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LIC SUSTAINABLE SOLUTIONS

Integrated energy efficient solutions for
Smart Cities

www.lic-eu.com



CityManager



*Manage your entire lighting infrastructure in a simple,
flexible and efficient way with the LIC Citymanager*

INTEGRATED ENERGY EFFICIENT SOLUTIONS FOR SMART CITIES

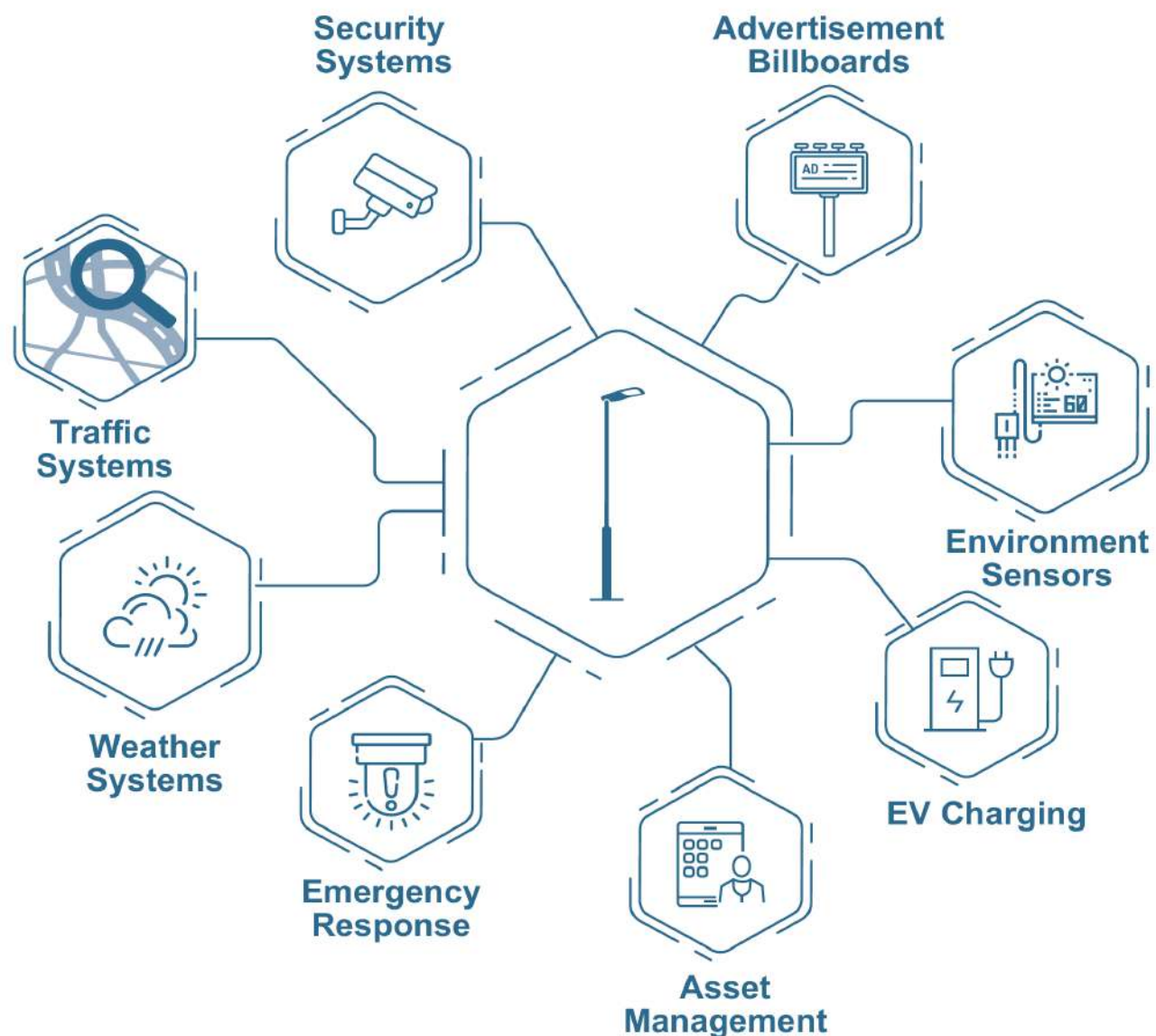
The population is increasing and more people are moving to urban areas; in fact, by 2050, 68% of the total population is projected to live in urban areas*. Which raises the question: how can municipalities create safer spaces for current and future citizens by increasing energy efficiency and maintaining an environmentally friendly attractive and livable space? Smart lighting solutions offer practical answers to many of these questions. With smart street lights, cities can save energy, reduce CO2 emissions and limit light pollution, while citizens feel safe and satisfied.

* Sources: United Nations (UN), European Comission (E-street), Climate Group (Lighting the Green Revolution)

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Open secure & Future ready



Our Open Architecture gives you a full future-ready solution to interconnect applications that fit your city's needs in a secure manner

Smart Cities begin with Smart Lighting

We believe that it is easier to begin a smart city journey with smart street lights. Public lighting represents one of the finest powered grids – spread across towns and cities throughout the globe. It is a nervous system of a city that connects over 360 million street lights worldwide with access to 24x7 power. Street pole is therefore an ideal spot for mounting smart city systems. For example, it is feasible to mount a security camera, an environmental sensor, a traffic counter or an EV charger on a street pole, only when the connected street light stays-off during the day time, while the power still flows through to the street pole mounted equipment.

Likewise, cities can benefit from the inter-connection between smart street lights and other smart city systems. For example, street lights of the future will adapt colour on the path of an emergency vehicle – so that traffic ahead can start moving aside even before hearing the siren of an emergency vehicle. LIC's secure DigiHub platform is designed to help cities to be future-ready and leverage such interoperability. Through our Open API approach, we enable multiple devices, systems and assets to be inter-connected.

Further good news is that unlike most smart city applications, intelligent lighting saves you money from day one. Besides a lower energy bill and reduced operational expenses, they offer exciting revenue generating opportunities e.g. leasing space for smart advertisement billboards.



Successful integration with 3rd parties

- Cisco Kinetics (Global)
- Siemens/ Atos (Europe)
- Dynniq ImCity (Europe)
- Bee Smart City (Europe)
- Osram LumIdent (Europe)
- SixData luxData.light (Germany)
- Thorn UrbaSens (UK)
- Montad Moon (Netherlands)

LIC's Smart Lighting

Are you looking for open, flexible and scalable smart lighting solution? If Yes, then you are at the right place. Whether you need – Group control, Individual light control, or simply an Asset Management tool – we have the right solution for you.

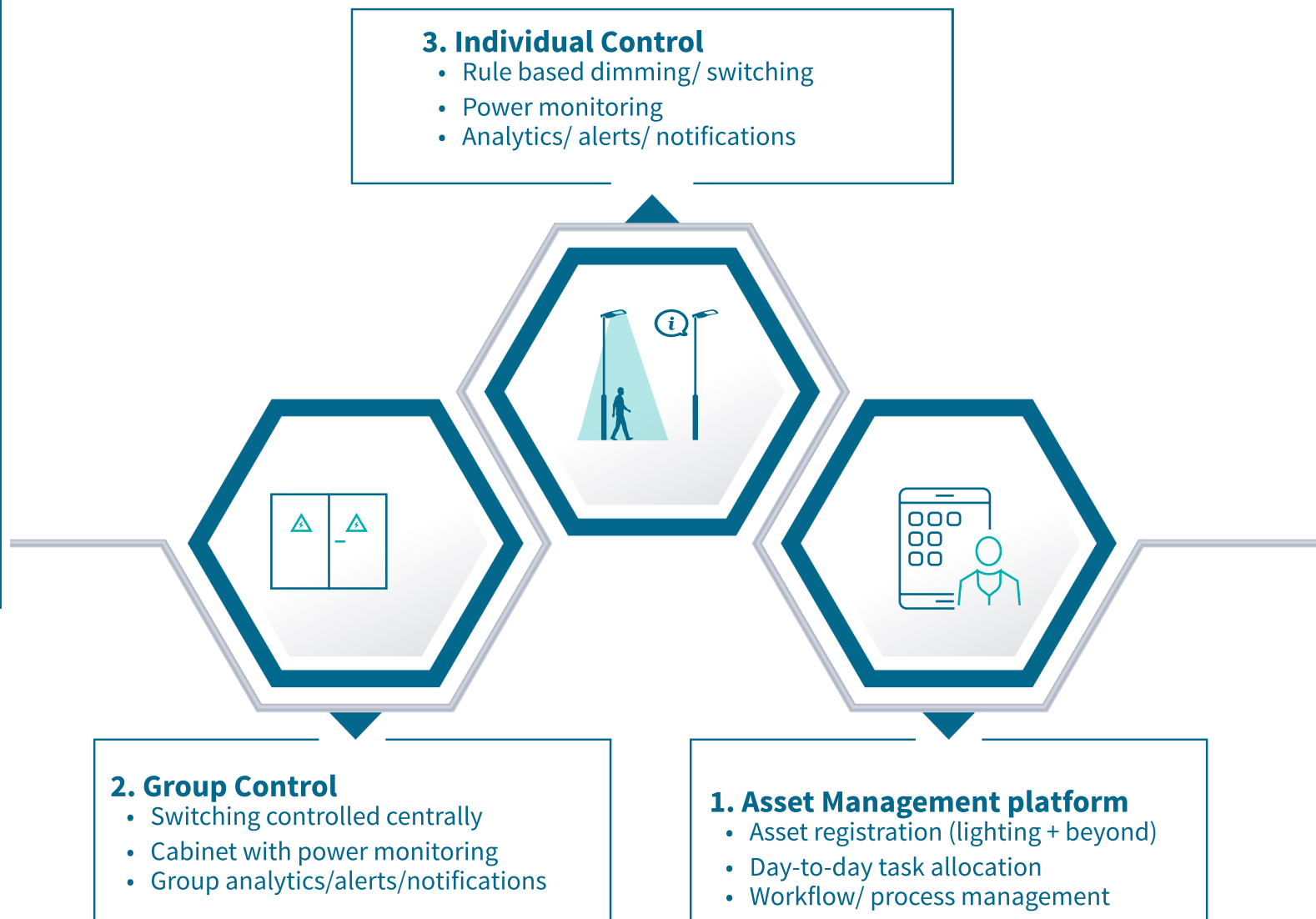
No two cities are alike, and each neighbourhood is unique. This requires great flexibility. LIC's smart lighting platform combines a complete software suite (including 3rd party tools) and hardware portfolio to enable full control over your citywide lighting infrastructure. Our solution provides excellent flexibility to decide the right solution fit per neighbourhood. We have the right toolset to help you manage infrastructure through its complete lifecycle (from planning to post-installation services).

Our solution has a proven track record of accelerating energy savings, optimising maintenance, generating cost savings and improving citizen safety. Recognised as one of the best solution providers in Europe, our solution is already in use by over 800 towns and cities spread across 20+ countries around the globe.



Take full control of your Lighting Infrastructure with a single platform

Connected + non-Connected public lighting



- Each city is different with unique needs. We offer a complete range of in-house and 3rd party solutions to meet diverse citywide lighting infrastructure needs
- Our team can help you choose the right solution to meet your needs

PUBLIC LIGHTING

LIC2011 SERIES



Power	35 - 200 Watt	Driver protection	Overvoltage, overcurrent
Input Voltage	90 - 305 VAC		temperature, short circuit
Frequency	47 - 63 Hz	Product materials	Aluminum alloy
Power factor	PF > 0.95		Tempered glass 4mm
IP-rating	IP66	Material finish	Electrostatic powder
IK-rating	IK08	Isolation material	EPDM
Luminous efficiency	160 lumens per Watt	Optional	Zhaga connection
Lumen maintenance	86.2% @ 50.000 hours		NEMA connection
Harmonic distortion	THD < 8%	Installation	Toolless opening
Operating temperature	-40 - +60°Celsius		Power-off connector
Color temperature	2700 - 6500 Kelvin	Surge protection device	20.000 Volt
Control options	LIC Mesh	Product certification	CE, RoHS
	0 - 10V, Dali	Standard warranty	10 years



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LIC's Streetlight

At LIC we develop a catered service for a changing ecosystem, empowering our customers to shape their energy consumption.

We turn challenges into opportunities, and take our knowledge of LED illumination and our pioneering digital solutions to set the core structure for Smart buildings and cities. At LIC we are convinced that the combination of digital technology, illumination, and energy potential is the key to mastering our society's increasing expectations

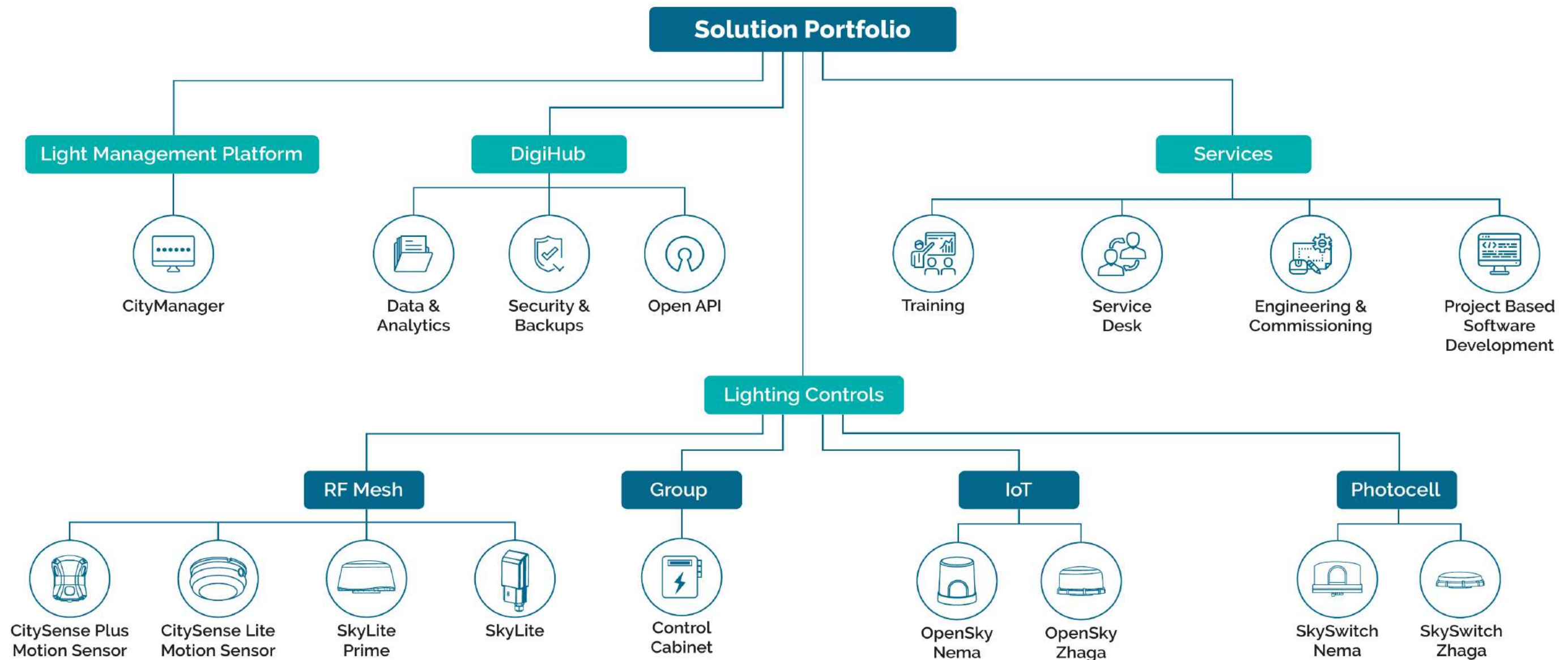
The luminaire designed and manufactured by LIC has a very high efficiency (20% above the market average) with an extremely competitive sale price and a 10-year guarantee.

Both technically and economically, it is a revolutionary product in the world of street lighting, with several internationally recognized certificates. Thanks to its Zhaga connections and smart driver, the luminaire is ready to be integrated into a smart city, working as a wireless communication base.



LIC's public lighting solutions consist of the latest LED technology and include three Zhaga connectors. This luminaire is compatible with the Mesh and IoT technology. The node come in the form of a small devices that directly connects to our luminaire. Once the device has power, it automatically joins its other nearby nodes to form a big and reliable network. It is able to connect thousands of devices within an autonomous and self-healing network. Every device receives and forwards data to surrounding devices. By using this methodology, a network becomes very reliable, scalable, and expands the signal's reach.

Solution Portfolio



We are here to help you from planning to post-installation services



CityManager

Our TALQ-certified CMS platform is designed to manage, monitor and control citywide lighting, providing you near real-time insight and analysis on the behaviour of your lighting infrastructure.

DigiHub

Our IoT cloud platform (DigiHub) collects data from all the devices and gateways, analyses it in real-time and makes it available to CityManager as well as third-parties via open APIs.

Lighting Control

We offer a full range of hardware control products & outdoor motion sensors to connect your street light on an individual (OLC) or a group level (feeder pillar).

Services

You do not need to be an expert on connected lighting. We offer optional managed services from pre-installation planning & training, engineering & commissioning to post-installation service desk.

Smart benefits for smart people

Cities everywhere are growing. Estimates indicate that by 2050 about 68% of the total population will be living in urban areas. It is a priority to find solutions on how to manage costs and logistics, while creating a liveable and attractive environment for citizens to habit. Thanks to new solutions, today's smart public lighting offers many ways to contribute to these goals and generate benefits for all stakeholders.



For Cities

Smart Lighting can help cities to realise cost savings on energy, operations and maintenance, while at the same time help to create a more attractive and safer environment. It allows to remotely monitor, manage and control the entire lighting infrastructure and get insight on its performance – through a single platform.

For Citizens

Consider a student travelling back home late night or a child crossing the street with their mother. Dark streets caused by lack of fault notifications and slow repairs can be dangerous. Auto-notifications generated by the CMS system can help overcome this and take prompt corrective actions (e.g. replace a broken LED driver).



For Lighting Operators

The largest benefit of Smart Lighting is the increased insight in performance and automated status & fault reporting. In combination with the asset management tool, this allows the system integrators/ installation contractors to automate maintenance and repair services, optimize workflow and generate significant cost savings.



Operate citywide

Lighting with Ease

Our **CityManager** TALQ-certified light management platform enables you to completely manage all your connected street lights via a user-friendly and secure web-application using any standard web browser. You gain remote access to all your devices and a near real-time status and performance information.

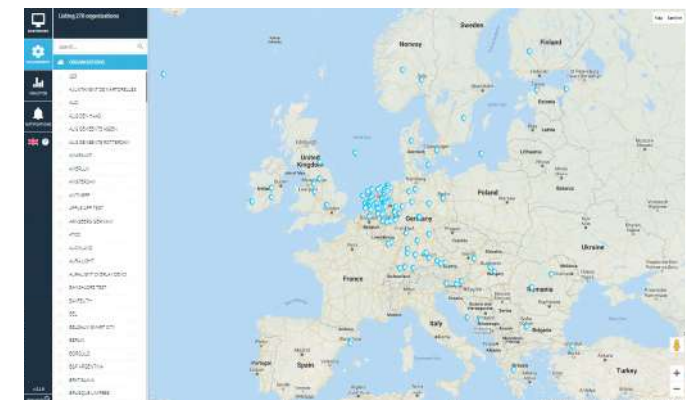


Manage

Control and define light levels for a specific street light, a street, or an entire region. Boost light levels to improve safety and visibility as the situation demands, or reduce the light levels to save energy, thereby cut carbon emissions and lower light pollution.

Monitor

Receive automatic status and fault reporting straight to your mailbox, thereby enabling you to promptly initiate a repair/ replacement process. The system can identify several lighting-related faults, so that you can exactly identify why a particular luminaire had failed.



Gain insight

Insightful data on energy usage and savings through metering or calculation of each individual luminaire or cabinet can help you optimise your entire lighting infrastructure. Accurate data also helps make actionable plans for the future.

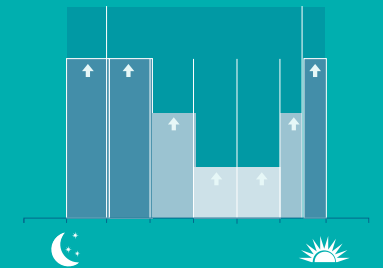
Adequate Light always



Meeting the shifting demands of citizens, businesses and visitors is a top priority for the city administration. At the same time, complying with the new laws and regulations cannot be neglected. Our CityManager platform offers a multitude of control options and flexibility to meet your specific needs.

Dim Profiles

You can specify an exact dimming profile for a single street light or a group, with our intuitive CityManager interface. For example, you can ensure that busy streets have more light during rush hours than residential areas, and you can reduce the light levels in the business districts when the working day is over.



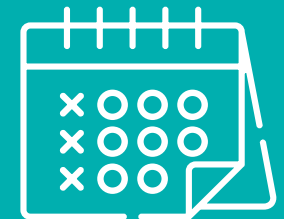
Light on demand

By adopting CitySense street light motion sensors, you can make your lighting infrastructure dynamic and responsive to human presence, maximising energy saving and optimising the availability of light when and where it is needed. Research shows that sensor-based lighting has a positive effect on citizen perception on safety.



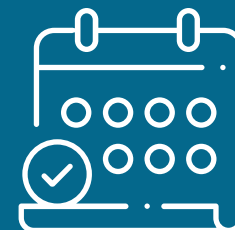
Calendar based

The Light Planner application allows for specific weekdays and weekends scheduling. This allows you to set individual profiles per day for each individual or group of luminaires. For example, you can keep the lights on higher levels on shopping nights or reduce light levels on specific occasions (e.g. when enjoying public fireworks) or during holidays.



Event based

We also offer a unique ability to control your lighting based on events, whether that is a central ALS (Ambient Light Sensor) system in your city, an external trigger (e.g. noise sensor), extreme weather conditions (e.g. heavy rain or fog), or traffic density based adaptive light levels. Such events, when opted, will temporarily overwrite the default profile. Light will return to its normal profile when the event has passed or when the event is switched-off.



OPTIMISE Operation & Maintenance



allows you to monitor citywide lighting status – via a single CMS dashboard. The performance and behaviour of the street lights are recorded in predefined reports for you. The platform automatically generates notifications in case of errors or faults, thereby enabling you to take prompt well-informed actions as well as reducing the need for night patrols.



Status Information

CityManager gives you near real-time information of every individual or group of luminaires. Faults and outages are automatically registered, and notifications are sent to the assigned person to undertake action.

Reporting

The platform allows you to track your city's lighting performance, status, energy consumption and savings over different locations and customizable periods of time.



Improve Efficiency

Automatically receive your daily reports on behaviour and performance of the lighting infrastructure and use analytics to improve the efficiency and use of your city's lighting.



Workflow Optimization

CityManager allows you to improve your city's lighting management further, by integrating with your preferred asset management application. Seamlessly integrated, it provides detailed insights about your lighting infrastructure, helping you to manage repairs better and improve the efficiency of all lighting-related workflows.



Increase PUBLIC Safety

Citizen safety is a comprehensive concept that is deeply ingrained into everything we do. From state-of-the-art motion-sensor based dynamic lighting to smart notifications & alerts by email, we aim to combine energy savings with improved citizen safety perception. We believe in the principle of *right light at right place & right time* – thereby balancing energy usage without compromising citizen comfort.



Safe Circle of Light

What if there was a way to cut energy waste and at the same time ensure public safety? We have designed an amazing motion-sensor based light-on-demand solution. This solution is currently used across the globe and has attracted major media attention from some of the most important media outlets.

This is how it works: as soon as a sensor detects human presence, the neighbouring lights brighten up to a pre-defined level. Whether it is a pedestrian, a cyclist or a driver, they will be surrounded in a safe, warm circle of light. By adopting this solution, you can prevent the overwhelming waste of electricity that occurs when the lights burn for nobody, without affecting the citizens' comfort.

Safe Streets and Safe Cities

Turning off the street lights completely during the night is undesired and, in most cases, not allowed, as it would compromise public safety and go against municipal guidelines. By setting right light levels depending on time and street specifics, cities can beautifully balance between energy usage and citizen comfort. Better lit street lights also help security cameras capture images of higher quality, thereby improving citizen safety perception and keep the criminals away.

Furthermore, automatic failure alerts and notifications help achieving swifter response to repair or replacement of a failed lamp, thereby avoiding dark streets for a longer period.



Minimize Environmental IMPACT OF YOUR CITY

The need for change is clear. Many reports all over the world support the fact that climate is changing. We have a joint responsibility to act and change the way we live. One of the key factors in this change is the use of energy. Apart from the change from fossil fuels to renewable energy, we urgently need to cut on the amount of energy being used.

With the expected growth of energy usage by 35% in 2030*, the fact that lighting accounts for 19% of the total global usage* and that lighting accounts for 30-50% of an average city's energy bill*, there is a great opportunity to improve by adopting Smart Lighting.

*Source:
Energy Efficient Street Lighting report by European Expertise Centre



Cut Energy Use

Our smart street lighting solutions allow energy savings of up to 80%. In absence of human presence, smart street lights burn at a predefined level of brightness, for instance, at 20% of the full capacity. This stops unnecessary wastage of energy. When the presence of a pedestrian, cyclist, or a car is detected, the smart street lights will adjust their brightness according to a pre-defined level. Other alternative is simply putting the lights to a pre-defined dimming schedule.



Lower CO₂ Emissions

Our intelligent street lighting solution significantly lowers CO₂ emissions. CO₂ or carbon dioxide occupies the largest share of today's greenhouse gases (the air pollution). This is bad for all living beings. Street lights waste a lot of energy, which contributes significantly to the increase in CO₂. Smart street lighting solutions from LIC save energy radically, thereby lowering the CO₂ emissions considerably and creating a healthier, more sustainable living environment.



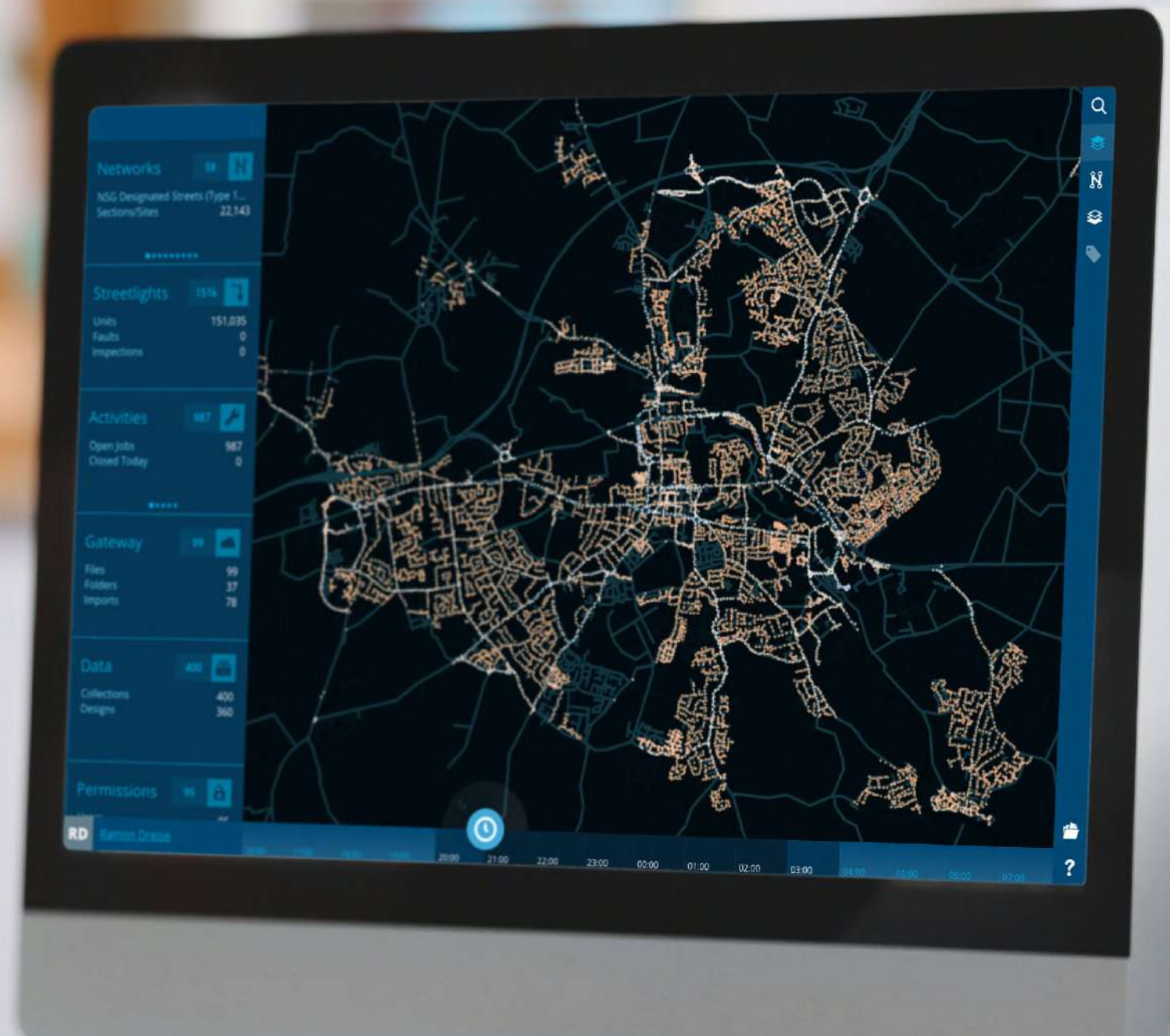
Curb Light Pollution

Our state-of-the-art street lighting solutions reduce light pollution. Regular street lights keep on burning at their full brightness, even when there is no one around. This negatively affects nocturnal animals as well as human biorhythm. Smart street lights burn at a pre-defined level of brightness, for example, 20% of the full capacity, during off-peak hours. This feature lowers the unwanted light pollution and in turn offers a healthier environment, soothing ecosystem, and unspoiled aesthetic setting.



CityManager

Your Smart City Lighting Platform



Open,
Secure & Scalable

The LIC platform is a complete suite of web-based software applications that provides full remote management for your entire lighting infrastructure, both on an individual light and group level. Open architecture and Open API allow secure integration to any of your preferred 3rd party application.



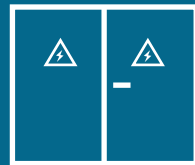
Command Centre

Command Centre is the central application for network configuration, tele-monitoring and tele-management of the entire street lighting infrastructure. It provides an in-depth near real-time analysis and monitoring of the state of assets, networks and sensors. Command Centre supports the system administrator during the installation and operation of the intelligent lighting network. It is used for the management of the luminaires/ devices, commissioning of the network and the identification of faults or errors during and after the installation.



Light Planner

Light Planner allows operators to program, change and adapt the level of urban lighting from the point of view of urban plan (city grid). Operators can set the light levels based on hours of sunset/ sunrise, daily/ weekly schedules, and advanced schedules. Variable night illumination profiles per lamp allow the light intensity to be modulated according to the street location, time, environment or current situation (traffic density, weather and so on **).



City Cabinet (group control)

City Cabinet is a web-based software for tele-management of the electric cabinet (feeder pillar). This platform allows for the control and analysis of a group of around 150 luminaires at the same time. It is also useful for replacing the traditional ‘tone frequency’ based switching function. City Cabinet delivers various group level functions such as: lamp switching based on in-built astronomical-clock/ central ALS/ photocell/ override mode, cabinet-based power-metering, and group analytics/ alerts/ notifications.



City Services

City Services is an asset management platform to help the local system integrators in their day-to-day operations of physical infrastructure (including street lights, grid cables, feeder pillars as well as other street furniture and outdoor assets). This software is used to manage inventories, allocate daily tasks, perform inspections and plan projects to maintain connected as well as non-connected lighting. This platform currently manages over 1 million light points.



Commissioning Export

This tool helps you to download a complete report about the commissioned lighting infrastructure based on a particular organisation or project. Using this report, you can gain an in-depth insight, such as device type, software version, luminaire wattage, etc. on each of the luminaire that has been commissioned. You can import this data to your preferred BI (business intelligence) or asset management tool for further analysis.



Passport

Passport is a dedicated identity and access management tool. This application helps you to create, manage and delete users and groups. As an admin, you can allocate various levels of access rights based on the role of a specific user. For example, you can offer different types of access to the installer, system integrator, maintenance personnel and asset manager. .



Scan & Go

The Scan & Go app enables fast, easy commissioning and maintenance of the extensive LIC intelligent lighting solutions using the phone’s internet connection. Available for both Android and iOS platforms, this easy-to-use tool simplifies the installation, maintenance and repair of the products on the field. The tool is specifically useful for street light installers, system integrators and maintenance crew.



Analytics

A part of the Command Centre software, Analytics tool helps you to track your city’s lighting performance, status, energy consumption and savings over different locations and customisable periods of time. Specific luminaire data, for example, grid voltage and driver temperature, can be tracked over a period of time. Device network analytics is also an integral part of this tool.



Notifications

Proactive and selective notifications to help take prompt actions. An application designed for the local asset manager/maintenance crew, the Notifications tool offers near real-time status information of every individual or group of luminaires. Faults and outages are automatically registered, and notifications are sent to the assigned person to undertake action.



Secure Solution

We take customer data protection seriously. That is why we invest diligent efforts in making end-to-end infrastructure and data connections highly secure. Furthermore, our inbuilt multilevel back-up system ensures that the lights default to safety mode in an unlikely case of system failure.



Data Security & GDPR

LIC fully complies to the European GDPR Legislation. Access to data is limited by our authorisation and access rights management tool. Only those that have explicitly been granted permission will have access to the information within their organisation.

The storage of personal information is limited to storing the email address of the user accounts in the system. Users to the system are invited to join by colleagues from within their own organisation. The information they receive through email from DigiHub is limited to

password resets, email notifications and reports. The latter two are opt-in registrations by the user and can likewise be disabled by the user. Password resets are, of course, only by request of the user.

Both our hosting partner and the data centres have the ISO 27001 certification, which ensures proper handling of data.



Data Centres

Our servers are hosted at top data centres in the Netherlands. Achieving 99,9999% availability since 2001, our partners are renowned players in the data centre market. Critical components, including connections to the power grid, have at least N+1 redundant.

Furthermore, the data centres are self-sufficient: in case main power supply fails, the entire energy supply can be provided by UPS and emergency power systems. Security is given top priority, so outsiders are kept out and authorised users have controlled access inside. Physical security is on duty 24/7/365 days of the year and is supported by smart CCTV systems, electronic access systems, and an advance facilities management system.

The table below provides an overview of our security infrastructure

Security group	Security Application	Security Measures
Physical environment	Access control	• High-security data centre with ISO 27001 certification
	Redundancy	• Multiserver environment with automatic roll-over
Connectivity layer	API	• Account and access control
	3rd Party integration	• Connected devices and applications require pre-authorisation
Software	Point-to-point encryption	• AES 256 encryption & VPN
		• Resistant to man-in-the-middle attacks
Hardware	Devices	• 3-level back-up system in case of system failure
		• Autonomous default mode; 100% light level in case of communication as well as RTC failure
	Between devices	• AES 128 message encryption
		• Multidevice failure resistant mesh network
		• Jammer-resistant signaling

Secure Data Connection



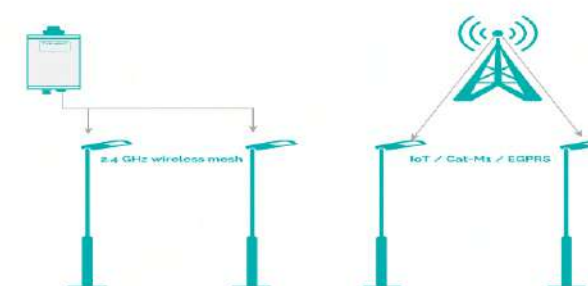
Device Communication

LIC's outdoor lighting controllers (OLCs) are available with two communication options:

(1.) IEEE 802.15.4 open standard based wireless communication. Here the devices communicate with each other through 2.4 GHz wireless mesh network that is self-configuring and self-healing. This network allows high bandwidth data with AES128 bit encryption. The mesh network is particularly useful when using motion-sensor based light-on-demand.

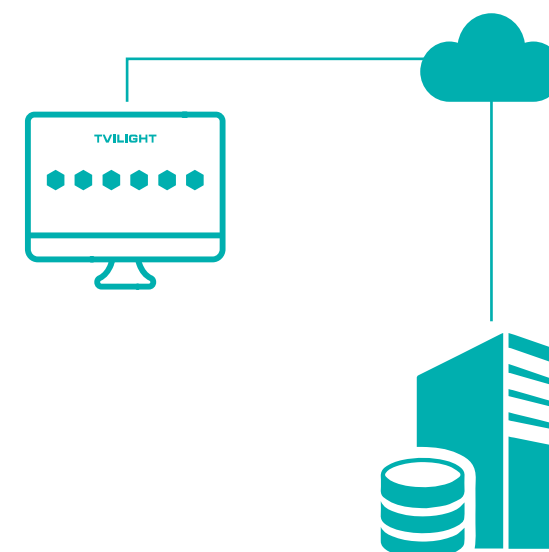
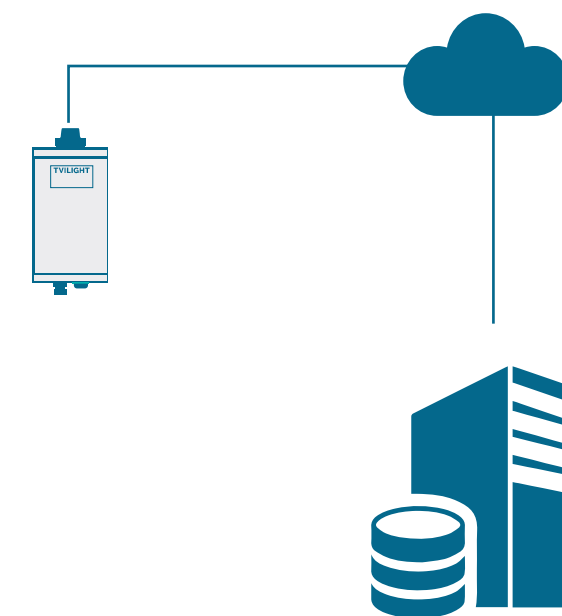
(2.) Global 3GPP telecom standard based NB-IoT/ Cat-M1 / EGPRS network. Here the device connects directly to the local telecom (cellphone) tower with in-built high telecom security standard.

For either of the above, in an unlikely case of an OLC failure, the specific lamp automatically switches back to the safety mode. Other OLCs in the network are not affected.



Gateway - Server communication

LIC's IoT Gateway (applicable only when using mesh network) is connected to the server through a Secure WebSocket (WSS Protocol RFC 6455). To guarantee integrity, we also use OAuth 2.0 alongside the Secure Sockets Layer. This way, the Gateway communication remains secure, even when a non-encrypted connection is used. In an unlikely case of Gateway failure, all lights automatically switch to the pre-determined fall-back level of brightness.



Server (DigiHub) to CityManager connection

CityManager uses REST API. The OAuth 2.0 protocol is used for the communication between the CityManager and DigiHub. The HTTPS ensures further security of the connection. In an unlikely case of server failure or loss of connection, the Gateway and the OLCs keep operating in their pre-defined dimming profile. Remote management of light would not be possible during this period.

Universally Compatible

We believe that publicly available open interoperable standards promote the development of new technologies. Open standards support a vendor-neutral ecosystem, enable interoperability, and provide the city with the freedom to choose among different solution providers. We believe that the customer should be able to choose from the best products available on the market, instead of being restricted to a single provider (the lock-in strategy).



Market Standards & Open API

LIC is a pro-active member of the , and contributes to the industry dialogue on standardisation Furthermore, our native Open API is used by major smart city and asset management platforms across the globe.



ZHAGA / NEMA Connectors

When it comes to street lights and public lights, and (7-pin, ANSI C136.41 dimming receptacle) are the industry-wide standardised sockets for OLCs. That's why, we have adopted both these standards, Zhaga as well as NEMA in our portfolio.

Device communication

Each city has its own unique requirement. That is why we offer robust hardware that can work on RF Mesh and IoT communication technologies.

RF Mesh is a 2.4 GHz based wireless self-configuring, self-healing network technology, which uses broadband signal for optimal results in both outdoor and tunnel-like environments. It is stable and secure network, and can be used globally without specific licensing permit.



NB-IoT (Narrow-Band IoT)/ CAT-M1/ EGPRS is a low power wide area (LPWAN) network solution, which uses a subset of the 3GPP LTE global standard for a long range, low power and low-cost communication. It creates a star wireless network, allowing devices to be deployed in the field without the need of a gateway device



Universal Lamp & Driver Compatibility

For maximum applicability, our outdoor lighting controllers (OLCs) are compatible with all lamp types that allow intelligent controlling (dimming). LIC offers standardised Zhaga and NEMA controllers for optimal flexibility in luminaire selection.

LIC is an associate member of DALI Association (DiiA) and supports other key industry standards for lamp controls: DALI, DALI 2.0, D4i, SR (Smart Driver) and 0-10V. The selected driver, to a certain extent, determines the available features within the CMS software.

	Smart Driver <small>Philips SR/Osram Dexal</small>	DALI	0-10V
Protocol type	Digital	Digital	Analogue
Dimming	■	■	■
Switching on/off	■	■	■
Status issue	■	■	■
Power Data ¹	■	■	■
Driver Data ²	■	■	■
Power Metering ³	■	■	■
Advanced Data ⁴	■	■	■

1. Load side data: Voltage Current, Power Power Factor; Calculated Power Usage
2. Driver temperature; Lamp load; Internal overheat: LED overheat; Internal driver diagnostics; Total working hours
3. Power metering details on line & load side. ANSI C136.52 compliant
4. GTIN & OEM ID; Hardware Identification; Fixture Identification; Driver health; LED diagnostics; LED performance; Operating performance; Software management



3rd Party Integration



Thanks to the open system architecture, LIC's Smart City lighting platform allows the integration of 3rd party hardware and software.

Software

Through Open API interface and/or TALQ compliance, we offer option to fully integrate LIC's smart lighting applications into your preferred Smart City dashboard or Asset Management software.

This way, you can use your preferred software platform, without losing any smart lighting functionalities. For example, Cisco integrated LIC smart lighting platform into "smart city dashboard".

Hardware (sensors & controls)

There are multiple ways to integrate 3rd party hardware to the LIC Smart Lighting Solution: on the light control level (hardware), on the application level (dashboard) or on the data integration level (DigiHub).

The uniqueness of our system architecture lies in its openness, which enables simple, standardised communication between all integrated hardware and software. The (OLCs) or other hardware components can therefore be easily connected to software applications.

GPIO hardware interface into SkyLite Prime

SkyLite Prime comes with in-built innovative LSI (logical signal input) pin. This interface can be used to connect a motion sensor. Once a sensor trigger is detected, our mesh network would also simultaneously trigger pre-selected neighbouring lights, thereby creating the light-on-demand experience similar to CitySense. The LSI pin can also be programmed to an output mode** wherein a low voltage signal can be sent to a connected relay. This relay in turn can trigger an externally connected object, for example, Christmas lights or an advertisement billboard

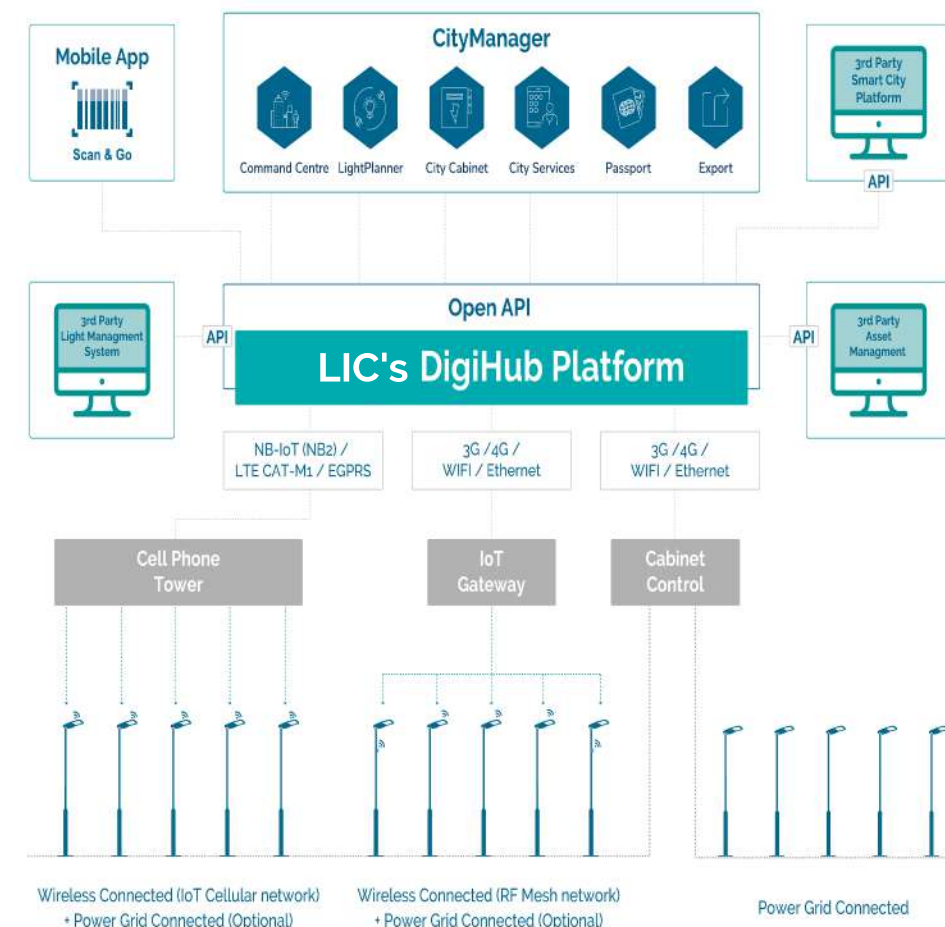
API integration into CityManager dashboard (application integration)

Are you looking for a single dashboard to manage multiple software applications? For example, do you want to manage street assets, cabinets and street lights, but also façade lighting, smart camera or advertising billboards – all via a single dashboard?

Please feel free to contact us and we might be able to help you. Upon request, we can enable access to multiple applications via single CityManager dashboard. You can also host the application to your preferred domain, for example: .

API data integration with DigiHub

Are you looking for interoperability between street lights and other smart city systems within your city? For example, do you want to integrate central ALS/ photocell in your city to simultaneously switch all connected street lights? Or connect local noise sensors to trigger local street lights? Please feel free to contact us and we might be able to help you. Upon request, we can create a custom interoperable design to interconnect objects specifically for your city.



Hardware portfolio

Lighting Controls (RF Mesh)

Our wireless mesh-communication based products are specifically designed for outdoor infrastructure environment. The 2.4 GHz wireless self-configuring, self-healing networks use broadband communication for optimal results. Real-time communication between the devices helps enable the light-on-demand application.



Lighting Controls (IoT)

Built on global telecom standard that securely connects billions of devices today, NB-IoT/ LTE CAT-M1/ EGPRS offers long range, high availability, high security and managed communication, IoT communication allows the device to connect directly to the local cell phone tower, eliminating the need for a local Gateway.



Group Lighting Control (City Cabinet)

With an experience of managing over a million streetlights through smart streetlight cabinets (feeder pillar), we offer best-in-class cabinet control solution in Europe and Asia. Each cabinet can typically control a group of 100 to 200 luminaires and offer a broad range of functions.



CitySense Plus

CitySense Plus is a revolutionary integrated wireless motion sensor for the presence-based monitoring and control of outdoor lighting. CitySense Plus integrates motion sensors, wireless communication and the lighting control – all in one single housing. It delivers on-demand dynamic lighting, making the lights adjust their brightness based on the presence of pedestrians, bicycles, or cars. As a result, the lights automatically dim-down during the off-peak hours when there is nobody in the vicinity. Upon detection of the human presence, all lights in the surrounding area return to the brightness levels previously defined by the user, thereby creating a safe circle of light. Adaptive lighting reduces the energy consumption by up to 80% without compromising public safety and citizen comfort.



Designed in the Netherlands
Made in Europe



Features



Revolutionary outdoor sensor
designed specifically for street
lighting application



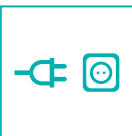
Advanced detection technology
with ultra-wide area coverage



Patented real-time neighbour
trigger functionality



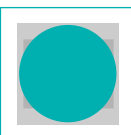
Heatmaps to track occupancy
levels and traffic intensity in the
area



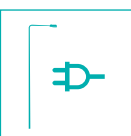
Integrated product including
wireless controls – plug & play
Installation



Inbuilt Astronomical Clock



Energy Monitoring



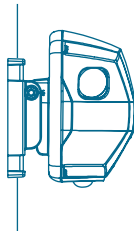
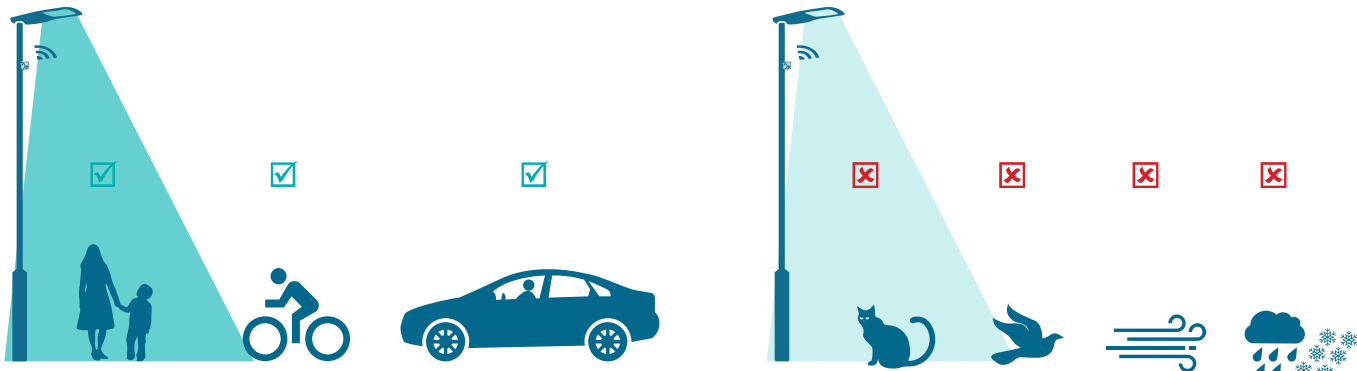
Universal Lamp Compatibility



Fail Proof: 3-Level Back-Up
System

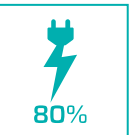


Full Remote Management &
Control via CityManager and 3rd
Party Software



CitySense Plus - Indicative Sensor Detection Zones
Mounting Height: 5 meters
Tilt: 0 degrees

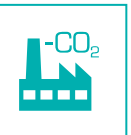
Benefits



Up to 80% energy savings



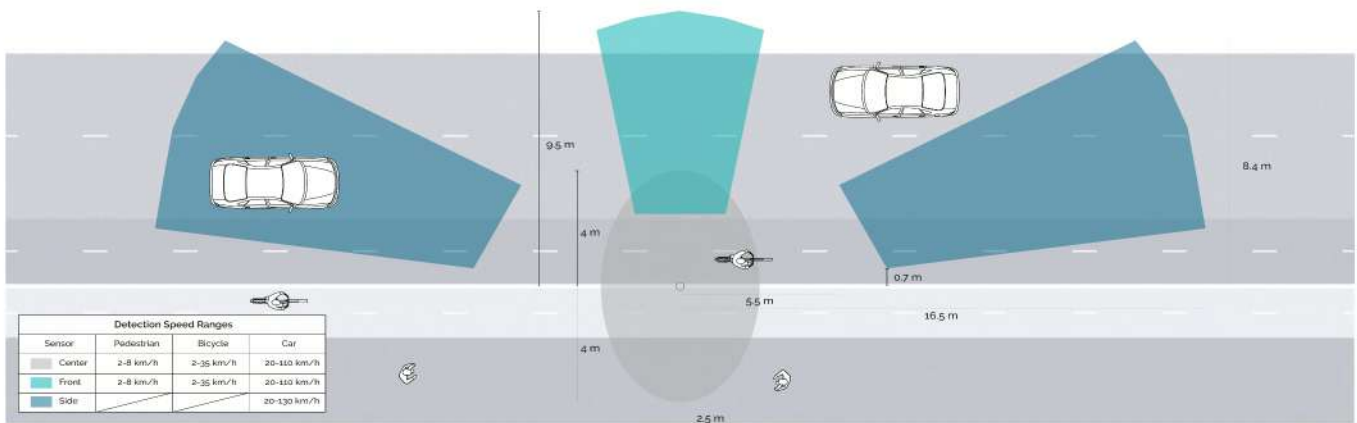
Up to 50% maintenance cost
reduction



Reduce light pollution
and CO2 emissions



True Light-on-demand



CitySense Lite

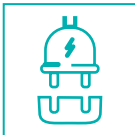
CitySense Lite is an innovative smart city street lighting solution, which comprises of D4i-based street light motion sensors and intelligent street light controllers.

Ensuring that luminaires are future-proof and ready to host diverse smart city and IoT applications, the CitySense Lite solution complies with the standardized Zhaga Book 18 smart interface.

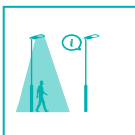
The connected street light system CitySense Lite carries all the benefits of our SkyLite Prime street lighting controller as well as the native features the third-party Zhaga street light sensor has to offer. Additionally, the system also brings the light-on-demand and neighbor triggering functionality, which offers illumination only during the human presence and creates a safe circle of light around an occupant.



Features



Zhaga compatible



Advance luminaire health information and monitoring



Rapid tool-free installation



Integrated ambient light sensor



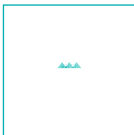
Heatmaps to track occupancy and traffic intensity in the area



Accurate power metering



Asset management support



Neighbour light triggering

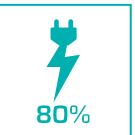


Open API for 3rd party software compatibility



Full remote management

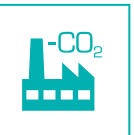
Benefits



Up to 80% energy savings



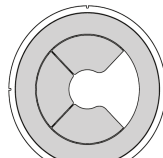
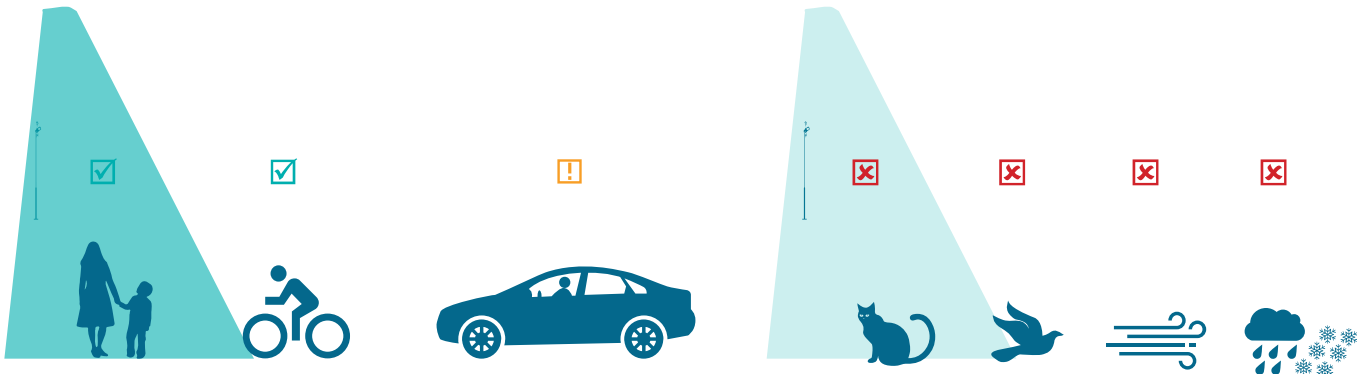
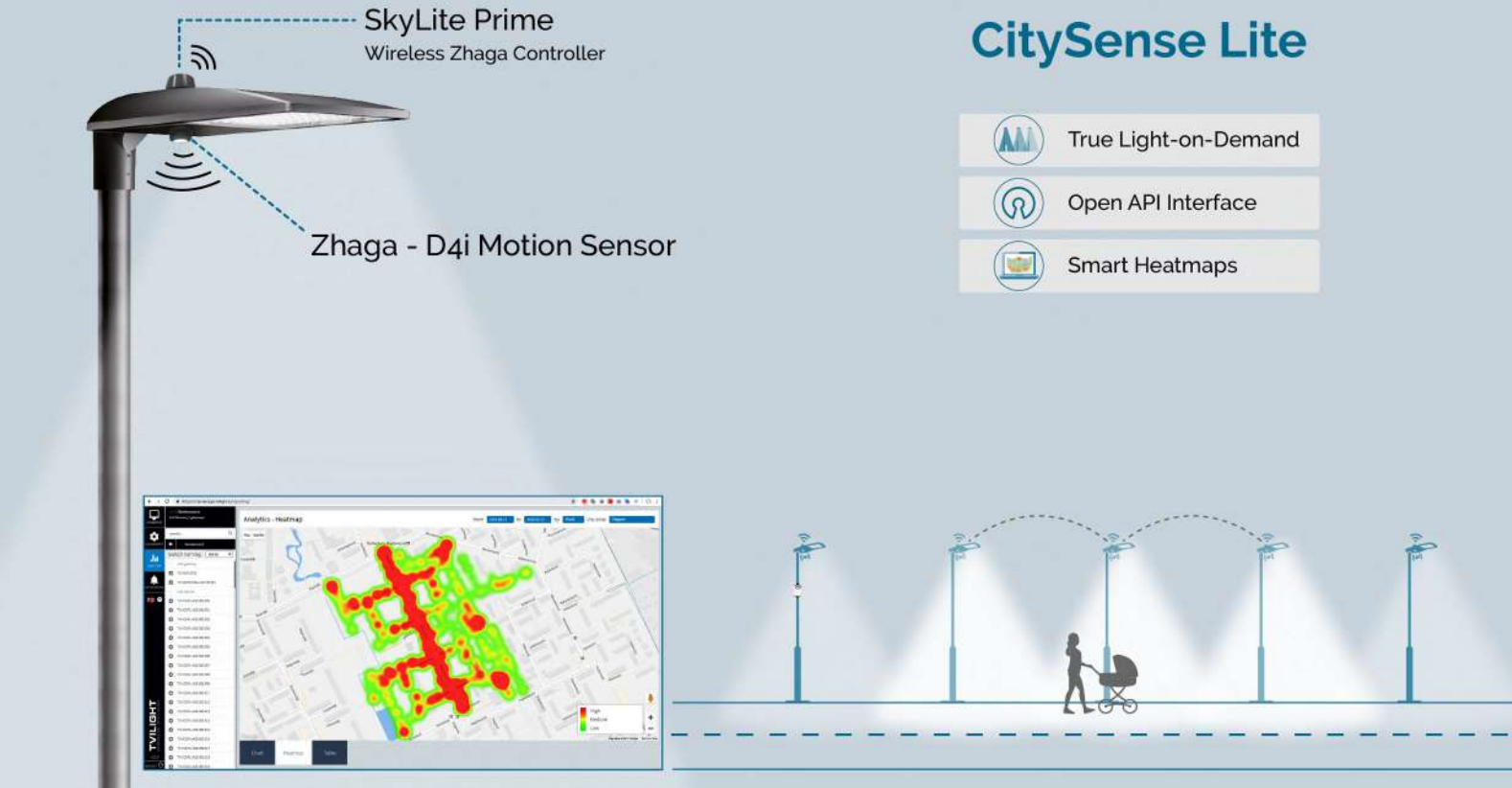
Up to 50% maintenance cost reduction



Lower CO2 emissions & light pollution



True Light-on-demand



Dimension: 41mm x 83mm
Mounting Height: 2.4 to 12.2 meters
Pattern: 45/90/135/180

Top and side coverage patterns



SkyLite Prime

With our next-generation Smart City lighting controller SkyLite Prime, cities can effortlessly upgrade their street lights with intelligent controls turning them into smart city connectivity hubs. When combined with a smart driver, SkyLite Prime delivers advanced system health analytics, power metering and asset management support. A standardised Zhaga (book 18) interface ensures a quick installation and universal luminaire compatibility.



Designed in the Netherlands
Made in Europe



SkyLite

SkyLite is a plug-and-play wireless lighting controller (OLC) for the monitoring and control of the outdoor lighting fixtures. It creates a smart, energy-efficient and safe environment, and serves as an idea, foundation for Smart City applications.

SkyLite supports seamless communication with other LIC products such as CitySense and LIC Gateway and can be managed remotely via CityManager.

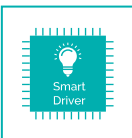
Remotely programmable lighting schedules allow users to reduce energy consumption by up to 80% in a safe and comfortable manner. The in-built monitoring tools notify users (via CityManager) about lighting-related faults such as a lamp or ballast failure. This greatly reduces both the need for expensive visual inspections as well as operation and maintenance costs.



Designed in the Netherlands
Made in Europe



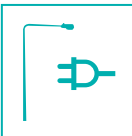
Features



Smart Driver ready
(Philips SR/ Osram Dexcel)



**Adaptive, autonomous,
AstroClock and
calendar-based dimming**



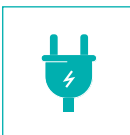
Lighting control via
0-10V / DALI / DALI 2.0 / SR



IP65 + UV Stabilized



Controls up to 4 drivers



**Compatible with all existing
LIC products**



**Lux sensor to measure ambient
light levels**



2.4 GHz communication

Benefits



Universal luminaire compatibility
via standard Zhaga (book 18)
socket



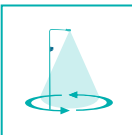
**Open API for third party software
compatibility**



**Advanced luminaire health
information and monitoring**



**High accuracy power metering;
ANSI 136.52 compliant for
supported drivers**



**External sensor input; trigger
surrounding lights, creating a safe
circle of light around the road
user**



Features



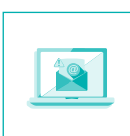
**Wireless outdoor lighting
controller (OLC)**



**Native interoperability with
CitySense**



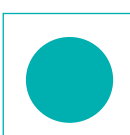
**Remote management & control
via CityManager and 3rd party
software**



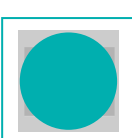
**Automatic failure and status
reports via CityManager and 3rd
party software**



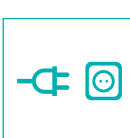
**Advanced dimming & adaptive
lighting schedule**



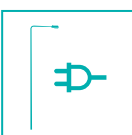
**Inbuilt astronomical clock with
backup battery**



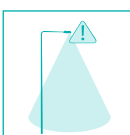
Energy monitoring



Plug & play installation

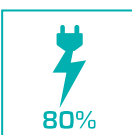


Universal lamp compatibility

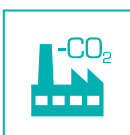


**Fail Proof
3-level back-up system**

Benefits



Up to 80% energy savings



**Reduce light pollution
and CO2 emissions**



**Up to 50% maintenance cost
reduction through automatic
notifications**



**Open Interfaces for third-party
compatibility (API) via DigiHub**

IoT Gateway

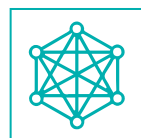
LIC's IoT Gateway is a state-of-the-art network interface device which bridges the outdoor lighting controller network (CitySense/ SkyLite) to the CMS platform (CityManager or similar third-party software).

The IoT Gateway has an in-built radio module for wireless network configuration, commissioning, and maintenance. It acts as a data concentrator to reliably communicate with a large number of devices spread across large distances. Several internet connectivity options offer robustness and flexibility. Our IoT Gateway encloses advanced industrial components for optimised performance worldwide.



Designed in the Netherlands 
Made in Europe 

Features



Supports up to 200 devices



High inbuilt surge protection



Secure end-to-end communication



IP65 Casing Design + UV protection



Simple installation



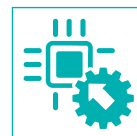
Contains advanced industrial components for optimised performance



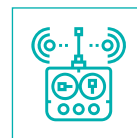
3G, WiFi & Ethernet connection



All-in-one housing (wireless communication, internet communication and antennas)



Over-the-air firmware updates

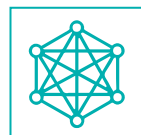


Easy remote configuration

Benefits



In-built SIM card (optional) for plug-and-play application



Manage 100 to 200 network devices with a single Gateway



Pay for only 1 SIM card for up to 200 devices



Auto-network configuration without manual intervention

City Cabinet

City Cabinet is a must have group control solution to safeguard your LED street lighting investment. The smart CPU, which is installed inside the control cabinets (feeder pillar), offers advanced grid monitoring and outdoor group lighting control functions.

With the CPU as the central building block, the cabinet control solution can be easily upgraded by adding optional modules such as earth leakage detector, 3-phase current sensor, connector for authorised energy meter, analogue photocell, overvoltage protector and external relays. The CPU can be installed inside the existing street cabinets without requiring new cabling. It can be used to complement the tone-frequency based lamp switching.

You can monitor and control all the street light cabinets in your city through our centralised street light management (CMS) system, accessible via any device with internet connection. Trusted by cities across Europe and Middle-East, this solution is already used to manage over 1 million street lights.



Features



Complete burn hour reports, fault monitoring and load balancing functions



Simplified maintenance – through automation, remote control and advanced field tools



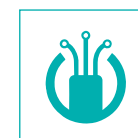
Compatible to existing cabinets (feeder pillar) without new cabling



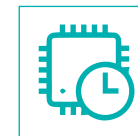
Additional functions, via optional modules, include alarm notifications, power metering, and switching external relays



Detecting power failures, cable breakages, leakages, theft detection, etc. using optional modules



Wireless (e.g. GSM/ GPRS) and wired (e.g. fiber optics) communication options



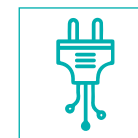
In-built real-time clock to send alarm in case of power failure



A-bus interface (RS-485) to auto-discover all connected optional modules and meters



MODBUS connectivity for authorised smart meters; S0 interface for traditional pulse meters



Switch 3 Phases independently per Phase (via intermediate breaker)

Benefits



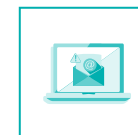
Excellent return-on-investment



Easily scalable from small single cabinet to citywide all street cabinets



Complement the 'tone frequency' system to switch the street lights on or off



Simplify maintenance through automated alarm notifications via email

OpenSky IoT NEMA

Built on the global telecom standard (NB-IoT (NB2)/ LTE CAT-M1/ EGPRS) that securely connects billions of devices today, OpenSky street light controller offers long range, deep coverage, high availability, high security and managed LPWA network.

OpenSky help cities to easily upgrade their regular street lights to intelligent street lights – In turn, creating an ideal foundation for a Smart City. M2M communication enables the street lights to connect directly to the local cell phone tower, thereby significantly improving the security and reliability, as well as eliminating the need for a local gateway.

OpenSky delivers advanced system health analytics, power metering and asset management support. A standardised NEMA interface combined with an in-built GPS ensures universal luminaire compatibility and a quick installation. This is ideal for large-scale citywide deployment wherein high installation speed is preferred.

Luminaires with OpenSky controllers can be remotely monitored, managed and controlled using LIC's CityManager or a third-party open API compliant CMS.



OpenSky IoT Zhaga

Built on the global telecom standard (NB-IoT (NB2)/ LTE CAT-M1/ EGPRS) that securely connects billions of devices today, OpenSky street light controller offers long range, deep coverage, high availability, high security and managed LPWA network.

OpenSky help cities to easily upgrade their regular street lights to intelligent street lights – In turn, creating an ideal foundation for a Smart City. M2M communication enables the street lights to connect directly to the local cell phone tower, thereby significantly improving the security and reliability, as well as eliminating the need for a local gateway.

When combined with a smart driver, OpenSky Zhaga delivers advanced system health analytics, power metering and asset management support. A standardised Zhaga (book 18) interface combined with an in-built GPS ensures universal luminaire compatibility and a quick installation. This is ideal for large-scale citywide deployment wherein high installation speed is preferred.

Luminaires with OpenSky controllers can be remotely monitored, managed and controlled using LIC's CityManager or a third-party open API compliant CMS.



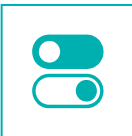
Features



LTE Cat M1/ Cat NB1/ EGPRS communication



Universal luminaire compatibility via standard NEMA (7-pin ANSI c136.41) interface



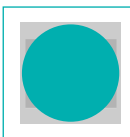
Remote switch on/ off/ dimming



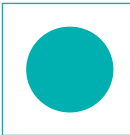
0 – 10V dimming interface / DALI support



Ambient light sensor / In-built GPS



Revenue grade energy metering



Autonomous, astro-clock and calendar-based dimming



Last Gasp - No data loss in case of unexpected power failure



IP 66 + UV stabilized



Remote management & control via CityManager and third-party software (Open API)

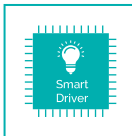
Features



LTE Cat M1/ Cat NB1/ EGPRS communication



Universal luminaire compatibility via standard Zhaga (book 18) socket



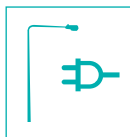
Smart Driver ready



IP 66 + UV stabilized



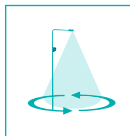
Ambient light sensor / In-built GPS



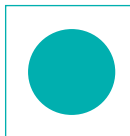
Lighting control via DALI / SR/ DALI 2.0/ D4I



Advanced luminaire health information and ANSI 136.52 compliant power metering



External motion sensor input; light-on-demand

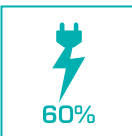


Adaptive, autonomous, astro-clock and calendar-based dimming

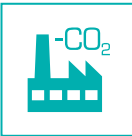


Remote management & control via CityManager and third-party software (Open API)

Benefits



Up to 60% energy savings



Substantial reduction in light pollution and CO2 emissions

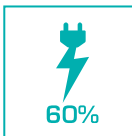


Up to 50% maintenance cost reduction

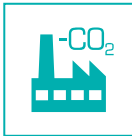


Wireless platform for Smart City

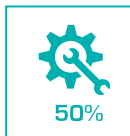
Benefits



Up to 60% energy savings



Substantial reduction in light pollution and CO2 emissions



Up to 50% maintenance cost reduction



Wireless platform for Smart City

SkySwitch NEMA

LIC's SkySwitch NEMA is a state-of-the-art street light photocell that autonomously controls street lighting based on the ambient lighting level of the surroundings. Sits on the top of a luminaire, SkySwitch tracks the brightness of the environment and turns a street light on or off as the situation demands. A standardized NEMA (ANSI C136.10) interface ensures a swift, tool-free installation.

The SkySwitch NEMA street light photocell has a 5-year warranty. It is designed to guarantee maximum operating life through the use of highest grade components, including ultra long-life capacitors and through-hole plating.



SkySwitch Zhaga

LIC's SkySwitch Zhaga is an innovative and energy saving photocell that enables street light switching based on the naturally available ambient lighting level of the surrounding. Compact and elegantly designed, it beautifully blends with the modern LED luminaires. Utilizing the Zhaga Book 18 and SR Driver capabilities, SkySwitch Zhaga delivers enhanced lighting control and data collection. The standardized Zhaga Book 18 interface also ensures quick, tool-free installation.

The SkySwitch Zhaga street light photocell has a 15-year life expectancy. It uses high grade components, which are encased in an IP66 and IK09 (optional) dome.



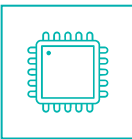
Features



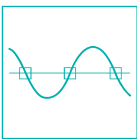
Excellent light sensor



Solid state relay



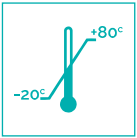
Superior quality components



Zero cross switching, reducing stresses

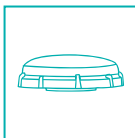


Weather resistant – IP 67



-20°C to +80°C operating ambient temp range

Features



Slick, compact design



Ultra low power consumption: <100mW



Weather resistant – IP 66



15-year life expectancy



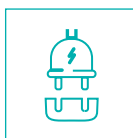
SELV (safe extra low voltage) product



Programmable lux levels



20:20 lux luminance ratio as standard



Zhaga Book 18 socket for plug & play installation

Benefits



Energy Saving: <0.25W power consumption



Better road safety



Reduced burning hours – improves luminaire life



Economical solution

Benefits



Energy Saving: <0.25W power consumption



Better road safety



Reduced burning hours – improves luminaire life



Economical solution

Dortmund's public lighting infrastructure monitored, managed and individually controlled through LIC's smart street light system



Achievements

- Monitoring and management of 25.000 street lights with a single platform from a centralized location
- Over 50% additional energy savings - beyond the savings generated from LED street lights
- Improved public and traffic safety with the right light, at their right place at the right time
- Significant reduction in maintenance costs, thanks to automatic alerts and fault notifications
- Open and interoperable solution enables the city to integrate IoT application from different vendors to become a true smart city
- Substantial reduction in CO2 emissions and light pollution

“ *This is what future smart light looks like today! I wholeheartedly recommend this smart lighting system. We are very pleased with the results. My colleagues from the neighbouring city councils are very interested in the project.* ”

Meinolf Pflug,
Dortmund Civil Engineering Office

Project Details

Locations:	Dortmund, Germany
Client:	City of Dortmund
Application areas:	Main roads, secondary roads, residential streets, parking lots
Products:	SkyLite, SkyLite Prime, CityManager

25.000
Smart Street Lights

50+ %
Energy Savings

300+
Tons CO2 Reduction

Safer bicycle highway in Mechelen & Bonheiden through Zhaga motion sensor based smart street lighting



Zhaga motion sensor-based intelligent street lights and smart city lighting management software from LIC allows the municipality of Mechelen and the municipality of Bonheiden (Belgium), to make their street safer for the cyclists and pedestrians at night. In addition to minimizing operational and maintenance costs, the solution enables the cities to cut energy wastage, carbon emissions and light pollution. The versatile solution also enables the cities to create a foundation for smart city applications.

Benefits

- Increased safety for road users during late evening hours
- Standardized Zhaga and DALI D4i interface for quick, tool-free upgrade to smart street lighting
- Lower operating costs through proactive and selective notifications and automatic reports tracking luminaire health and performance
- Significant reduction in energy wastage, CO2 emissions and light pollution
- User-friendly web application to remotely monitor, manage and control public lighting
- Open API for seamless integration with other smart city applications, such as asset management, weather system and traffic system among others

“Many youngsters visit the cinema, the skating ring, sports facilities and pubs around transit M (Mechelen) during late evening hours. Sometimes they move in group, but often alone, and then good lighting is essential for a better sense of safety. This is an excellent initiative for the bicycle highway.”

Abdrahman Labsir, ships (Mechelen) of Youth and Prevention

SkyLite Prime

Zhaga - D4i Motion Sensor



Project Details

Location	Bicycle highway N15 (opposite the Nekkerhal)
Client	Cities of Mechelen & Bonheiden
Application area	2.2 kilometer bicycle path
Street light height	4m and 8m
Products	SkyLite Prime, CitySense Lite & CityManager



Transforming Helmond into a Smart City with connected intelligent street lights

Highlights

Public Safety & Energy Savings

With LIC's CitySense, there is always the right level of illumination to make the citizens feel safe and comfortable. In the absence of human presence, street lights dim to a predefined level, creating exceptional energy savings.

Smart City Ready

LIC's intelligent lighting solutions, which use Open APIs, allow Helmond to integrate multiple third-party sensors, software and applications

Adaptive Lighting

The versatile light management software, CityManager allows setting the right levels of illumination for each street light based on time, road type and citizens' needs.

Luminaire Independence

The city uses a variety of luminaries, yet they all can be monitored, managed and controlled via the LIC's smart system.

“We are interested in sensor applications and Big Data analytics. We see connected lighting networks as a gateway to this. We are already testing several sensors and exploring the possibilities to interconnect smart street lights and traffic lights. To achieve all of this you need a system that is open and ready for the future. With LIC, we can.”

Alfred Groot, Public Lighting Manager,
Municipality of Helmond



Motion-based intelligent street lighting and a smart, intuitive light management software from LIC enables the city of Helmond, the Netherlands, reduce its carbon footprint, save energy, increase public safety and comfort, and take a leap towards becoming a smart city in Europe.

Project Details

Location Helmond, the Netherlands

Client Municipality of Helmond

Application Areas Residential areas, industrial terrain, pedestrian zones, bicycle paths

Products CitySense, SkyLite & CityManager (a variety of LED street lights)

Energy efficient, greener and safer railway stations with LIC adaptive lighting solution

Highlights

Reduced Energy Wastage

With the LIC's intelligent lighting solution, the lights automatically dim (to 40%) when no one is around. This enables significant energy savings and improves the lamp runtime

Green Railroad Stations

Intelligent connected lighting helps these stations reduce CO2 emissions and curb light pollution, making them some of the most sustainable stations in Europe.

Improved Safety

As soon as any human presence is detected, LIC's smart lighting system triggers all the lights around the occupant to glow at full brightness. This makes the occupants feel safe and comfortable at all times.

Complete Remote Control

LIC's smart lighting management software, CityManager, enables the Dutch Railways to monitor, manage and control its entire lighting infrastructure remotely.

“ We wanted to accomplish a few things, namely reducing energy consumption at the stations and lowering light pollution for people living in the area. At the same time, we wanted to ensure passenger safety. LIC’s solution combined this beautifully. ”

Eelco Krakau, Contract Manager,
Dutch Railways



LIC's sensor-based adaptive lighting solutions and a smart, feature-rich light management software platform enables majority of train stations in the Netherlands, reduce energy consumption and lower light pollution, all while ensuring public safety.

Project Details

Locations	Over 400 train stations
Client	ProRail + NS
Application areas	Station's platforms, overhead structures, tunnels, parking spaces
Products	CitySense, SkyLite, City Cabinet & CityManager

Largest Sensor-Based Smart Lighting Project in India

Highlights

- 72% energy savings and thereby reduced costs, CO2 emissions and light pollution
- Better maintenance and accountability, as it doesn't require around the clock manual intervention or night patrols
- User friendly web-application helps to remotely monitor, manage and control entire public lighting infrastructure
- Open API allow integration with other Smart City applications
- Automatic reports and diagnosis help tracking luminaire health and performance, thus saving time and achieving faster services
- Better electrical infrastructure extends asset lifetime
- Improved public safety perception as street lights illuminate automatically to a higher level upon detection of human presence
- Enhances city aesthetics through better lighting quality

“Jaipur is a historical city that attracts tens of millions of tourists annually from all over the world. We aim at becoming a Digital City with greater connectivity and information access for the citizens as well as the tourists. With intelligent lighting solution, this vision became a reality. Our city is benefiting in every aspect – from safety and security, to easy access to information, to overall improvement of our image and a stepping into the “Smart City” arena.”

Shikhar Agrawal,
Government of Rajasthan



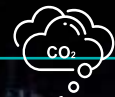
Revolutionary smart street light sensors and versatile lighting controllers from LIC enables the 'Pink City' Jaipur (India) to reduce energy consumption, lower maintenance costs, improve safety and quality of life of the citizens, and take a leap towards becoming one of the forefront smart cities in the country.

Project Details

Location Jaipur, India
Client Jaipur Development Authority (JDA)
Application Areas Main and Secondary roads
Products LIC's CitySense and SkyLite



Save Energy



Cut CO₂ Emissions



Lower Light Pollution

About us

LIC Sustainable Solutions is a Dutch organization with offices in The Netherlands, Spain, Colombia and Hong Kong. From here it designs, produces and executes energy efficiency projects, with LED lighting at its core.

The company is specialized in designing illumination plans that enable the migration from conventional lighting to LED, obtaining substantial benefits such as savings of between 60 and 90% in energy consumption and no maintenance or replacement costs during the first 10 years.

In addition to the LED technology, LIC has developed an intelligent communication network (remote management) which is completely wireless.

The management of lights is done by radio frequency communication independently of any

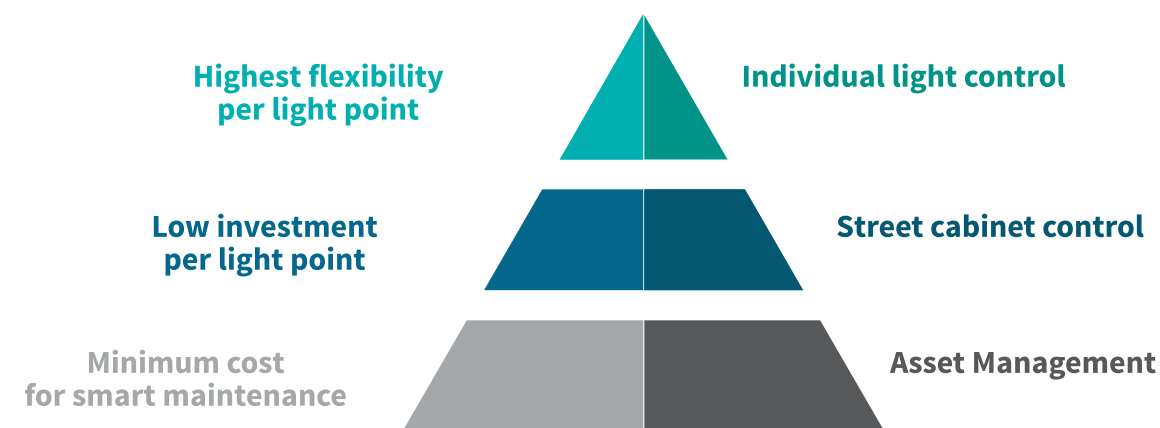
other network, such as the telephone network. We distinguish ourselves from other systems by being an independent, robust, secure (bank-level) and scalable solution. The nodes are easily connected to the luminaire with a Zhaga connection and the network is organized automatically by recognizing the next nodes in neighboring luminaires (collective intelligence). Thus, in addition to illuminating a space in the most efficient way possible, we also turn it into a smart building, block, neighborhood, to the extent of an entire smart city.

LIC works towards providing and promoting sustainable energy. Our service portfolio includes renewable energy solutions, such as, photovoltaic modules, waste to energy plants, and more.



Open, secure and affordable smart city lighting – is our motto

Smart Lighting Solution powered by **TVILIGHT**
EMPOWERING INTELLIGENCE



One-Stop Solution

- Complete end-to-end hardware and software control portfolio for your city
- From managing standard LED street lights to Group (street cabinet) and Individual lamp control
- Software catalogue to meet your needs and your budget

Open System

- We truly believe in open and interoperable smart city and IoT systems, so that you can achieve the true benefit of smart cities.
- All our products, software and systems are designed with native open interfaces to prevent vendor lock-in.

Managed Services

- Service Desk for online support
- Over-the-air software update (no field activities needed)
- Project Management support for the entire project
- Network Design and commissioning support
- Training

True Light-On-Demand

- Our network architecture offers sensors a central role, so that citizens can experience real-time light-on-demand and feel safe (i.e. having neighbouring lights triggering instantaneously)
- CityManager software interface is designed to help you achieve this with ease



INTEGRATED ENERGY
EFFICIENT SOLUTIONS

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