

Why should Smart Cities demand true interoperability for their lighting controls?

AHR Las Vegas, 1st February 2022



LONMARK International

LonMark is a non-profit international organization recognized for the certification, education and promotion of interoperability standards for control networking

One of LonMark's fundamental purposes is in *providing direction* to members and the general public—whether that's for device creation or network integration, standardization or creating a plan for an integration specification.

Topics

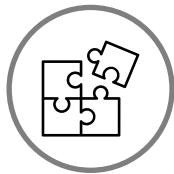
- What is interoperability?
 - Levels of interoperability
 - Benefits of interoperability
- Importance of interoperability for Smart City Lighting Controls?
 - Phased approach to implementation
 - Future addition of new applications
 - Future coordination with neighboring municipalities
- Features of LON
- Comparison to other protocols

What is Interoperability?

Difference of terms Compatibility, Interchangeability, Interoperability:

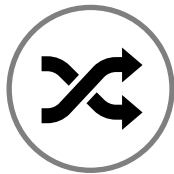
- **Compatibility**

A state in which two things can exist or occur together without problems or conflict,
e.g. two components are compatible if they can operate in one system without corrupting, interfering with, or hindering the operation of each other.* This is important but does not ensure good communication!



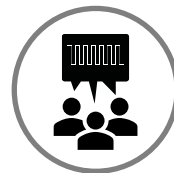
- **Interchangeability**

The ability of two devices to be substituted with each other without affecting the operation of the system or two components are interchangeable if they can be physically exchanged for each other and provide identical operation in a system without additional configuration.* This normally applies to devices with the same function such as two controllers.



- **Interoperability**

The ability of two devices or applications to perform a given task using a single set of rules
e.g. two components are interoperable if they can both operate in a system as intended, typically facilitated by an ability to share a common defined set of information.* This is needed for devices that communicate within a system but have different functions such as a controller and a router.



* PNNL Advanced Lighting Team, Michael Poplawski

Levels of Interoperability

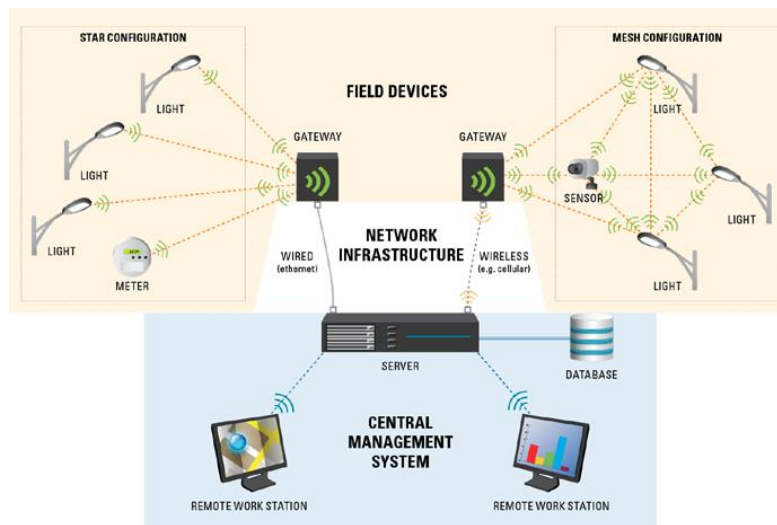
- **Proprietary systems**
are “closed” i.e. communication protocol is owned by a single organization with limited availability.
- **Interoperable systems**
are based on an open protocol which is generally standardized and available to anyone.

Levels of interoperability across the layers of a communication network

7 Layers of the OSI Model

Application	<ul style="list-style-type: none">• End User layer• HTTP, FTP, IRC, SSH, DNS
Presentation	<ul style="list-style-type: none">• Syntax layer• SSL, SSH, IMAP, FTP, MPEG, JPEG
Session	<ul style="list-style-type: none">• Synch & send to port• API's, Sockets, WinSock
Transport	<ul style="list-style-type: none">• End-to-end connections• TCP, UDP
Network	<ul style="list-style-type: none">• Packets• IP, ICMP, IPSec, IGMP
Data Link	<ul style="list-style-type: none">• Frames• Ethernet, PPP, Switch, Bridge
Physical	<ul style="list-style-type: none">• Physical structure• Coax, Fiber, Wireless, Hubs, Repeaters

Various parts of the system



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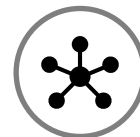
Benefits of Interoperability

Advantages for designers, integrators, owners and operators

- Ability to use best available components from different vendors
- Ability to modify and expand a system according to post deployment needs
- Ability to manage the risk of component or manufacturer obsolescence
- Ability to adopt future communication technology developments

Results in

- Ability for devices to communicate and share data with each other
- Reducing the total cost of ownership
- Future-proofing the solution (it avoids the problem of “vendor lock-in”)



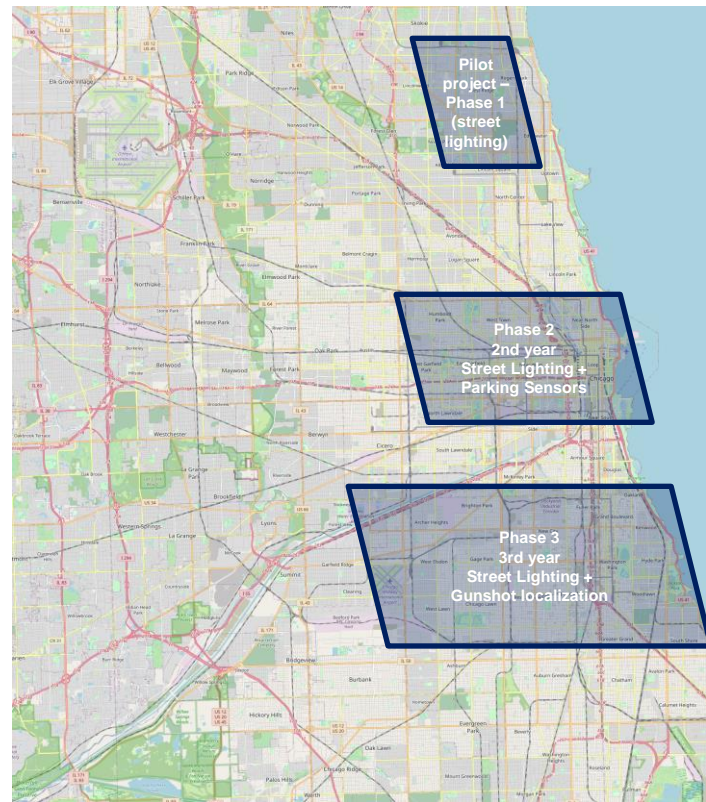
Importance for Smart City Lighting Controls

- It all starts with implementation of LED Lighting in streetlights
 - Easy to switch on/off, dimmability, color change
 - Ideally controls will be installed at the same time as LED implementation
- Generally LED and controls implementation will happen **in phases over a period of years**, with cities expanding their controls network as they grow.



STREET LIGHTING forms the basis for communication in Smart Cities!

Using standardized, open protocol and interoperable devices ensures the availability of supply over the life of the project.

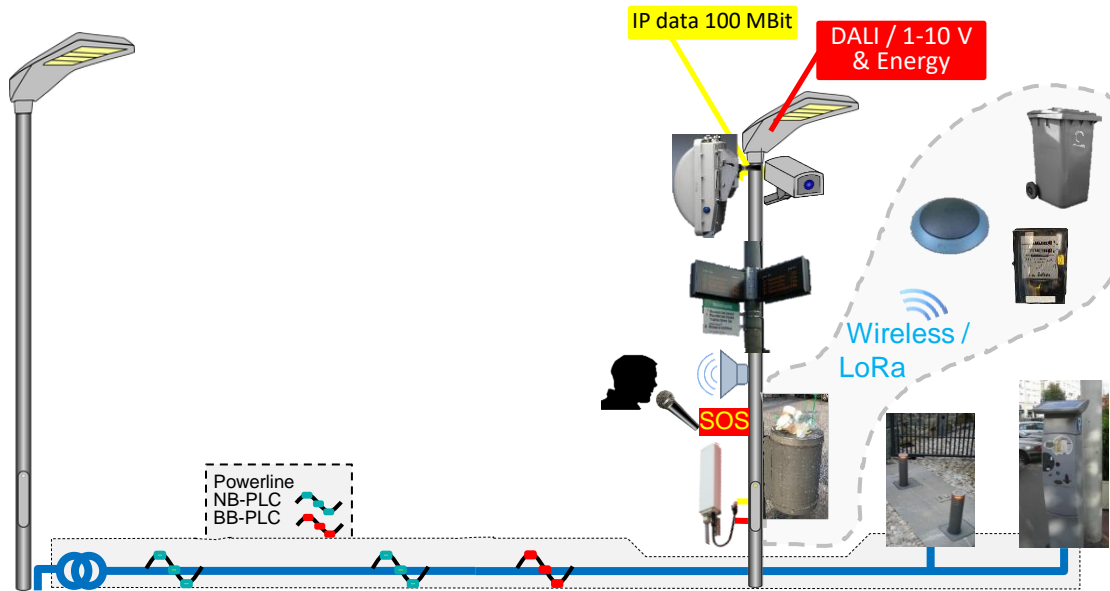


Source: <https://www.openstreetmap.org/#map=12/41.8638/-87.7688>

Importance for Smart City Lighting Controls

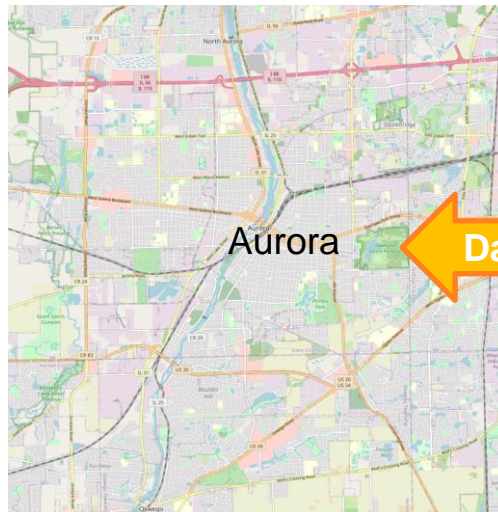
- Lighting controls → often first technologies to be implemented in cities
 - because significant energy savings help to finance the equipment and installation costs
- Lighting installations → provide an ideal platform for other technologies and applications
 - because they are distributed across the territory and are “ready-connected” with electrical power

Open interoperable standardized communication protocol ensures the ability to easily add new applications in the future.

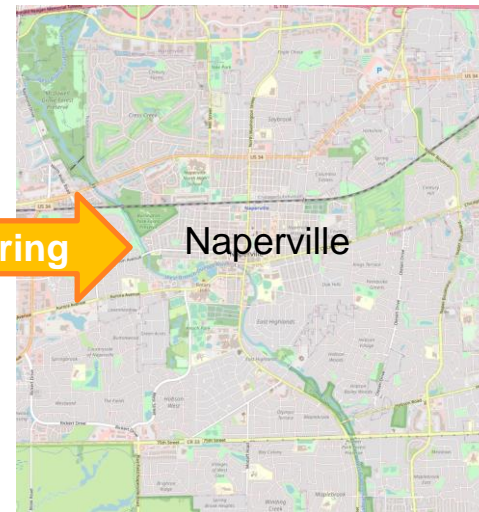


Importance for Smart City Lighting Controls

- In the beginning cities and municipalities are focused on implementing solutions for their individual jurisdictions (islanded solutions).
- We are already seeing a movement towards “connected smart buildings”.
- There is also a need to connect buildings to outdoor spaces.
- It is highly likely that cities will gain benefits from systems that are able to share data and communicate with neighboring municipalities in the future.



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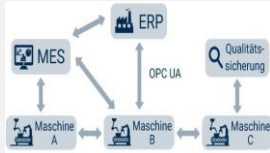
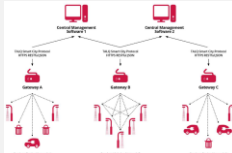


Open standardized interoperable devices ensure the possibility of data sharing in the future.

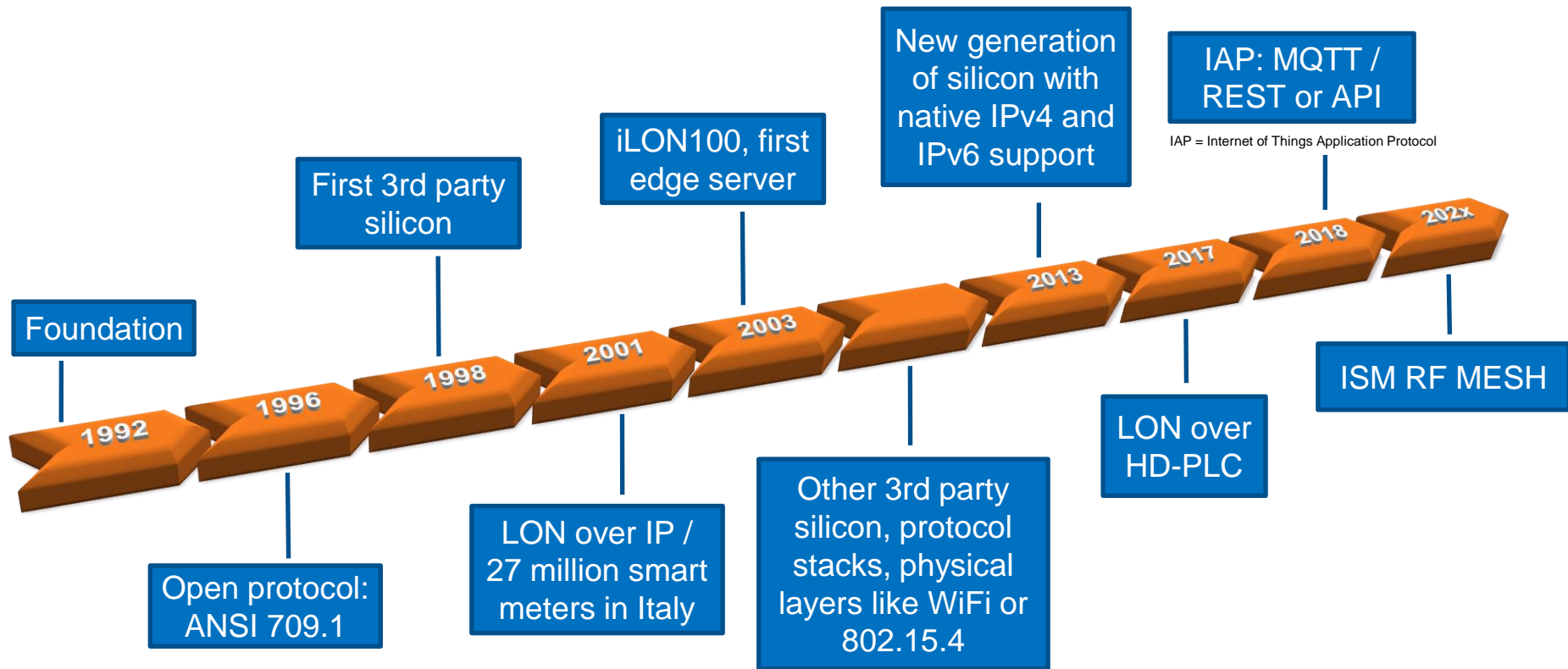
Comparison of interoperable protocols

- **Field Communication Technologies**

- LoRa
- ZigBee
- Wi-SUN
- NB-IoT
- BLE

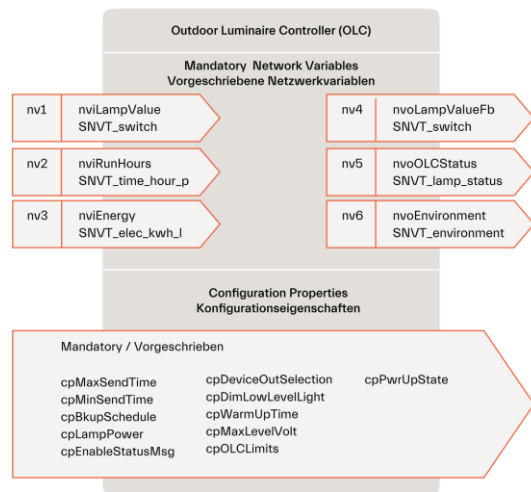
	Integration technologies		Translation technology
	LON	OPC-UA	TALQ
Field communication	Various communication media, IP, RF, RF Mesh	RS232/RS485/IP	Standardised interface between CMS ↔ CMS → Edge controller
Cloud	Open Standard MQTT, REST with ANSI/CTA 709.10	Own standard	Own standard
Strength	Any media		
Routable protocol	YES		
Standardized application layer	YES		
Number devices / edge controller	32385 per edge controller	Infinite	infinite
Foundation	1992	OPC foundation, 1994	Spec TALQ 1, 2012
Layer implementation	1 2 3 4 5 6 App	Spec OPC-UA, 2017	Spec TALQ 2, 2018
ISO/IEC	ISO/IEC 14908-x (ANS/CTA 709.x)	User association	User association
Tools for commissioning	Part of technology	No	No

Continuous development makes LON future proof



LON was first with interoperability

LON protocol is used in many application areas.



Standardized data model with standardized objects and data types



Luggage transport system at Oslo Airport



Modular equipment for hospital beds



New York Metro



Building automation



> 30.000 petrol stations in Europe



Acela Highspeed Train



Tap control



Fire protection systems on ships



Emergency lighting on large airports e.g. Dubai

Why is LON ideal for Smart City applications?

Cloud	LON : continuous data model on all layers	<ul style="list-style-type: none">• No exclusive cloud supplier or API lock-in• Open standard for cloud connection with ANSI/CTA 709.10 (IAP = Internet of Things Application Protocol)• Easy integration of other technologies with IAP
SCADA		<ul style="list-style-type: none">• No application lock-in• Covers multiple application types• 1000s of standardized data objects and data types• Access by LON, IAP, XML/SOAP and others
CONTROL		<ul style="list-style-type: none">• Multivendor, no supplier lock-in• No loss of information due to conversion of data in gateways• Different physical media available in the same project due to transparent routing
FIELD		<ul style="list-style-type: none">• No technology lock-in to one physical media• Adopting new media like HD-PLC or RF-MESH• Various physical media already existing including IPv4 and IPv6

How to include LON in your project specifications

LONMARK website: www.lonmark.org

Smart City/Streetlighting white papers:

<https://www.lonmark.org/stakeholder/smart-city/smart-streetlight>

Lonmark Streetlighting Video:

https://www.youtube.com/watch?v=mrqC_GiLKAc

Specification Documents:

https://www.lonmark.org/wp-content/uploads/2020/12/OutdoorLightingManagement-HW_Specification-V33.pdf