DRAFT Networked Lighting Control System Technical Requirements

Version 4.0 Draft 2

April 22, 2019

Note: Changes from Version 3.0 are highlighted in ==yellow==.

Changes from Version 4.0 Draft 1 are highlighted in ==blue==.

Schedule of Revisions

Revision Number	Date	Description
1.0	Apr 21, 2016	• Initial Technical Requirements published.
1.01	May 7, 2016	• Clarified that the Technical Requirements are for Interior Control Systems. Systems designed and marketed exclusively for exterior applications are not eligible to be qualified.
1.02	Feb 24, 2017	• Clarified that the Technical Requirements do not cover DC or PoE systems.
2.0	Jun 1, 2017	• Version 2.0 published, with addition of Exterior Control Systems.
3.0	Jun 1, 2018	• Version 3.0 published, with addition of DC/PoE Systems, Scenes, and multiyear plans for Energy Monitoring and Cybersecurity.

This document defines requirements to be met or reported for lighting control systems listed on the DesignLights Consortium® (DLC) Networked Lighting Controls Qualified Products List (QPL).

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Scope of Technical Requirements

These are requirements for Interior and Exterior networked lighting control (NLC) systems associated with commercial and industrial buildings, roadways, and exterior environments. NLC systems are defined for the purposes of these requirements as the combination of sensors, network interfaces, and controllers that effects lighting changes to luminaires, but does not include the luminaires themselves. Any luminaire-specific control requirements are addressed separately by the DLC's Solid-State Lighting Technical Requirements and Qualified Products List.

DC and PoE networked lighting control systems are eligible to be qualified, in conjunction with the SSL Testing and Reporting Requirements for DC and PoE Lamps, Luminaires, and Retrofit Kits.

Building Management Systems that control networked lighting plus other building systems such as HVAC, are eligible to be qualified as NLC systems and listed on the QPL, provided that they meet all of the DLC's requirements for NLC. Note that the DLC does not claim to qualify any HVAC-specific capabilities of these systems at this time.

Horticultural control systems are not eligible to be qualified at this time.

Definition of "Required" vs. "Reported" Capabilities

The Technical Requirements are built on "Required" and "Reported" system capabilities.

"Required" Capabilities: Required capabilities shall be available in all systems to be listed on the QPL. Systems that do not offer these capabilities are not eligible to be listed. A successful application will provide information on the availability of these capabilities and characteristics. Key information provided by the manufacturer will be published on the QPL.

Note: While the DLC requires systems to offer a particular capability, the DLC does not specify whether a capability must be installed on a project. For instance, while the DLC requires systems to have daylight harvesting/photocell capability, the DLC does not specify which rooms or luminaires on a project must be installed with daylight harvesting/photocell capability. Project-specific requirements for rebates and incentives are determined by individual efficiency programs.

"Reported" Capabilities: The DLC will report on the presence or absence of, type, and/or characteristics of each Reported capability for qualified systems. While systems are not required to include these capabilities, a successful application will provide information on the presence or absence of these capabilities and their characteristics. Key information provided by the manufacturer will be published on the QPL.

Additional Requirements (in addition to Tables 1,2,3)

"Customer Available Information": In order for an applicant to claim a capability listed in Tables 1 and 2, the manufacturer's customer literature must specify that the system has the capability, with instructions for how to configure and/or use this feature.

"Customer available" means the documentation is a finished product available publicly on a website, and/or included with the product packaging, and/or provided to the customer upon request. It should not be a document produced for the sole purpose of obtaining DLC qualification without further use for customers. The DLC reserves the right to accept, reject, or require changes to documentation to satisfy this requirement. Any documentation provided to the DLC will be used for the purpose of verifying compliance with DLC Technical Requirements and will not be made available publicly or distributed.

The following capabilities from Table 1 and 2 are exempt from this requirement:

- Continuous Dimming
- Individual Addressability
- Luminaire Level Lighting Control (LLLC, integrated)
- Networking
- Ease of Implementation
- Type of User Interface

Warranty: The DLC requires a minimum warranty of at least 5 years for all components of the system addressed by the requirements, with the exception of software, on-premises computer server, and cloud service. An optional warranty extension to 5 years is acceptable for meeting this requirement; however, the QPL will identify that an extended warranty must be purchased to meet the requirements.

Commercial Availability and Verification: All systems must be fully commercially available, able to be purchased, and with complete, final documentation and literature readily available on the manufacturer's website before they can be listed. The DLC requires that a qualified system has been installed and operated successfully in at least one actual field installation. The DLC will verify this through a case study and/or a customer reference. See the Application Form for more information.

System Overview Presentation: As part of the application review process, the DLC requires a system overview to be presented via webinar or in-person to the DLC. See the Application Form for more information. For annual re-listings of a previously qualified system for which a recording of a prior presentation is available and the system has not changed extensively, this requirement may be waived or shortened.

All requirements documents, including the Application Form, instructions, and supporting documentation can be found on the DLC website at **https://www.designlights.org/lighting-controls/qualify-a-system**.

Multi-Year Plans

In order to serve the needs of stakeholders for long term planning, the DLC includes Multi-Year Plans for some topics and/or requirements. These plans outline a general direction for each topic over the next few years, subject to refinement through the stakeholder engagement process.

Energy Monitoring Plan

In alignment with the multi-year plan proposed in the prior V3.0 requirements, Energy Monitoring is now a required capability with V4.0 with an exception for room-based systems. Data is reported via .CSV file and/or API, as described in Table EM-1 below. Various methods of energy monitoring are acceptable for meeting this requirement, including automated measurement methods and methods that require manual input of wattage to measure energy use.

Energy Monitoring capability is not required for room-based systems

A "room-based system" is defined as follows: A system that is designed to control lighting in a single room or space and where the control, configuration, and management of the system must be contained within the room or space illuminated by the system. In order to interact with the system, for instance to change any settings or to download any data, a user must be physically present in, or in close proximity to, the room illuminated by the system.

Table EM-1

The DLC's utility and energy efficiency program members have requested that data be made available in energy data reports to support networked lighting control incentive/rebate programs. In the absence of an applicable standard describing energy data reports, Table EM-1 describes the minimum contents that an energy data report must provide, in order to meet the DLC requirement for Energy Monitoring. This table is derived from the DLC report "Energy Savings from Networked Lighting Control (NLC) Systems", 9/21/2017, Appendix A, Tables 8 and 9. As part of the application or re-application process, each product that qualifies for Energy Monitoring will provide to the DLC a sample .CSV file or API documentation that meets the requirements of Table EM-1.

116 **Table EM-1: Data Reporting Guidelines for .CSV or API**

Row	Topic	Data Element	Definition	Note
1	Headings	For each field	Each type of data element is identified by a heading.	Text
2	System	NLC Manufacturer	The manufacturer of the NLC system	
3	System	NLC Product	The name of the NLC system	
4	Site	Building/Business Type [*Note A]	The main business function in the portion of the building where the NLC system is installed	Select from ASHRAE 90.1-2016 Table 9.5.1
5	Baseline for NLC	Maximum Rated Power without Controls	The maximum possible power consumption of the lighting system without any control strategy in effect. If a luminaire retrofit has occurred, this value is equal to the maximum rated power of the new luminaire(s).	Luminaire or zone level if feasible; else site level. Units = Watts
6	Energy	Reporting Interval [*Note B]	The frequency an energy measurement is reported	15 minutes or less; Units = minutes
7	Energy	Data method [*Note C]	How is interval data (typically in 15 minute intervals) calculated?	Text
8	Energy	Timestamp	Date and time of each energy measurement	Unix time or RFC 3339 time
9	Energy	Energy data	The actual energy readings that are recorded for each luminaire or group of luminaires	Units = kWh
10	Energy	Nominal Accuracy	% accuracy of the energy data	Units = %
11	Energy	Confidence Level	The percentage of all possible samples expected to include the true population parameter.	Units = %
12	Energy	Record Duration	Capacity for at least 1 year of 15 minute interval data	

117 **Note A:** For Building/Business Type, ASHRAE 90.1-2016 Table 9.5.1 can be viewed as follows:

118 At https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-
119 ashrae-standards, choose "Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise
120 Residential Buildings". Scroll to Table 9.5.1 on page 151 of the standard (PDF page 155).

121 **Note B:** The need for 15 minute interval data is derived from the IPMVP Options A and B, as typically
122 implemented by utility programs (International Performance Measurement and Verification Protocol:
123 Core Concepts and Options for Determining Energy and Water Savings EVO-10000-1.2016, Efficiency
124 Valuation Organization, evo-world.org.)

125 **Note C:** For example, is the peak value reported from each 15 minute interval; or an average of N samples? A
126 typical calculation would be an average of 3 or more samples.

127 **Plan for V5.0 in 2020**

128 In V5.0, to be released in June 2020, the DLC intends to continue to refine the data requirements in table EM-1
129 including further details on output data via API, and alignment with ongoing data model efforts from
130 ANSI/NEMA C.137 and ANSI/ASHRAE 223P Committees.

131 ## Cybersecurity Plan

132 In alignment with the multi-year plan proposed in the prior V3.0 requirements, the DLC is taking the next step
133 to help ensure qualified systems utilize best-practice standards for cybersecurity.

134 **In V4.0 (2019):**

135 • The DLC is establishing criteria for acceptable cybersecurity standards. Systems must have been
136 certified with one or more of these standards in the past 2 years in order to claim the optional
137 Reported "Cybersecurity" capability.
138 • Self-certification is sufficient, provided that it is accredited by the standard setting body or the
139 National Voluntary Laboratory Accreditation Program (NVLAP).

140 **Criteria for acceptable cybersecurity standards**

141 The DLC recognizes cybersecurity standards that meet the following criteria:

142 1. Certifiable with a standardized methodology established through either:
143   a. A voluntary consensus process such as ANSI, ISO, IEC, *et al*
144   b. A federal agency of the USA or Canada
145   c. A collaborative multi-stakeholder engagement process such as the Cloud Security Alliance
146 2. Applies to one or more of the following:
147   a. Product development process lifecycle
148   b. Components/Embedded Devices
149   c. System
150   d. Cloud Services
151 3. Includes at least 3 of the following technical content, for (2. b,c,d) above
152   a. Penetration testing
153   b. Communication robustness testing
154   c. Vulnerability identification testing
155   d. Multiple levels of security

156 **Definitions**

157 **Cybersecurity:** The practice of defending networked systems and data from malicious attacks.

158 **Process:** Standards that address the development process in order to reduce the number of cybersecurity
159 vulnerabilities that are designed into components, systems and services, and that manifest over the product
160 lifecycle.

161 **Components:** Standards that address the cybersecurity of each individual component in a networked system.

162 **System:** Standards that address the networked system including aspects such as authentication, data
163 confidentiality, system integrity, and service availability.

164 **Cloud Services:** Standards for cloud services that address secure integration with services from a remote cloud
165 computing provider.

166 **Standards that meet the criteria**

167 In V4.0 (2019), in order to claim the optional cybersecurity capability on the QPL, certification within the past 2
168 years is required with the cybersecurity standards shown in Table CS-1. These standards have been deemed to
169 meet the DLC's proposed criteria for acceptable cybersecurity standards:

170 **Table CS-1**

Standard	Process	Components/ Embedded Devices	System	Cloud Services
ANSI/UL 2900-1	y	y	y	
IEC 62443	-4-1	-4-2	-3-3	
SOC2	y		y	y
CTIA (cellular)	y	y		
ISO 27001	y			
ISO 27017 (with 27001)				y
FedRAMP				y
CSA STAR				y

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172 **In V5.0 (June 2020):**

173 • Products will be required to be certified with at least one standard that meets the DLC criteria for
174 acceptable cybersecurity standards. This will include all of the standards shown in Table CS-1, and
175 may be expanded in 2020 to also include potential new standards such as ANSI/UL 2900-2-4 for BMS,
176 ANSI/UL 2900-2-5 for lighting, and CSA T200.
177 • Certification in any 1 of the 4 categories (Process, Components, System, Cloud Services) within the
178 past 2 years will be sufficient.
179 • For room level systems that cannot be upgraded later to join a larger network, an exception or delay
180 in the requirement will be considered in the stakeholder engagement process.

181 **In V6.0 (June 2021):**

182 • Products will be required to be certified with at least one cybersecurity standard that addresses
183 "Process" as shown in Table CS-1.
184 • The DLC policy regarding the length of time that certifications are recognized between audits
185 (currently 2 years in V4.0 and V5.0) will be considered for modification in the stakeholder engagement
186 process.

187 In either V5.0 or V6.0, the DLC intends to introduce a tiering system to recognize products that achieve higher
188 levels of cybersecurity certification, beyond the minimum requirement.

Cybersecurity Notes

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190 **Note 1:** While all of the standards in Table CS-1 can be applied to NLCs, not all of their recommendations may
191 be applicable. Manufacturers should carefully review each standard to identify appropriate aspects
192 for their particular application.

193 **Note 2:** Cloud certification is inherited from the organization that operates the cloud server. This is typically a
194 third party such as Amazon Web Services (AWS).

Future Plans

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196 Later in 2019, the NLC QPL will migrate from its current Excel format to an online format similar to the DLC SSL
197 QPL. In that process, the organization of the data will be modified in order to support a better user
198 experience.

Interoperability

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200 The DLC is currently researching and developing a multi-year plan for interoperability to be included in the
201 V5.0 update in 2020. This may include proposals to characterize the level of interoperability supported by
202 listed systems for specific use cases. The DLC may introduce a tiering system to identify systems that support
203 higher levels of interoperability.

204 **Interoperability Definition**: The ability of systems or systems components to transmit, receive, interpret,
205 and/or react to data and/or power and function in a defined and appropriate manner. *(Modified from*
206 *NEMA/ANSI C137.0-2017.)*

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208 Annual Revisions and Grace Period

209 The DLC revises the Networked Lighting Controls Technical Requirements annually, with final revisions
210 completed on June 1 of each year. Each manufacturer must requalify and relist a system each year with the
211 annual Technical Requirements revision schedule.

212 **Grace Period Policy:** A twelve month listing grace period will be provided for systems that have been qualified
213 under a previous version of the Technical Requirements, but do not meet revised requirements. These
214 systems can be requalified and listed under the previous version of the Technical Requirements. This will allow
215 a period of one year to develop an updated or new system that can be submitted for evaluation according to
216 the most current Technical Requirements.

217 Table 1 provides a Summary of "Required" and "Reported" System Capabilities for Interior Lighting Systems.

218 Table 1: Interior Lighting Systems

'Required' Interior System Capabilities	'Reported' Interior System Capabilities
• Networking of Luminaires and Devices • Occupancy Sensing • Daylight Harvesting / Photocell Control • High-End Trim • Zoning • Luminaire and Device Addressability • Continuous Dimming • Energy Monitoring	• Control Persistence • Scheduling • Device Monitoring / Remote Diagnostics • Type of User Interface • Luminaire Level Lighting Control (LLLC, integrated) • Personal Control • Load Shedding (DR) • Plug Load Control • External Systems Integration • Emergency Lighting • Cybersecurity • Color Changing / Tuning • Ease of Implementation • Scene Control

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220   Table 2 provides a Summary of "Required" and "Reported" System Capabilities for Exterior Lighting Systems.

221   ## Table 2: Exterior Lighting Systems

'Required' Exterior System Capabilities	'Reported' Exterior System Capabilities
• Networking of Luminaires and Devices • Occupancy Sensing AND/OR Traffic Sensing • Daylight Harvesting / Photocell Control • High-End Trim • Zoning • Luminaire and Device Addressability • Continuous Dimming • Scheduling • Energy Monitoring	• Control Persistence • Device Monitoring / Remote Diagnostics • Type of User Interface • Load Shedding (DR) • External Systems Integration • Emergency Lighting • Cybersecurity • Color Changing / Tuning • Ease of Implementation • Scene Control

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224 Table 3 provides the detailed definitions for each capability or technical requirement. This table applies to
225 both Interior and Exterior, except where noted. Please note that the Application Form specifies in more detail
226 what information the DLC requires from manufacturers for each capability and what information will be
227 published on the QPL.

228 Table 3: Capability and Requirement Definitions

Row	Capability	Definition
1	Networking of Luminaires and Devices	The capability of individual luminaires and control devices to exchange digital data with other luminaires and control devices on the system. This capability is required at the room, space, or area level, but not at the whole building level or beyond (e.g. non-lighting systems, or the internet).
2	Occupancy Sensing	The capability to affect the operation of lighting equipment based upon detecting the presence or absence of people in a space or exterior environment. Exterior systems must include either Occupancy Sensing or Traffic Sensing. They may include both, but that is not required.
3	Traffic Sensing	The capability to affect the operation of lighting or other equipment based upon detecting the presence or absence of moving vehicles in an area. Systems may satisfy this requirement through *External Systems Integration* as described below in lieu of in-system sensors if another source of data is used for presence or absence detection. Exterior systems must include either Occupancy Sensing or Traffic Sensing. They may include both, but that is not required.
4	Daylight Harvesting / Photocell Control	The capability to automatically affect the operation of lighting or other equipment based on the amount of daylight and/or ambient light that is present in a space, area, or exterior environment. This capability is typically called Daylight Harvesting for Interior systems, and Photocell Control for Exterior systems.
5	High-End Trim*	The capability to set the maximum light output to a less-than-maximum state of an individual or group of luminaires at the time of installation or commissioning. High-End Trim must be field reconfigurable. This capability is distinct from automatic compensation for lumen depreciation, which automatically increases output as a system operates over time. *While the DLC specifically requires "High-End Trim", some manufacturers refer to this capability as "Task Tuning" or "Tuning" within their system interfaces. Refer to NEMA LSD 64-2014 for definitions of Lighting Controls Terminology.
6	Zoning	The capability to group luminaires and form unique lighting control zones for a control strategy via software-defined means, and not via physical configuration of mechanical or electrical installation details (e.g. wiring). Interior: Zoning is required for Occupancy Sensing, High End Trim, and Daylight Harvesting control strategies except for systems that feature Luminaire Level Lighting Control (LLLC) capabilities as defined in these requirements under "Reported Capabilities", in which case zoning is only required for Occupancy Sensing and High-End Trim control strategies. Exterior: Zoning is required for High End Trim

7	Luminaire and Device Addressability	The ability to uniquely identify and/or address each individual luminaire, sensor, controller, and user interface device in the lighting system, allowing for configuration and re-configuration of devices and control zones independent of electrical circuiting.
8	Continuous Dimming	The capability of a control system to provide control with sufficient resolution in output (100+ steps) to support light level changes perceived as smooth (as opposed to step dimming with a small number of discrete light levels).
9	Control Persistence	The capability of a networked lighting control system's lowest-level ("edge device") luminaire controllers to execute three energy saving strategies (occupancy sensing, daylight harvesting, and high-end trim) at a room-level, or finer, resolution in the absence of communications with the next higher networked element in the system's topology.
10	Scheduling	The capability to automatically affect the operation of lighting equipment based on time of day. Scheduling capability is Reported for Interior systems and Required for Exterior systems. Exterior systems are required to have event scheduling, and "astronomical" scheduling functionality for sunrise and sunset programming, based on geographical location and time of year.
11	Energy Monitoring	The capability of a system to report the energy consumption of a luminaire and/or a group of luminaires. • Individual luminaire monitoring as well as energy monitoring on dedicated lighting circuits is acceptable. • The method by which the system implements this capability must be clearly described, including whether the system provides automated energy measurement or relies on numerical manual input during system setup for accurate measurement (such as inputting the wattage of each luminaire in a project). • Output data must be available as described in Table EM-1 of the DLC "Networked Lighting Control System Technical Requirements Version 4.0" via one or more of the following: .CSV file, API. • Energy Monitoring is not required for room-based systems.
12	Device Monitoring / Remote Diagnostics	The capability to monitor, diagnose, and report operational performance including system and/or component failures.
13	Type of User Interface	The type of interface provided by the control system for users to read and adjust control system settings during system start-up, commissioning, and/or ongoing operation.
14	Luminaire Level Lighting Control (LLLC, integrated)	The capability to have a networked occupancy sensor and ambient light sensor installed for each luminaire, and directly integrated or embedded into the luminaire form factor during the luminaire manufacturing process. In addition to these required integrated components, LLLC systems must have Control Persistence capability as described in this document. To demonstrate commercial availability of the integrated component options, at least one family, luminaire or kit with integrated control must be verified by the DLC. Manufacturers may choose whether or not to list this information publicly on the QPL.

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15	Personal Control	The capability for individual users to adjust to their personal preferences, via networked means, the illuminated environment of a light fixture or group on of light fixtures in a specific task area. The publicly available information must clearly describe a control interface for use by a single individual who does not have access to system-wide settings.
		A wireless dimmer switch may only be considered a personal control interface if product documentation:
		    a) shows that the physical configuration is suitable for workstation use (i.e. a small, self-contained unit without any external wiring, suitable for use as a handheld remote control), and
		    b) describes configuration for personal control within a larger area.
		A software-based interface may only be considered personal control if product documentation:
		    a) shows it provides a specific interface intended for personal control by an individual user within a subsection of a larger space and that
		    b) the interface only allows access to personal control functions for the light fixtures in the specific areas being controlled (i.e. each occupant can control their own area, but not their neighbors' areas).

16	Load Shedding (Demand Response)	The capability to reduce the energy consumption of a lighting system, in a pre-defined way, on a temporary basis, in response to a demand response signal. The method by which the system implements this capability must be clearly described in the publicly available reference(s).
17	Plug Load Control	The capability to control the power delivered to receptacles through scheduling or occupancy sensing. The method by which the system implements this capability must be clearly described in the publicly available reference(s).
18	External Systems Integration (e.g. BMS, EMS, HVAC, Lighting, API)	The capability to exchange data with other networked systems such as Building or Energy Management Systems (BMS/EMS), Heating Ventilation and Air Conditioning (HVAC) Systems, or other Lighting and Building Systems via BACnet, Application Program Interface (API) or other methods. The method, including formats and languages, by which the system implements this capability must be clearly described in the publicly available reference(s).
19	Emergency Lighting	Publicly available documentation illustrating how a system's luminaires connect with an emergency power source. The QPL will provide the URL(s) for online documentation provided by manufacturers for system designers to refer to. This documentation will identify wiring diagrams, required components, and/or application guides needed to understand design considerations for integrating the system into an emergency lighting system.

20	Cybersecurity	The compliance with a cybersecurity standard that meets the DLC criteria. The current list of standards is shown in Table CS-1: | Standard	Process	Components /Embedded Devices	System	Cloud Services
ANSI/UL 2900-1	y	y	y	
IEC 62443	-4-1	-4-2	-3-3	
SOC2	y		y	y
CTIA (cellular)	y	y		
ISO 27001	y			
ISO 27017 (with 27001)				y
FedRAMP				y
CSA STAR				y	
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21	Color Changing / Tuning	The capability to alter the output and color of tunable white and/or variable color output luminaires via a dedicated control interface(s). To demonstrate compliance with this capability, the interface(s) must be clearly described in the product literature and allow for at least two CCT settings. These settings may be described in terms of CCT, such as 3000K or 5000K, or simple descriptive terms for the desired setting such as 'Night' or 'Day'. The product literature must also specify installation and configuration requirements to implement this functionality.
22	Ease of Implementation	The QPL will identify the most typical responsible party and their required level of training to start-up and configure the system to the extent that all Required Capabilities are functioning. Documentation is not required.
23	Scenes	The capability of a system to provide two or more pre-programmed light level settings for a group or multiple groups of luminaires to suit multiple activities in a space, and allow for recall of these settings via a switch, control device, or signal from a BMS or API.

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