

# Street Light Control and Smart City Application, using HD-PLC



**iciti.**





Matthias Lürkens is acting as Chief Technical Officer at LVX Global Deutschland GmbH since May 2021.

In that role he is designing the communication architecture for Smart City and Streetlighting products at LVX. He is taking an active role in creating new standards together with observing and adopting existing standards.

He is having a diploma in electrical engineering from the RWTH Aachen in Germany. Since more than 30 years he is specialists for communicating embedded systems, which got the name IoT.

At LonMark International he is chairman of the Technical Committee. In this role he is participating in evolving the ISO/IEC 14908 control network protocol standard. He is having a world leading know how in 14908 and is coauthor of the 14908-7/8/ standards. As a DIN member he is delegated into CEN TC247WG4 (Open System Data Transmission for Buildings) and in that role liaison manager to ISO/IEC JTC1/SC6 (Telecommunications and information exchanges between systems).



Through technology we use existing infrastructure to enable the benefits of smart cities and buildings to be realized. iciti is efficient tech for smart city solutions, it provides proven and robust NB-PLC and HD-PLC technology as well as RF-MESH and IP communication. For Smart City infrastructures it reduces risk, saves energy, and leads to reduction of maintenance and associated costs. The standardized interoperable iciti product system solution offers future and investment security because it is independent of specific manufacturers.



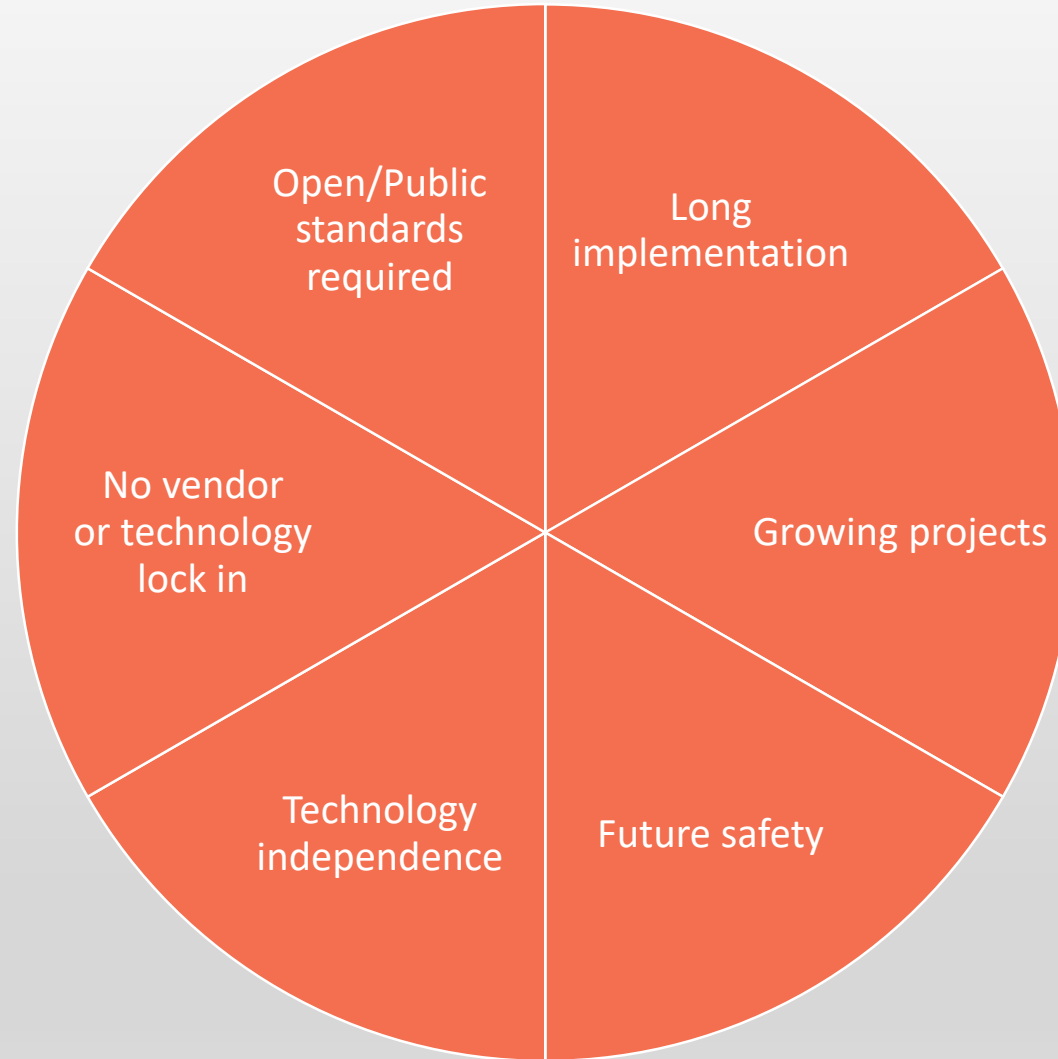
FireM is an IoT Technology enabled engineer-led end-to-end solution that identifies and maps the location of events within a building and interfaces to any fire, security or building management system.

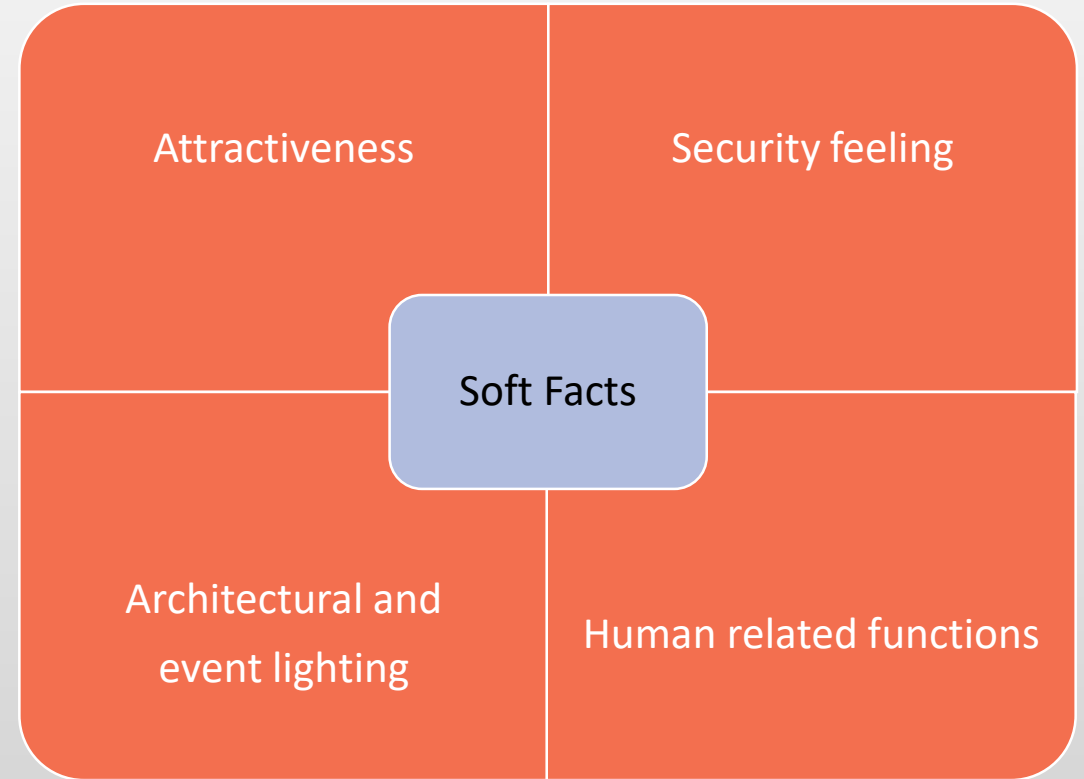
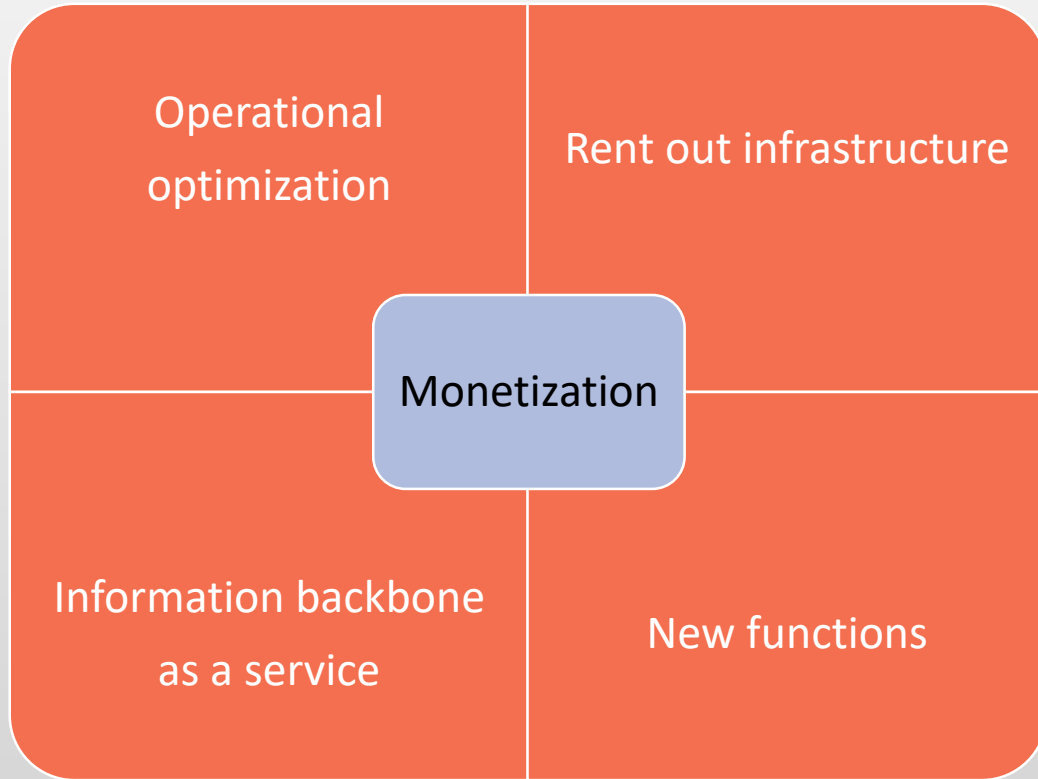


Norman Asset Delivery consults to clients in the resources, property and public infrastructure sectors offering services such as, engineering, project management, design management and authority approvals. With extensive experience and outstanding industry relationships Norman Asset Delivery ensures clients successful delivery of assets



The Smart Cities Council, the world's largest smart cities network, envisions a world where innovation, technology and data leverages smart, sustainable cities with high-quality living and high-quality jobs. The Smart Cities Council serves as an objective and neutral network for sharing knowledge and accelerating projects.







Smart Lighting

Smart Parking

Digital Signage

Vehicle Charging

Submetering

Intercom

Noise Indication & Map

Public Announcements

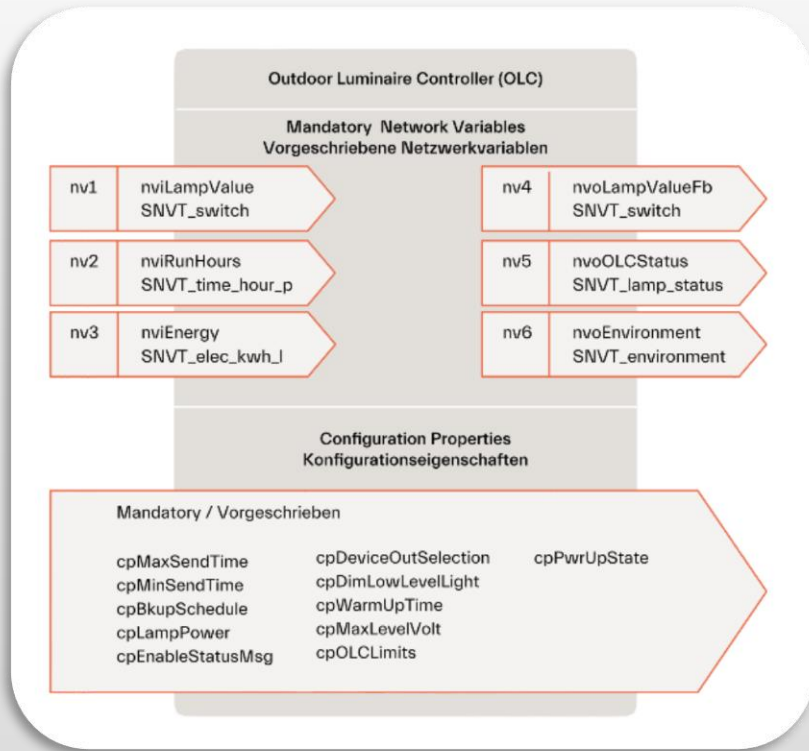
CCTV

Waste Management

Environmental Sensors

Connectivity for Edge Gateways / Public WiFi





Modular equipment for hospital beds



New York Metro



Luggage transport system at Oslo Airport



> 30.000 petrol stations in Europe



Acela Highspeed Train



Building automation



**LONMARK®**  
**INTERNATIONAL**



Emergency lighting on large airports e.g. Dubai



Fire protection systems on ships



Tap control



		Cloud	MQTT / REST (IAP = IoT Access Protocol)	ANSI/CTA 709.10 (NWIP for EN 14908-10)
ISO/OSI Layer	6,7	Application / Presentation	Network variables / explicit messages / network management	ANSI/CTA 709.5 & 709.6 EN 14908-5 & 14908-6
	5	Session	Request / Response	ISO/IEC 14908-1
	4	Transport / Authentication / Transaction	Acknowledged / Unacknowledged / Repeated	
	3	Network	Addressing / domain / subnet / node / group / broadcast	
	2	MAC / Link	Framing / CRC / Data / Encoding	
	1	Physical	Wire / Ethernet / Powerline / RF / Optical	

Free Topology ISO/IEC 14908-2	Narrowband Powerline ISO/IEC 14908-3	IP-Tunneling ISO/IEC 14908-4	Internet Protocols 709.7 & 14908-7	CNP/HD-PLC 709.8 & 14908-8	RF 709.9 & 14908-9
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- Open International Standard
- License free
- LON protocol stack open source
- Ongoing Development
- Transparent Routable
- Hardware Independent
- Multiple Vendors  
(Products & Core Technology)

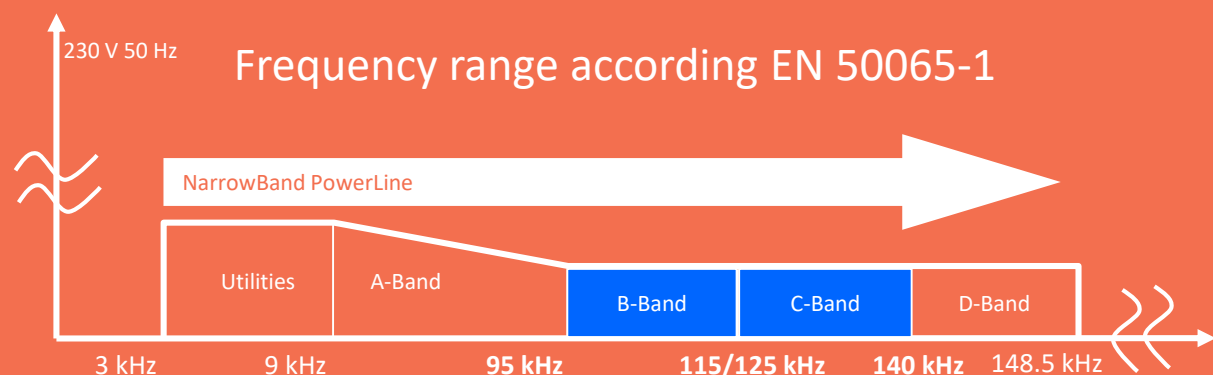
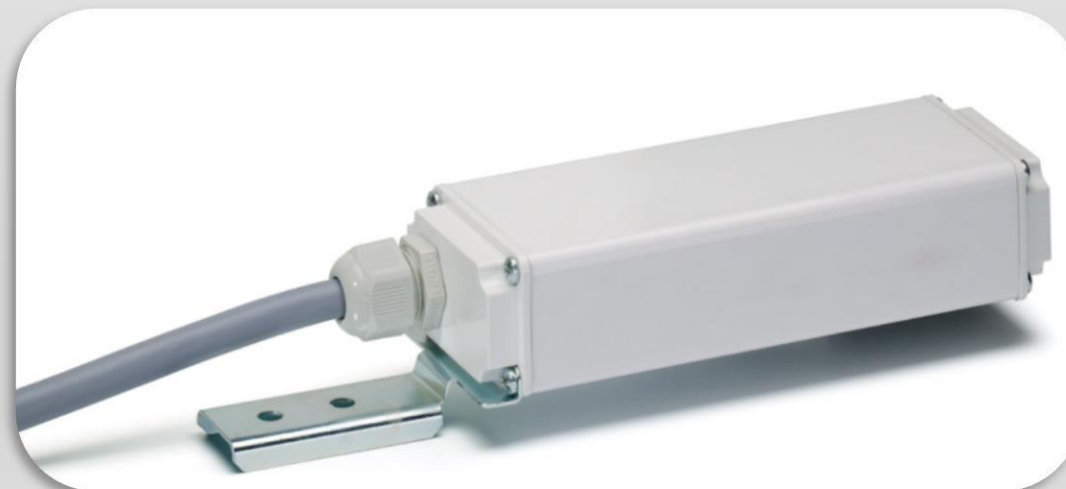
## Narrow Band Power Line Communication

- Bandwith approx. 5 kBit/sec
- Band B & C (95-125 kHz & 125-140 kHz)
- Repeating technology for robust data transmission
- Typical max. 5 repeaters
- Single source neuron chip (Echelon, now Renesas)
- (ENEL smart meter project Italy)

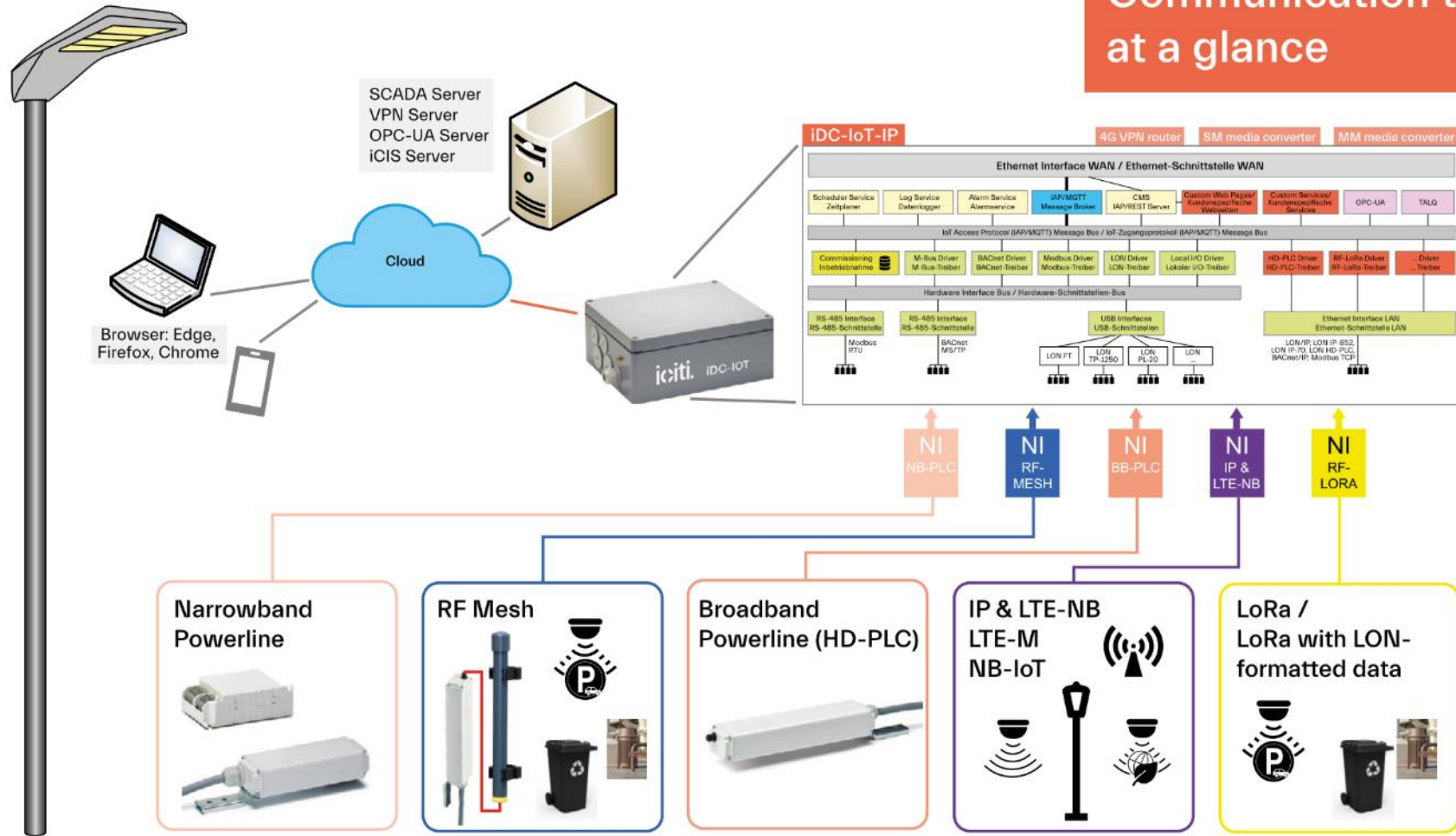
Luminaire Controller



Pole Controller



## Communication technologies at a glance



		Powerline		Direct IP	sub GHz		2.4 GHz		Cellular				
		HD-PLC	NB-PLC	fiber optics	LoRa	802.15.4 related	802.15.4 related	WiFi (2.4 / 5 GHz)	LVX ISM-RF-MESH	CAT-M2	CAT-M1	4G/5G/6G	
Performance	distance	>10 km	>10 km (Mesh)	80 km	10km	10km	< 1km	<500m	10km	< 2km	< 2km	< 2km	
	throughput	> 40 Mbit/s	5-240 kbps	Gigabit	50 kbit/s	100 kbit/s	< 100 kbit/s	Gigabit	100 kbit/s	250 kbit/s	380 kbit/s	> 10 Mbit	
	mesh	yes	possible	no (star/bus)	no	yes	yes	proprietary	yes	no (star)	no (star)	no (star)	
	peer to peer	yes	yes	yes	no	yes	yes	yes	yes	cloud			
	latency	5 ms	> 50 ms	us	high	mid	20 ms	low	>5 ms	2-6 seconds	15 ms	1 ms	
	packets/sec	high	<20	high	low	low	< 50	high	200	low	low	high	
	encryption	AES	(AES)	IP based	AES	AES	AES	IP based	AES	AES	AES	IP based	
	battery powered	no	no	no	yes	yes	no	no (WiFi6 yes)	yes	yes	yes	no	
	device cost	low	low	high	very low	very low	very low	low/mid	low	low	low	mid	
	licensed	no	no	no	no	no	no	no	no	yes			
	traffic limit	no	no	no	yes	no	no	no	no	yes	yes	no	
recurring costs	no	no	no	no	no	no	no	no	yes				
Standardization	Standards	IEEE 1901 ITU-T G.9905	ITU-T G.9903 (G3.PLC)	IEEE 802.3xxxx	proprietary	IEEE 802.15.4	IEEE 802.15.4	IEEE 802.11	EN 14908-11 ANSI 709.11	3GPP releases			
		HD-PLC	proprietary	ISO/IEC 8802.3xxxx		802.11ah				2G/3G ongoing obsolete			
	Openess	high	mid	high	low	mid	mid	high	high	low			
	Body	IEEE	G3-PLC alliance	IEEE	Semtech	IEEE	IEEE	IEEE	IEEE	CEN IEEE	3GPP		
		ITU	ITU	ISO/IEC	LoRa Alliance	ISO/IEC	ISO/IEC	ISO/IEC	ISO/IEC		ITU		
		HD-PLC alliance	proprietary			WiSUN	CSA (Matter)	WiFi Alliance					
							WiFi Alliance	Bluetooth SIG					
							Thread Group						
						WiFi Alliance							

Up to 10 hops

Long distances

Media independent

1024 Devices

Low latency

Running on HD-PLC silicon

Ethernet

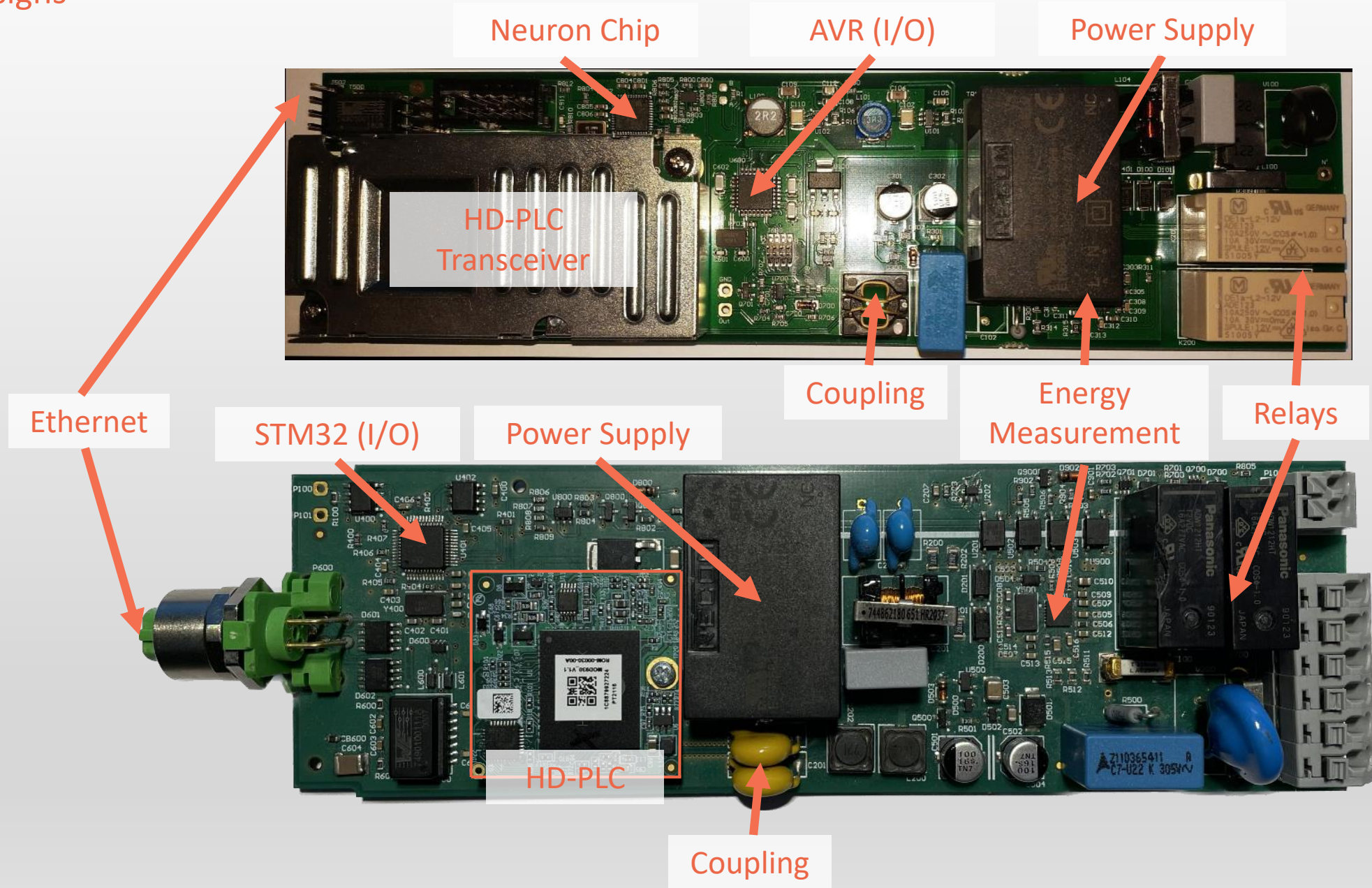


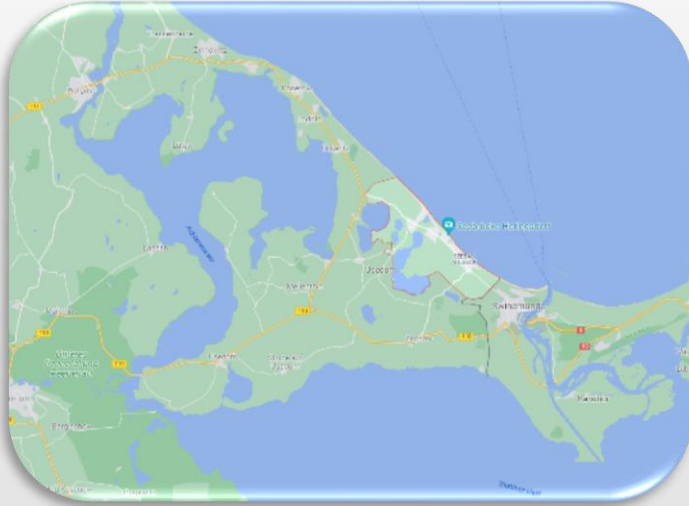
2 relays

Dimmable ballasts

DALI / 1-10V / PWM

Energy measurement





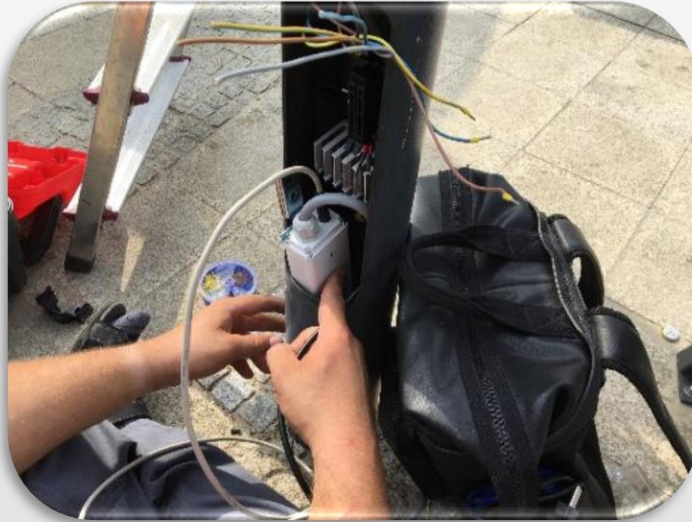
## Situation

- No light control
- Bad 4G coverage at the coast promenade and the shore
- No mobile internet for tourists
- Low attractiveness



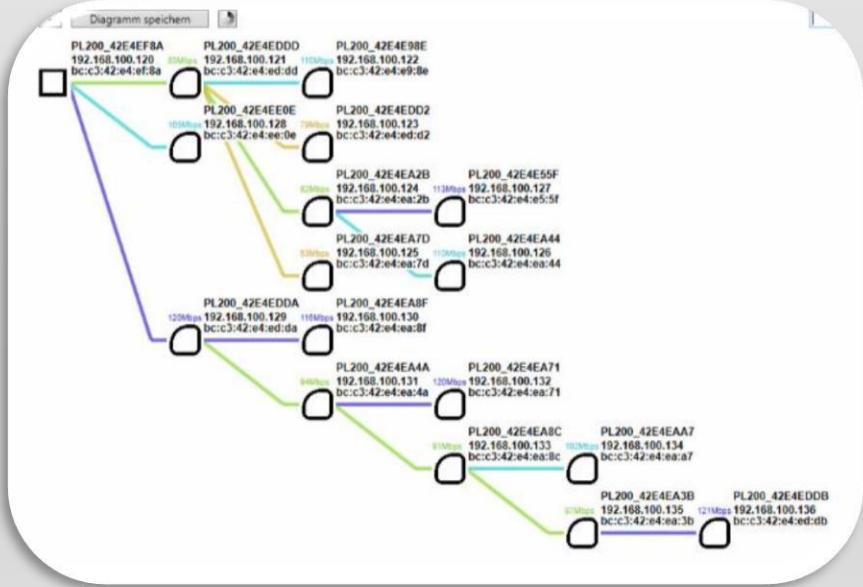
## Solution

- HD-PLC based street light control
- Public WiFi access points for public internet



Situation

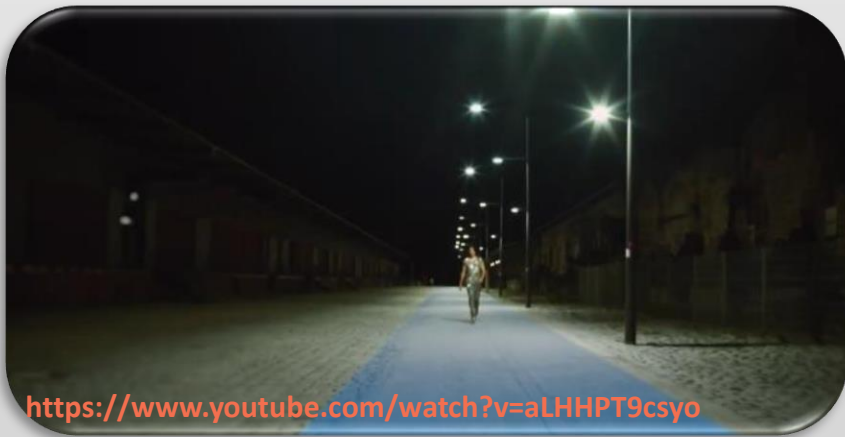
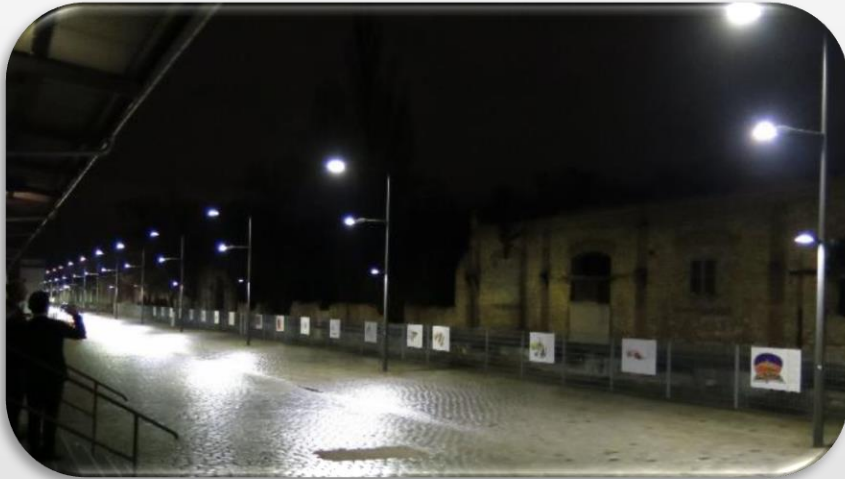
- No light control
- Bad 4G coverage in the city centre
- No mobile internet for tourists
- Low attractiveness



Solution

- HD-PLC based street light control
- Public WiFi access points for public internet





<https://www.youtube.com/watch?v=aLHHPT9csyo>

<https://www.led-laufsteg.de/>

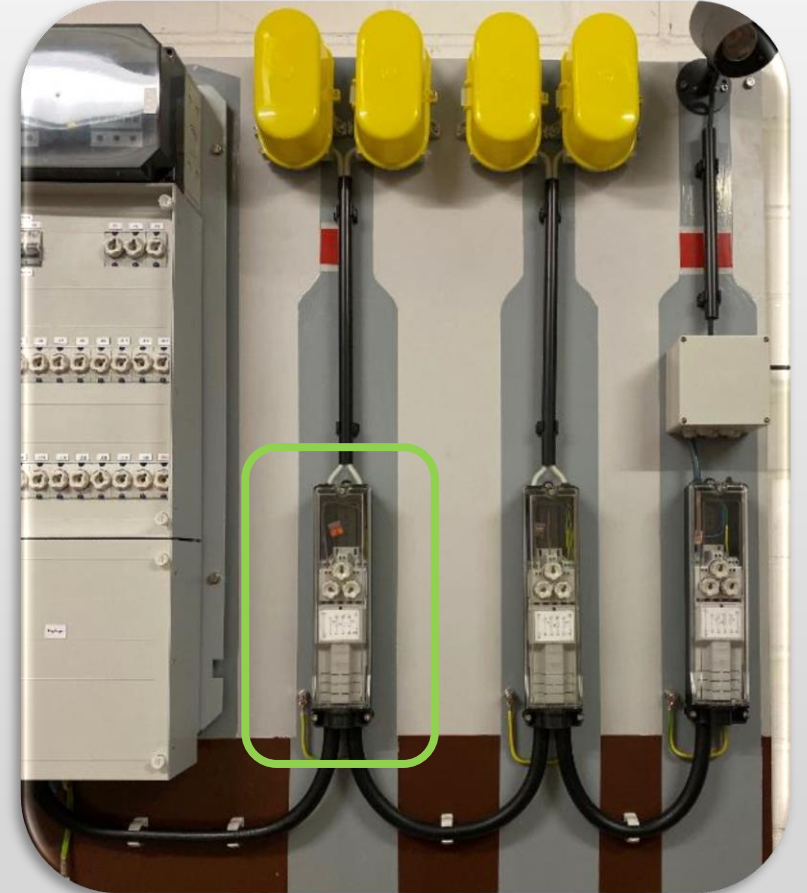
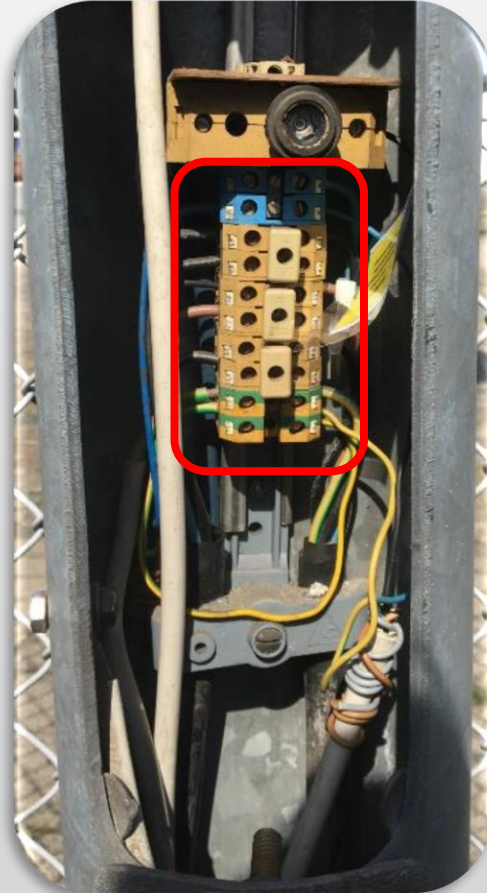
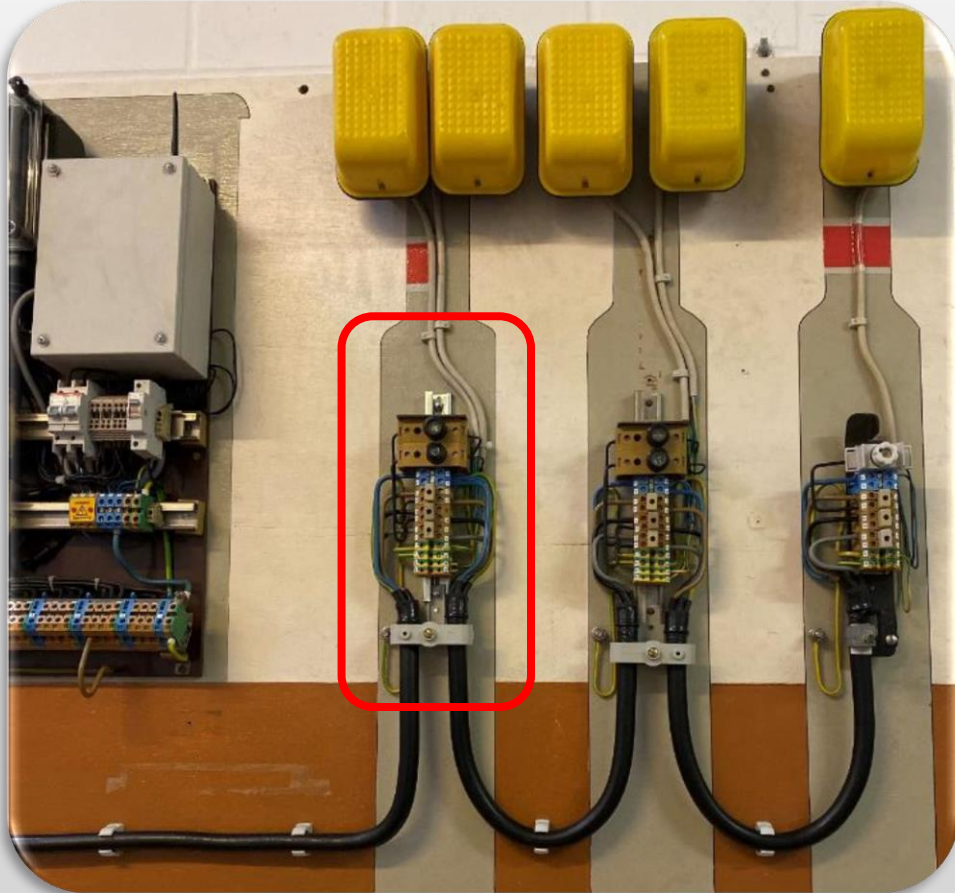
## Situation

- Testing of future street light function
- High reliability
- Low latency
- High speed

## Solution

- > 70 HD-PLC light controllers
- Multiple luminaire types connected
- Local control implemented on edge server
- Reference platform and benchmark for future light projects in Europe uses HD-PLC

# Wiring is a challenge, each clamp is attenuation



## GENERAL

- Scalable network performance
  - Faster / Slower
- Successor for NB-PLC
  - X4/5/6/7 much faster than 5 kbit/s with 14908-3
  - Faster than G3-PLC
- Better security due to 802.1X
- Improved interoperability of diagnostics commands

## IOT DEVICE

- Simpler designs
  - Gen3 BGA->Gen4 QFN
- **MORE I/O ON HDPLC SILICON**
  - **SIMPLER DESIGN OF HD-PLC IOT DEVICES**
- Single Chip design
- Better SW infrastructure
  - Easier integration of automation protocols like LON, BACnet, Modbus/TCP and others
- Less power consumption
- Cheaper

- Teststreet with poles with a distance around 30m
- Gen3 didn't work
- Gen4 covered the whole distance of 163m with a PHY rate between 4 and 7 Mbit/s
- No hops needed



Thank you for your attention

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