communication: Wireless IEEE 802.15.4
3. Integrated, self-contained unit providing a constant hot plug connection and a controlled plug connection.
4. Relay Output:

    a. 20amp 120VAC constant hot
    b. 20amp 120VAC controlled load

5. The controlled-load plug shall be labelled with "Controlled" and NEMA standard symbols for controlled plug loads.
6. Controlled outlet calculated energy consumption data available through the WaveLinx CORE.
7. It shall provide an LED indication of status and wireless communication and an override button.
8. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.
9. Standards/Environmental regulations:

   a. FCC certified.
   b. cULus Listed.
   c. RoHS

G. Wireless Outdoor Load Control Module

1. Basis-of-design Product: WaveLinx PRO Outdoor Load Control [WOLC]
2. Communication: Wireless IEEE 802.15.4
3. Power failure memory:

   a. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.

4. Control wireless reporting:

   a. Load status

5. Outdoor load control shall turn ON/OFF/DIM-connected outdoor luminaire based on wireless communications signal from the WaveLinx Area Controller.
6. The WaveLinx Area Controller shall control the Outdoor load controller using the following:

   a. Time Schedule
   b. Astronomic schedule
   c. Manual pushbutton from a connected wallstation

7. The controller shall wirelessly transmit; light-level power to the WaveLinx Area Controller, which allows the data to be stored in a central location on-premises and displayed via the WaveLinx Mobile Application.
8. The controller shall have remotely adjustable settings for dimming and time-based.
9. The controller shall be able to remotely adjust light output and remain as-is for an adjustable period before turning off when a space is vacant.
10. Default programming is stored in each sensor and the WaveLinx Area Controller. Sensors operate independently from WaveLinx Area Controller, so single-point failure cannot be. Systems must operate so there is no single point of failure.
11. Standards/Environmental regulations:

    a. FCC certified.
    b. cULus Listed.
    c. RoHS

H. Wireless Personal Control Interfaces

1. Basis-of-design Product: WaveLinx PRO Line-Voltage Wallstation [W-Series], [WW-Series]
2. Communication: Wireless IEEE 802.15.4
3. Input power: 120-1277VAC
4. Shall provide individual button LED indication of status and wireless communication and selected button.
5. Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.
6. WaveLinx PRO Line-Voltage Wallstation shall be a Class 1 device.

7.   Wireless momentary pushbutton switches in 1, 2, 3, 4, 5 and 6 button configurations; available in white, ivory (W-series only), grey (W-series only) and black (W-series only); compatible with wall plates with decorator opening. WaveLinx PRO Line-Voltage Wallstations shall include the following features:

   a.   Multi-level scene selection
   b.   Scene raise/lower
   c.   Toggle ON/OFF
   d.   Removable buttons for field replacement with engraved buttons and/or alternate color buttons [ENGRV-*BTNL-*], [ENGRV-*BTNS-*]. Button replacement may be completed without removing the switch from the wall.
   e.   Intuitive button labelling to match application and load controls.
   f.   Pre-defined digital button configurations. Each wallstation is shipped with pre-defined digital button configurations, automatically mapped to specific area/zone controls when added to an area in the WaveLinx Mobile Application.

8.   Multiple WaveLinx PRO wallstations may be installed in an area by simply connecting them to the WaveLinx PRO network. No additional configuration will be required to achieve multi-way switching.
9.   WaveLinx PRO Line-Voltage Wallstations are delivered with pre-defined functions, including raise, lower, Half Lights, Full Lights, Read, Relax, Dimmed, Night, manual and scene control.
10. WaveLinx PRO Line-Voltage Wallstations may also be delivered with field-programmable generic labelled buttons such as Scene 1, Scene 2, etc.
11. Optional custom labelling is available for application or location-specific wallstation button labels.
12. Color options: White, Red, Ivory, Black, Light Almond, Gray.
13. Environmental regulations:

   a.   FCC certified.

I.   Wireless Battery Powered Wallstation [WB-Series], [WWB-Series]

1.   Basis-of-design Product: WaveLinx PRO Battery Powered Wallstation [WB-Series], [WWB-Series]
2.   Communication: Wireless IEEE 802.15.4
3.   Input power: Four (4) AAA standard alkaline batteries (WB-Series) or two (2) CR123A alkaline batteries (WWB-Series)
4.   Shall provide individual button LED indication of status (WB-Series only) and wireless communication LED status.
5.   Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and restored.
6.   WaveLinx PRO Battery Powered Wallstation shall be FCC certified.
7.   Wireless momentary pushbutton switches in 1, 2, 3, 5 and 6 button configurations; available in white; compatible with wall plates with decorator opening. WaveLinx PRO Battery Wallstations shall include the following features:

   a.   Multi-level scene selection
   b.   Scene raise/lower
   c.   Toggle ON/OFF
   d.   Intuitive button labelling to match application and load controls.

8.   Multiple WaveLinx PRO wallstations may be installed in an area by simply connecting them to the WaveLinx PRO network. No additional configuration will be required to achieve multi-way switching.
9.   WaveLinx PRO Battery Powered Wallstations are field programmable with specific labelling (FULL LIGHTS, HALF LIGHTS, etc.) or generic labelled buttons (Scene 1, Scene 2, etc.)

<ol start="10">
Optional custom labelling is available for application or location-specific wallstation button labels.

J. Wireless In-Fixture Indoor Sensor

1. Basis-of-design Product: WaveLinx PRO Integrated Sensor [WAA], [WPS]
2. Communication: Wireless IEEE 802.15.4
3. Sensing mechanism:

    a. Infrared: Utilize multiple-segmented lens with internal grooves to eliminate dust and residue build-up.
    b. Photocell: Utilize integrated photocell to provide closed-loop daylight dimming control. Each WaveLinx PRO Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
    c. Bluetooth radio: Utilize additional internal Bluetooth radio capable of offering Real-Time Location Services (RTLS) – IoT Software Upgrade Required

4. Power failure memory: Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
5. Products tested in identical manner, compliant to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
6. Sensor shall have time delays from 10 to 20 min
7. Sensor shall provide unique daylight calibration considering the light level at the sensors, work surface and integrated luminaire light output.
8. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation

    a. Green LED indication when the sensor is in out-of-the-box operation mode
    b. White LED indication when the sensor has been connected to the WaveLinx lighting control system

9. Test mode - fifteen second time delay
10. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.

    a. The occupied default light level is 75%
    b. The unoccupied default light level is OFF
    c. The occupancy default time out is 20 minutes

11. Sensors shall monitor changes in occupancy changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
12. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Area Controller, which allows the data to be stored in a central location on-premises and displayed via the WaveLinx Mobile Application and the WaveLinx CORE software applications.
13. Calculated energy consumption data available on the WaveLinx CORE
14. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
15. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
16. Sensors may remotely adjust the light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.
17. Default programming is stored in each sensor in addition to the WaveLinx Area Controller. Sensors operate independently from WaveLinx Area Controller, so single-point failure cannot be. Systems must operate so there is no single point of failure.
18. Standards/Environmental regulations:

<ol type="a" start="1">
FCC certified
cULus Listed
RoHS

<ol type="K" start="11">
Wireless In-Fixture Industrial Sensor

1. Basis-of-design Product: WaveLinx PRO Industrial Integrated Sensor [SWPD2, SWPD3]
2. Communication: Wireless IEEE 802.15.4
3. Sensing mechanism:

    a. Infrared: Utilize multiple-segmented lens with internal grooves to eliminate dust and residue build-up.
    b. Photocell: Utilize integrated daylight sensor to provide closed-loop daylight dimming control. Each WaveLinx PRO Integrated Sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.

4. Power failure memory: Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
5. Products tested in identical manner, compliant to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
6. Sensor shall have time delays from 10 to 20 min
7. Sensor shall provide unique daylight calibration considering the light level at the sensors, work surface and integrated luminaire light output.
8. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation

    a. Green LED indication when the sensor is in out-of-the-box operation mode
    b. White LED indication when the sensor has been connected to the WaveLinx lighting control system

9. Test mode - fifteen second time delay
10. Walk-through mode
11. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.

    a. The occupied default light level is 100%
    b. The unoccupied default light level is 10%
    c. The occupancy default time out is 20 minutes

12. Sensors shall monitor changes in occupancy changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
13. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Area Controller, which allows the data to be stored in a central location on-premises and displayed via the WaveLinx Mobile Application and the WaveLinx CORE software applications.
14. Calculated energy consumption data available through the WaveLinx CORE
15. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
16. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
17. Sensors may remotely adjust the light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.
18. Default programming is stored in each sensor in addition to the WaveLinx Area Controller. Sensors operate independently from WaveLinx Area Controller, so single-point failure cannot be. Systems must operate so there is no single point of failure.
19. Standards/Environmental regulations:

<ol type="a" start="1">
FCC certified
cULus Listed
RoHS

L. Wireless In-Fixture Outdoor Sensor

1. Basis-of-design Product: WaveLinx PRO Outdoor Integrated Sensor [SWPD4, SWPD5]
2. Communication: Wireless IEEE 802.15.4
3. Sensing mechanism:

    a. Motion sensing: Passive infrared with multiple-segmented lens with internal grooves to eliminate dust and residue build-up.
    b. Daylight sensing: Photocell to provide closed-loop daylight dimming control. Each sensor provides an individual daylight dimming zone to provide highly accurate daylight levels at the work surface throughout the entire space.
    c. Power failure memory: Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.

4. Products tested in identical manner, compliant to NEMA WD 7 -2011 Occupancy Motion Sensors Standards
5. Sensor shall have time delays from 10 to 20 min.
6. Sensor shall provide unique daylight calibration considering the light level at the sensors, work surface and integrated luminaire light output.
7. All sensors shall provide an LED as a visual means of indication to verify that motion is being detected during both testing and normal operation.

    a. Green LED indication when the sensor is in out-of-the-box operation mode
    b. White LED indication when the sensor has been connected to the WaveLinx lighting control system.

8. Test mode - fifteen second time delay
9. Walk-through mode
10. Sensor shall provide out-of-the-box functionality of occupancy detection, directly controlling integrated fixture.

    a. On at dusk / Off at dawn
    b. The occupied default light level is 100%
    c. The unoccupied default light level is 50%
    d. The occupancy default time out is 15 minutes.

11. Sensors shall monitor changes in occupancy changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
12. Sensor shall wirelessly transmit occupancy status and light level to the WaveLinx Area Controller, which allows the data to be stored in a central location on-premises and displayed via the WaveLinx Mobile Application and the WaveLinx CORE software applications.
13. Calculated energy consumption data available through the WaveLinx CORE
14. Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
15. Sensors have remotely adjustable settings for dimming levels, occupied/unoccupied light levels, occupancy/vacancy sensing, and sensitivity to changes in motion and changes in ambient light levels.
16. Sensors may remotely adjust the light output to reduced levels and remain at that reduced level for an adjustable period before turning off when a space is vacant.
17. Default programming is stored in each sensor in addition to the WaveLinx Area Controller. Sensors operate independently from WaveLinx Area Controller, so single-point failure cannot be. Systems must operate so there is no single point of failure.
18. Standards/Environmental regulations:

       a.   FCC certified.
       b.   cULus Listed
       c.   RoHS

M.   Wireless 7-Pin Outdoor Load Controller

1.   Basis-of-design Product: WaveLinx PRO Outdoor Load Controller [WOLC]
2.   Sensing mechanism:

       a.   Daylight sensing: Photocell to provide open-loop daylight dimming control. Each sensor provides an individual daylight dimming zone to provide highly accurate daylight levels.

3.   Power failure memory: Controls incorporate non-volatile memory. Settings and parameters saved in protected memory shall not be lost should power be interrupted and subsequently restored.
4.   Sensor shall provide out-of-the-box functionality of daylight detection, directly controlling integrated fixture.

       a.   On at dusk / Off at dawn

5.   Sensors shall monitor changes in ambient light levels and communicate digital control commands to light fixtures according to a control strategy.
6.   Sensor shall wirelessly transmit light level to the WaveLinx Area Controller, which allows the data to be stored in a central location on-premises and displayed via the WaveLinx Mobile Application and the WaveLinx CORE software applications.
7.   Calculated energy consumption data available through the WaveLinx CORE
8.   Sensors shall be fully adaptive with the ability to have the sensitivity and timing to be remotely adjusted to ensure optimal lighting control for any use of the space.
9.   Sensors have remotely adjustable settings for dimming levels and changes in ambient light levels.
10. Sensors may remotely adjust the light output to reduced levels.
11. Default programming is stored in each sensor in addition to the WaveLinx Area Controller. Sensors operate independently from WaveLinx Area Controller, so single-point failure cannot be. Systems must operate so there is no single point of failure.
12. Standards/Environmental regulations:

       a.   FCC certified.
       b.   cULus Listed
       c.   RoHS

N.   Contact Closure Interface Module

1.   Basis-of-Design Product: WaveLinx PRO Contact Closure Interface Module [CCI-P-V]
2.   Communication: Wireless 802.15.4
3.   Input Voltage: 120~347 VAC
4.   Ability to support NFPA 101 without additional supervisory network devices.
5.   Ability to support occupancy sensor input mode and contact closure mode.
6.   Ability to configure modes in the mobile application.
7.   Contact Closure inputs: 4 x dry contact inputs that are momentary and/or maintained.
8.   Contact closure modes should be capable, but not limited to supporting:

       a.   Alert mode
       b.   After-hours occupancy mode
       c.   Demand response (without any additional supervisory network appliance)
       d.   Partition wall input

9.   Mounting: Plenum rated, inline wired, and screw mountable.
10. Standards/Environmental regulations:

       a.   cULus Listed
       b.   RoHS

2.6 RELAY PANEL CONTROLLER, AREA HUB, AREA CONTROLLER, SUPERVISORY APPLIANCES

A. Wired Communication Bridge

1. Basis-of-Design Product: WaveLinx Area Hub [WAH-POE]
2. An appliance that acts as gateway by converting the data received from eight areas to an area controller via ethernet.
3. Communication: low voltage network cable to the wired control devices and ethernet to the IP network switch.
4. Communication Ports: Nine (9) RJ-45 ports with 8 used to connect to 8 areas/spaces and one used to connect the communication bridge to an IP network switch and area controller.
5. Input power: Power over Ethernet (PoE – IEEE 802.3af) powered.

B. Area Controller

1. Basis-of-Design Product: WaveLinx Area Controller [WAC2-POE]
2. An appliance that allows users to discover, program, and manage WaveLinx wired and wireless control devices and connected luminaires.
3. Outdoor Area Controller
4. Basis of-Design Product: WaveLinx Area Controller
5. An appliance that allows users to discover, program, and manage wireless control devices and connected luminaire outdoors
6. Communication:

   a. Wireless IEEE 802.15.4 to communicate with WaveLinx wireless devices.
   b. Wireless IEEE 802.11 a/b/g/n to communicate with mobile devices with compatible browser and/or WaveLinx Mobile Apps
   c. 1 x RJ45 to communicate with the area hub and supervisory appliance via ethernet.

7. Power source: standardized Power over Ethernet (IEEE802.3af) input, enables building PoE network switches (by others) or a PoE injector [WPOE2-120] (accessory by Cooper Lighting Solutions) for power and network connection.
8. Maximum Ethernet (CAT5 or better) cable distance between the WaveLinx Area Controller and a network PoE switch is 328 feet (100 meters). Care shall be taken when routing the cable not to exceed the 328 feet (100 meters) limitation, including travel distance up and down structures.
9. For outdoor Area controller the power source is : AC: 120VAC, 30W (max) or PoE: IEEE 802.3af/at, 30W (max), 100m (300ft) maximum cable length
10. The Wi-Fi access point allows users to use the WaveLinx mobile app to program the system.

    a. The user shall be able to disable/enable the Wi-Fi access point.

11. 2.4 GHz Transceiver for IEEE 802.15.4 wireless radio to connect devices and sensors.
12. Shall support AES 128-bit encryption.
13. Shall use industry-standard HTTPS security with AES-128 encryption safeguards the entire system's integrity.
14. LED indicators for the status of various wireless radios and communications.
15. Shall be FCC Part 15 Class A, RoHS certified.
16. WaveLinx Area Controller connection cables shall be plenum rated.
17. Shall be Class 2 devices.
18. Shall have IEC62443-4-2 certification by a third-party IEC authorized lab. Self-certification will not be accepted.
19. Spaces defined within the WaveLinx area controller shall be equipped with a control device to shut off lighting in those areas automatically. This automatic control device shall function on either:

a. A timeclock scheduling basis where the interior and exterior lights controlled by the WaveLinx Area Controller are changed based on the time of day or the astronomic (sunrise and sunset).
   1) The astronomical time clock shall be integrated into the WaveLinx Area Controller and shall not require any internet connection to maintain its time.
   2) After a power loss, the timeclock programming and time clock settings shall be retained.
   3) The time clock shall allow weekly recurrences.
   4) Time clock events can be scheduled to:
      a) Set areas to desired scenes.
      b) Zone light levels to the desired light level
      c) Zone light levels when occupied.
      d) Zone light levels when unoccupied
b. An occupancy basis where the interior and exterior lights controlled by the WaveLinx Area Controller are changed based on the occupancy set status. The occupancy set is composed of one or more occupancy sensors, and it shall turn lighting off within 20 minutes of an occupant leaving a space.
c. A manual command basis where a user or a program sends an override command using a wired or wireless wallstation, the mobile application, or BACnet/IP or Public API. The BACnet/IP and Public API signal will be received via the Insight Manager/supervisory system.

20. Shall allow users to backup the programming to prevent data loss and restore fixtures to operational modes.
21. Shall allow users to centrally manage other supervisory appliances (e.g. WaveLinx CORE) when moving through a job site.
22. Construction Grouping

   a. PAIR button to allow automatic creation of Construction Group allowing simplified automatic control of all connected devices and sensors.
   b. The patent-pending Construction Grouping mode permits contractors to complete a quick system start-up to confirm that the devices have been installed correctly instead of waiting for factory-trained technicians to get the lights on a project in working order. Contractors follow a straightforward process to pair the wireless devices with the appropriate WAC and initiate occupancy-based lighting control functionality. This saves lighting energy during the project's construction phase by ensuring that the lights are turned off when the area is unoccupied.
   c. Construction grouping visually indicates to the installer that devices have received wireless communication from the WaveLinx Area Controller and received a unique individual address. Systems that do not provide a visual indication of device connection status shall not be acceptable.
   d. Construction grouping provides an automatic grouping of connected devices to provide simple occupancy-based and wallstation control of all devices without requiring a factory-trained technician. Systems that require special software or training to group wireless devices shall not be acceptable.

23. Scalability and Data Integrity

   e. The WaveLinx Area Controller can be deployed as a dedicated installation managing up to 400 wired devices (devices connected using a CAT5 or higher cable).
   f. The WaveLinx Area Controller can be deployed as a dedicated installation managing up to 400 wired devicesWhen deployed as a dedicated installation, the WaveLinx Area Controller acts as a local wireless access point for the Wi-Fi connection method to the WaveLinx Mobile or Web-based Application.
   g. The WaveLinx Area Controller can be deployed as a network or hybrid installation managing up to 400 total devices with a maximum of 150 wireless devices (connected devices, connected sensors) per WaveLinx Area Controller. When

deployed as a network installation, the WaveLinx Area Controller connects to the building LAN or wireless network as a client using DHCP. The maximum number of WaveLinx Area Controllers on the building network depends on the building network configuration.

      h.   In spaces where multiple WaveLinx area controllers are centralized using a supervisory appliance such as the WaveLinx CORE, central changes should be permitted via the WaveLinx area controller in an area. After authentication, the WaveLinx area controller allows direct login to the supervisory appliance.

C. Supervisory Appliance

1.   Basis-of-Design Product: WaveLinx CORE [TRX-TCPRO2, TRX-TCENT2, TRX-TCVRT2]
2.   An appliance that allows users to manage a connected system remotely via a web browser or mobile app.
3.   Provides holistic control and integration of various services that is not dependent on technology (technology agnostic).
4.   Communication:

      a.   2 x RJ45 to communicate with the area controllers via a network switch

5.   Power source: low voltage power adapter for physical appliance versions.
6.   Ability to connect to up to 300 WaveLinx Area Controllers. The entry-level model (WaveLinx CORE Pro) shall support up to 20 WaveLinx Area Controllers, while the enterprise-level model (WaveLinx CORE Enterprise) shall support up to 500 WaveLinx Area Controllers.
7.   Shall be able to be hosted on a virtual VMWare appliance (TRX-TCVRT2)
8.   Shall host all applications needed to manage the lighting system, analyze the data gathered by the sensors and locate assets/personnel.
9.   No need to install a software application.
10. Shall hosts interfaces used to exchange data with third-party system: BACnet/IP, REST API and OpenADR (for Title24 compliance).
11. Shall have IEC62443-4-2 certified by an IEC authorized lab. Self-certification will not be accepted.
12. Ability to store 13 months of energy and occupancy data
13. Ability to enable a user input device (e.g. wallstation) or contact closure interact from any user-defined area to control any or all spaces from other WaveLinx Area Controllers in a building (cross-WAC communication or multi-area switches).

2.7   SOFTWARE APPLICATIONS

A. Mobile Application (Networked installation)

1.   Basis-of-Design Product: WaveLinx Mobile Application [WAPP]
2.   iOS and Android mobile application allowing users to program the areas being controlled by WaveLinx wired and wireless control devices including lighting control panels (or networked relay/dimming panel).
3.   The Mobile Application shall support the following features:

      a.   Discovery of the control devices, connected luminaires, area hubs and area controller.
      b.   Blink identification of control devices, area hubs and connected luminaires by blinking them or devices connected to them.
      c.   Identified connected devices and sensors will indicate on the WaveLinx Mobile Application their selection by the device icon pulsing on the screen
      d.   Unique administrative login credentials for each area controller.
      e.   Discovery of wireless devices per area controller (Find Devices).
      f.   Creation of up to fifty (50) areas per area controller.

g.   Ability to utilize drag and drop, multi-select and filter capabilities for the easy association of connected devices and sensors to a defined area.
h.   Creation of up to sixteen (16) zones per area – up to 200 total zones per area controller.
i.   Creation of up to six (6) occupancy sets per area – up to 100 total occupancy sets per area controller.
j.   Creation of daylight sets per area.
k.   Creation of Demand Response values for each area.
l.   Definition of scene values for each area.
m.   Definition of time-based events to turn the lights on/off for one or many areas.

4.   Automatic Code Commissioning features include:

a.   Automatic association of all devices added to an area to provide a California Title 24 code-compliant sequence of operations.
b.   All occupancy sensors are joined together to provide an Automatic ON to 50% light level
c.   All occupancy sensors are joined together to provide an Automatic OFF of all luminaires and plug loads after 20 minutes with no occupancy detected.
d.   Automatic closed-loop daylighting to approximately 500 lux (46 footcandles)
e.   Automatic wallstation button mapping provides the dominant button providing a 50% light level all other buttons provide multi-level dimming control from 30%-100%
f.   Automatic display of area power measurement data
g.   Automatic Demand Response of 20%
h.   Additional screens if needed to adjust Automatic Code Commissioning settings.

B.   Web-Based enterprise software application (networked and hybrid installation)

1.   Basis-of-Design Product: CORE lighting (TRX-LGT)
2.   The application shall be offered as a mobile application running on Android and IOS devices as well as via HTML5 compatible web browsers such as Microsoft Edge, Google Chrome and Apple Safari.
3.   The application shall support multiple computing device types, i.e. smartphones, tablets, laptops and desktop computers.
4.   The software application shall be designed for touch interaction.
5.   The application shall utilize HTTPS (industry-standard certificate-based encryption and authentication for security).
6.   The system shall display the location of devices, zones and areas on a floor plan (jpeg or svg)
7.   The system shall allow users to monitor and control the lights:

a.   Area lights can be monitored for on/off status
b.   Area lights can be modified to a pre-defined scene or defined light level
c.   Zone lights can be monitored for on/off status
d.   Zone lights can be modified to define the light level
e.   Individual control devices can be monitored for on/off status
f.   Individual control devices can be modified to define light levels or on/off status.

8.   The system shall allow users to monitor and control the light schedules:

a.   Display the light schedule on a daily, weekly or monthly calendar
b.   Configure a light schedule based on a specific day or astronomic time clock event.

9.   The system shall display the system's fault in near real-time. System faults include loss of communication with the WaveLinx Area Controller, wired wallstation, wired ceiling sensor, wired switchpack, wired daylight sensor, wired control module).
10. The system shall display the system's fault in near real-time. System faults include loss of communication with the WaveLinx Area Controller, wireless wallstation, wireless ceiling sensor, wireless switchpack, wireless daylight sensor, wireless control module

11. The system shall log all current and past system faults to provide better insight into the system's health.
12. The system shall offer context-sensitive troubleshooting tips for each alarm.
13. The system shall send e-mail notifications to subscribe users for each fault. The user shall provide the SMTP server information to allow the WaveLinx CORE to send out e-mail notifications.
14. The system shall display the energy usage for the buildings controlled by the WaveLinx system:

    a. The user shall filter the data based on the building hierarchy, i.e. building, floors, areas and zones, as well as the source type, i.e. lighting and/or receptacles.
    b. The system shall collect energy usage data for 13 consecutive months.
    c. The user shall change the period for the energy usage, i.e. last 24 hours, last 7 days, last 30 days, last 3 months, last 12 months.
    d. The user shall obtain the energy savings generated by the lighting system in kWh for the selected period.
    e. The user shall see the average energy savings for the selected period.

15. The system shall display the space for the buildings controlled by the WaveLinx system:

    a. The user shall filter the data based on the building hierarchy, i.e. building, floors, areas and zones.
    b. The system shall be able to collect space usage data for 13 consecutive months.
    c. The system shall display the space usage based on 24 hours or working hours.
    d. The system shall display in sorting order the least to most-used spaces.
    e. The system shall display the space usage for each area based on the selected period.

C. BACnet Interface (networked and hybrid installation)

1. Basis-of-Design Product: BACnet Interface (TRX-BACNET)
2. Allow a building automation system to gather data from the lighting system and control the light levels within different spaces.
3. The BACnet/IP interface shall support the following capabilities:

    a. Monitor (Read):
        1) Area scene
        2) Area energy usage
        3) Dimming zone level (0-100%)
        4) On/off zone level (on/off)
        5) Occupancy sensor's occupied/unoccupied status
        6) Daylight sensor's level
    b. Control (write):
        7) System-wide Demand Response enable/disable
        8) Building light level
        9) Floor light level
        10) Area scene
        11) Dimming zone level (0-100%)
        12) On/off zone level (on/off)
        13) Occupancy sensor

4. The system shall allow users to select which object types the system shall expose, i.e. Area, Zones, input devices and output devices.
5. The system shall be able to generate the electronic PICS document and allow users to send the PICS document to the proper stakeholders.

D. API Interface (networked and hybrid installation)

1. Basis-of-Design Product: Public API (TRX-API)

2. The Public API allows third-party system to exchange data with the WaveLinx CORE appliance.
3. The Public API interface shall support the following get/put capabilities

   a. Get:
   1) Building hierarchy information (areas, zones, devices)
   2) Area scene
   3) Area energy usage
   4) Dimming zone level (0-100%)
   5) Zone level (on/off)
   6) Occupancy sensor's occupied/unoccupied status
   7) Occupancy set status
   8) Daylight sensor's level

   b. Put:
   1) System-wide Demand Response enable/disable.
   2) Area scene
   3) Dimming zone level (0-100%)
   4) Zone level (on/off)
   5) Occupancy sensor

E. OpenADR Interface (networked and hybrid installation)

1. Basis-of-Design Product: OpenADR interface (TRX-OPNADR)
2. The interface shall allow users to connect their lighting system with utility companies' Demand Response Automation Server (DRAS) using OpenADR 2.0b standard.
3. Initiate load shed event using OpenADR protocol in an auto-Demand-Response event without additional interfaces or gateways.

F. Real-Time Location Services (networked and hybrid installation)

1. Basis-of-Design Product: CORE Locate (TRX-LOCBAS)
2. The application shall enable users to enable real-time location services on the sensors.
3. The application shall allow users to assign Bluetooth Low Energy tags to assets or people.
4. The application shall allow users to track equipment and locate people in real-time in a floor plan view and table view with "room-level accuracy."
5. The application shall not require any access to public network or manufacturer cloud to work.
6. The application shall allow users to search and filter for a particular asset they are looking for using the parameters defined.
7. The application shall allow users to review the historical movement of an asset or a person in floor plan view.
8. The application shall provide location data through Application Programming Interface (API)

G. Space Utilization Application (networked and hybrid installation)

1. Basis-of-Design Product: CORE Insights (TRX-INSOCC)
2. The CORE Insights is a space analytics software application that allows users to monitor, compare and analyze their space usage to transform the occupancy data gathered by WaveLinx CORE/WaveLinx smart devices and occupancy sensors in ways that provide a deeper understanding of building space utilization and unlock optimization opportunities.
3. This application stores 13 months of Occupancy data
4. This application shall enable users to view key space performance indicators like avg occupancy %, # empty space vs total space, # of buildings, floors, sensors.
5. This application shall allow users to access the Occupancy dashboard to monitor space occupancy across the enterprise - sites/buildings/floor/etc.

6. This application shall allow users to quickly navigate from Enterprise level to Site, Area and Room level – Desktop, Mobile and Kiosk compatible views.
7. This application shall enable users to view occupancy information on the floor plan in real-time.
8. This application provides users with an intuitive chart view with space trending – bar/line chart, reports.
9. The application shall provide Occupancy data through Application Programming Interface (API)

PART 3 - EXECUTION

3.1 INSTALLATION

A. The control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits.

B. Install the work of this Section in accordance with the manufacturer's printed instructions unless otherwise indicated.

C. Provide written or computer-generated documentation on the commissioning of the system, including room by room description including:

D. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

E. A sequence of operations, (e.g., manual ON, Auto OFF. Etc.).

F. Load parameters (e.g., blink warning, etc.).

3.2 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the owner. Factory assistance shall solve programming or application questions concerning the control equipment

3.3 FACTORY COMMISSIONING (OPTIONAL)

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative, who will verify a complete, fully functional system.

B. The electrical contractor shall provide both the manufacturer and the electrical engineer with twenty-one (21) working days' written notice of the system start-up and adjustment date.

C. Upon completion of the system commissioning, the factory-authorized technician shall provide the proper training to the owner's personnel on the system's adjustment and maintenance.

D. Qualifications for factory certified field service engineer:

E. Certified by the equipment manufacturer on the system installed.

F. Make the first visit upon completion of the installation of the WaveLinx Connected Lighting system:

G. Verify locations of WaveLinx Area Controllers

H. Verify implementation of Construction Group process

I. Identify connected devices and programs using WaveLinx Mobile Application and Automatic Code Commissioning.

J. Verify that system operation control is based on the defined Sequence of Operations (SOO).

K. Obtain sign-off on system functions.

L. Make a second visit (optional) to demonstrate and educate the owner's representative on system capabilities, programming, fine-tuning and maintenance.

M. Due to building operations, the start-up of the WaveLinx Connected Lighting system may be required outside of normal business hours (Monday through Friday, 7 a.m. to 5 p.m.).

3.4 CLOSEOUT ACTIVITIES (OPTIONAL)

A. Training Visit

    1. Lighting control system manufacturer to provide one (1) day of additional on-site system training to site personnel. This shall be a part of the second visit by field service to the site. A separate third visit will require an additional charge.

B. On-site Walk-through

    1. For LEED projects, the manufacturer shall conduct an on-site walk-through to demonstrate system functionality to a Commissioning Agent.

    2. During this visit, the manufacturer's Field Service Engineer will perform tasks at the request of the facility representative or Commissioning Agent, such as demonstrating wall control functions explain or describing occupancy and/or daylight sensor functionality.

    3. Lighting control system manufacturer to provide a factory-certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

3.5 MAINTENANCE

A. Capable of providing on-site service support within 48 hours anywhere in the continental United States and within 72 hours worldwide except where special visas are required.

B. Offer renewable service contract on a yearly basis, including parts, factory labor, and annual training visits. Make service contracts available up to ten (10) years after the date of system start-up. Additional service contracts and warranties need to be verified as being available.

C. Prior to bid, confirm if an on-site meeting between the Lighting Control System Manufacturer and a Facility Representative will be required to evaluate system usage after the building has been in operation for a predetermined period. If a field service visit is required for Acceptance Testing or building commissioning, then it shall be as an additional service charge unless specifically stated in the specification and confirmed on the WaveLinx Connected Lighting bill of materials.

END OF SECTION