Model Specification for

Adaptive Control and Remote Monitoring of

LED Roadway Luminaires

Version: 1.0

Prepared by:

MSSLC Adaptive Control and Remote Monitoring Committee

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The MSSLC welcomes questions about the goals and development of this tool, and suggestions for improving it. Municipalities or utilities that are particularly interested in further developing the model specification are encouraged to inquire about joining the MSSLC task force that is already working on the next version. Please send comments and questions to [MSSLC@seattle.gov](mailto:MSSLC@seattle.gov)

The U.S. Department of Energy (DOE) Municipal Solid-State Street Lighting Consortium’s effort to develop a model specification for adaptive control and remote monitoring of LED roadway luminaires began on September 29, 2010 with the initiation of a task force consisting of representatives of municipalities, electric utilities and others who recognized the potential this technology held to improve service and further conserve energy.

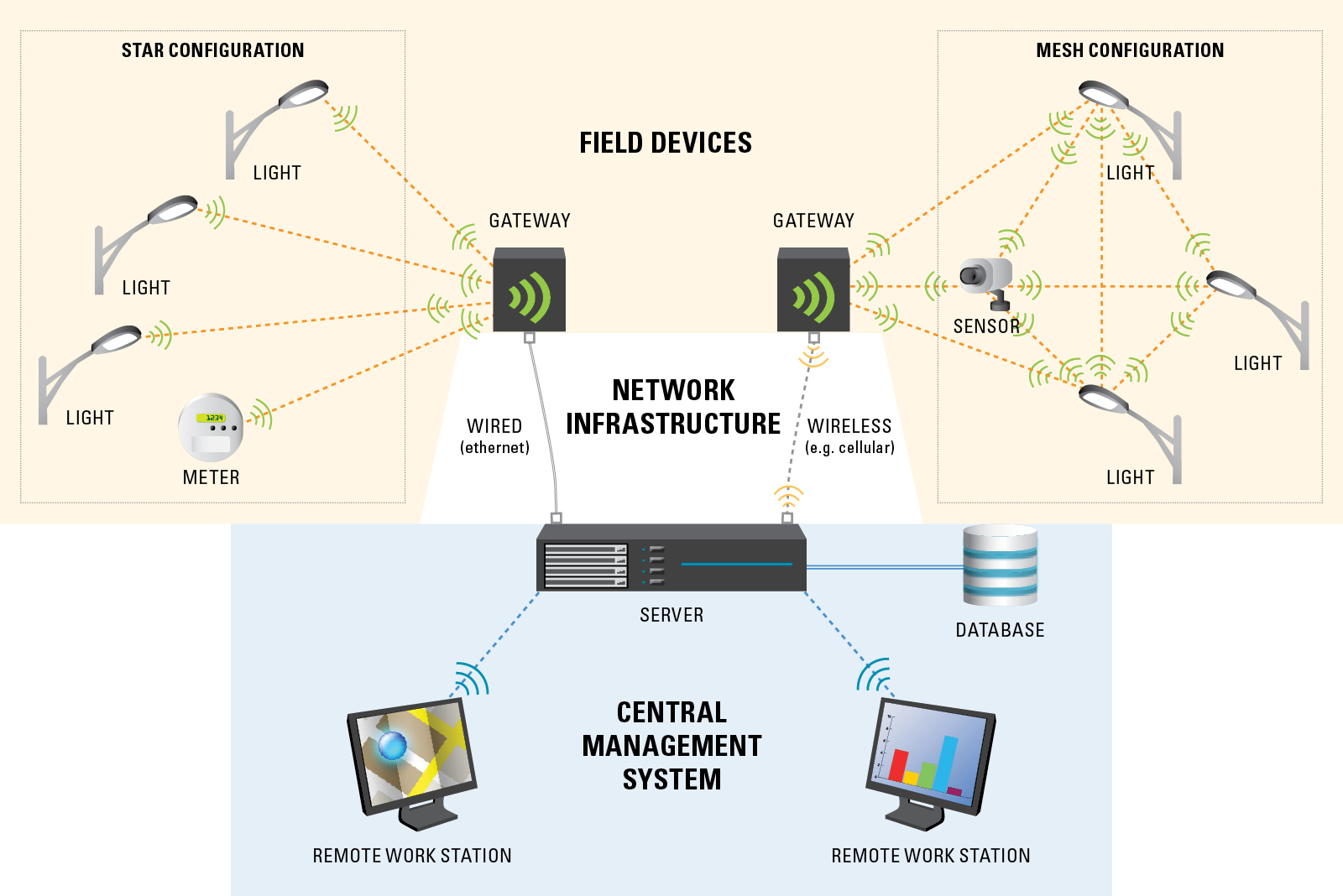
The DOE Municipal Solid-State Street Lighting Consortium's Model Specification for Adaptive Control and Remote Monitoring of LED Roadway Luminaires is a tool designed to help cities, utilities, and other local agencies accelerate their adoption of systems that can further reduce the energy and maintenance costs of operating their streetlights.   While the capabilities of monitoring and control systems on the market are enticing, many of these raise questions for users who are uncertain about how (or even if) they should be implemented, and how their true value can be assessed.  As a result, user interests currently vary widely and are likely to continue to do so for the foreseeable future, until adaptive lighting best practices and the ability to forecast energy and maintenance savings (along with the value of other features) becomes more universally proven.

The model specification provides both a suggested set of high-level requirements and a template for translating unique user needs into clear and consistent specification language.  This version has undergone one public review cycle, where input from users, technology providers, and other industry stakeholders was used to determine: what requirements should be mandatory; how best to support the breadth of system architectures and features available in the marketplace; and where the development of standards that reduce user risk could be encouraged. The market for this technology and its commercial offerings are still in their infancy, however, and likely to evolve over time.  This model specification is therefore intended to be a living document that will likewise evolve to accommodate future changes in the market.

Networked control systems are best described by a layered set of tiers. The core of any system is the network of Field Devices, which are fundamentally producers and consumers of data that exchange information with each other in various ways. Field Device networks always include Controllers, which for streetlight systems turn lights on and off, and perhaps set dimmed levels and monitor performance, all according to some internal programming. Multiple Controllers may route data through Gateways, which at minimum act as communication bridges to outside networks, but may also provide other system functions.

Field Device networks may be accessed and managed remotely by a Central Management System, which facilitates user interaction, typically through Graphical User Interfaces, and typically consolidates and stores retrieved data. These Systems communicate to Field Device networks through one or more Backhaul Communication Networks, which may take various forms (including wired and wireless).

*Image Credit: California Lighting Technology Center, UC Davis*



# Goals for Future Versions of the Model Specification

* Expansion of Introduction section
* Broad scope updates based on feedback received during the Version 0.5 public comment period
* Utility vetted power metering and/or energy reporting criteria
* Further refinement focused on facilitating independent bids for Central Management System(s), Backhaul Communication Network(s), and Field Devices
* Introduction of (optional) Field-to-Field Device communication requirements
* Introduction of Backhaul Communication Network section, and requirements
* Introduction of Sensor section, and requirements
* Separation of Start-Up and Commissioning sections, with updated or enhanced requirements for both

# Major updates in Version 1.01 of the Model Specification

* Introduction of new Introduction section
* Introduction of gray box user notes
* Reorganization of Part 4 (Central Management System) and Part 5 (Field Devices) criteria into Physical Features and Requirements, Logical Features and Requirements, and Management or Control Features and Requirements
* Consolidation, simplification of control requirements

# Major updates in Version 1.0 of the Model Specification

* Narrow scope updates based on feedback received during the Version 0.5 public comment period
* Integration of all definitions into a single subsection
* Introduction of Part 3 – System Definition/Integration
* Separation of Central Management System and Field Device (Controller and Gateway) performance requirements
* Identification of need for separate Start-Up and Commissioning requirements
* Consolidation of interchangeability and interoperability requirements into new Central Management System and Field Device sections
* Simplification of Appendices, now focused on describing existing equipment

The unedited model specification is not intended to serve as a standard specification, and therefore cannot result in a single list of qualified products. Requirements inherently vary from jurisdiction to jurisdiction, and consequently a product that meets the needs of one user will not necessarily meet the needs of another. In all applications, the model specification should be customized as needed to meet the needs of a specific user.

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1. GENERAL
   1. NORMATIVE REFERENCES

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available.

* + 1. American National Standards Institute (ANSI)
       1. C12.1-2008 “American National Standard for Electrical Meters – Code for Electricity Metering”
       2. C12.19-2008 “American National Standard for Utility Industry End Device Data Tables”
       3. C12.20-2010 “American National Standard for Electricity Meters – 0.2 and 0.5 Accuracy Classes”
       4. C136.10-2010 “American National Standard for Roadway and Area Lighting Equipment—Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing”
       5. C136.35-2009 “American National Standard for Roadway and Area Lighting Equipment—Luminaire Electrical Ancillary Devices (LEAD)”
    2. Council of the European Union (EC)
       1. Directive 2002/95/EC, Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)
    3. Department of Defense
       1. MIL-HDBK-271F(2) (1995) “Reliability Prediction of Electronic Equipment”
    4. Department of Energy Municipal Solid-State Street Lighting Consortium (DOE MSSLC)
       1. “Model Specification for LED Roadway Luminaires”
    5. Federal Communications Commission (FCC)
       1. Title 47, Chapter 1, Subchapter A, Part 15, Radio Frequency Devices
    6. International Electrotechnical Commission (IEC)
       1. 61968-9 ed1.0 (2009-09), “Application integration at electric utilities - System interfaces for distribution management - Part 9: Interfaces for meter reading and control”
       2. 60929 ed4.0 (2011-05) “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements, Annex E (normative), Control interface for controllable control gear”
       3. 62386-101 ed1.0 (2009-06) “Digital addressable lighting interface - Part 101: General requirements – System”
       4. 62386-102 ed1.0 (2009-06) “Digital addressable lighting interface - Part 102: General requirements - Control gear”
       5. 62386-207 ed1.0 (2009-08) “Digital addressable lighting interface - Part 207: Particular requirements for control gear - LED modules (device type 6)”
    7. National Fire Protection Association (NFPA)
       1. 70 (2011) “National Electrical Code” (NEC)
    8. National Transportation Communications for ITS Protocol (NTCIP), a joint standardization project of the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electronics Manufacturers Association (NEMA)
       1. 1213 v02 (2011), NTCIP Object Definitions for Electrical and Lighting Management Systems (ELMS)
    9. Telcordia
       1. SR-332 (2011) “Reliability Prediction Procedure for Electronic Equipment”
    10. Underwriters Laboratories (UL)
        1. 916 (2007) “Energy Management Equipment”
  1. INFORMATIVE REFERENCES
     1. Illuminating Engineering Society (IES)
        1. RP-16-10 “Nomenclature and Definitions for Illuminating Engineering”
        2. TM-23-11 “Lighting Control Protocols”
        3. DG-28 “Guide for Selection of Controls for Outdoor Lighting”
  2. RELATED DOCUMENTS

Instructions: Insert a list of all documents containing user-specific requirements and conditions not addressed in this specification

* + 1. [e.g. Contract Forms or Documents]
    2. [e.g. Contract Conditions]
    3. [e.g. Special Conditions]
    4. [e.g. Addendums]
    5. [e.g. Drawings]
  1. DEFINITIONS

Lighting terminology is used herein consistent with IES RP-16-10, with clarifications and exceptions noted as necessary. Lighting control terminology is used herein consistent with IES TM-23-11, with clarifications and exceptions noted as necessary.

* + - 1. Adaptive Control – a method of controlling a system using parameters that vary, or are initially uncertain.
      2. Astronomical Clock – a device that creates modifications to a control signal that account for variations in sunrise and sunset that occur at different times of the year, and/or that occur at different geographical locations.
      3. Backhaul (Communication Network) – a communication network linking the Central Management System to the Field Device Network.
      4. Central Management System – a computer environment that functions as the core of the System by providing all shared System services, and consolidating and storing (or managing the storage of) all System data.
      5. Compatible –the ability of a device to operate on a network or in the same physical environment with another device without corrupting, interfering with, or hindering the operation of the other device.
      6. Component – any installed, replaceable and/or upgradable item with a unique product number that is necessary to meet the requirements of this specification.
      7. Control Point – the location where a Luminaire is installed on a pole or other apparatus.
      8. Controller – from IES TM-23-11: the device that originates a command to execute a lighting change. Most commonly associated with a lighting control station or control console, a controller may also be a sensor or other automatic device operating without human interaction. For the purposes of this document, refers specifically to a device that that physically monitors and controls Luminaires installed at Control Points, reacts and responds to logical and physical inputs, makes control decisions using internal algorithmic and logic functions, and communicates via a network protocol.
      9. Electric Service Point – the location where electrical service is delivered to one or more luminaires. In addition to service conductors, this point may contain protective devices and other equipment required for providing a customer interface to electrical service.
      10. Field Devices – the entire set of networked Components (hardware and embedded software, consisting of Controllers and possibly Gateways) installed in the field that, following purchase, installation, start-up and commissioning, function together to adaptively control and remotely monitor Luminaires.
      11. Functional Profile – a model defining a set of specific required and optional functionality, interfaces, and resources for a device, a subsystem, or a system. The Functional Profile should be well enough defined such that multiple vendors’ products can be tested and certified for interoperability.
      12. Gateway – from IES TM-23-11: a device designed for interfacing between two communication networks that use different protocols, such as BACnet to DALI, or DMX512 to 0-10VDC. A Gateway may contain devices such as protocol translators, impedance matching devices, rate converters, fault isolators, or signal translators as necessary to provide system interoperability. For the purposes of this document, refers specifically to a device that (at a minimum) serves as the interface between one or more Controllers and a Central Management System.
      13. Graphical User Interface (GUI) – from IES TM-23-11: a screen-based, pictoral or diagrammatic representation of a system. In many lighting control systems, the GUI becomes one point of contact between the system and a user.
      14. Host Site – The physical location of the Central Management System. For the purposes of this document, refers specifically to a facility owned and operated by the User, the Vendor, or an independent 3rd party. The Central Management System is said to be hosted by the owner and operator of the Host Site.
      15. Interchangeability – the ability of a device to operate on a network in the exact same manner as a like device, where each device can be exchanged for the other in the system with no configuration, performance, or functional differences.
      16. Interoperability – the ability of a device to operate on a network in a consistent manner with a similar or related device, sharing a common defined set of information.
      17. Latency – the measure of time delay in a system. For the purposes of this document, refers specifically to the time delay between a creation and execution of a command (e.g. the time delay between an automated or manually created command to change the light output of a set of luminaires in the System and actual change in light output.
      18. Luminaire – from IES RP-16-10: a complete lighting unit consisting of a lamp(s) and ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to a power supply. For the purposes of this document, refers specifically to a roadway lighting Luminaire installed with electrical service at a Control Point.
      19. Management Station – a device that provides an interface to users with appropriate privileges to access the Central Management System. These devices may come in various form factors (e.g. mobile, desktop), and facilitate various levels of interaction (e.g. update status, configure, access historical data).
      20. Network – from IES TM-23-11: a group of systems that function cooperatively and/or interdependently to provide a chain of command for lighting control. For the purposes of this document, refers specifically to either a Field Device Network or a Backhaul Network. The Field Device Network is typically a Local Area Network (LAN) that connects and enables communication between (exclusively) Field Devices. The Backhaul Network is typically a Wide Area Network (WAN) that connects and facilitates communication between (at a minimum) one or more Field Device Networks with a Central Management System.
      21. Online Operation: the normal operating condition whereby Field Devices are communicating with the Central Management System.
      22. Offline Operation – any condition whereby Field Devices are not communicating with the Central Management System. Such conditions can occur during Start-Up or Commissioning, or as a result of an unplanned event that interrupts an existing network connection.
      23. Photoelectric Sensor – a device that creates a control signal by measuring the ambient light level and comparing it with a preset threshold. The Photoelectric sensor itself may be installed at a Control Point, or located remotely, such as at an electrical service point with multiple light contactors.
      24. Protocol/Communication Mode/Method – from IES TM-23-11: a set of standard rules – the syntax, semantics, and synchronization – for communicating over a computer network or a lighting control system or both. The protocol defines the methods for data representation, signaling, authentication and error correction to ensure control or enable the connection, communication, and data transfer between computing or control endpoints. Protocols may be implemented by hardware, software, or a combination of the two. At the lowest level, a protocol defines the behavior or a hardware connection. For the purposes of this document, are only introduced and used when referenced to a standard that is explicitly identified in Section 1.1 REFERENCES.

For example, the use of “0-10VDC” as the required protocol for communication between a Controller and Luminaire may include a reference to IEC 60929, which is explicitly identified in Section 1.1 REFERENCES as 60929 ed4.0 (2011-05) “AC and/or DC-supplied electronic control gear for tubular fluorescent lamps - Performance requirements”, Annex E (normative) “Control interface for controllable control gear”.

* + - 1. Vendor – the seller of any Component of the System.
      2. User – the purchaser of Components and/or operator of the System.
      3. Scalability – the ability of a system to handle a growing amount of work, or its ability to be enlarged to accommodate that growth. For the purposes of this document, may refer to the ability of the System to handle the transport of a greater amount of data (e.g. retrieve more information from each Controller), to transport data at a higher data rate (e.g. reduce command latency or scheduled time between data updates), or to be enlarged to accommodate the described increase in work, or accommodate additional Control Points.
      4. The System – the entire set of set of networked Components (hardware and software, typically consisting of Field Devices, Backhaul, a Central Management System, and one or more Management Stations) that, following purchase, installation, start-up, and commissioning, function together to adaptively control and remotely monitor Luminaires.
      5. Testing Bodies – bodies identified by the US Occupational and Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL), including UL (Underwriters Laboratory), CSA (Canadian Standards Association), and Intertek.

1. SUBMITTALS
   1. VENDOR ELIGIBILITY

Instructions: Select ONE or MORE, as desired

* + 1. 🞏 Any Vendor offering field proven products that comply with the Specification is eligible to submit a proposal.
    2. 🞏 Any qualified Buy American Vendor offering products that comply with this Specification is eligible to submit a proposal.
    3. 🞏 Only Vendors with the following references and/or qualifications are eligible to submit a proposal:

Instructions: Enter list of required references and/or qualifications

* + - 1. [e.g. Previous installations requirements i.e. size, location]
      2. [e.g. Performance bonding requirements]
      3. [e.g. Request of Qualifications or Proposal process requirements]
    1. 🞏 Only the pre-qualified Vendors selected per Request for Qualifications (RFQ) are eligible to submit a proposal. The following Vendors have been pre-qualified:

Instructions: Enter list of eligible Vendors

* + - 1. [Vendor 1]
      2. [Vendor 2]
  1. WRITTEN MATERIALS

Submitted materials shall be in orderly bound hardcopy form or bookmarked electronic form with Components requiring installation clearly identified. Submittals shall include the following, as applicable:

* + 1. A cover sheet that indicates the project name, submittal date, vendor name and contact information, manufacturer name(s) and contact information, and a table of contents.
    2. Cut sheets for all Components, including Components intended for installation inside luminaires. Cut sheets shall contain, at a minimum, the following information:
       1. Complete and unique catalog numbers. All catalog number elements (describing options) shall be noted and explained.
       2. Complete specifications, without references to other documents unless those documents are included with the submitted cut sheets.
       3. Power requirements, as specified.
       4. Rated Life and Reliability, as specified.
       5. Safety certifications and NEC file number for Field Devices.
       6. Recyclability and/or End of Life policy.
       7. RoHS Compliance.
       8. Made in America Compliance.
       9. Network protocol and physical setup instructions, as applicable.
       10. Logical device configuration and commissioning instructions, as applicable.
       11. Network management tool requirements, as applicable.
    3. Brochures, technical bulletins, parts lists, service instructions, drawings, calculations and other technical information relevant for describing the Components to be used in the proposed System.
    4. Required and optional installation, and start-up, and commissioning tools.
    5. Documentation of the layout of the proposed System, including Controller and Gateway locations, as applicable.
    6. Documentation of the proposed Field Device topology and layout (e.g. Star or Mesh communication, number of Controllers, number of Gateways) that addresses installation site characteristics (e.g. available mounting locations, active and passive sources of interference) and meet key performance specifications (e.g. reporting frequency, latency, expandability). This shall include communications from the Field Devices to the Central Management System, if applicable.
    7. A description of the analyses used to support the proposed Field Device topology and layout.
    8. Documentation supporting claims of recyclability and RoHS compliance.
    9. Documentation of Maintenance coverage (if applicable), as specified.
    10. Documentation of Warranty coverage, as specified.
    11. Documentation of requirements that proposed system can not meet.
    12. Documentation of non-required features that the proposed system provides.
  1. QUALITY ASSURANCE
     1. Vendor shall make available, at User’s request, standard production model samples of any Component to be used in the proposed System for inspection.
     2. Prior to purchase, User may submit for independent testing (at User’s own cost) any provided Component to be used in the proposed System, to verify performance and/or compliance with any specifications.
  2. COSTS AND FEES
     1. Submittal shall include costs (one-time) and fees (recurring) for a System that fully meets this specification, and does not require any additional options or upgrades. A specification that “the System shall be capable…” refers to a System requirement, as priced.
     2. Submittal shall include costs (one-time) and fees (recurring) broken out separately for each of the following categories, as applicable:
        1. Hardware Components (including any extended warranty and/or maintenance, license fees).
        2. Software Components (including any extended warranty and/or maintenance, license fees) for a period of no less than 5 years.
        3. Any and all mandatory upgrades.
        4. Installation Support
        5. Installation and Maintenance Tools (required and optional)
        6. Personnel Training
        7. Backhaul Service
        8. Hosting
        9. Component or System Maintenance
        10. Any other one time and/or recurring costs such as taxes, fees, etc.
     3. Submittal shall include a list of user-replaceable Components and their unit costs.
     4. 🞏 Optional – Mark to select: Pricing for a single-source written Component replacement warranty covering material and workmanship should be provided for EXTENDED periods, beyond the requirement specified. Pricing shall be provided for the following terms, at a minimum:

Instructions: Select ONE OR MORE, as desired

* + - 1. 🞏 One Year
      2. 🞏 Two Years
      3. 🞏 Three Years
      4. 🞏 Four Years
      5. 🞏 Five Years
      6. 🞏 Other \_\_\_\_\_\_\_
    1. 🞏 Optional – Mark to select: Pricing for System maintenance should be provided for EXTENDED periods, beyond the requirement specified. Pricing shall be provided for the following terms, at a minimum:

Instructions: Select ONE OR MORE, as desired

* + - 1. 🞏 One Year
      2. 🞏 Two Years
      3. 🞏 Three Years
      4. 🞏 Four Years
      5. 🞏 Five Years
      6. 🞏 Other \_\_\_\_\_\_\_
  1. PAYMENT TERMS
     1. Submittal shall include Payment Terms.
     2. Submitted Payment Terms shall address specified material, installation and training costs and timing.
  2. FINANCING OPTIONS

Instructions: Select ONE OR MORE, as desired

* + 1. 🞏 Submittal shall include Vendor financing options
    2. 🞏 Submittal shall include Vendor specified 3rd Party financing options
    3. 🞏 Submittal shall not include financing options

1. SYSTEM INTEGRATION
   1. SYSTEM SIZE AND SCALABILITY
      1. The System shall be capable of performing all functions and meeting all requirements described herein for a minimum of [Instructions: enter appropriate number] Control Points.
      2. 🞏 Optional – Mark to select: The System shall be capable of being upgraded (e.g. through the incorporation of additional Gateways, or higher performing Gateways) to handle up to [Instructions: enter appropriate number] additional Control Points.
      3. 🞏 Optional – Mark to select: The System shall be capable of being upgraded (e.g. through the incorporation of additional Gateways, or higher performing Gateways) to transport of a greater amount of data (e.g. retrieve more information from each Controller) while maintaining specified command Latency and Reporting Frequency.
      4. 🞏 Optional – Mark to select: The System shall be capable of being upgraded (e.g. through the incorporation of additional Gateways, or higher performing Gateways) to transport data at a higher data rate, thereby facilitating a reduction in command Latency or increase in Reporting Frequency).
   2. CENTRAL MANAGEMENT SYSTEM

Note: A System typically utilizes only ONE Central Management System.

Instructions: Select ONE

* + 1. 🞏 The System shall utilize a Central Management System that meets the requirements specified in Part 4, and is hosted by the User or a User specified 3rd Party.
    2. 🞏 The System shall utilize a Central Management System that meets the requirements specified in Part 4, and is hosted by the Vendor. Hosting fees are not allowed.
    3. 🞏 The System shall utilize a Central Management System that meets the requirements specified in Part 4, and is hosted by the Vendor. Hosting fees are allowed.
    4. 🞏 The System shall utilize an existing Central Management System that is specified in Appendix A.
  1. BACKHAUL COMMUNICATION NETWORK

Note: A System may utilize ONE or MORE Backhaul Communication Networks.

Instructions: Select ONE or MORE, as desired

* + 1. 🞏 The System shall utilize a Backhaul Communication Network specified by the Vendor. The Vendor shall provide all available Backhaul Communication Network options, EXCLUDING those which have pre-defined fees (e.g. Vendor negotiated cellular contracts).
    2. 🞏 The System shall utilize a Backhaul Communication Network specified by the Vendor. The Vendor shall provide all available Backhaul Communication Network options, INCLUDING those which have pre-defined fees (e.g. Vendor negotiated cellular contracts).
    3. 🞏 The System shall utilize an existing Backhaul Communication Network that is specified in Appendix B.
  1. FIELD DEVICES

Note: A System may utilize ONE or MORE Field Device Networks, or sets of connected Field Devices. Interchangeability or Interoperability between Field Devices in different Field Device Networks is specified in Part 5.

Instructions: Select ONE or MORE, as desired

* + 1. 🞏 The System shall utilize Field Devices that meet the requirements specified in Part 5.
    2. 🞏 The System shall utilize existing Field Devices that are specified in Appendix C.

1. CENTRAL MANAGEMENT SYSTEM
   1. PHYSICAL FEATURES AND REQUIREMENTS
      1. The Vendor shall disclose what features and functions are provided via a Graphical User Interface (GUI).
      2. The Vendor shall disclose what features and functions are provided via a report or other mechanism.
      3. The Vendor shall provide sample screen images of each GUI page or section.
      4. The Vendor shall provide sample screen images depicting the following features and functions, as applicable:
         1. Map Data
         2. Satellite Image Data
         3. Control Point location
         4. Control Point equipment type (i.e. luminaire type, sensor type)
         5. Controller and Gateway status (i.e. online, online reporting error, offline)
         6. Luminaire status (On, Off)
         7. Luminaire Dimmed State
         8. System power requirements (Current requirement, Peak requirement in last prescribed time period e.g. Peak in last 24 hours)
         9. System energy consumption (Daily over last prescribed time period – e.g. Daily for last 7 days)
      5. The Central Management System shall be accessible to individual users only by name and password.
      6. The Central Management System shall be capable of restricting user access to specific functions. At a minimum, these functions shall include the following:
         1. Creating and managing users and groups.
         2. Configuration
         3. Monitoring
         4. Control
         5. Basic report generation
         6. Custom report generation
      7. 🞏 Optional – Mark to select: The Central Management System shall be accessible through a handheld mobile device via a WEB BROWSER that renders content in a format designed to accommodate the size and user interface of the mobile device.
      8. 🞏 Optional – Mark to select: The Central Management System shall be accessible through a handheld mobile device via a NATIVE APPLICATION that has been designed to accommodate the size and user interface of the mobile device.
      9. All asset data shall be stored on the Central Management System.
      10. The Central Management System shall be capable of storing the following asset information for all Control Points:
          1. Pole number
          2. Pole type
          3. Pole GPS location
          4. Pole grouping
          5. Luminaire make and model
          6. Luminaire nominal input voltage
          7. Luminaire power requirement (wattage)
          8. Luminaire installation date
          9. Utility billing account number
      11. The Central Management System shall store all remote monitoring data.
   2. LOGICAL FEATURES AND REQUIREMENTS
      1. The Central Management System shall ensure secure communication between itself and all Field Devices by logically enabling security features inherent to the underlying communications protocols.
      2. The Central Management System shall be capable of detecting communication failures between Field Devices and the Central Management System.
      3. The Central Management System shall be capable of delivering Field Device firmware upgrades over the Backhaul Communication Network.
      4. The Central Management System shall be capable of remotely monitoring Field Device performance, in order to identify and report any exception to normal Field Device operation.
   3. MANAGEMENT FEATURES AND REQUIREMENTS
      1. The Central Management System shall be capable of RETRIEVING and STORING the following online Control Point parameters:
         1. Controller status (Online, Offline, Warnings, Errors)
         2. Luminaire status (ON, OF, Dimmed State, Warnings, Errors)
         3. Average input voltage (RMS) in ON state
         4. Average input current (mA) in ON state
         5. Average input power (W) in ON state
         6. Average input power factor in ON state
         7. Cumulative ON state time (minutes)
         8. Cumulative energy consumption (kWh)
         9. 🞏 Optional – Mark to select: Driver status (Warnings, Errors)
         10. 🞏 Optional – Mark to select: Ambient light (via photoelectric sensor)
         11. 🞏 Optional – Mark to select: GPS location
         12. 🞏 Optional – Mark to select: Temperature
      2. The Central Management System shall be capable programming the online Control Point parameter Reporting Frequency for ALL Control Points.
      3. The Central Management System shall be capable of programming the online Control Point parameter Reporting Frequency for A SINGLE Control Point.
      4. The Central Management System shall be capable of defining Luminaire groups.
      5. The Central Management System shall be capable of Manual Control, whereby the ON/OFF and DIMMED state of a single Luminaire or group of Luminaires is modified in response to commands created by the Central Management System.
      6. The Central Management System shall be capable of creating programs for Scheduled Control, whereby the ON/OFF and DIMMED state of a single Luminaire or a group of Luminaires is modified according to a predefined schedule.
      7. The Central Management System shall be capable of creating programs for Scheduled Control containing a minimum of (Instructions: enter appropriate number) times/events per day).
      8. The Central Management System shall be capable of creating programs for Scheduled Control that is either time-based, whereby Controllers modify Luminaire operation when a specific time in the schedule occurs, or event-based, whereby Controllers modify Luminaire operation when the next event in the schedule occurs.
      9. The Central Management System shall be capable of creating programs for time-based Scheduled Control that are defined:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 On a daily recurring basis
      2. 🞏 On a weekday recurring basis
      3. 🞏 On a weekend recurring basis
      4. 🞏 For special events which occur on a daily or daily recurring basis
    1. The Central Management System shall be capable of creating programs for event-based Scheduled Control that are defined according to inputs from sensors or commands from the Central Management System.

Note: sensors available for event-based Scheduled Control are specified in Section 5.1-M and/or Appendix G

* + 1. The Central Management System shall be capable of creating programs for Adaptive Control, whereby the ON/OFF and DIMMED state of a single Luminaire or a group of Luminaires is modified in response to dynamic inputs from sensors or commands from the Central Management System.

Note: sensors available for Adaptive Control are specified in Section 5.1-M and/or Appendix G

* + 1. The Central Management System shall be capable of creating programs for Prioritized Control, whereby the Scheduled Control of individual Luminaires or groups of Luminaires is modified or overridden according to input from sensors or commands from the Central Management System.
    2. 🞏 Optional – Mark to select: Field Devices shall be capable of true input power control, whereby the Luminaire DIMMED state is actuated to achieve to a desired true input power (percent relative watts).

Note: This feature requires knowledge of the relationship between Luminaire input control signal and true input power (watts), which must be imported (manually or automatically) according to some pre-defined means, or measured using some internal (metering) capability.

* + 1. 🞏 Optional – Mark to select: The Central Management System shall be capable of creating commands and programs for light output control, whereby the Luminaire DIMMED state is actuated to achieve a desired light output (percent relative lumens).

Note: This feature requires either a) knowledge of the relationship between Luminaire input control signal and light output (lumens) or b) knowledge of both the relationship between Luminaire input control signal and true input power (watts) and the relationship between Luminaire true input power (watts) and light output (lumens); these relationship(s) must be imported manually or automatically according to some pre-defined means.

* + 1. 🞏 Optional – Mark to select: The Central Management System shall be capable of creating programs for automatically maintaining constant Luminaire light output (lumens) over time by compensating for Luminaire lumen depreciation.

Note: This feature requires either a) knowledge of the relationship between Luminaire input control signal and light output over time (lumen depreciation) or b) knowledge of both the relationship between Luminaire input control signal and true input power (watts) and the relationship between Luminaire true input power (watts) and light output over time (lumen depreciation); these relationship(s) must be imported (manually or automatically) according to some pre-defined means or measured using some internal capability. This feature will also result in increasing Luminaire true input power over time.

* + 1. 🞏 Optional – Mark to select: The Central Management System shall be capable of creating programs for ensuring that a maximum Luminaire true input power (watts) is never exceeded.
    2. The Central Management System shall be capable of creating pre-defined asset reports.
    3. The Central Management System shall be capable of creating customized asset reports.
    4. The Central Management System shall be capable or comparing all reported Control Point parameters with optional pre-defined maximum and minimum thresholds, and generating error messages in real-time (based on reported data availability) for any condition that violates a specified threshold a specified number (1 or more) of times.
    5. The Central Management System shall be capable of creating Remote Monitoring reports:
       1. Based on the generation of an error message
       2. Based on a schedule
    6. The Central Management System shall be capable of creating pre-defined Remote Monitoring reports containing:
       1. Instances of communication loss between Field Devices and the Central Management System.
       2. Control Points with error conditions, sorted by error type and/or Electrical Service Point location.
       3. Energy Consumption Data for individual Luminaires and/or groups of Luminaires.
    7. The Central Management System shall be capable of creating customized Remote Monitoring reports.
    8. The Central Management System shall be capable generating Notifications, whereby specified Remote Monitoring reports (pre-defined or customized) are sent to assigned users and/or user groups via text message (SMS) and/or email.
    9. 🞏 Optional – Mark to select: The Central Management System shall be capable of detecting and reporting wire theft through use of an algorithm that identifies when the following conditions exist:
       1. A user-defined number of Controllers report a loss of electrical service.
       2. The loss of electrical service to the prescribed number of Controllers occurs within a user-defined time window.
       3. The group of Controllers reporting losses of electrical service within the prescribed time window are physically located consecutively along a roadway.
  1. INTERCHANGEABILITY AND INTEROPERABILITY
     1. 🞏 Optional – Mark to select: The Central Management System shall be compliant with the TALQ v\_\_\_\_\_ standard, and Interoperable with TALQ compliant Field Devices.
     2. 🞏 Optional – Mark to select: The Central Management System shall be compatible with the Computing Infrastructure specified in Appendix A.
     3. 🞏 Optional – Mark to select: The Central Management System shall be Interoperable with the Backhaul Communication Network(s) specified in Appendix B.
     4. 🞏 Optional – Mark to select: The Central Management System shall be Interoperable with the Field Devices specified in Appendix C.
     5. 🞏 Optional – Mark to select: The Central Management System shall be Interoperable with the Sensor(s) specified in Appendix G.
     6. 🞏 Optional – Mark to select: The Central Management System shall be Interoperable with the Asset Management System specified in Appendix E.
     7. 🞏 Optional – Mark to select: The Central Management System shall be capable of importing asset information from the Asset Management System specified in Appendix E for the creation of Control Points.
     8. 🞏 Optional – Mark to select: The Central Management System shall be capable of exporting asset information created in the System in a format compatible with the Asset Management System specified in Appendix E.
     9. 🞏 Optional – Mark to select: The Central Management System shall be capable of synchronizing asset information between its database of Control Points and the Asset Management System specified in Appendix E, such that changes made in the Central Management System are automatically reflected in the appropriate fields of the Asset Management System.
     10. 🞏 Optional – Mark to select: The Central Management System shall be capable of synchronizing asset information between its database of Control Points and the Asset Management System specified in Appendix E, such that changes made in the Asset Management System are automatically reflected in the appropriate fields of the System.
     11. 🞏 Optional – Mark to select: The Central Management System shall have an API capable of supporting integration through web services (e.g. SOAP, Restful) available in the Asset Management System specified in Appendix E.
     12. 🞏 Optional – Mark to select: The Central Management System shall support CIM messaging.
     13. 🞏 Optional – Mark to select: The Central Management System shall be Interoperable with the Intelligent Traffic System(s) specified in Appendix F.

1. FIELD DEVICES
   1. PHYSICAL FEATURES AND REQUIREMENTS
      1. Field Devices shall be capable of normal operation over an ambient temperature range of:

Instructions: Select ONE

* + - 1. 🞏 -40 degrees C to 70 degrees C (full commercial environment)
      2. 🞏 -40 degrees C to 50 degrees C (cold environment)
      3. 🞏 0 degrees C to 70 degrees C (hot environment)
    1. Field Devices installed external or remote to luminaires shall be rated:

Instructions: Select ONE

* + - 1. 🞏 IP54
      2. 🞏 IP65
      3. 🞏 IP66
    1. Field Devices shall operate from the following input voltage (nominal ±10%):

Instructions: Select ONE OR MORE, as desired

* + - 1. Dedicated AC input 🞏 120 🞏 208 🞏 240 🞏 277 🞏 347 🞏 480
      2. Universal AC input 🞏 120-277 🞏 347-480 🞏 Other \_\_\_\_\_\_\_\_\_
      3. Dedicated DC input 🞏 5 🞏 12 🞏 20
    1. The Vendor shall provide an estimate of the peak and average power requirement of all Field Devices, and describe the methodology and assumptions used to create this estimate.
    2. Controllers shall be integrated (mechanically and electrically connected) at Control Points:

Instructions: Select ONE

* + - 1. 🞏 Internal to LED Drivers, with a remote antenna if necessary.
      2. 🞏 Internal to Luminaires, with a remote antenna if necessary. Internal mounting compatibility shall be verified for all Luminaires to be connected to the System, as specified in Section 4.4 and Appendix D.
      3. 🞏 External to Luminaires, using a NEMA C136.10 standard 3-terminal polarized locking-type receptacle for electrical connectivity and a Vendor defined and described scheme for dimming control signal connectivity.
      4. 🞏 External to Luminaires, using a (forthcoming) NEMA C136.41 standard 5-terminal polarized twist-lock receptacle for both electrical and dimming control signal connectivity.
      5. 🞏 Remote to Luminaires, using a Vendor defined and described scheme for both electrical and dimming control signal connectivity. The connectivity scheme shall be verified for all Luminaires to be connected to the System, as specified in Section 4.4 and Appendix D.
      6. 🞏 Using an integration method appropriate for the specific Luminaire mounted at a specific Control Point, as specified in Section 4.4 and Appendix D. Controllers to be integrated with Luminaires that do not have a specified standardized connector or internal cavity shall be mounted Remote to Luminaires.
    1. Controllers shall be capable of actuating the status (ON state, OFF state) of Luminaires.
    2. Controllers shall be capable of actuating a Luminaire OFF state that results in a ZERO watt power requirement for the Luminaire. It is understood that the Controller will require power to remain online.

Note: a) this requirement is not compatible with luminaires that require a DALI control signal; b) this requirement necessitates switching both hot legs for 480V luminaires.

* + 1. Controllers shall be capable of actuating a Luminaire DIMMED state by creating:

Instructions: select ONE or MORE, as desired

* + - 1. 🞏 A 0-10V control signal. Control signal interoperability shall be verified with all Luminaire to be connected to the System, as specified by Section 4.4 and Appendix D.
      2. 🞏 A DALI control signal. Control signal interoperability shall be verified with all Luminaire to be connected to the System, as specified by Section 4.4 and Appendix D.
      3. 🞏 A control signal appropriate for the specific Luminaire mounted at a specific Control Point, as specified in Section 4.4 and Appendix D.
    1. Actuated changes to Luminaire DIMMED states by Controllers shall occur at the following rate:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 Instantaneously, or as dictated by the Luminaire
      2. 🞏 Over a user programmable range (% change per minute) disclosed by the Vendor
      3. 🞏 Greater than [Instructions: enter % change] per minute
      4. 🞏 Less than [Instructions: enter % change] per minute
    1. Controllers shall be capable or measuring instantaneous true input power, input voltage (RMS), input current and power factor.
    2. True input power, input voltage (RMS), input current and power factor shall be measured, at each Control Point for:

Instructions: Select ONE

* + - 1. 🞏 The Luminaire ONLY
      2. 🞏 The Luminaire AND the Controller
    1. Controllers shall measure true input power according to the following specifications:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 With an accuracy and precision of ±5% over the ambient temperature range specified in 4.1-A and a load range of 0.1% to 100% relative power, for all specified Luminaires (see section 4.4 and Appendix D).
      2. 🞏 With an accuracy and precision of ±2% over the ambient temperature range specified in 4.1-A and a load range of 0.1% to 100% relative power, for all specified Luminaires (see section 4.4 and Appendix D).
      3. 🞏 With an accuracy and precision of ±5% over the ambient temperature range specified in 4.1-A and a load range of [Instructions: enter MAXIMUM luminaire input voltage and MINIMUM luminaire input power that will be connected to the System] to [Instructions: enter MINIMUM luminaire input voltage and MAXIMUM luminaire input power that will be connected to the System].
      4. 🞏 With an accuracy and precision of ±2% over the ambient temperature range specified in 4.1-A and a load range of [Instructions: enter MAXIMUM luminaire input voltage and MINIMUM luminaire input power that will be connected to the System] to [Instructions: enter MINIMUM luminaire input voltage and MAXIMUM luminaire input power that will be connected to the System].
      5. 🞏 In accordance with ANSI C12.20.
    1. Controllers shall be capable sensing or otherwise determining the following parameters:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 Nominal sunrise and sunset times (via Astronomical Clock)
      2. 🞏 Ambient light (via photoelectric sensor)
      3. 🞏 GPS Location
      4. 🞏 Temperature
    1. Field Devices shall be capable of logging cumulative hours in the ON state for each Control Point.
    2. Field Devices shall be capable of logging cumulative energy consumption at each Control Point.
    3. Field Devices shall log cumulative energy consumption according to the following specifications:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 IEC 61968-9
      2. 🞏 The requirements specified by [Instructions: Enter name of utility], as documented in [Instructions: enter reference to appropriate document listed in Section 1.2]
    1. During Offline Operation, Field Devices shall be capable of monitoring and STORING the following offline TIME-STAMPED Control Point parameters:
       1. Controller status (Online, Offline, Warnings, Errors)
       2. Luminaire status (ON, OFF, Dimmed State, Warnings, Errors)
       3. Cumulative ON state time (minutes)
       4. Cumulative energy consumption (kWh)

Note: this feature requires the integration of some type of memory or data storage device, which will increase unit cost.

* + 1. During Offline Operation Field Devices shall be capable of STORING measurements of all offline parameters at a STORING frequency of less than once every [Instructions: enter maximum STORING frequency in hours or days].

Note: requiring shorter STORING frequencies may increase unit cost.

* + 1. During Offline Operation Field Devices shall be capable of STORING measurements of all offline parameters at the specified STORING frequency for a STORING period of greater than [Instructions: enter minimum STORING period in hours, days, or weeks].

Note: requiring longer STORING periods may increase unit cost.

* + 1. 🞏 Optional – Mark to select: If a Field Devices loses electrical service due to an unscheduled or otherwise unforeseen event, the Field Device shall:
       1. Be capable of communicating the loss of electrical service to the Central Management System
       2. Be capable of communicating any STORED data to the Central Management System

Note: this feature requires the integration of some type of battery or energy storage device, which will significantly increase unit cost.

* 1. LOGICAL FEATURES AND REQUIREMENTS
     1. During Online Operation, Field Devices shall be capable of monitoring and REPORTING the following online Control Point parameters:
        1. Controller status (Online, Offline, Warnings, Errors)
        2. Luminaire status (ON, OF, Dimmed State, Warnings, Errors)
        3. Average input voltage (RMS) in ON state
        4. Average input current (mA) in ON state
        5. Average input power (W) in ON state
        6. Average input power factor in ON state
        7. Cumulative ON state time (minutes)
        8. Cumulative energy consumption (kWh)
        9. 🞏 Optional – Mark to select: Driver status (Warnings, Errors)
        10. 🞏 Optional – Mark to select: Ambient light (via photoelectric sensor)
        11. 🞏 Optional – Mark to select: GPS location
        12. 🞏 Optional – Mark to select: Temperature
     2. During Online Operation, Field Devices shall be capable of REPORTING all online Control Point parameters for ALL Control Points at a maximum Reporting Frequency of once every:

Instructions: Select ONE

* + - 1. 🞏 24 hours
      2. 🞏 12 hours
      3. 🞏 60 minutes
      4. 🞏 30 minutes
    1. During Online Operation, Field Devices shall be capable of REPORTING all Control Point parameters for A SINGLE Control Point at a maximum Reporting Frequency of once every:

Instructions: Select ONE

* + - 1. 🞏 15 seconds
      2. 🞏 30 seconds
      3. 🞏 1 minute
      4. 🞏 5 minutes
    1. Field Devices shall respond to any single command received from the Backhaul Communication Network in less than 3 seconds.
    2. Field Devices shall automatically REPORT all data STORED during Offline Operation once Online Operation is restored.
  1. CONTROL FEATURES AND REQUIREMENTS
     1. Field Devices shall be capable of controlling a single Luminaire or groups of Luminaires.
     2. 🞏 Optional – Mark to select: Changes in the ON/OFF or DIMMED states to groups of Luminaires shall be staggered to limit the inrush current through other electrical components (e.g. contactors, relays, circuit breakers) on the Luminaire group electrical circuit.
     3. Field Devices shall be capable of Manual Control, whereby the ON/OFF and DIMMED state of a single Luminaire or group of Luminaires is modified in response to commands from the Central Management System.
     4. Field Devices shall be capable of Scheduled Control, whereby the ON/OFF and DIMMED state of a single Luminaire or a group of Luminaires is modified according to a predefined schedule.
     5. Field Devices shall be capable of Scheduled Control that is defined for a minimum of (Instructions: enter appropriate number) times/events per day).
     6. Field Devices shall be capable of Scheduled Control that is either time-based, whereby Controllers modify Luminaire operation when a specific time in the schedule occurs, or event-based, whereby Controllers modify Luminaire operation when the next event in the schedule occurs.
     7. Field Devices shall be capable of time-based Scheduled Control that is defined:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 On a daily recurring basis
      2. 🞏 On a weekday recurring basis
      3. 🞏 On a weekend recurring basis
      4. 🞏 For special events which occur on a daily or daily recurring basis
    1. Field Devices shall be capable of event-based Scheduled Control that is defined according to inputs from integral sensors or the Central Management System.

Note: sensors available for event-based Scheduled Control are specified in Section 5.1-M and/or Appendix G

* + 1. Field Devices shall be capable of Adaptive Control, whereby the ON/OFF and DIMMED state of a single Luminaire or a group of Luminaires is modified in response to dynamic inputs from integral sensors or the Central Management System.

Note: sensors available for Adaptive Control are specified in Section 5.1-M and/or Appendix G

* + 1. Field Devices shall be capable of Prioritized Control, whereby the Scheduled Control of individual Luminaires or groups of Luminaires is modified or overridden according to input from integral sensors or the Central Management System.
    2. During Offline Operation Field Devices shall be capable of maintaining Luminaire control by:

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 Continuing to operate according to the most recently programmed Scheduled Control or a default Scheduled Control if one has not yet been programmed.
      2. 🞏 Continuing to operate according to the most recently programmed Adaptive Control or a default Adaptive Control if one has not yet been programmed, using input from an integral sensor.
    1. 🞏 Optional – Mark to select: Field Devices shall be capable of true input power control, whereby the Luminaire DIMMED state is actuated to achieve to a desired true input power (percent relative watts).

Note: This feature requires knowledge of the relationship between Luminaire input control signal and true input power (watts), which must be imported (manually or automatically) according to some pre-defined means, or measured using some internal (metering) capability.

* + 1. 🞏 Optional – Mark to select: Field Devices shall be capable of light output control, whereby the Luminaire DIMMED state is actuated to achieve a desired light output (percent relative lumens).

Note: This feature requires either a) knowledge of the relationship between Luminaire input control signal and light output (lumens) or b) knowledge of both the relationship between Luminaire input control signal and true input power (watts) and the relationship between Luminaire true input power (watts) and light output (lumens); these relationship(s) must be imported manually or automatically according to some pre-defined means.

* + 1. 🞏 Optional – Mark to select: Field Devices shall be capable of automatically maintaining constant Luminaire light output (lumens) over time by compensating for Luminaire lumen depreciation.

Note: This feature requires either a) knowledge of the relationship between Luminaire input control signal and light output over time (lumen depreciation) or b) knowledge of both the relationship between Luminaire input control signal and true input power (watts) and the relationship between Luminaire true input power (watts) and light output over time (lumen depreciation); these relationship(s) must be imported (manually or automatically) according to some pre-defined means or measured using some internal capability. This feature will also result in increasing Luminaire true input power over time.

* + 1. 🞏 Optional – Mark to select: Field Devices shall be capable of ensuring that a maximum Luminaire true input power (watts) is never exceeded.
  1. INTERCHANGEABILITY AND INTEROPERABILITY
     1. 🞏 Optional – Mark to select: Field Devices shall be compliant with the TALQ v\_\_\_\_\_ standard, and Interoperable with TALQ compliant Central Management Systems.
     2. 🞏 Optional – Mark to select: Field Devices shall be Interoperable with the Central Management System specified in Appendix A.
     3. 🞏 Optional – Mark to select: Field Devices shall be Interoperable with the Backhaul Communication Network(s) specified in Appendix B.
     4. 🞏 Optional – Mark to select: Field Devices shall be Interchangeable with the Field Devices specified in Appendix C.
     5. 🞏 Optional – Mark to select: Field Devices shall be Interoperable with the Luminaires specified in Appendix D.
     6. 🞏 Optional – Mark to select: Field Devices shall be Interoperable with the Sensor(s) specified in Appendix G.
  2. RATED LIFE & RELIABILITY
     1. The rated life of all Field Devices shall be 10 years or more at an ambient temperature of 25 degrees Celsius.
     2. The Vendor shall report the reliability of the following Field Devices, as measured by Mean Time between Failures (MTBF):

Instructions: Select ONE or MORE, as desired

* + - 1. 🞏 Gateway
      2. 🞏 Controller

Instructions: enter list of other Components requiring reliability reporting

* + - 1. 🞏 [Other Component]
      2. 🞏 [Other Component]
    1. 🞏 Optional – Mark to select: The reported MTBF shall be calculated according to Telcordia SR-332.
    2. 🞏 Optional – Mark to select: The reported MTBF shall be calculated according to MIL-HDBK 217.

1. COMPONENT WARRANTY
   1. WARRANTY PERIOD

Instructions: Select ONE

* + 1. 🞏 Warranty periods shall begin on date of commissioning. The Vendor shall provide the User with appropriate signed warranty certificates immediately upon completion of Commissioning.
    2. 🞏 Warranty periods shall begin on date of shipment. The Vendor shall provide the User with appropriate signed warranty certificates together with shipment.
  1. HARDWARE
     1. All Components shall be covered by a single-source written replacement warranty covering material and workmanship for a period of:

Instructions: Select ONE

* + - 1. 🞏 FIVE years
      2. 🞏 TEN years
      3. 🞏 TWENTY years
    1. Components which are provided to a luminaire Vendor for installation within the luminaire prior to field installation of the luminaire shall be warranted for the terms and conditions described herein by:

Instructions: select ONE

* + - 1. 🞏 Luminaire Vendor
      2. 🞏 Control Vendor
    1. The User may perform field measurements and/or send components to independent laboratories for testing to enforce warranty provisions at any time during the warranty period.
    2. 🞏 Optional – Mark to select: The written replacement warranty shall be converted to a written ON-SITE replacement warranty if the field observed and documented MTBF (over any consecutive 12 month period) for any Component exceeds the Vendor specified MTBF. On-site warranty replacement includes removal and disposal of failed Components, along with delivery and installation of new Components.
    3. 🞏 Optional – Mark to select: The written replacement warranty shall be converted to a written ON-SITE replacement warranty if the field observed and documented failure exceeds 5 percent for any installation of 100 or more identical Components. On-site warranty replacement includes removal and disposal of failed Components, along with delivery and installation of new Components.
  1. SOFTWARE & FIRMWARE
     1. All software and firmware shall be covered by a written replacement warranty covering material and workmanship for a period of ONE year.

1. COMPONENT INSTALLATION
   1. RESPONSIBILITY

Instructions: Select ONE

* + 1. 🞏 Components shall be installed by the Vendor
    2. 🞏 Components shall be installed by the following 3rd Party: [Insert 3rd party name]
    3. 🞏 Components shall be installed by the User
  1. REQUIREMENTS
     1. All hardware, software and firmware necessary for installation, provisioning for network communication, commissioning, operation and management of all Components shall be provided.
  2. VENDOR SERVICES
     1. If Components are installed by the Vendor:
        1. All Components shall be mounted, wired, provisioned for network communication, configured to default or user specified settings, and operationally (i.e. field) tested, as applicable.
        2. 🞏 Optional – Mark to select: All wiring shall be checked for continuity.
        3. 🞏 Optional – Mark to select: All wiring shall be checked for insulation resistance (i.e. megger tested).
        4. 🞏 Optional – Mark to select: All software shall be loaded and configured on the User’s Central Management System.
     2. If Components are installed by 3rd Party or User:
        1. The Vendor shall provide all pertinent installation and startup instructions and manuals in Portable Document Format (PDF).
        2. The Vendor or a manufacturer-qualified representative shall provide installation support in person, or via telephone and/or the internet.
        3. The Vendor shall provide installation training.
        4. 🞏 Optional – Mark to select: The Vendor shall provide an installation audit.

1. SYSTEM START-UP AND COMMISSIONING
   1. RESPONSIBILITY

Instructions: Select ONE

* + 1. 🞏 The System shall be commissioned by the Vendor.
    2. 🞏 The System shall be commissioned by the following 3rd Party: [Insert 3rd party name].
    3. 🞏 The System shall be commissioned by the User.
  1. REQUIREMENTS
     1. The System shall be examined for any hardware, software, or firmware incompatibilities or errors that occurred during installation, and any updates, upgrades, or additional installations required for proper operation of the System shall be completed.
     2. The Commissioning period shall begin immediately following the completion of installation, successful Start-Up, successful demonstration of all System functions and capabilities, and Vendor commissioning training.
     3. The Commissioning period shall include a trial period comprised of:

Instructions: Select ONE

* + - 1. 🞏 30 consecutive calendar days of System operation
      2. 🞏 60 consecutive calendar days of System operation
      3. 🞏 90 consecutive calendar days of System operation
    1. The trial period should not start until the system has reached "substantial completion", been signed off by the User or Users representative, and has met the specification requirements.
    2. Over the course of the trial period, all System functions and capabilities described during Vendor training shall be successfully demonstrated.
    3. Over the course of the trial period, all System functions and capabilities shall operate normally for at least ninety-nine percent (99%) of the time.
    4. The Commissioning Period shall end following User acceptance of a successful trial period.
  1. VENDOR SERVICES
     1. Training
        1. The Vendor shall provide comprehensive training at the User's facility, covering (at a minimum) calibration, testing and programming, configuration, administration, operation, and troubleshooting of the system. The contractor shall integrate a review of the User’s manual and commissioning materials into User training.
        2. The Vendor training shall be scheduled based on availability of User’s staff.
        3. The Vendor shall provide training manuals and all other documentation (i.e. Operations and Maintenance manuals) in Adobe™ Acrobat format.
        4. The Vendor shall provide all necessary instructional equipment to be used during the training sessions for training purposes.
        5. The Vendor training shall provide instruction using the installed System (not using a remote system or a simulated system), and geared towards new users.
        6. The User may elect to record these training sessions for User’s sole use for future training purposes. The resulting recordings shall be the sole property of the User and for the sole use of the User.
        7. The Vendor shall specify the degree of coordination needed with the User's IT staff in regard to communications with existing systems.
     2. If the System is Commissioned by the Vendor:
        1. The Vendor shall disclose the methodology for system commissioning i.e. either onsite or via remote access (phone/internet) and shall provide estimated time for completion.
        2. The Vendor shall submit as-constructed drawings and materials prior to completion of commissioning.
        3. As-constructed drawings and materials shall include all modifications made during commissioning and shall accurately represent the commissioned System.
        4. As-constructed drawings and materials shall be sufficiently detailed to facilitate repair or replacement of any Component of the System, as required by routine or emergency maintenance.
        5. A full report of all inventory and commissioned (default or User specified) settings and security policies are to be supplied to the User upon completion of the installation.
     3. If the System is Commissioned by a 3rd Party or the User
        1. The 3rd Party or User may require a manufacturer or manufacturer-authorized representative to be available during the testing period.

1. SYSTEM MAINTENANCE
   1. RESPONSIBILITY

Instructions: Select ONE

* + 1. 🞏 The System shall be maintained by User.
    2. 🞏 The System shall be maintained by 3rd Party: (Insert 3rd party name).
    3. 🞏 The System shall be maintained by the Vendor.
  1. VENDOR SERVICES
     1. If the System is Maintained by a 3rd Party or the User:
        1. The Vendor shall provide comprehensive maintenance training at the User’s facility, covering all aspects of The System.
        2. The Vendor shall provide hardware and software maintenance and support according to the warranty terms for the duration of the warranty period. Any Maintenance term shall start following the applicable warranty period.
        3. The Vendor shall specify any and all mandatory maintenance required to maintain the terms of the warranty.
        4. 🞏 Optional – Mark to select: Software and firmware upgrades, maintenance and support shall be provided for one year at no extra cost.
        5. 🞏 Optional – Mark to select: Software and firmware upgrades, maintenance and support shall be provided for the current version(s) and the next two subsequent major version updates at no extra cost.
     2. If the System is Maintained by the Vendor:
        1. The Vendor shall be responsible for the complete maintenance of the System, ensuring compliance with all terms of the Specification at all times.
        2. If the Vendor is hosting the system, Vendor shall provide its comprehensive backup plan for software/system/server services, and data (in database).
        3. 🞏 Optional – Mark to select: Monthly maintenance records and reports shall be submitted to the User. These shall include (but are not limited to) inspection reports, documentation of maintenance performed, and expected future maintenance requirements.
        4. 🞏 Optional – Mark to select: The Vendor shall provide a mechanism to allow the User to submit requests for addressing any system malfunctions or maintenance requirements.

1. Existing Central Management System
   1. Description of Central Management Software

Instructions: describe the specific Central Management Software that Field Devices are intended to be Interoperable with. See examples below for structure and format.

[Example 1: Vendor Hosted System]

* + 1. Central Management Software make: [Make]
    2. Central Management Software model: [Model]
    3. Central Management Hardware platform: Cloud

[Example 1: User Hosted System]

* + 1. Central Management System make: [Make]
    2. Central Management System model: [Model]
    3. Central Management Hardware platform: Server
  1. Description of Computing Infrastructure

Instructions: describe the specific Computing Infrastructure that the Central Management Software is intended to be Compatible with. See examples below for structure and format.

[Example 1: Microsoft OS Based System]

* + 1. Server make: Dell
    2. Server model: [Model]
    3. Server OS make: Microsoft
    4. Server OS model: Windows Server 2012
    5. Database make: Microsoft
    6. Database model: SQL Server 2012

[Example 2: Apple OS Based System]

* + 1. Server make: Apple
    2. Server model: [Model]
    3. Server OS make: Apple
    4. Server OS model: X Mountain Lion Server
    5. Database make: Oracle
    6. Database model: MySQL Community server 5.5.23

[Example 3: Windows Server with VMWare virtualization]

* + 1. Server make: Dell
    2. Server model: R720
    3. Server OS make: Microsoft
    4. Server OS model: Windows 2008 R2 Enterprise Edition
    5. Database make: Microsoft
    6. Database model: SQK Server 2012

[Example 4: UNIX Server with Oracle VM Server for SPARC virtualization]

* + 1. Server make: Oracle
    2. Server model: Oracle SPARC T4 series
    3. Server OS make: Oracle
    4. Server OS model: 64 bit Solaris 10 for SPARC
    5. Database make: Oracle
    6. Database model: Oracle 11g
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Central Management Software compatibility with the existing Computing Infrastructure prior to installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Central Management Software Components required for User verification of compatibility with the existing Computing Infrastructure prior to installation.
     3. 🞏 Optional – Mark to select: The Vendor shall demonstrate Field Device compatibility with the existing Central Management System prior to installation.
     4. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Field Device Components required for User verification of compatibility with the existing Central Management System prior to installation.
     5. 🞏 Optional – Mark to select: The Vendor shall demonstrate Backhaul Communication Network compatibility with the existing Central Management System prior to installation.
     6. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Backhaul Communication Network Components required for User verification of compatibility with the existing Central Management System prior to installation.

1. Existing Backhaul Communication Network(s)
   1. Description(s)

Instructions: describe the specific Backhaul Communication Network(s) that the Central Management System and/or Field Devices are intended to be compatible with. See examples below for structure and format.

[Example 1: Wired connection to Ethernet]

* + 1. Physical Layer: RJ45
    2. Data Link Layer: IEEE 802.3
    3. Hardware Make: [Make]
    4. Hardware Model [Model]

[Example 2: Wired connection to Wi-Fi]

* + 1. Physical Layer: RJ45
    2. Data Link Layer: IEEE 802.11a/b/g/n MAC
    3. Hardware Make: [Make]
    4. Hardware Model [Model]

[Example 3: Wireless connection to Wi-Fi]

* + 1. Physical Layer: IEEE 802.11a/b/g/n PHY
    2. Data Link Layer: IEEE 802.11a/b/g/n MAC
    3. Hardware Make: [Make]
    4. Hardware Model: [Model]
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Central Management System Compatibility with the existing Backhaul Communication Network(s) prior to installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Central Management System Components required for User verification of Compatibility with the existing Backhaul Communication Network(s) prior to installation.
     3. 🞏 Optional – Mark to select: The Vendor shall demonstrate Field Device Compatibility with the existing Backhaul Communication Network(s) prior to installation.
     4. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Field Device Components required for User verification of Compatibility with the existing Backhaul Communication Network(s) prior to installation.

1. Existing Field Devices
   1. Description(s)

Instructions: describe the specific Field Devices that a) the Central Management System, and/or Backhaul Communication Network(s) are intended to be Interoperable with or b) Field Devices are intended to be Interchangeable with. See examples below for structure and format.

[Example 1: Controller]

* + 1. Controller Make:
    2. Controller Model:
    3. Controller URL:
    4. Controller Catalog Number:

[Example 2: Gateway]

* + 1. Gateway Make:
    2. Gateway Model:
    3. Gateway URL:
    4. Gateway Catalog Number:
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Central Management System Interoperability with the existing Field Devices prior to installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Central Management System Components required for User verification of Interoperability with the existing Field Devices prior to installation.
     3. 🞏 Optional – Mark to select: The Vendor shall demonstrate Backhaul Communication Network Interoperability with the existing Field Devices prior to installation.
     4. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Backhaul Communication Network Components required for User verification of Interoperability with the existing Field Devices prior to installation.
     5. 🞏 Optional – Mark to select: The Vendor shall demonstrate Field Device Interchangeability with the existing Field Devices prior to installation.
     6. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Field Device Components required for User verification of Interchangeability with the existing Field Devices prior to installation
     7. 🞏 Optional – Mark to select: The Vendor shall demonstrate Sensor Interoperability with the existing Field Devices prior to installation.
     8. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Sensor Components required for User verification of Interoperability with the existing Field Devices prior to installation.

1. Existing Luminaires
   1. Description(s) of Luminaires at existing Control Points

Instructions: Describe the Luminaire(s) at existing Control Points that Field Devices are intended to be interoperable with. Enter Reference Codes from Control Point Inventory tables

[Example 1]

* + 1. Control Point Inventory Reference Code: Cully Boulevard
  1. Description(s) of Uninstalled Luminaires

Instructions: Describe the Luminaire(s) not yet installed at specified Control Points that Field Devices are intended to be interoperable with. Enter Reference Codes from Luminaire Inventory tables

[Example 1]

* + 1. Luminaire Inventory Reference Code: 150W HPS
  1. Luminaire Specification(s)

Instructions: Describe the Luminaire(s) not yet purchased that Field Devices are intended to be interoperable with. Enter items from Section 1.2 Related Documents containing Luminaire specifications.

[Example 1]

* + 1. MSSLC Specification for LED Roadway Luminaires – Arterial 1
    2. MSSLC Specification for LED Roadway Luminaires – Collector 1
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Field Device Interoperability with the existing Luminaires prior to installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Field Device Components required for User verification of Interoperability with the existing Luminaires prior to installation.

Control Point Inventory

Instructions: Fill out a table for each luminaire type installed at specified Control Points.

|  |  |  |  |
| --- | --- | --- | --- |
| Reference Code | [Insert suitable reference e.g. “Cully Boulevard”] | | |
| Technology | 🞏 LED 🞏 Induction 🞏 CMH 🞏 MH 🞏 HPS 🞏 LPS | | |
| Control Point | Number of Instances |  | |
| Pole Height |  | |
| GPS Coordinates | [Insert reference to Related Document] | |
| GIS File | [Insert reference to Related Document] | |
| Luminaire | Make |  | |
| Model |  | |
| Catalog Number |  | |
| Controller Integration | 🞏 NEMA C136.10 🞏 NEMA C136.41  🞏 Internal Cavity | |
| Rated Input Power |  | Watts |
| Power Factor |  | At Rated Input Power |
| Other Notes |  | |
| Ballast/Driver | Control Signal | 🞏 0-10V 🞏 DALI 🞏 Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🞏 Not dimmable | |
| Make |  | |
| Model |  | |
| Catalog Number |  | |
| Input Voltage | 🞏 120 🞏 208 🞏 240 🞏 277 🞏 347 🞏 480 🞏 120-277 🞏 347-480 🞏 Other \_\_\_\_\_\_\_\_\_ | |
| Other Notes |  | |

Luminaire Inventory

Instructions: Fill out a table for each luminaire type.

|  |  |  |  |
| --- | --- | --- | --- |
| Reference Code | [Insert suitable reference e.g. “150W HPS”] | | |
| Technology | 🞏 LED 🞏 Induction 🞏 CMH 🞏 MH 🞏 HPS 🞏 LPS | | |
| Luminaire | Number of Instances |  | |
| Make |  | |
| Model |  | |
| Catalog Number |  | |
| Controller Integration | 🞏 NEMA C136.10 🞏 NEMA C136.41  🞏 Internal Cavity | |
| Rated Input Power |  | Watts |
| Power Factor |  | At Rated Input Power |
| Other Notes |  | |
| Ballast/Driver | Control Signal | 🞏 0-10V 🞏 DALI 🞏 Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🞏 Not dimmable | |
| Make |  | |
| Model |  | |
| Catalog Number |  | |
| Input Voltage | 🞏 120 🞏 208 🞏 240 🞏 277 🞏 347 🞏 480 🞏 120-277 🞏 347-480 🞏 Other \_\_\_\_\_\_\_\_\_ | |
| Other Notes |  | |

1. Existing Asset Management System(s)
   1. Description(s)

Instructions: describe the specific Asset Management System(s) that the Central Management System is intended to be interoperable with. See examples below for structure and format.

[Example 1: User created and managed spreadsheet]

* + 1. Software make: Microsoft
    2. Software model: Excel 2010
    3. Software URL: <http://office.microsoft.com/en-us/excel/>

[Example 2: Generic Description: ArcGIS]

* + 1. Software make: Esri
    2. Software model: ArcGIS 10
    3. Software URL: <http://www.esri.com/software/arcgis/arcgis10/index.html>

[Example 3: Work and Asset Management]

* + 1. Software make: Oracle
    2. Software model: WAM 9.x
    3. Software URL: <http://www.oracle.com/us/products/applications/utilities/business-solutions/work-asset-management/overview/index.html>

[Example 4: Service Orientated Architecture Bus]

* + 1. Software make: Oracle
    2. Software model: SOA Suite 11
    3. Software URL: <http://www.oracle.com/us/products/middleware/soa/suite/overview/index.html?origref=http://www.oracle.com/us/industries/utilities/solutions/index.html>

[Example 5: Google Earth/Maps/MapsGL based system]

* + 1. Software make: [Make]
    2. Software model: [Model]
    3. Software URL: <http://www.google.com/mapmaker>

[Example 6: OpenGIS based system]

* + 1. Software make: [Make]
    2. Software model: [Model]
    3. Software URL: <http://www.opengeospatial.org/>
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Central Management System Interoperability with the existing Asset Management System prior to Installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Central Management System Components required for User verification of Interoperability with the existing Asset Management System prior to installation.
     3. 🞏 Optional – Mark to select: The Vendor shall import asset information from the existing Asset Management System to the Central Management System during System Commissioning.

1. Existing Intelligent Traffic System(s)
   1. Description(s)

Instructions: describe the specific Intelligent Traffic System(s) that the Central Management System is intended to be Interoperable with. See examples below for structure and format.

[Example 1]

* + 1. Traffic Signal System Make:
    2. Traffic Signal System Model:
    3. Traffic Signal System URL:
    4. Traffic Signal System Catalog Number:

[Example 2]

* + 1. Traffic Signal System Make:
    2. Traffic Signal System Model:
    3. Traffic Signal System URL:
    4. Traffic Signal System Catalog Number:
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Central Management System Interoperability with the existing Intelligent Traffic System prior to Installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Central Management System Components required for User verification of Interoperability with the existing Intelligent Traffic System prior to installation.

1. Existing Sensor(s)
   1. Description(s)

Instructions: describe the specific Sensor(s) that Field Devices are intended to be Interoperable with. See examples below for structure and format.

[Example 1]

* + 1. Photoelectric Sensor Make:
    2. Photoelectric Sensor Model:
    3. Photoelectric Sensor URL:
    4. Photoelectric Sensor Catalog Number:

[Example 2]

* + 1. Occupancy Sensor Make:
    2. Occupancy Sensor Model:
    3. Occupancy Sensor URL:
    4. Occupancy Sensor Catalog Number:
  1. Vendor Services
     1. 🞏 Optional – Mark to select: The Vendor shall demonstrate Field Device Interoperability with the existing Sensor(s) prior to installation.
     2. 🞏 Optional – Mark to select: The Vendor shall provide standard production model samples of all Field Device Components required for User verification of Interoperability with the existing Sensor(s) prior to installation.