Schréder
Experts in lightability™

EXEDRA

System Overview

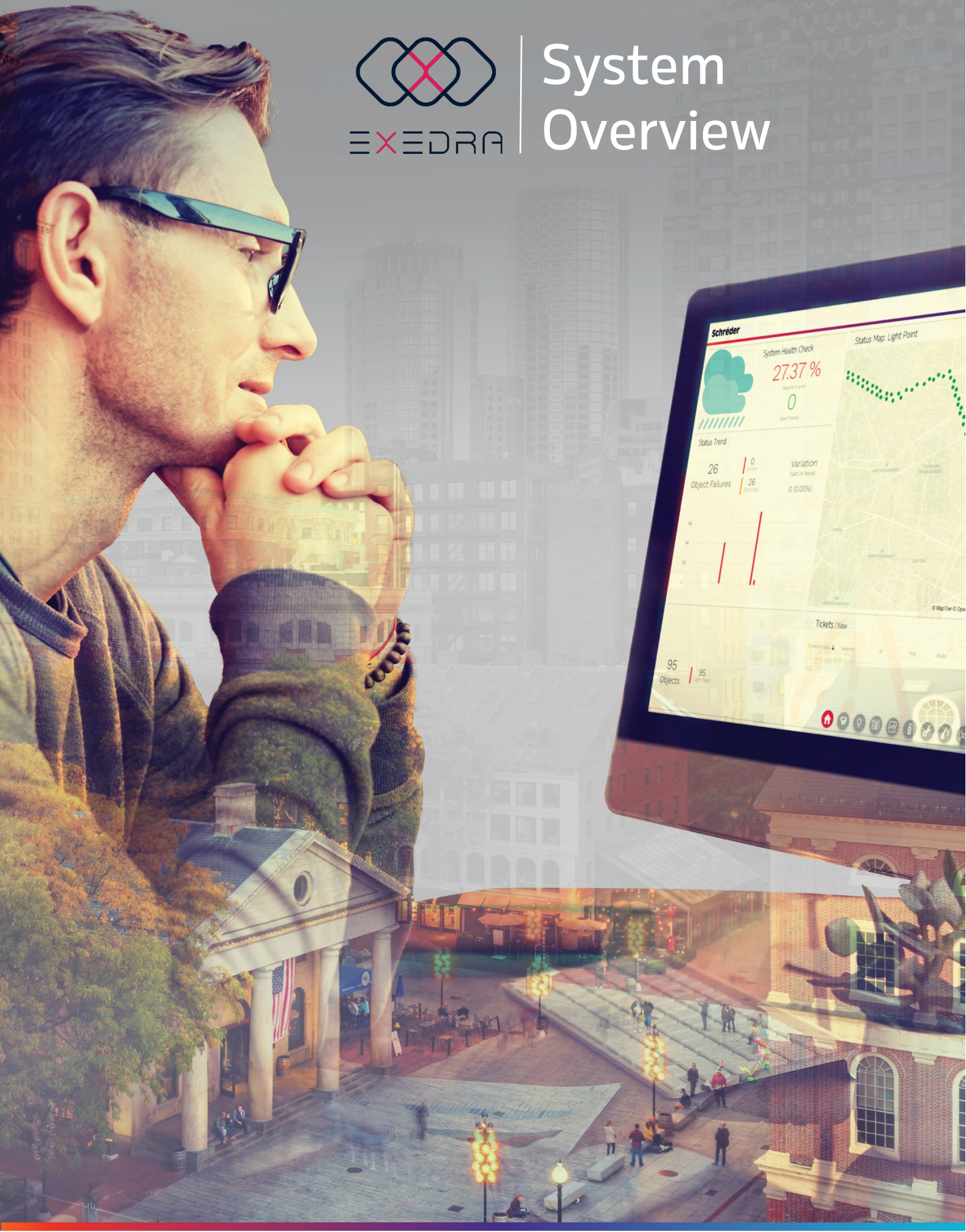


Table of Contents

1 Document history

Date	Version	Change details
2020-11-03	1	First version

2 Introduction

This document aims to provide information about the Schréder EXEDRA system, its end-to-end architecture, main components, key features, and functionalities. This document is not intended to be legally binding. It is designed for all interested stakeholders, such as Schréder customers and partners looking for information on the system architecture and capabilities.

The editor reserves the right to modify this document without prior notice.

3 About Schréder

Schréder is a leading independent provider of outdoor lighting solutions across the world. We believe that lighting can empower people, impact lives, support communities, and transform spaces, cities and the planet. At Schréder, we are experts at using light, but not just that. We have the ability to make that light human, a skill we call Lightability™. Schréder's ambition is to help our customers build cities people love to live in, through caring about their character, community, environment and the future.

Cities need integrated solutions that allow them to go on a **journey**, and that is what Schréder does. We create, advise, innovate, integrate, provide solutions, and support our customers all the way. It is not a question of choosing a one-size-fits-all solution, nor is it about choosing one business or one type of technology. The journey is about understanding the **uniqueness** of every city, its pain points and its opportunities, and aligning new values with that. We want to find out how a city works, how the **natural environment** coexists in urban spaces, and build on our unique expertise in lighting, offering innovative approaches and new solutions and bringing value beyond just illumination. Achieving this requires a different way of thinking about things.

Schréder takes a **technology-agnostic** approach by using only open standards and protocols. It is not about the technology – which is our skill and expertise – it is about understanding what can be done to improve **neighbourhoods and communities** by deploying the right solutions in the right places.

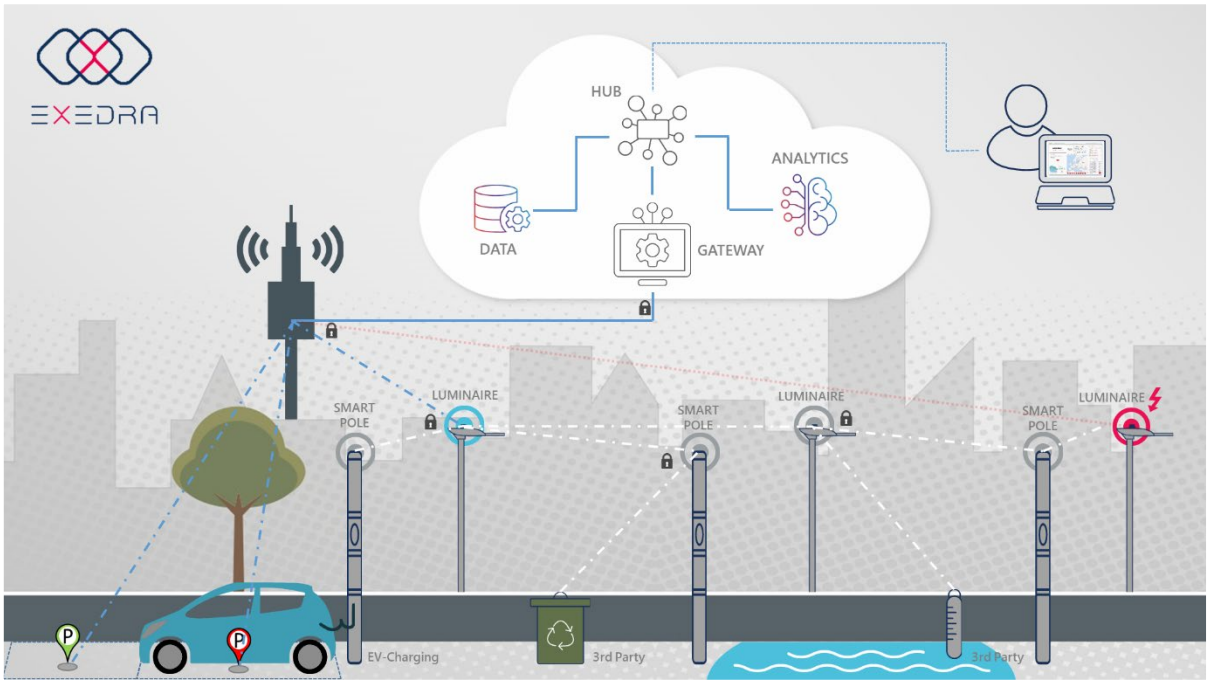
By mastering the end-to-end solution, from choosing the right light to implementing the proper control solution, Schréder can build up bespoke lighting **system backbones** that can evolve and adapt to the needs of different urban areas. This is a technology-agnostic approach that will make cities **futureproof**, able to integrate not only with solutions from Schréder but also with other smart city providers. It is that central role of system integration that cities need for the infinite potential of untapped IoT value to become tangible. Building cities people love to live in is about putting technology at the service of its citizens. This is what Lightability™ is all about.

4 Schréder EXEDRA IoT platform

4.1 System overview

Schréder has over 12 years of experience in smart lighting solutions from Owlet Nightshift to Owlet IoT. The new Schréder EXEDRA IoT platform, described in this document, has been designed to draw on a rich past to facilitate and innovate the future with a practical citizen-centric user interface.

Schréder EXEDRA is an open smart city platform and Central Management System (CMS) that enables users to configure, control, command, and monitor different types of asset (interoperability based on open standards)[1]. It supports Schréder luminaires and luminaire controllers, as well as luminaires and luminaire controllers from other suppliers. It also has the capability and potential to do the same for other connected IoT devices such as streetlight cabinet controllers, pole monitors, sensors, weather stations, and much more.



[1] For further details about interoperability and compatibility with third-party devices or solutions, please contact Schréder.

4.2 Key features

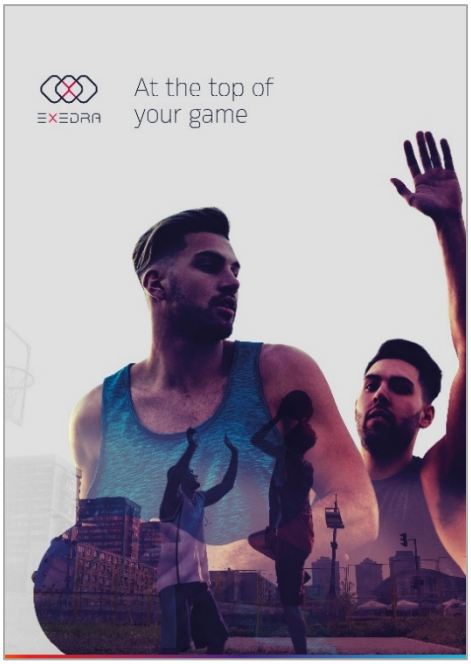
Schréder EXEDRA is a highly effective remote lighting management system that offers a beneficial alternative to complex proprietary IoT network infrastructures. With Schréder hardware, there is no need for field gateways or network configuration, making Schréder EXEDRA a plug-and-play system. It is also open to the integration of third-party devices and sensors, being able to support the concept of "Light as a Hub". In this way, it provides a real foundation or backbone for a city to become smart.

The key features of the Schréder EXEDRA system are as follows:

4.2.1 Easy & straightforward

- **Gateway-less** – Owlet IoT luminaire controllers offered by Schréder have no field gateways. It makes the commissioning and maintenance process a lot simpler and easier to handle.
- **Auto-commissioning** – With Owlet IoT luminaire controllers, this operation is zero-touch, with no additional installation tool. The luminaire controllers show up automatically on the User Interface with their geolocation.
- **Auto-inventory** – For Schréder luminaires, all asset data are automatically brought into the system via an RFID tag. For non-Schréder luminaires, the system can import all asset data.
- **Integrated dynamic lighting** – Schréder EXEDRA System has integrated real-time adaptive lighting capability. Sensors (such as a PIR motion sensor) with an open-collector or relay output can be connected to Schréder's Owlet IoT luminaire controllers, and sensor triggering can be easily configured via the user interface.
- **Automation Centre** – An integrated automation centre allows users to set up automated actions based on predefined inputs.

4.2.2 Rich features list



The Schréder EXEDRA User Interface offers a comprehensive list of features such as:

- Fully configurable dashboard
- Inventory & device management
- Device status & real-time information
- Lighting schedule management – control programs & calendars
- Dynamic adaptive lighting – linking sensors to groups of luminaires
- Reports, alarms & data analytics
- Energy consumption management
- Surveillance, monitoring & real-time control
- Asset maintenance & ticket centre
- Automation centre
- User management – roles & rights

4.2.3 Technology-agnostic

The Schréder EXEDRA system relies on open standards and protocols. We refer to this as **technology-agnostic**. The system architecture is designed to seamlessly interact with other open third-party software and hardware solutions. Part of the Schréder EXEDRA system that helps us take a technology-agnostic approach are:

- Standards used on the different layers of the solution, such as the uCIFI data model and LwM2M device management protocols.
- TALQ Smart City Protocol certified CMS.
- Open microservices architecture cloud solutions to facilitate scalability and the integration of other technologies.
- Ecosystem of partners able to provide other solutions.

4.2.4 Data management

Schréder believes in a strong data management strategy that starts by identifying the right tools for acquiring, validating, storing, protecting, and processing required data, to ensure the accessibility, reliability, and timeliness of data. Additionally, Schréder also implements tools to guarantee:

- **Data residency** – to address requirements for data storage on specific regions.
- **Data isolation** – to address requirements for isolated data storage (keeping data apart from other clients' data).
- **Isolated identity** – to address requirements for the isolation of users, groups, profiles, etc. from other clients.
- **Isolated access** – to address requirements of dedicated frontends and exposed API instances.
- **Isolated device management** – to address requirements of physical segregation of their device's digital representation and functionalities.
- **Isolated device metering** – to address requirements of physical segregation of devices' telemetry.
- **Isolated performance analytics** – to address requirements of physical analytical data isolation from other clients' analytical data.

4.2.5 State-of-the-art security

When developing innovative IoT (Internet of Things) solutions, Schréder strives to implement the highest level of security in its products. Schréder's focus on product security and the company's security measures aim to optimise the availability, integrity, and confidentiality of data and sensitive customer information, as well as its protection from potential vulnerabilities.

The increase of external device integration with Schréder EXEDRA IoT platform and the adoption of cloud services has made Schréder increase product security measures. Since data and applications exist both inside and outside the firewall, Schréder's security and IT Teams strive to ensure that future 3rd party devices outside Schréder EXEDRA IoT platform are as safe as devices on the inside (end-to-end security). Schréder focuses, therefore, on granting access to external devices only after a strict evaluation of the risk associated with each request. In addition, Schréder only grants access to users by following the PAM (Privileged Access Management) principles. To protect the Schréder EXEDRA system against suspicious systems, devices, applications and/or user behaviour, Schréder logs and monitors security incidents via a SIEM (Security Incident Event Management) system supported by a dedicated incident response team. Being committed to the continuous protection and success of its customers, Schréder has been implementing measures and procedures based on the best practices that identify and mitigate potential solution security risks during the development, testing, and production of Schréder EXEDRA system in accordance with security by design principles.

To address these security concerns, Schréder follows a multi-layered approach, where specific security measures are taken at the device, communication, and cloud levels. This security methodology provides continuous analysis of security risk vectors and mitigation of threats through security processes and mechanisms.

In terms of security, the Schréder EXEDRA system makes use of a unified infrastructure security management system that strengthens the security posture of data centres and provides advanced threat protection. The Schréder EXEDRA system has strong DDoS mitigation capacities, supported by high quality cloud, application, and infrastructure service providers, with the following characteristics:

- **DDoS attack protection** and scrub traffic at the cloud provider network edge, before it can impact the availability of our services.
- **Always-on traffic monitoring** that provides near-real-time detection of a DDoS attack and automatically mitigates it once detected.
- **Adaptive tuning** providing advanced intelligence that automatically configures and tunes DDoS Protection settings.
- **Multi-layered protection** – deployed with an application gateway web application firewall, DDoS protection defends against a comprehensive set of network layer (layer 3/4) attacks. It protects solutions from common application layer (layer 7) attacks, such as SQL injection, cross-site scripting attacks, and session hijacks. The web application firewall is preconfigured to handle threats identified by the open web application security project top 10 common vulnerabilities.

Finally, the Schréder EXEDRA system is submitted to full penetration tests performed yearly by reputed and certified third-party companies. The scope is the end-to-end solution, hardware, communication, and software platform testing.

5 End-to-end system architecture

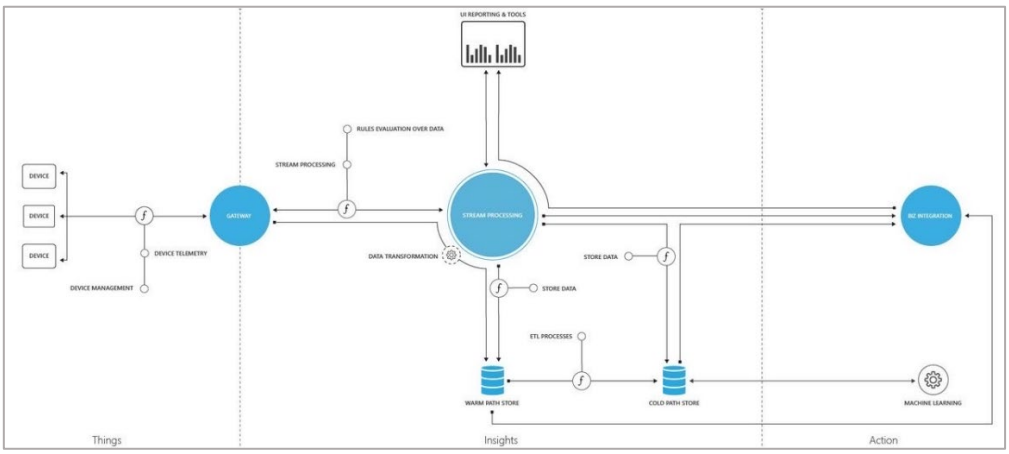
The Schréder EXEDRA system is composed of the following components:

- **Cloud architecture – Schréder EXEDRA IoT platform**
  - Native cloud-based platform built on open and interoperable standards
  - User Interface
- **Network architecture**
  - Owlet IoT luminaire controllers and communications network
- **Hardware architecture – luminaire controllers**

5.1 Cloud architecture – Schréder EXEDRA IoT platform

The Schréder EXEDRA platform architecture is built on open and interoperable standards. The cloud solution consists of a backend and a User Interface (UI). The IoT platform architecture is cloud-native, microservice, and serverless-based. The solution subsystems are built as discrete services that are independently deployable and scalable. These attributes enable greater scalability and more flexibility in updating individual subsystems, and provide the flexibility to choose appropriate technology on a per subsystem basis. This allows the monitoring of individual subsystems, as well as of the IoT platform as a whole.

The backend of the Schréder EXEDRA IoT platform consists of Schréder's own development components, Microsoft Azure IoT components, and a third-party user interface deployed on the Azure cloud.



Cloud architecture blocks

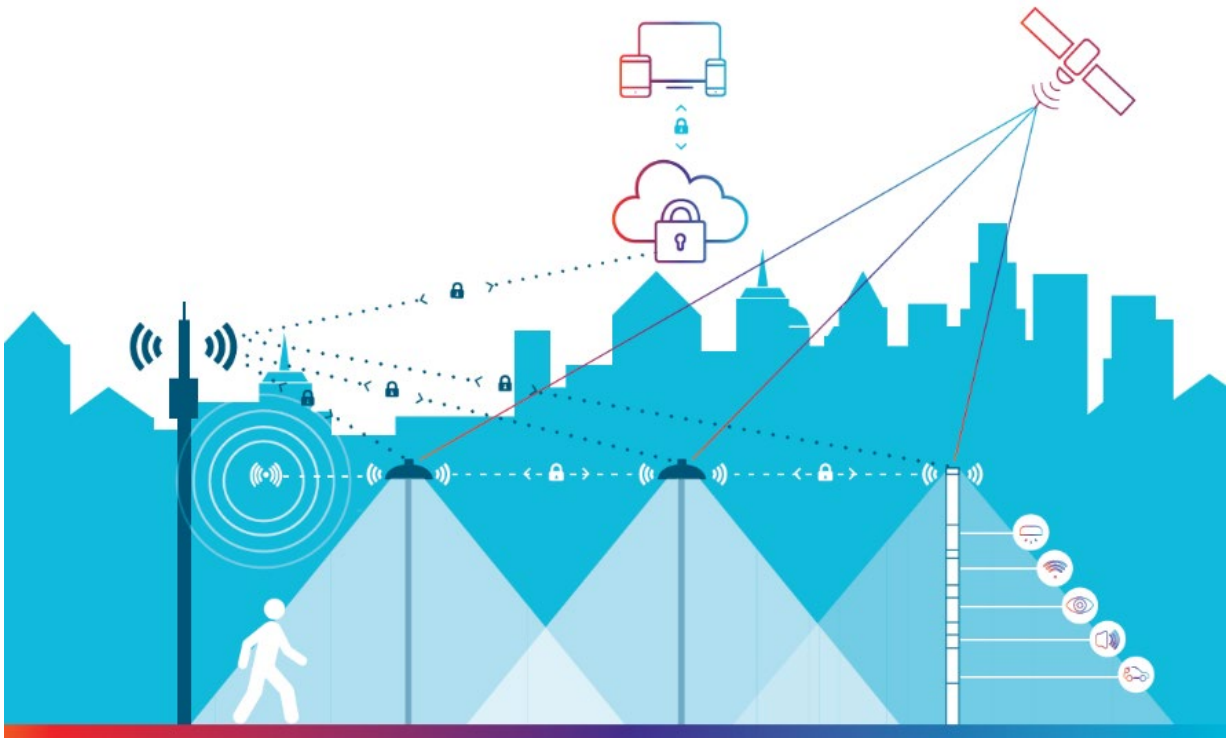
The following list describes the core components of the Schréder EXEDRA IoT platform:

- **Devices** (and/or on-premises edge gateways) allow secure registration with the cloud and connectivity options for sending and receiving data with the cloud.
- **Gateways** are software blocks that enable protocol, data, and schema adaptation. These gateways allow authentication, message transformations, compression/decompression, or encryption/decryption.
- **Stream processing** manages large streams of data records and evaluates rules for those streams. It includes the Device Provisioning Service (DPS) and the IoT hub. The DPS represents the step of the device lifecycle when a device is to be made known to the system and handles interactions with external systems such as a mobile operator's machine to machine (M2M) API to enable or disable SIMs. The provisioning workflow ensures that the device is registered with all backend systems that need to know its identity and additional metadata attributes. The IoT hub is a high-scale service that enables secure bidirectional communications from a variety of devices. It connects the devices and supports high-volume telemetry ingestion to the cloud backend, as well as command and control traffic to devices.
- **Business Integration** is a set of APIs that enable connection to other external platform systems.

5.2 Network architecture – Owlet IoT

Owlet IoT hardware is gateway-less, in the sense that it does not require field gateways to be deployed. The nodes of this system connect via a cellular operator. The network includes the following key features:

- **Easy to install** – installing a new device on the network is fast and intuitive without requiring a human operator to perform any complicated procedures.
- **Secure** – the network is secure.
- **Reliable** – the network is robust with no point of failure.
- **Low power** – the network is extensible to low-power devices, such as sensors.
- **Proven** – the network is built on existing and proven technologies.
- **Open and interoperable** – the network is designed to be open, flexible, and interoperable.



Owlet IoT system architecture

5.2.1 Device-to-cloud (vertical communications)

Each streetlight is equipped with an Owlet IoT luminaire controller that connects to an existing 3G cellular network to interact with the backend system. If for some reason the 3G network is not available, a fallback to 2G is available providing continuous connectivity to the backend system.

At the cellular operator core, network data sessions associated with the luminaire controllers are handled separately and assigned to dedicated resources within the cellular network. This is achieved through Private APNs (Access Point Names) assigned to Schréder. A dedicated radius server handles and manages the IP address assignment independently for the devices. A device can only receive an IP address if it is known in the backend and provides a unique username and password during the IP address request. The connection between the cellular operator core network and Schréder data centres hosting the backend layer is made using a dedicated IP data connection carried on a private MPLS (Multiprotocol Label Switching) network.

5.2.2 Device-to-device (horizontal communications)

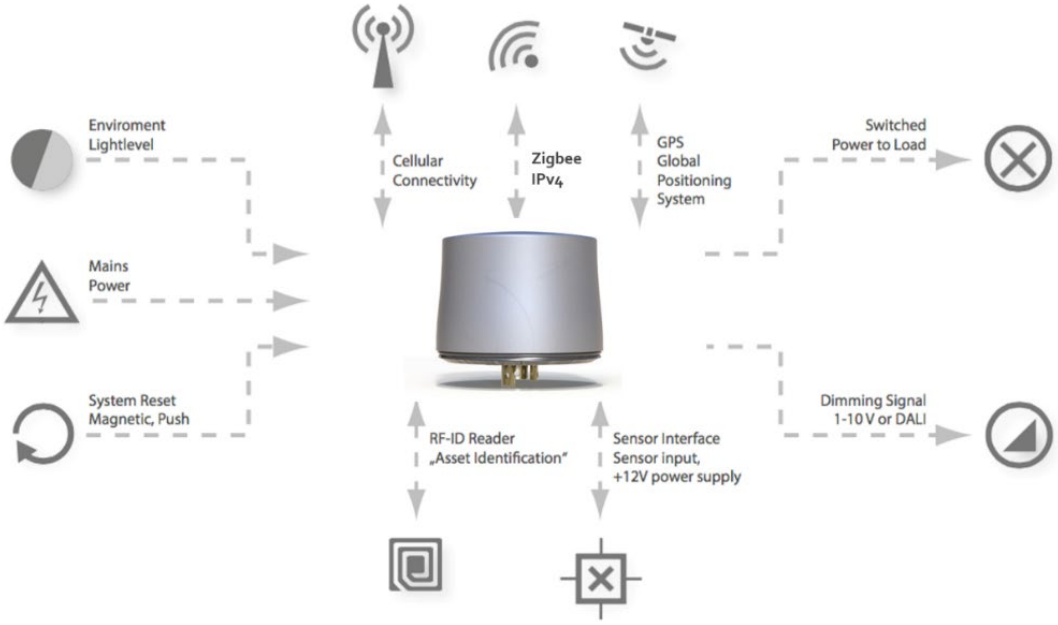
The Owlet IoT hardware solution that will be connecting to the Schréder EXEDRA IoT platform also makes use of a mesh-based network solution for horizontal device-to-device communication. The horizontal device-to-device mesh network is automatically deployed through the open Zigbee communication protocol. This short-range mesh network is used for sensor networks with fast response time requirements like movement sensors used for dynamic lighting.

5.3 Hardware architecture – Owlet IoT luminaire controllers

Owlet IoT luminaire controllers (LUCO P7 CM or LUCO P7 CM HV) include the following features and interfaces:

- Utility grade meters with a metering accuracy higher than 1% over the complete dimming range
- Support for both DALI and 1-10V protocols to control the luminaires
- Support for up to 4 DALI devices (relays and drivers)
- Integrated photocell that provides failsafe functionality

- Inbuilt GPS module to support auto-commissioning and time synchronisation of the real-time clock
- The RFID reader allows for full inventory management functionality for Schréder luminaires
- Zero crossing detection to limit inrush currents through relay switching is inbuilt
- ANSI C136.41 (7 pin) NEMA twist lock connector
- Firmware upgrade over-the-air



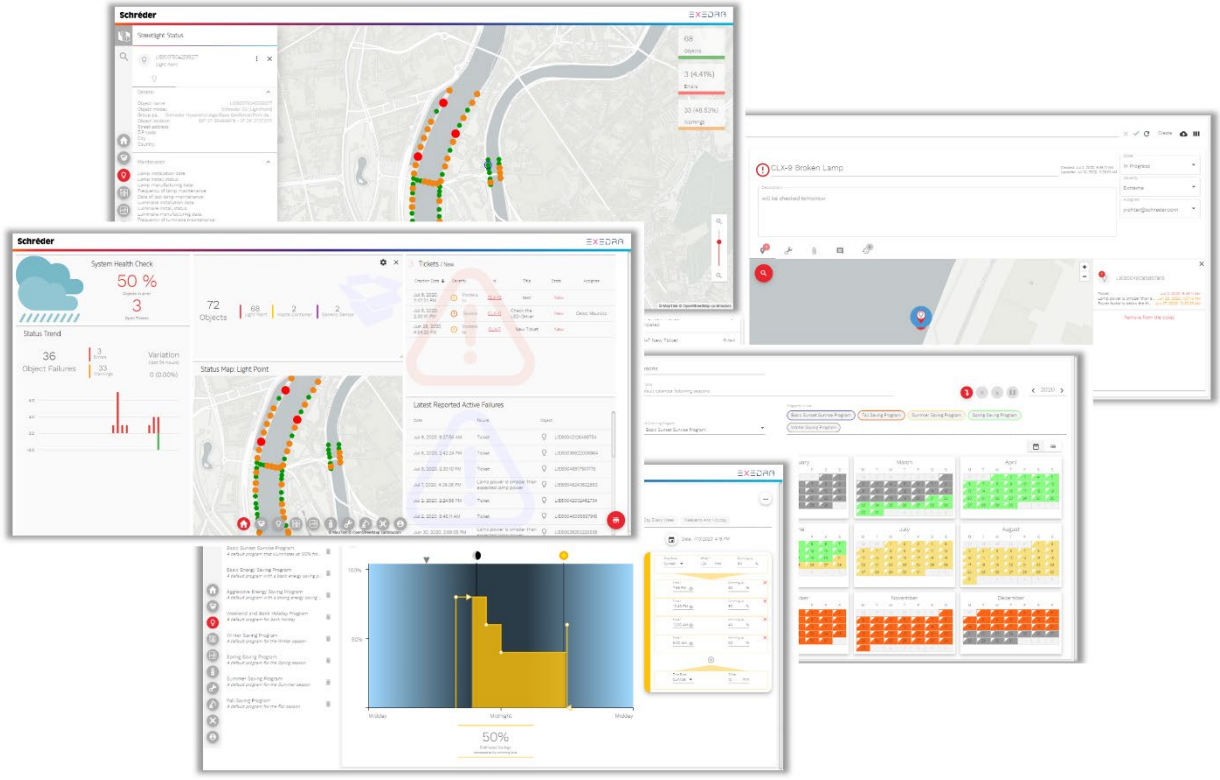
Luminaire controller interfaces

Owlet IoT luminaire controllers are designed for easy installation and plug-and-play commissioning. The installation process and assignment of the controllers can be summarised in the following way:

1. The luminaire controllers read the luminaire identifier on the RFID sticker (on Schréder luminaires) and the GPS position of the luminaire, and report back to the backend, so that the device can be automatically registered on the right project.
2. These data are then passed to the User Interface or to third-party Central Management Software (CMS), enabling the system to know which luminaire controller is installed on which luminaire (which supplier, type, model) in which street, and at which address.

6 Schréder EXEDRA User Interface

The User Interface of the Schréder EXEDRA IoT platform is a responsive, user-friendly, robust software component. It is a web-based software application that enables users to remotely configure, control, and monitor many types of device in a connected network – either Schréder luminaires, luminaires from other suppliers, or luminaire controllers from other suppliers. The User Interface also allows users to configure and control other sensors, register additional offline assets and show them on the map.



User Interface for monitoring smart cities solutions

The User Interface offers new features and functionalities for an improved user experience. Its main features are described in the following sections.

6.1 Two versions: EXEDRA SMART & EXEDRA PRO

The User Interface is available in two different versions:

- **Schréder EXEDRA SMART**
- **Schréder EXEDRA PRO**

Schréder EXEDRA SMART is a state-of-the-art lighting management platform that can control, monitor and analyse streetlighting in a user-friendly way. It is focused on smart lighting management and is one of the most feature-complete systems on the market, including:

- An extensive set of features (beyond the existing Nightshift & Owlet IoT platforms)

Schréder EXEDRA PRO is based on the SMART offering but provides a more tailored and flexible customer experience opening the way to go beyond smart city lighting applications:

- Additional features in the User Interface to improve flexibility and agility (e.g. automation engine)
- Potential to create and manage many different city objects within the User Interface through a transversal data model (e.g. cabinet controllers, pole monitors, door openings, sensors, weather stations, pollution sensors, etc.)[2]
- Access to monthly expert & optimisation webinars

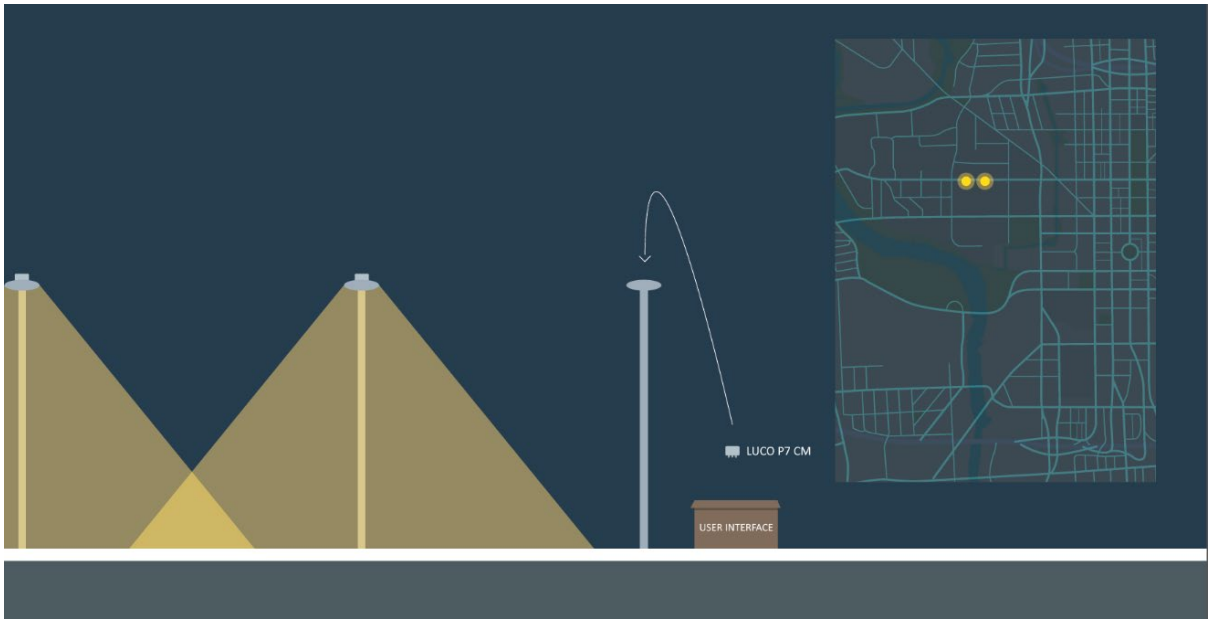
[2] Managing other objects is not available yet on the User Interface but the PRO version will open up this possibility in the near future (contrary to SMART).

6.2 Commissioning

For intelligent streetlighting, Schréder delivers one of the most straightforward solutions to install and commission on the market. The first customer interaction with the Schréder EXEDRA system is during the installation of the luminaire controllers.

The provisioning of a streetlight control system ensures that only known devices are authorised to connect to the system (i.e those provisioned by the Schréder factory and registered in the asset database).

Physical **installation** of the controllers is simple and, after powering on the luminaire, the controllers will also be powered to validate the installation.

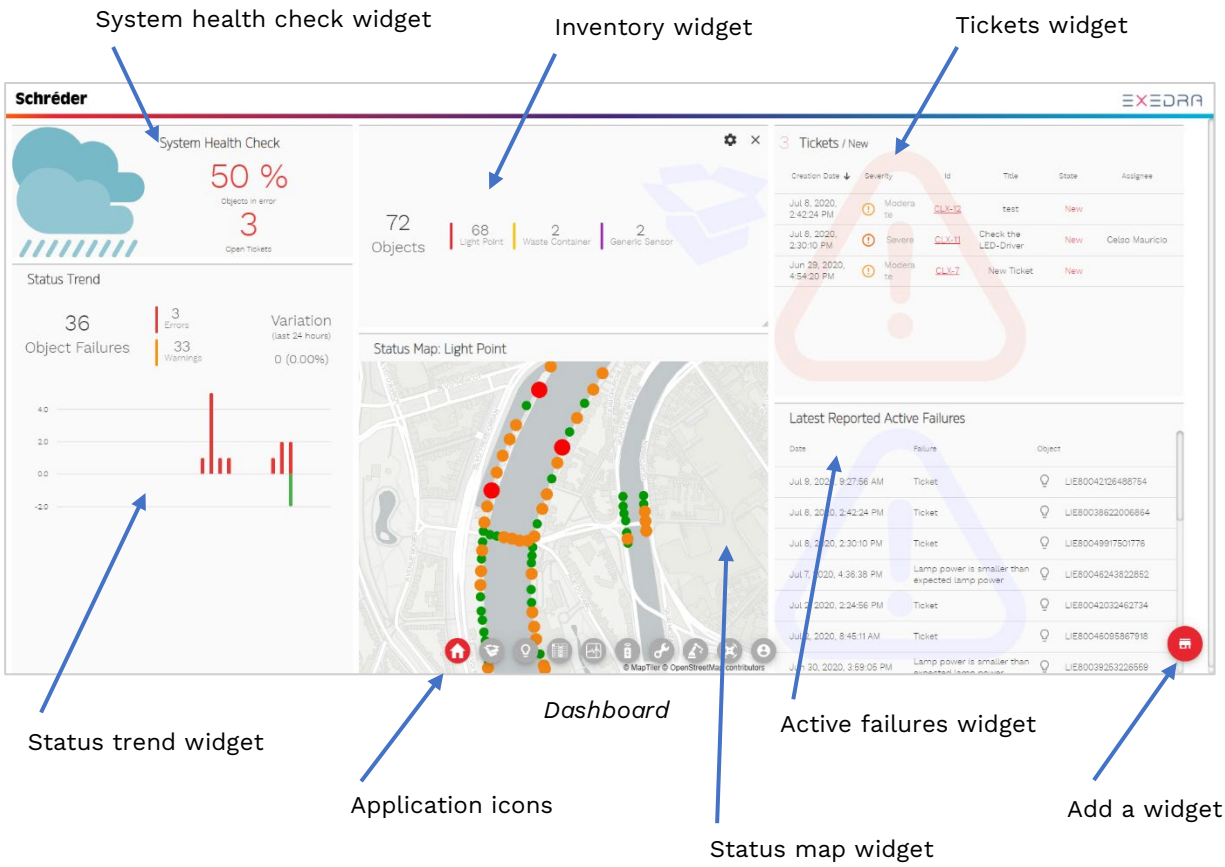


Luminaire controller installation with auto-commissioning

A few moments after the luminaire controllers have been successfully installed, they will **automatically register** on the IoT platform to be fully commissioned.

6.3 Fully configurable dashboard

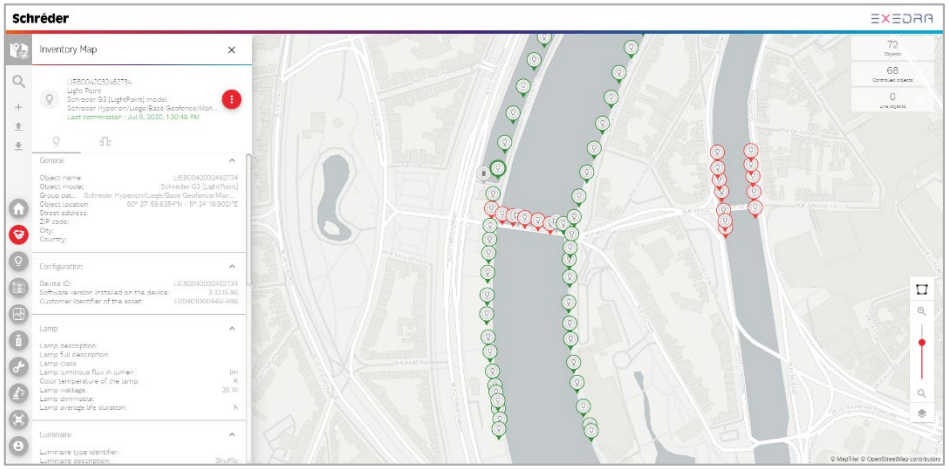
The **Dashboard** shows a detailed overview of the project. It is composed of several panels, called widgets, that show the number of devices, latest reports, failures, tickets, etc.



The Dashboard is fully configurable and can be saved on a per user basis. Users can move, resize, reorganise, add, or remove widgets to suit their needs.

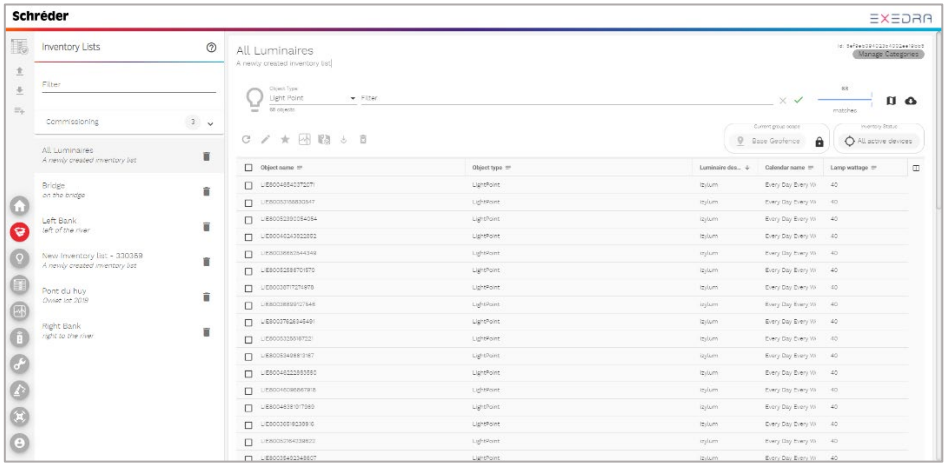
6.4 Inventory & device management

The **Inventory** application allows users to manage devices. Users can create, edit, and delete their own devices manually on the map, using a CSV file import, or through APIs to automate inventory synchronisation with third-party GIS/Asset Management systems. The **Inventory map** application provides a map view of all project devices controlled by the Schréder EXEDRA IoT platform.



Inventory map – map view of devices

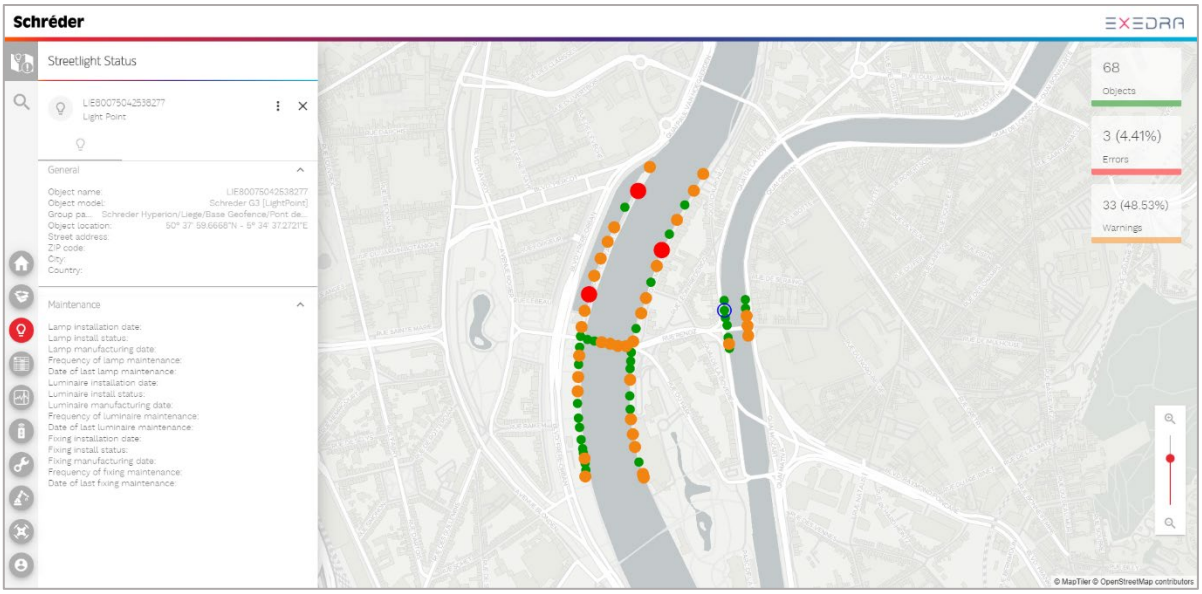
The **Inventory lists** application allows users to query the inventory of devices controlled by the Schréder EXEDRA system in a powerful and flexible way. Users can create multiple inventory lists to answer different needs such as: "List all devices that are consuming more energy than expected" or "List all streetlights that reported more than 5 failures last month", etc. It also allows to bulk edit thousands of devices at once, create favourite lists, or trigger immediate or delayed device commissioning.



Inventory lists – list of devices

6.5 Device status & real-time information

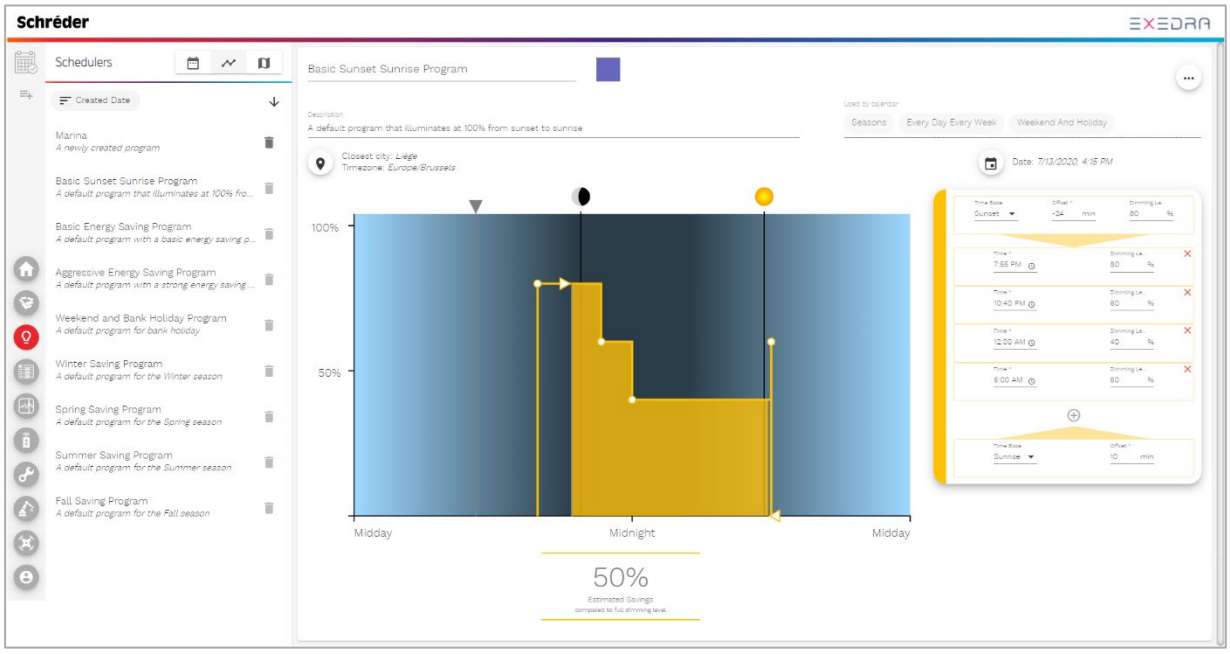
The **Streetlight status** application shows a quick overview of the system state and provides historical data for all devices. It also offers a comprehensive graphical representation of all incidents/failures reported from the devices. It can display hundreds of thousands of devices in a navigable map to provide, at a glance, the key performance indicators, an overview of the network, device states, the location of the main outages, and access to further information (e.g. metering historical data) for further analysis.



Streetlight status – map view of device status

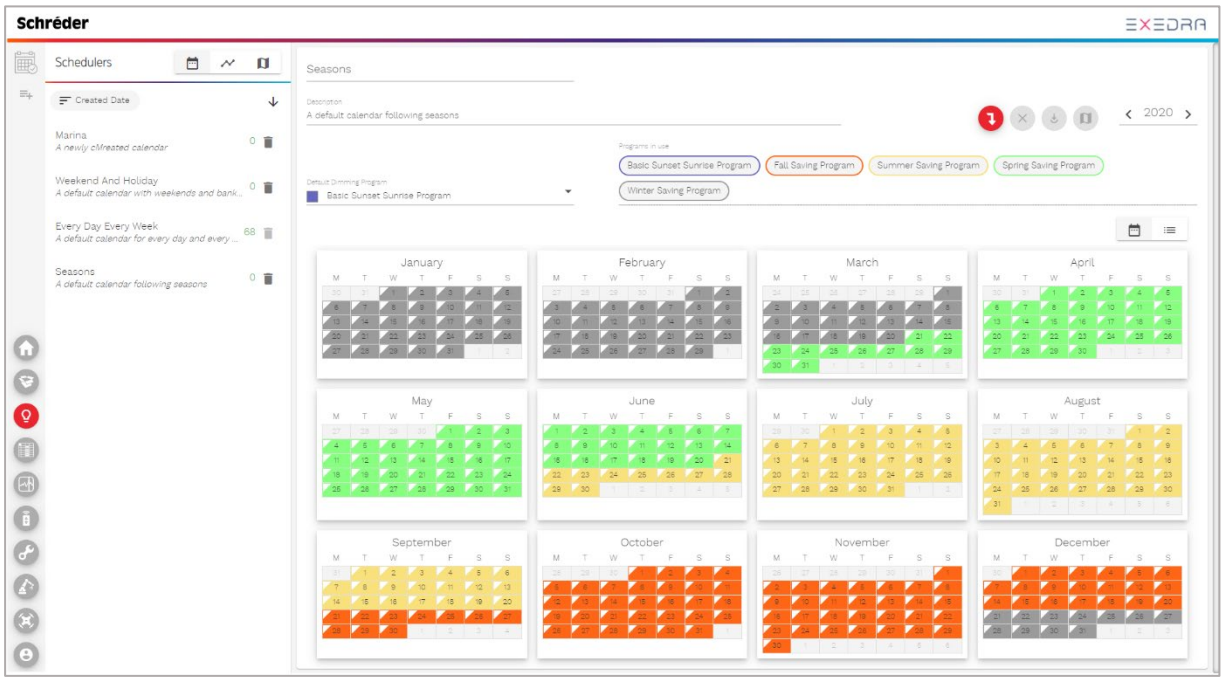
6.6 Lighting schedule management – control programs & calendars

Schréder offers new features regarding dimming profile capabilities, which enhances those of its previous Owlet IoT system. What was known as dimming profiles is now split into control programs and calendars. The **Streetlight schedulers** application enables easy creation, editing and deletion of control programs with different dimming levels and timings according to various scenarios, and achieve significant energy savings.



Streetlight schedulers – control programs

Control programs may be assigned to days or events in calendars. This provides excellent flexibility, allowing cities to adapt lighting to different scenarios (e.g. weekdays, weekends, seasons, holidays, specific events, etc.). Calendars are displayed with different colours to distinguish exceptional control programs for particular days or periods.

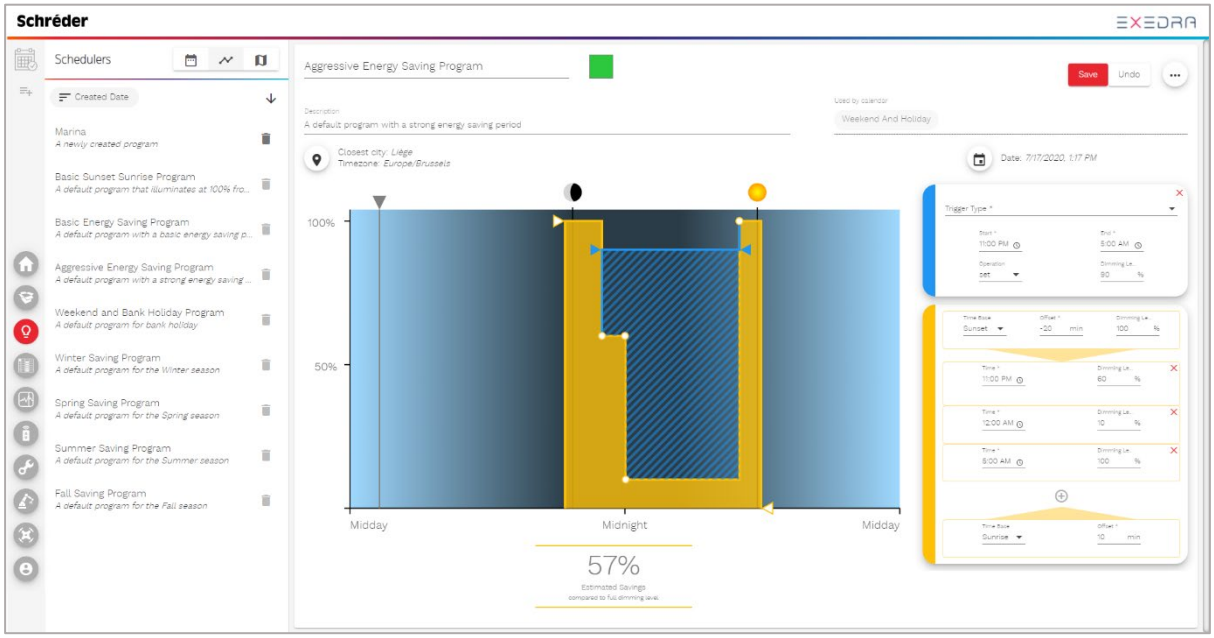


Streetlight schedulers – calendars

6.7 Dynamic adaptive lighting – linking sensors to groups of luminaires

The **Streetlight schedulers** application also enables users to configure scenarios for dynamic lighting systems. This configuration methodology is fully compatible with the dynamic lighting functions specified in the TALQ v2 protocol.

Users may add one or more dynamic control rules, define an active period, and select the trigger type (sensor) and dimming level to be applied when triggered. For instance, as shown below, a default control program (in yellow) is configured to set a dimming command to 10% between 12:00 AM and 5:00 AM, but the dynamic control rule, with a higher priority, will bring back the dimming level to 90% if the sensor event is triggered during the dynamic control period (in stripy blue).

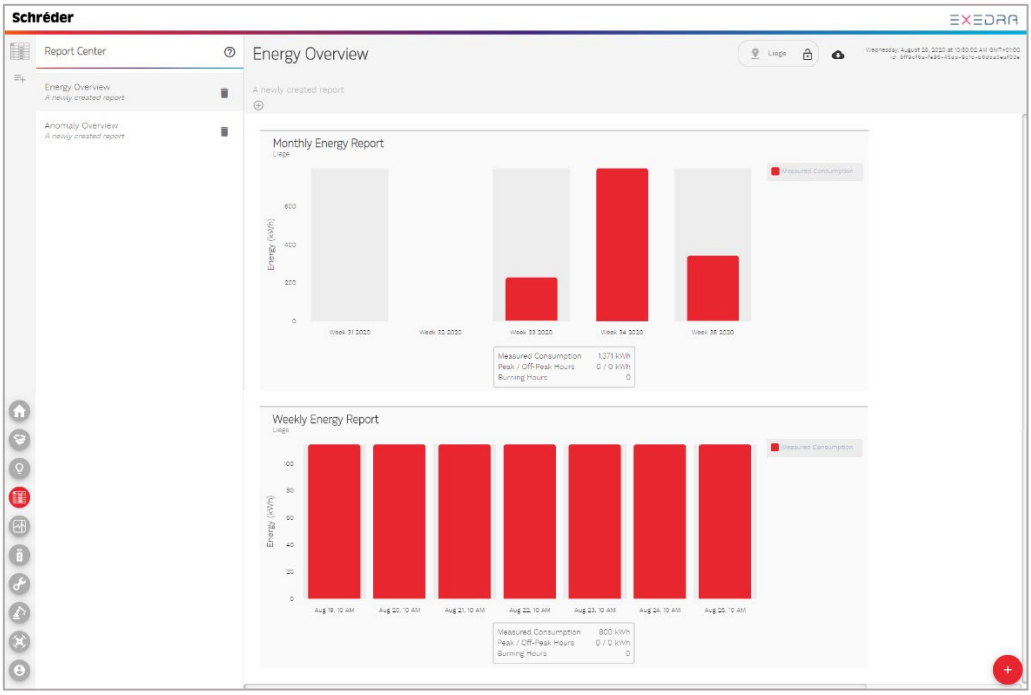


Streetlight schedulers – dynamic control

6.8 Reports, alarms & data analytics

The Schréder EXEDRA IoT platform collects data from all devices (luminaire controllers and other device types) in the field and displays them on the User Interface in numerical and graphical forms. Data are immediately available in a large set of advanced data analytics tools, on the map and in reports, to enable users to identify outages, and analyse and fix them. The **Reports center** and **Energy reports** applications provide a powerful, intuitive way to document the overall state and detailed data of managed devices. Users can view and create a variety of reports such as:

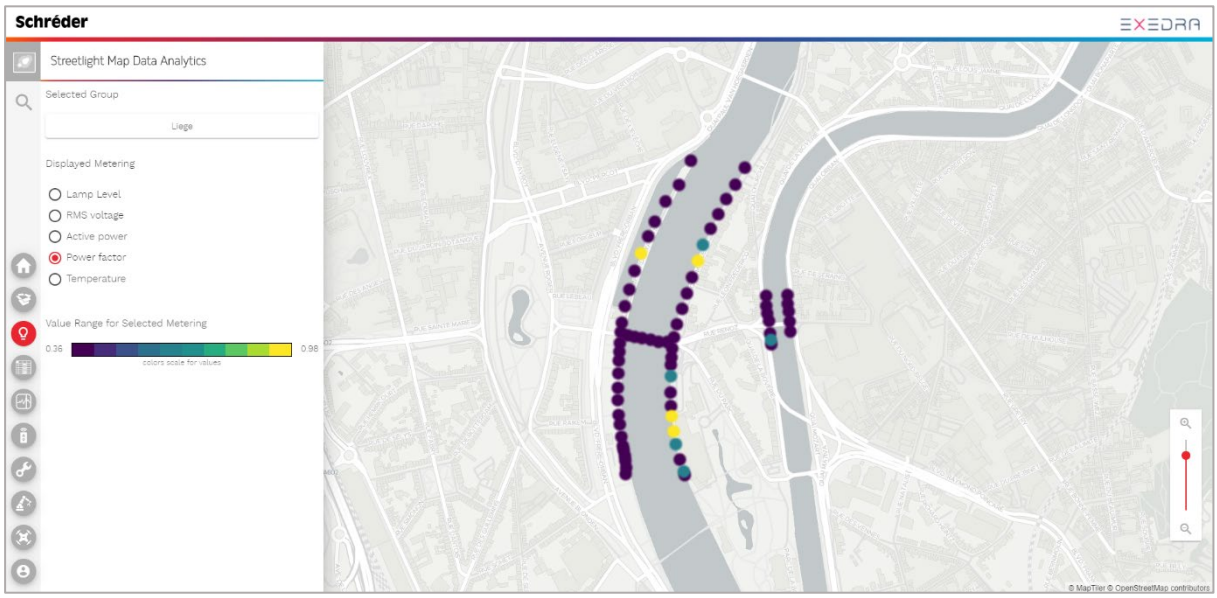
- Energy reports to calculate the energy consumption (in kWh), peak and off-peak hour charts (in kWh) for any geographical zone, sub-zone, or any other group. It calculates the energy consumption for all luminaire controllers in the selected group, and the energy saved compared to full lamp power, and the equivalent CO2 savings. The information is displayed both with bar graphs and in list mode with monthly, weekly, or daily aggregation.
- System health check and status trend charts to view the evolution, per night, of minor and major reported issues for the luminaires.
- Cumulated number of lamp running hours to evaluate energy saving.
- Advanced and custom reports.



Reports center – energy overview report

Additionally, the **Streetlight map data analytic** application enables users to view and create multiple heatmaps containing device data analytics such as:

- Lamp level
- Mains voltage (in V)
- Active power (in watts)
- Power factor
- Temperature

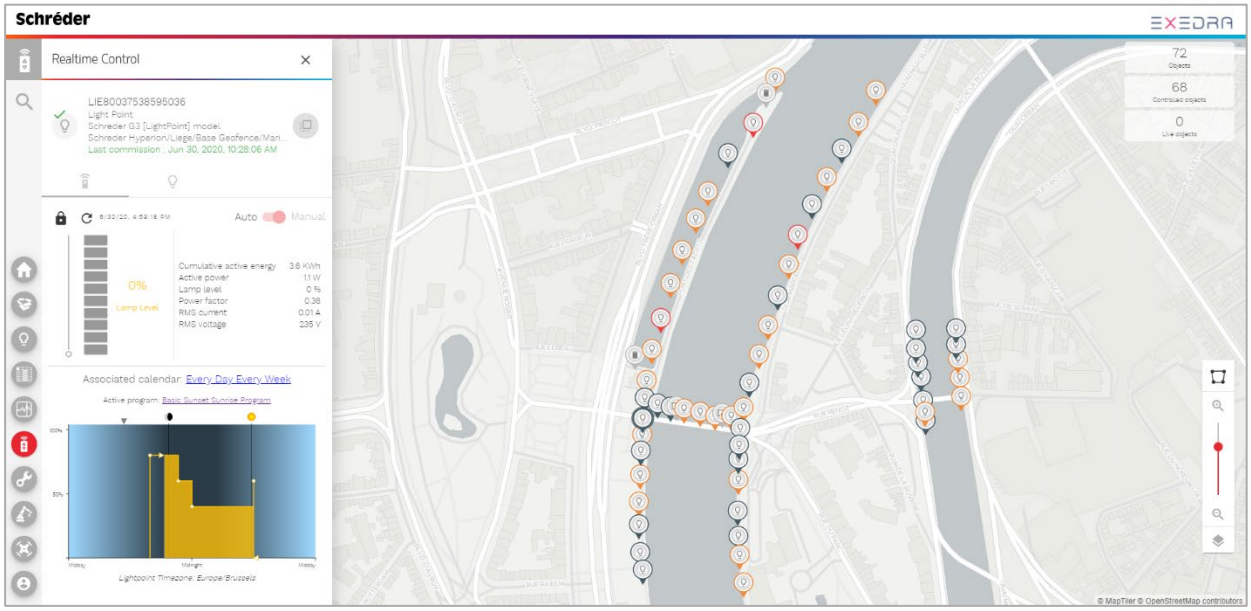


Streetlight map data analytics – heatmap

6.9 Surveillance, monitoring & real-time control

Regardless of the type of communication network and device model, Schréder EXEDRA system provides a complete and intuitive set of real-time remote control and manual command features. All manual commands are password-activated to be sure nothing can be done to compromise the city's security. It enables users to:

- Send a manual override command to a single or to a group of luminaire controllers with a specific timing (e.g. switch this light ON for 15 minutes and then go back to automatic).
- Read the metering values from a single or a group of luminaire controllers in real-time and display values and timestamps.

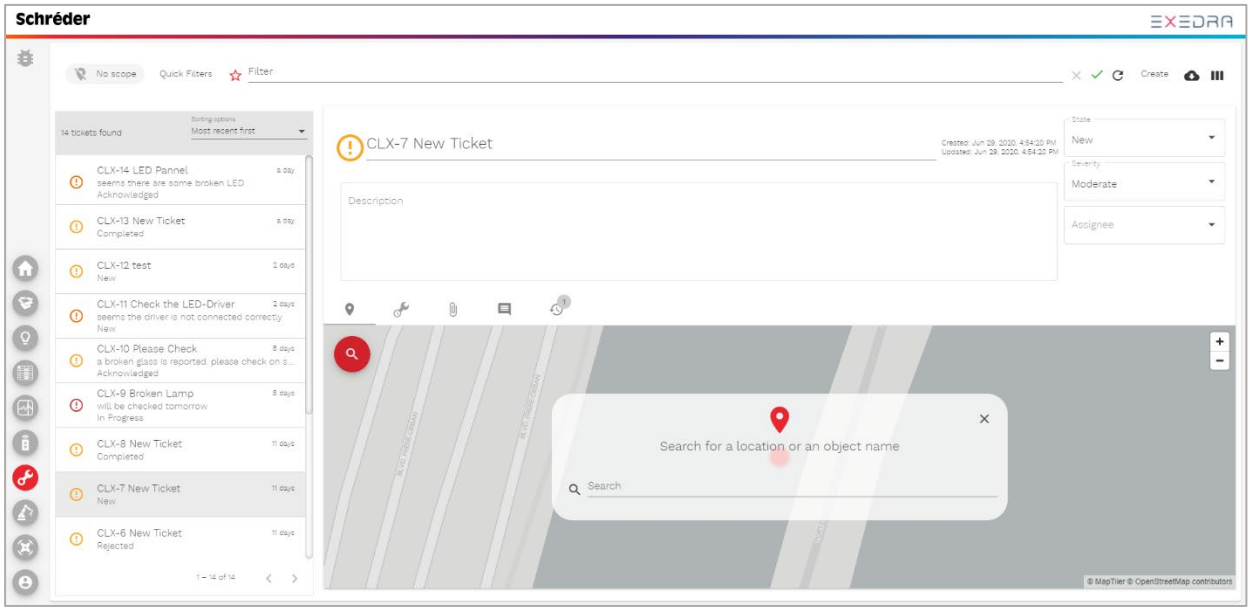


Real-time control – manual device control

6.10 Asset maintenance & ticket centre

The User Interface provides a simple and efficient way of handling the entire lifecycle of issues and failures associated with the devices. The **Streetlight maintenance** application displays a list of failures and a trend chart for selected group(s) of devices.

The **Tickets center** application enables the user to create, prioritise, assign, track, and manage issues (tickets), or any other events, and associate them with any devices in the inventory. All types of asset (e.g. controlled or non-controlled luminaires, cables, cabinets) can be associated to a ticket along with a state, severity, assignee, description, optional comments and attached file (e.g. photo).

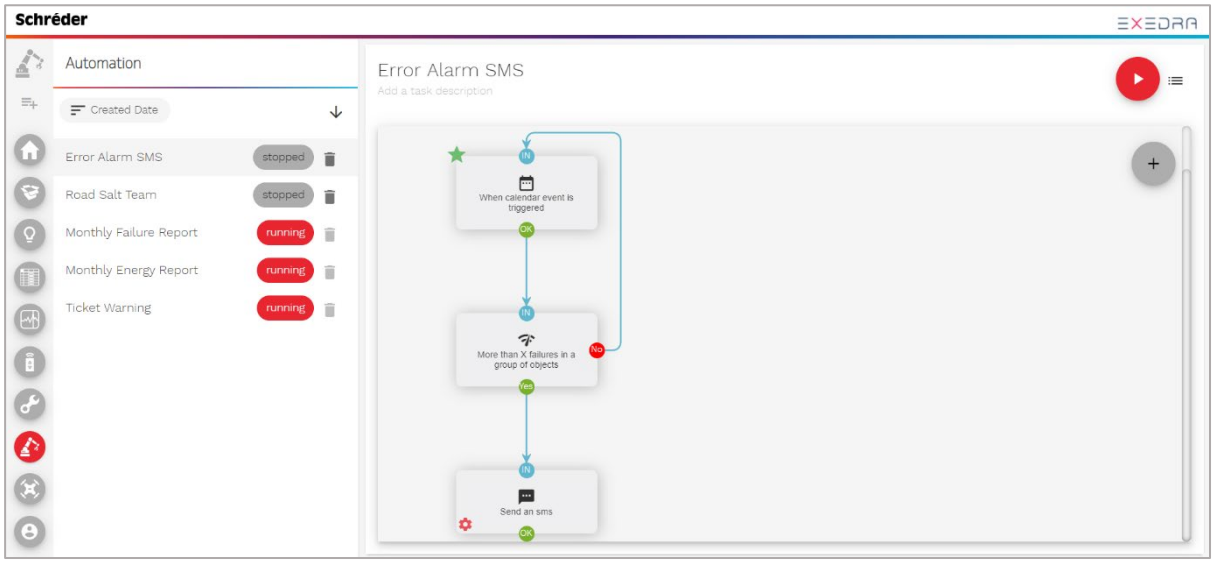


Tickets center – ticket management

6.11 Automation centre

The User Interface provides an intuitive graphical interface to define complex and custom rules using a library of functional blocks that the user can select, configure and link together like Lego.

The **Automation center** adds great customisation capabilities to the IoT platform, covering the creation of alerts, notifications, creation of custom events on the platform, performance of complex calculations, triggering of reports, and data aggregation. The execution of these tasks can be constantly monitored by the customer, and tasks can be scheduled as required.

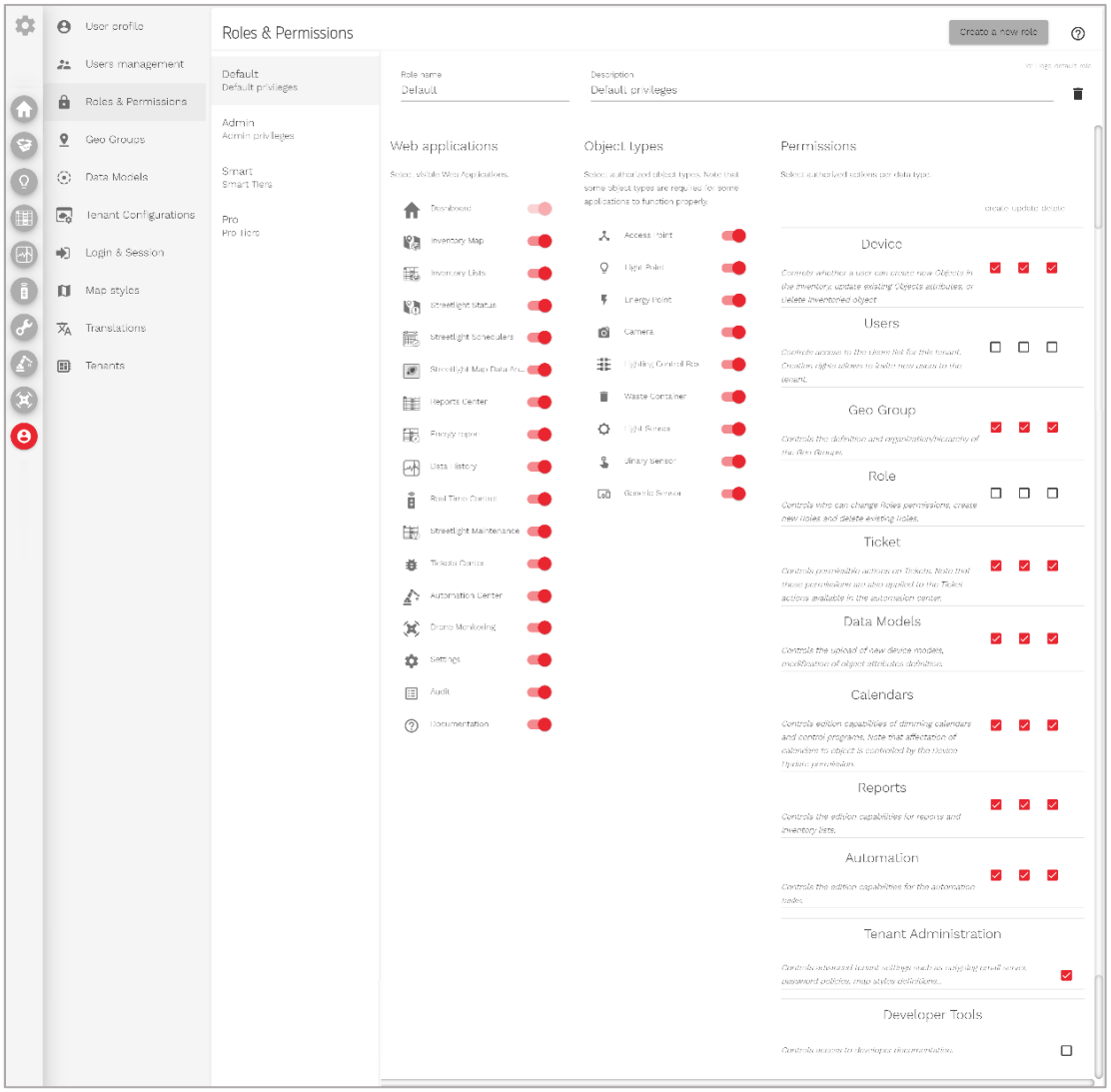


Automation center – alert management

6.12 User management – roles & rights

The User Interface offers two-step user authentication (password and security code) that allows the system administrator to enforce system security.

The **User settings** application enables system administrators to create different user profiles and assign them to a role. Roles are configured to assign access rights per application/feature, per device type, and per geographical group. It is easy to create specific access for maintenance operators, energy operators, managers, sub-contractors, or city operators. It is also possible to limit the access rights to some applications (i.e. manual ON/OFF, dimming command, inventory update, etc), and limit access to specific geographical areas.



User profiles – roles & permissions

7 Definitions and terminology

The following list describes the technical terms, acronyms and abbreviations found in this document.

API (Application Programming Interface) – A program interface using a set of functions, procedures, definitions, and communication protocols that enables interactions/interconnections, communication, and seamless exchange of data between different systems (such as the CMS), software and connected devices.

APN (Access Point Name) – The name of a gateway between a GSM, GPRS, 3G or 4G mobile network and another computer network, usually the internet.

Asset – A piece of equipment (luminaire, cabinet, etc.) that can be identified, configured, monitored, and maintained remotely using the Schréder EXEDRA system.

Auto-commissioning – The process that guarantees that a Schréder luminaire controller is automatically registered and configured as an asset on the Schréder EXEDRA IoT platform without human intervention, from the moment it is energised on the luminaire.

CMS – CMS can have different meanings although they generally have the same purpose: Central Management Software, Central Management System, or City Management System. In the context of Smart Cities, CMS refers to Central Management Software – an application that enables remote configuration, control, command and monitoring of networked connected devices.

Gateway – A physical or virtual device intended to be a translator between two different communication networks. It is bidirectional and able to manage communication protocols and physical and virtual networks, as well as handling priorities of communications between both networks.

IoT (Internet of Things) – A wide-ranging ecosystem of physical objects connected to the internet, capable of identifying themselves and communicating data to other objects with the

help of a communication network for digital processing.

LwM2M (Light Weight Machine to Machine) – An application-level protocol designed for low-power devices that provides a set of procedures to handle IoT devices lifecycle and defines a data model framework understandable by LwM2M devices. LwM2M protocol is defined by Open Mobile Alliance (OMA) SpecWorks, which has a strong connection with the telecommunication industry.

NEMA (National Electrical Manufacturers Association) – Association of Electrical Equipment and Medical Imaging Manufacturers.

Network – The network and connectivity elements of the Schréder EXEDRA system, enabling the Owlet IoT luminaire controllers to connect to the Schréder EXEDRA IoT platform.

OTA (Over-the-Air) – In programming, OTA refers to several methods of distributing new software, configuration settings, and updating encryption keys to devices.

Owlet IoT luminaire controllers – Hardware devices (LUCO P7 CM and LUCO P7 CM HV) and their embedded software components designed to monitor and control luminaires based on electronic drivers and sensors.

Owlet Nightshift – Schréder remote lighting solution made of the combination of luminaire controllers (Owlet P7, Owlet NXP, or Owlet ADP), segment controller, backend, and software (Web User Interface).

PIR (Passive InfraRed) sensor – An electronic sensor that measures infrared (IR) light radiating from objects in its field of view. It is used in automatic lighting applications and security alarms to detect general movement.

Schréder EXEDRA IoT platform – Schréder's IoT platform designed for remote lighting management, composed of servers, databases, software components, and including the User Interface.

Schréder EXEDRA system – Complete solution comprised of the Schréder EXEDRA IoT platform, Owlet IoT luminaire controllers, the Network, and the User Interface.

Star *versus* **Mesh** – Star and Mesh are radio network topologies with different connection schemes. In star networks each node is connected to a gateway node/border router. In mesh networks each node is directly connected to another in order to create a mesh, in opposition to a star.

TALQ – The name of a consortium and Smart City protocol that enables Outdoor Device Networks (ODNs) from various suppliers to interoperate and communicate with a single Central Management Software (CMS) system through a standard application protocol.

uCIFI – A non-profit alliance of individual companies, cities & IoT leaders committed to standardise smart city and utilities data models.

User interface (UI) – The frontend of the Schréder EXEDRA IoT platform. It is accessible through a web browser and enables users to control streetlights remotely.

Zigbee – A wireless network based on the IEEE 802.15.4 technical standard. It is designed for high-level communication protocols used to create personal area networks with low data rate, low-power digital radios, and other low-power low-bandwidth needs.

NOTE: The terms listed above are for information purposes only, and are not intended to have a legal or any other binding effect.