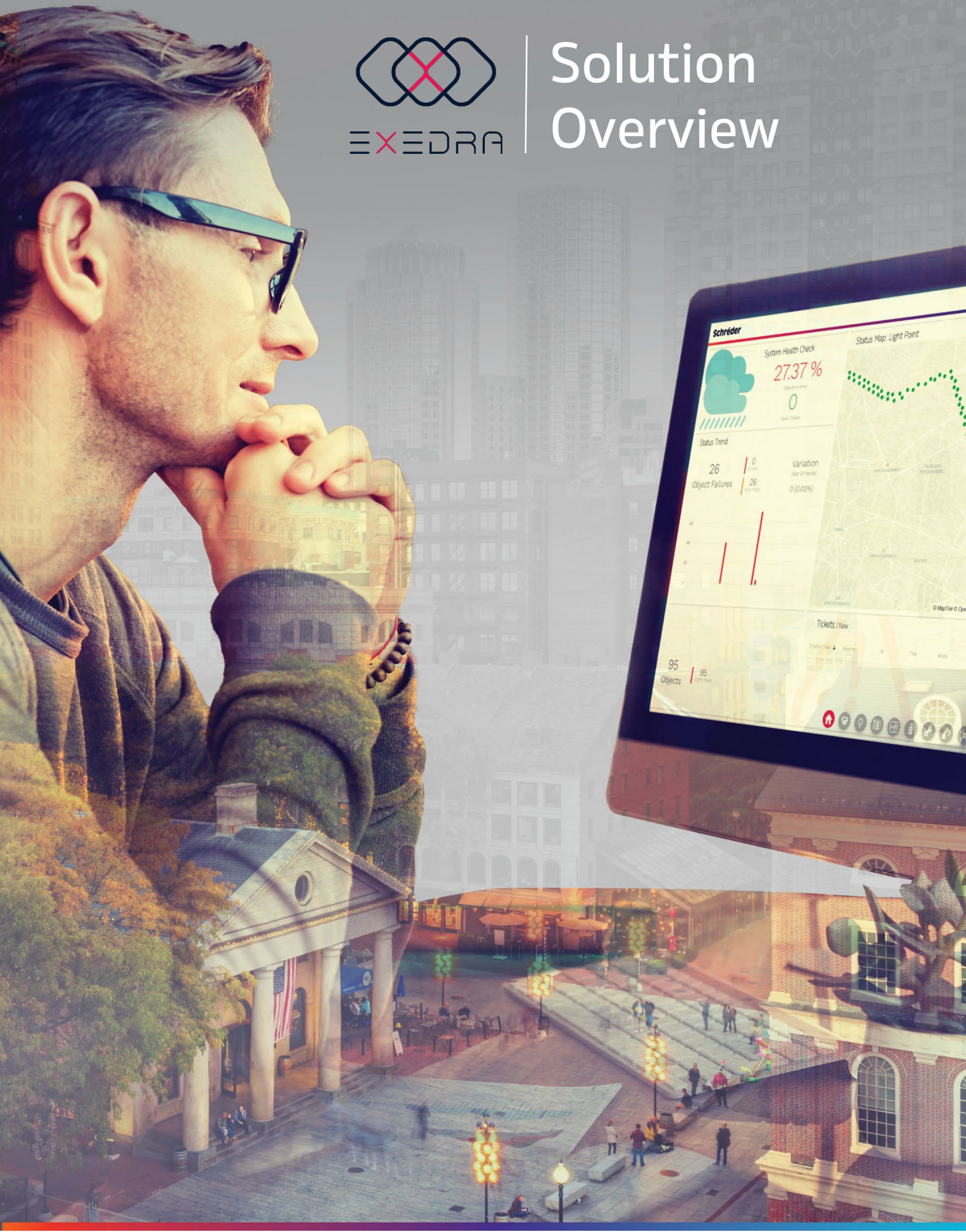
Schréder
Experts in lightability™

EXEDRA

Solution Overview



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1 Document history

Date	Version	Change details
2020-11-03	1	First version
2022-01-31	2	Update for OWLET IV launch

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2 Introduction

This document aims to provide information about Schréder EXEDRA, 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 Schréder EXEDRA architecture and capabilities.

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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.

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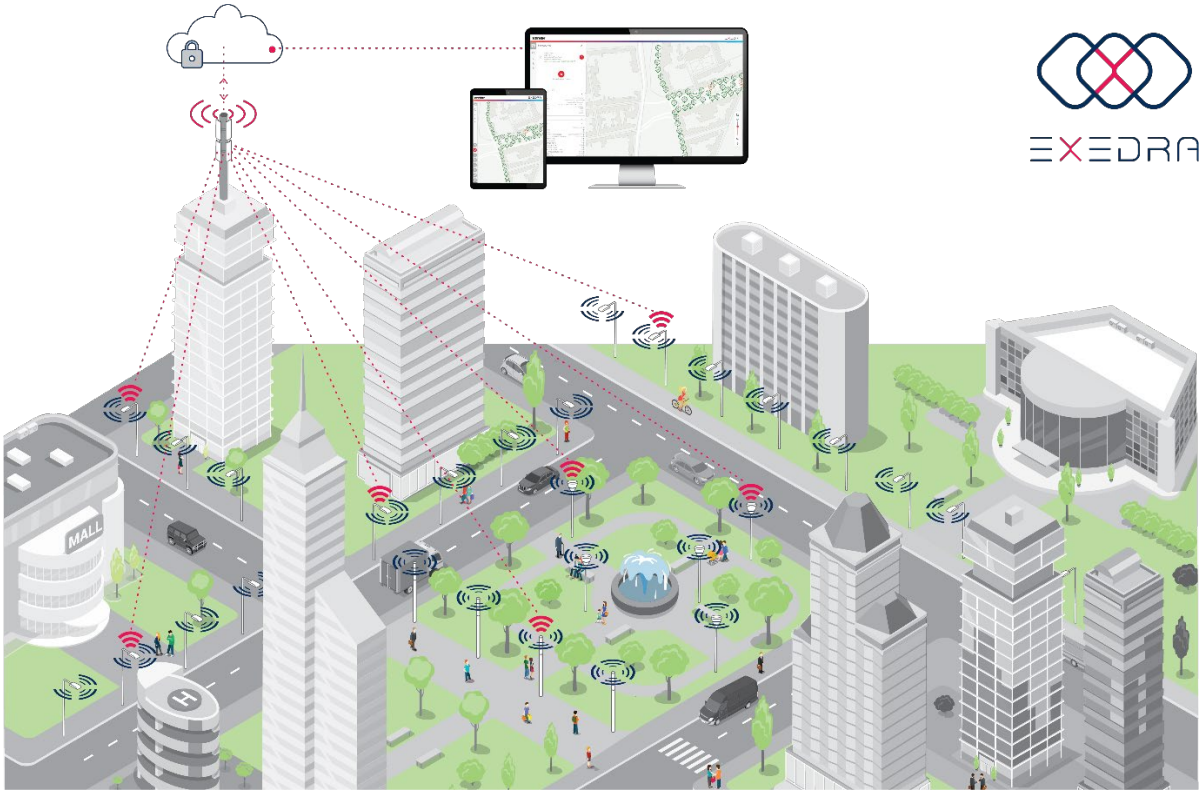
4 Schréder EXEDRA IoT platform

4.1 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, smart poles, IoT sensors, weather stations, and much more.



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

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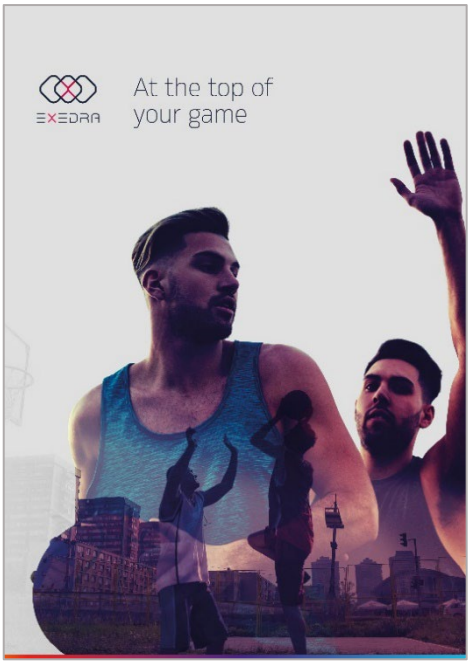
4.2 Key features

Schréder EXEDRA is a secure, open and interoperable smart city platform. It provides a highly effective remote lighting management solution, open to the integration of third-party devices and platforms. It supports multiple use cases related to smart lighting and beyond, and provides a real foundation for a city to become smart.

The key benefits of Schréder EXEDRA smart city platform are:

- Extensive list of supported features
- Intuitive and friendly user interface
- Mobile accessibility
- Powerful automation centre
- Technology-agnostic approach
- Robust data management
- State-of-the art security

4.2.1 Extensive list of supported features



Schréder EXEDRA supports an extensive list of key features such as:

- 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
- User management – roles & rights

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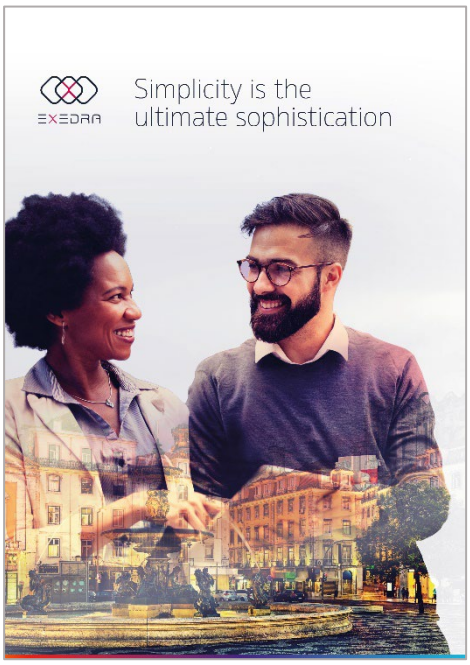
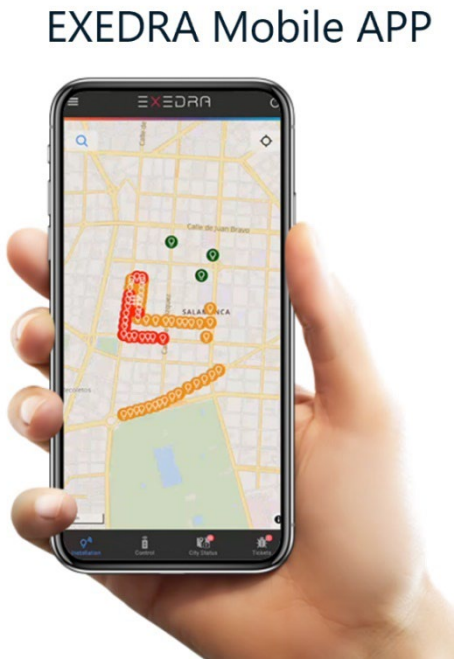
4.2.2 Intuitive and friendly user interface



Fully configurable dashboard:

- Ability to add customisable widgets
- Predefined set of reports
- Geolocation asset display and management
- Intuitive real-time control with visual feedback

4.2.3 Mobile accessibility



Schréder EXEDRA platform can be accessed using a Mobile App (Play Store and Apple Store) supporting multiple use cases:

- Installation support
- Real-time control
- City status & inventory
- Maintenance tasks

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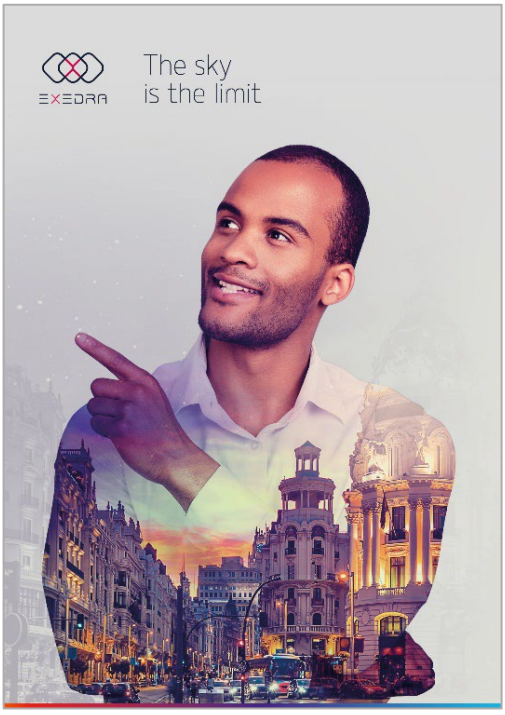
4.2.4 Powerful automation centre

The automation centre adds great customisation capabilities to the Schréder EXEDRA IoT platform, covering the creation of alerts, notifications, setting-up of custom events on the platform, performance of complex calculations, triggering of reports, and data aggregation.

4.2.5 Technology-agnostic

Schréder EXEDRA 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. The components of Schréder EXEDRA that help 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.

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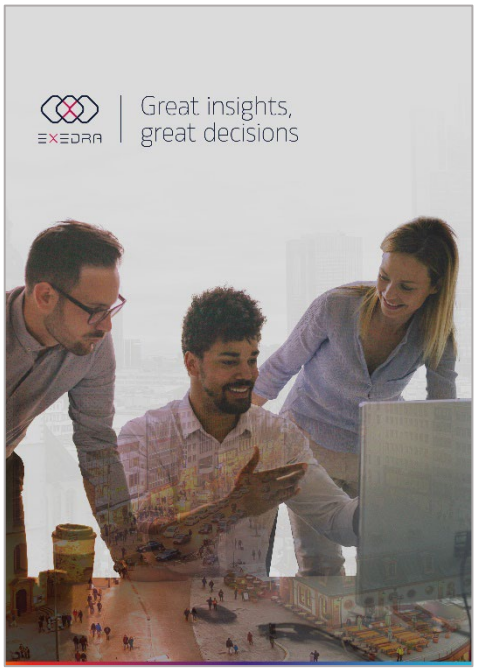
4.2.6 Data insights with robust data management

Schréder EXEDRA can process a huge amount of data collected from multiple sources to provide highly valuable data insights and analytics to the users, optimising the management of the smart city infrastructure. Schréder also believes in a strong data management strategy that starts by identifying the right tools for acquiring, validating, storing, protecting, and processing the 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.

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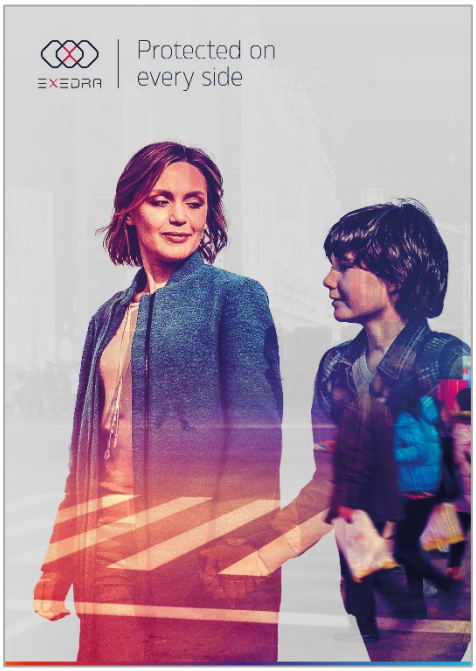
4.2.7 State-of-the-art security



Protecting customers and city infrastructure from harm is a key priority for Schréder. 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 in external device integration with the 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 third-party devices outside the 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 Schréder EXEDRA 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 in accordance with security by design principles. At the company IT organisation level, Schréder is in the process of setting up an ISO 27000 compliant Information Security Management System (ISMS) and obtaining ISO 27001 certification.

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5 End-to-end smart city solution overview

Schréder EXEDRA is part of our end-to-end smart city solution, being composed of the following components and layers:

- **Hardware platform & components**
  - OWLET luminaire controllers
  - Streetlight cabinet controllers
  - IoT sensors
- **Network and Communications platform**
  - Communications network: cellular, 802.15.4 mesh based on Wi-SUN FAN
  - Data models and protocols: LWM2M, uCIFI
- **Schréder EXEDRA IoT Platform – Central Management Software**
  - Schréder EXEDRA User Interface
  - Backend of Schréder EXEDRA IoT Platform

5.1 Schréder EXEDRA IoT Platform architecture

The Schréder EXEDRA platform architecture is built on open and interoperable standards. The cloud solution consists of a backend and a user interface. 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 sub-systems, and provide the flexibility to choose appropriate technology on a per subsystem basis. This allows the monitoring of individual subsystems, as well as the IoT platform as a whole.

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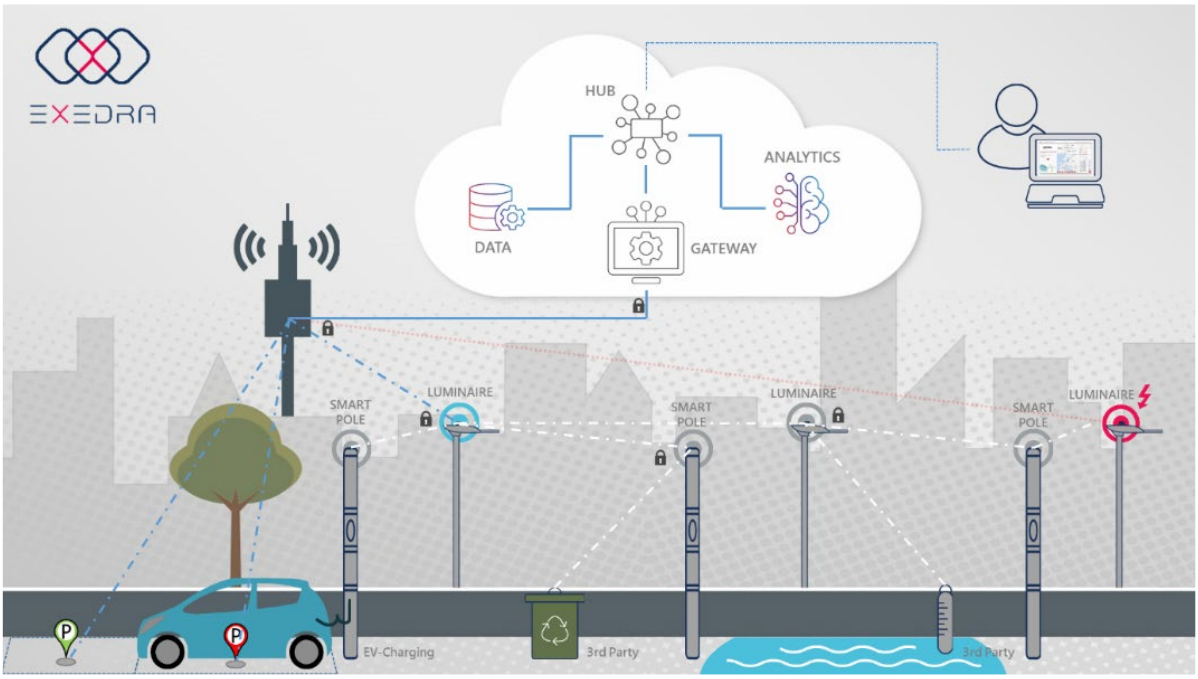
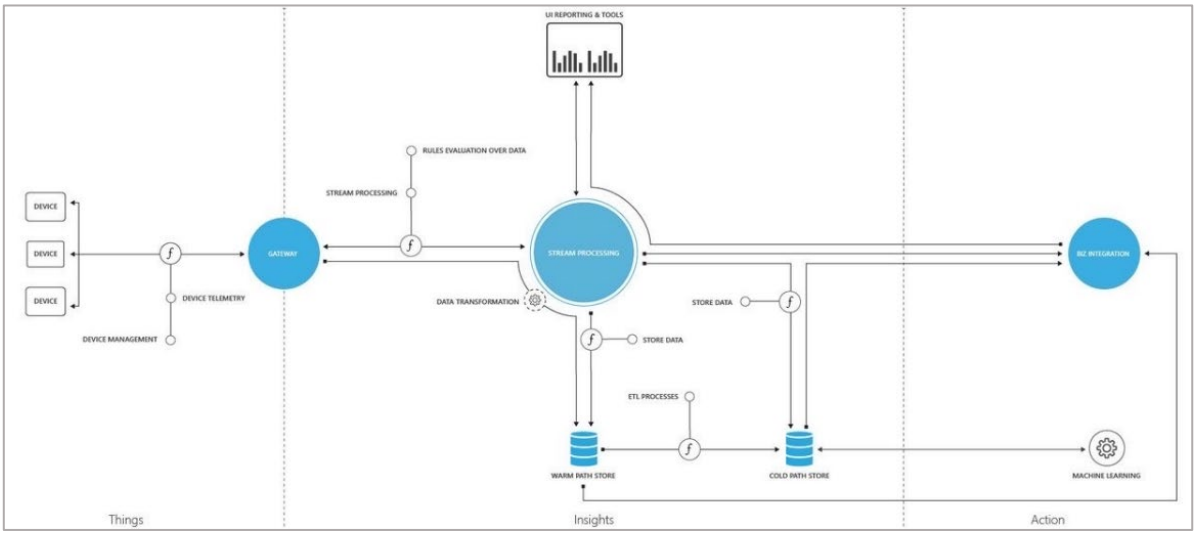


The backend of Schréder EXEDRA IoT Platform consists of Schréder's own development components, Microsoft Azure IoT components, and a user interface deployed on the Azure cloud.



Cloud architecture blocks

The **OWLET** luminaire controllers and Schréder EXEDRA IoT ecosystem include the following main components:

- **OWLET luminaire controllers** allow secure registration with the cloud and connectivity options for sending and receiving data with the cloud.

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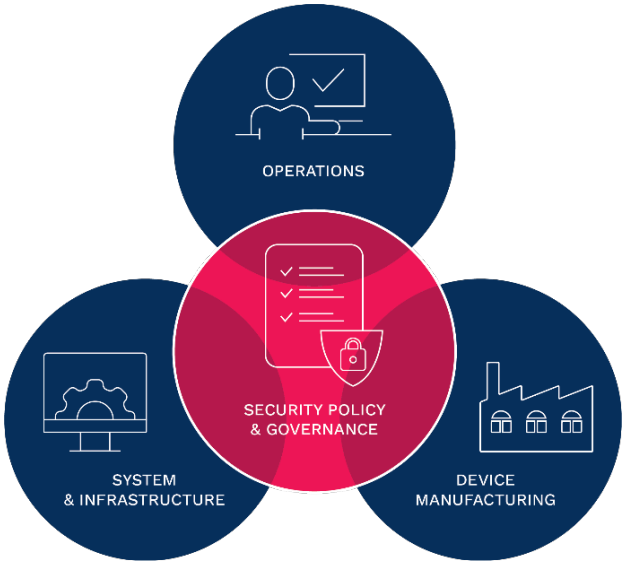
- **Virtual gateways** are software blocks that enable protocol, data, and schema adaptation. These gateways allow authentication, message transformations, compression/decompression, or encryption/decryption.
- **Stream processing** manages large streams of data records and evaluates rules for those streams.
- **Business Integration** is a set of APIs that enable connection to other external platform systems.

5.2 End-to-End security



To ensure that Schréder's smart city products and systems are robust and resilient to current cyber threats, Schréder (together with industry-leading security partners) devises and continuously improves security policies that apply to the entire lifecycle of its products, including specification, development, testing, operation, and maintenance.

To thoroughly control and protect assets from unauthorised access, disclosure of data, or manipulations to the intended device behaviour, it is not enough to focus on technological solutions. To this end, Schréder's **security policies** incorporate three key areas:

- Security features and design practices applied to **systems & infrastructure.**
- The enforcement of processes and best practices that result in **secured operations** of said systems.
- The combination of both **security features and operational processes** required to guarantee the security of assets during device manufacturing and assembly (a key domain in IoT security).

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5.2.1 Security policy & governance

At the company IT organisation level, Schréder is in the process of setting up an ISO 27000 compliant Information Security Management System (ISMS) and obtaining ISO 27001 certification. Besides ISO 27001, the security requirements envisaged for Schréder's smart city ecosystem draw heavily on the following security guidelines and regulations:

Identified regulations
EU NIS, EU GDPR **US FISMA** - US Import / Export Control (ECCN) - US Consumer Data Security and **Notification Act**

List of Schréder's selected IoT cybersecurity standards	
For the organisation	NIST CSF, ENISA, NISTIR 8259A, ENISA, ETSI, OWASP IoT TOP10
For the device	NISTIR 8259A, ENISA, ETSI, OWASP IoT TOP10
For the end-to-end IoT system	NISTIR 8259, ENISA IoT Security Standards Gap Analysis (V1.0 - 2018), IoT Security Foundation Framework
Secure Development Lifecycle (SDL)	Microsoft SDL or IEC62443

5.2.2 Securing operations

Over and above developing technical capabilities to provide an effective defence against cybersecurity threats, Schréder's commitment with security extends to the processes associated with the lifecycle of its smart city products and the governance of its operational teams.

Security policies are in place to evaluate new risks and threats, identify and assess adherence to relevant industry regulations/standards, train IT/security teams and raise employee awareness of security concerns and how to counter them. These practices are further supported by the following tools and processes supporting day-to-day operations:

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- **Schréder applies a Secure by Design methodology** – security requirements and associated impacts considered as early as possible in the system design and architecture studies.
- **Secure Development Lifecycle (SDL)**
- **Security Operations Centre (SOC)** monitoring the Schréder EXEDRA ecosystem – identifies, investigates, and resolves threats and cyber attacks.
- **Yearly security testing & audits** – Schréder EXEDRA is submitted to full penetration tests performed by reputed and certified third-party companies. The scope is the end-to-end solution, hardware, communication, and software platform testing.

5.2.3 System and infrastructure security

Traditional IT security solutions deal primarily with protecting sensitive information from exposure, corruption, or theft. Beyond data protection, device-related risks and security need to be considered as well when deploying a smart city solution on a large scale in the city.

To address these concerns, Schréder follows a multi-layered approach to system and infrastructure security, where specific measures are taken at the **device, communications**, and **data & application** layer. This **defence-In-depth** methodology provides continuous analysis of security risk vectors and mitigation of threat through a set of security processes and mechanisms described below.

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Within the Schreder EXEDRA IoT platform, security at the **data and application** layer encompasses all the security mechanisms and processes adopted on Schréder's cloud, which include the following:

- **Highly Available (HA) architecture** – Resiliency mechanisms are in place to minimise the impact of single points of failure and are complemented by proper backup and recovery procedures.
- **Services** are designed using a defence-in-depth architecture consisting of Azure Virtual Networks, firewalled access, and cloud-based monitoring.
- Use of **Microsoft Azure Security Centre** with machine learning to process trillions of signals across cloud services and systems, to provide alerts of threats to environments, such as DDOS, brute-force attacks and SQL injections.
- **Secure coding** (Web Application Security, API Security).
- **Data protection** at rest using an AES256 cryptographic algorithm. Data is encrypted during storage and restricted to read/write access to only authorised individuals, devices, and services.
- **User session security** – TLS 1.2, Multi-Factor Authentication (MFA), and session timeout.

5.3 Device commissioning and management

For intelligent streetlighting, Schréder delivers one of the most straightforward solutions to install and commission on the market. The first customer interaction with Schréder EXEDRA 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).

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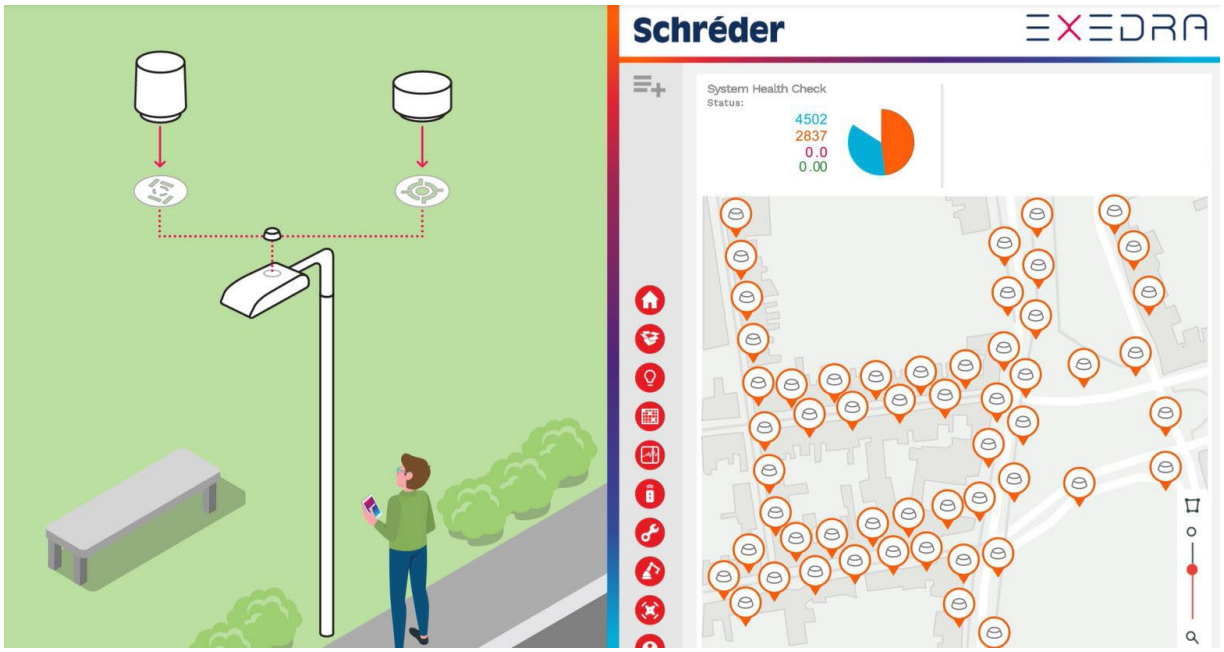
Physical **installation** of the controllers is simple and, after powering on the luminaire, the controllers will also be powered on to validate the installation.



Luminaire controller installation with auto-commissioning

A few moments after the luminaire controllers have been successfully installed, they will **automatically register** on the Schréder EXEDRA IoT platform to be fully commissioned. By mapping the geolocation of the devices to the geofences of the projects available on the platform, each device gets automatically assigned to the appropriate project, and gets commissioning data accordingly.

Additionally, the Schréder Exedra IoT platform offers device management functionality including firmware updates to IoT devices.

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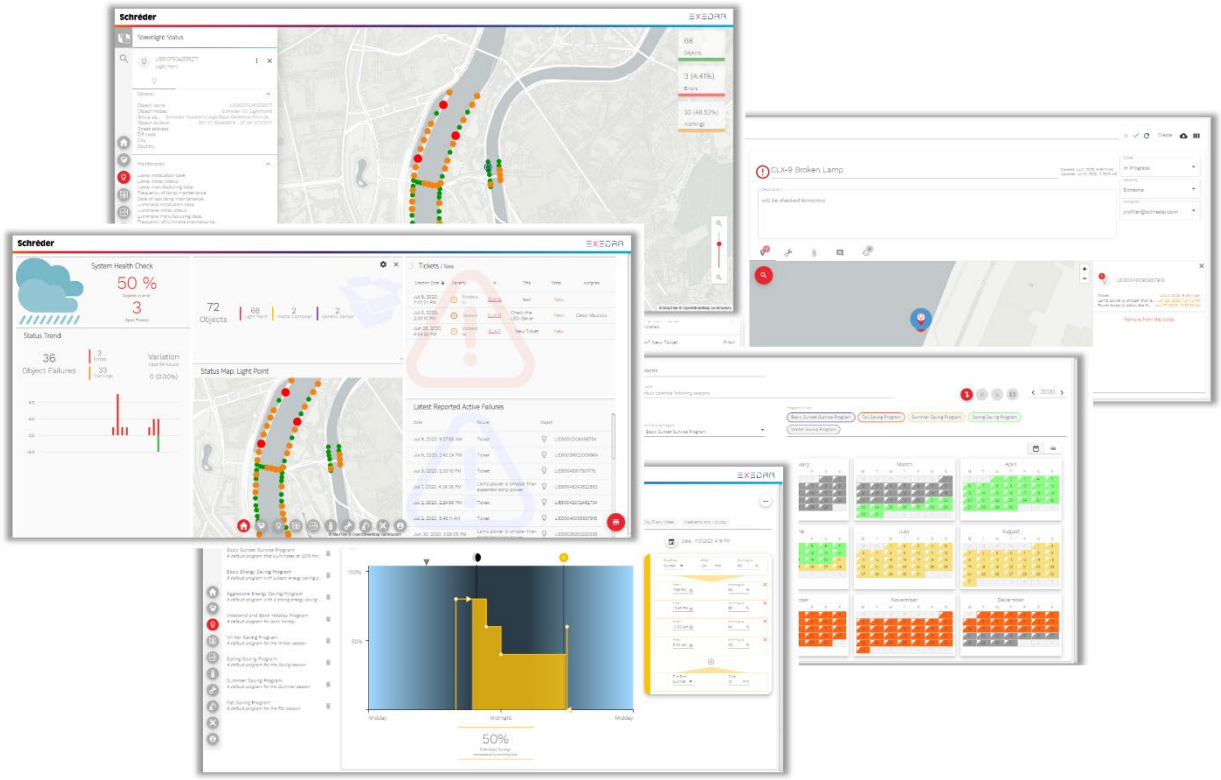
6 Schréder EXEDRA User Interface

The User Interface of the Schréder EXEDRA IoT platform is a responsive, user-friendly, robust software application. It is a web-based 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 Schréder EXEDRA 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 city solutions

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

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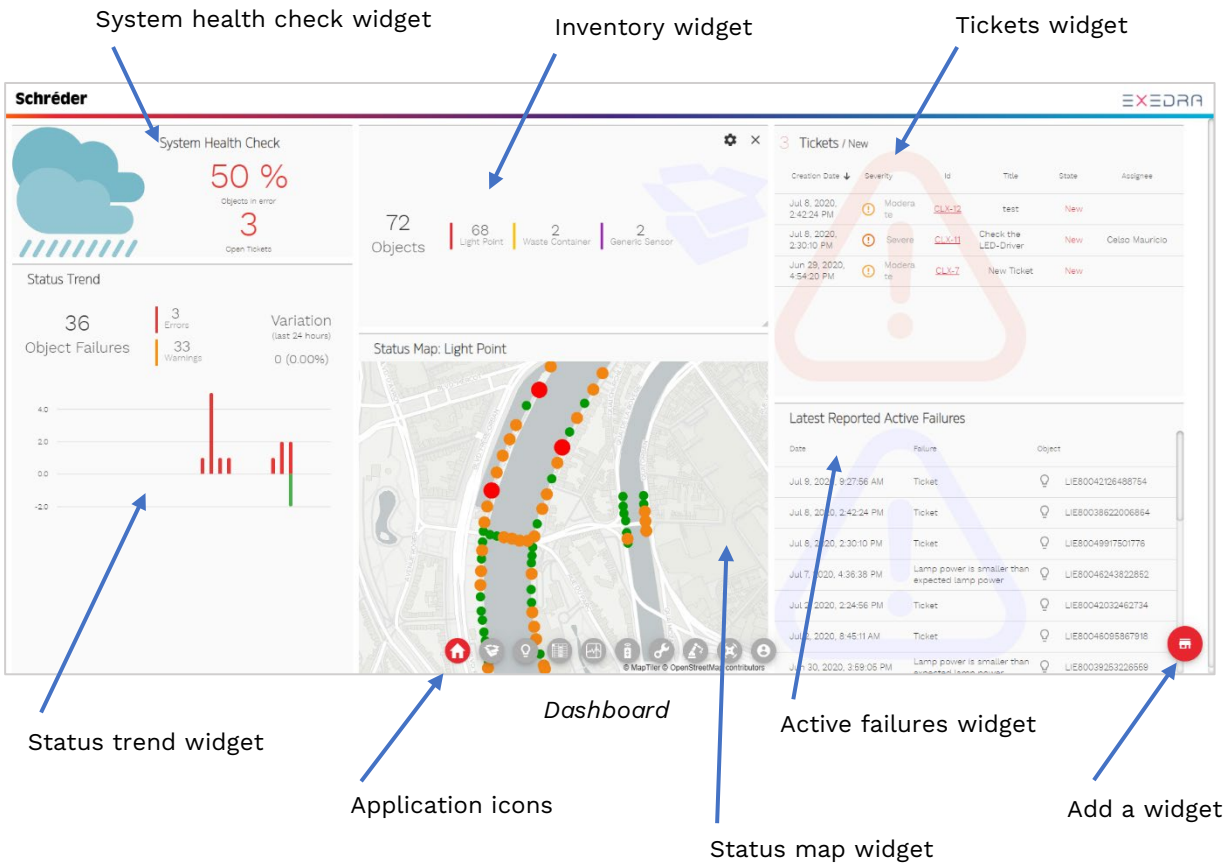
6.1 Fully configurable dashboard

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 customised per user. Users can move, resize, reorganise, add, or remove widgets to suit their needs.

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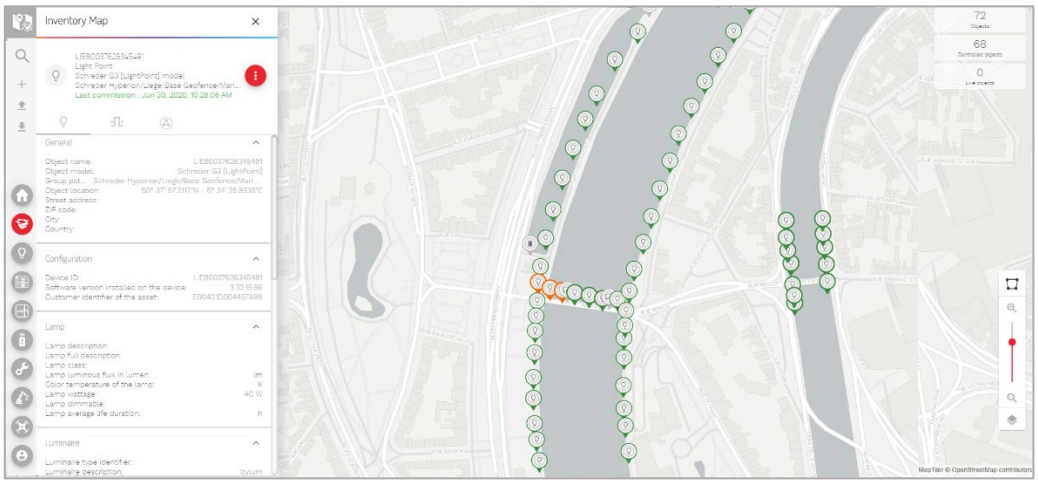
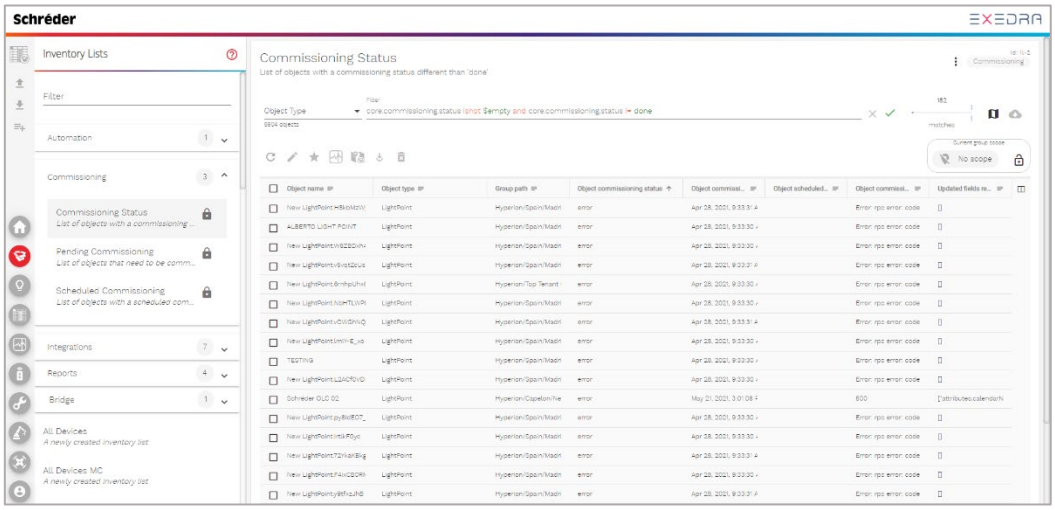
6.2 Inventory & device management

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 Schréder EXEDRA 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 thousands of devices to be bulk edited at once, create favourite lists, or trigger immediate or delayed device commissioning.



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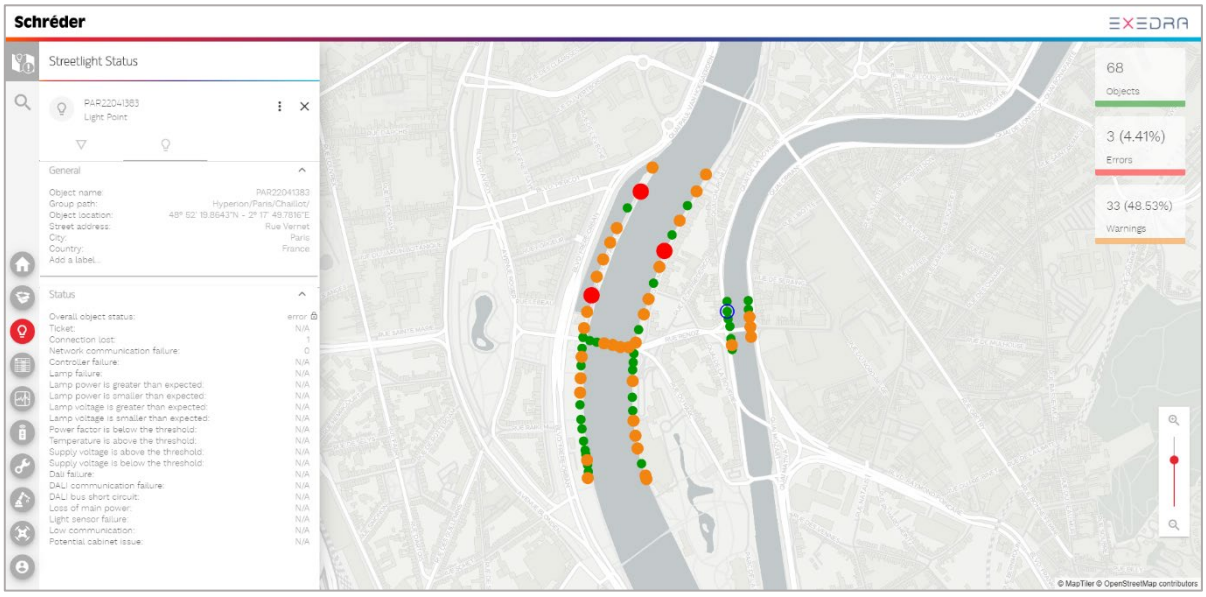
Inventory lists – list of devices

6.3 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

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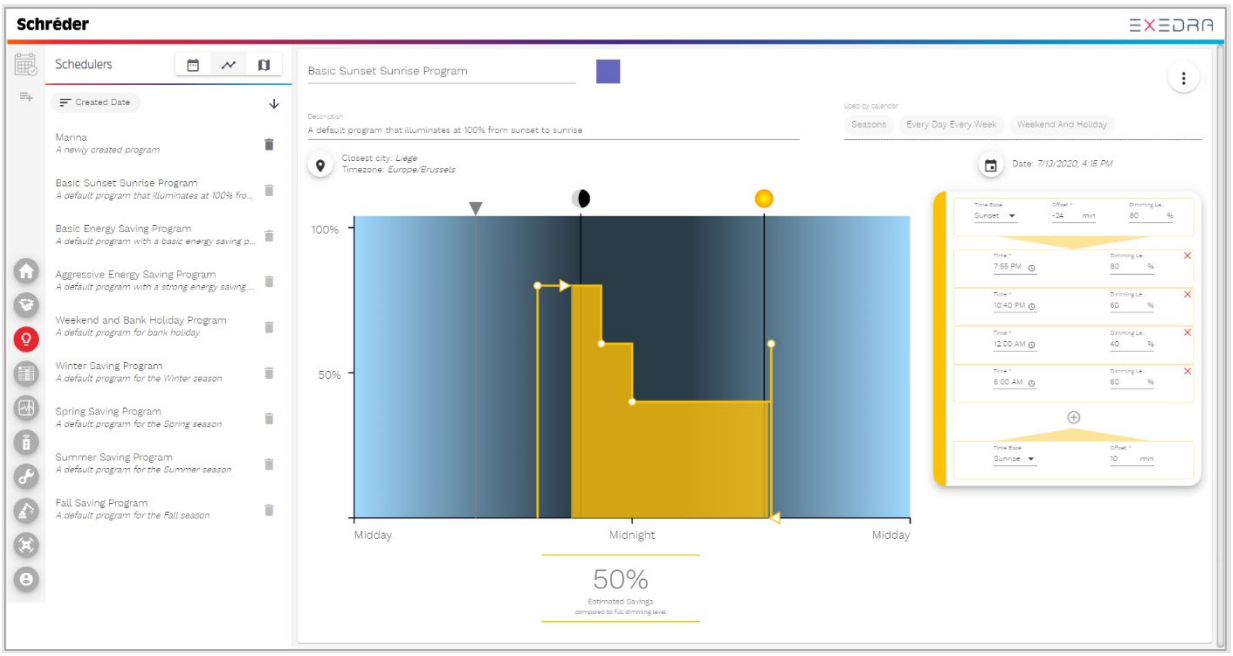
6.4 Lighting schedule management – control programs & calendars

Schréder offers new features regarding lighting dimming profile capabilities. The **Streetlight schedulers** application enables easy creation, editing, and deletion of control programs with different dimming levels and timings according to various scenarios, enabling significant energy savings to be achieved while protecting wildlife habitats.



Streetlight schedulers – control programs

The **Streetlight schedulers** application also enables users to configure control programs, adjusting light level and colour temperature on luminaires which support this technology. This feature is known as “tunable white” and allows modification of the light colour temperature of luminaires with a variable colour range.

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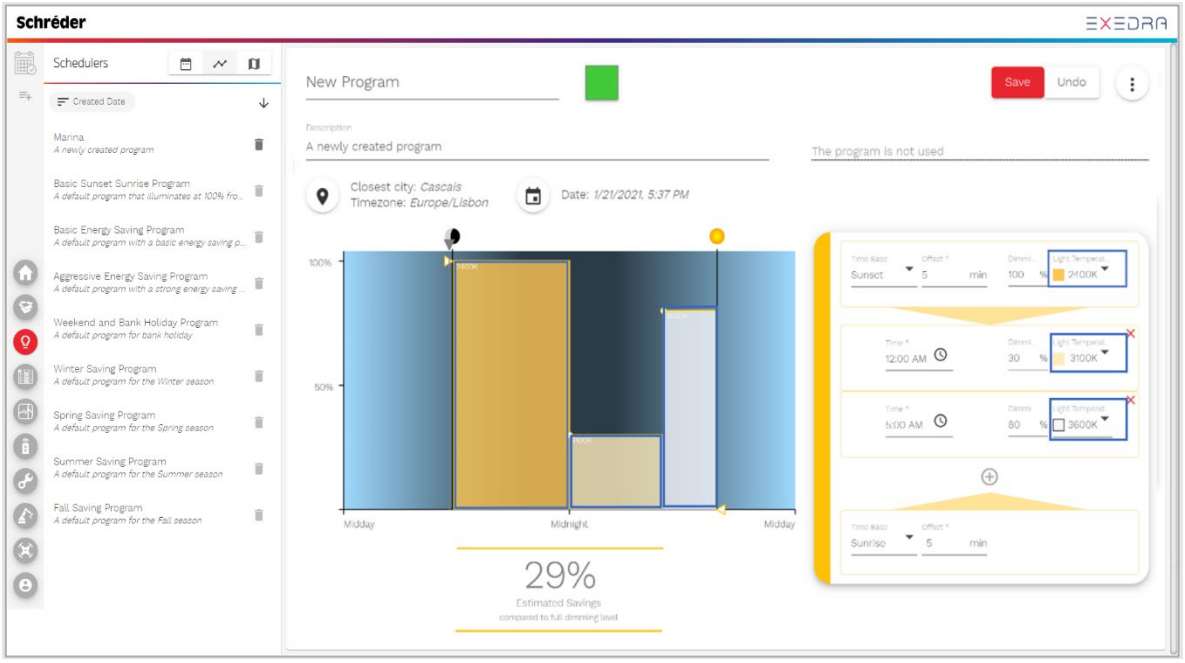
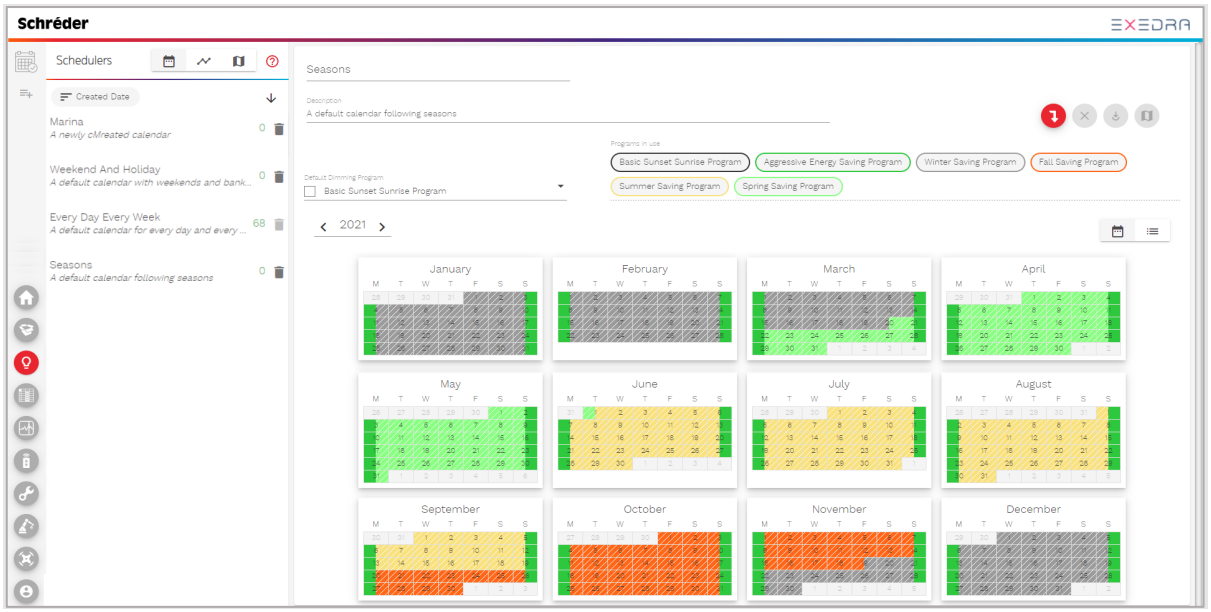


Streetlight schedulers – tunable white feature

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

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6.5 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 30% 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

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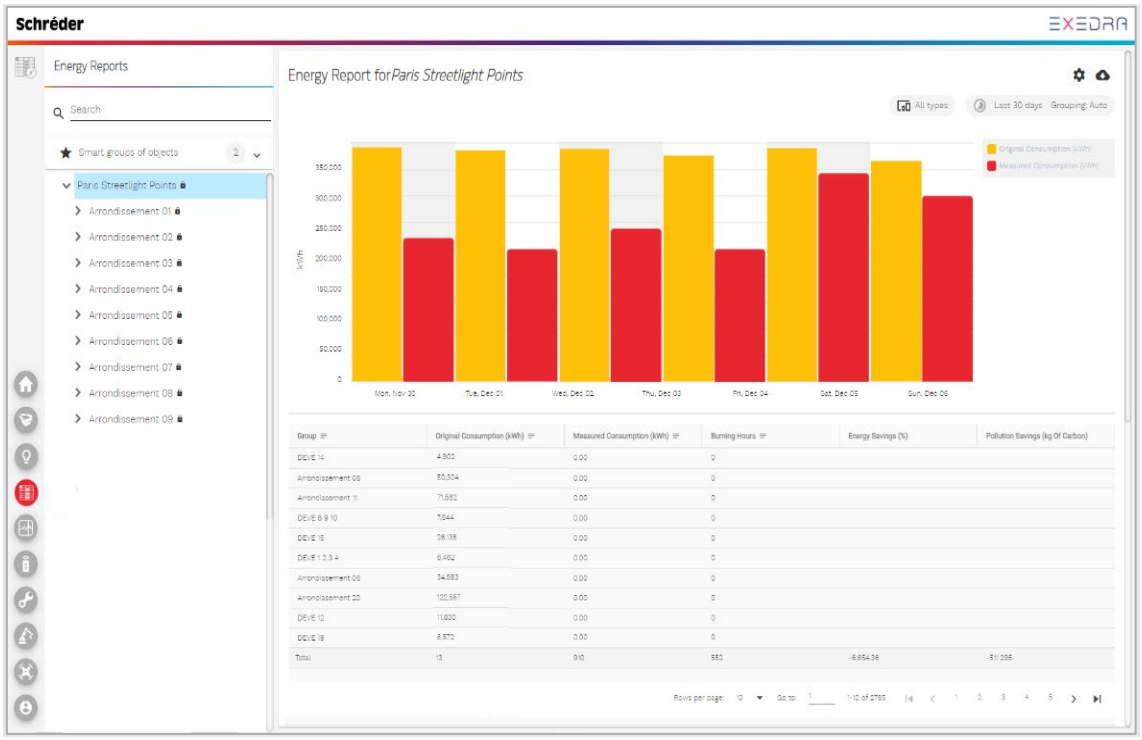
6.6 Reports, alarms & data analytics

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, analyse and fix them. The **Reports centre** 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) 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 CO_2 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.



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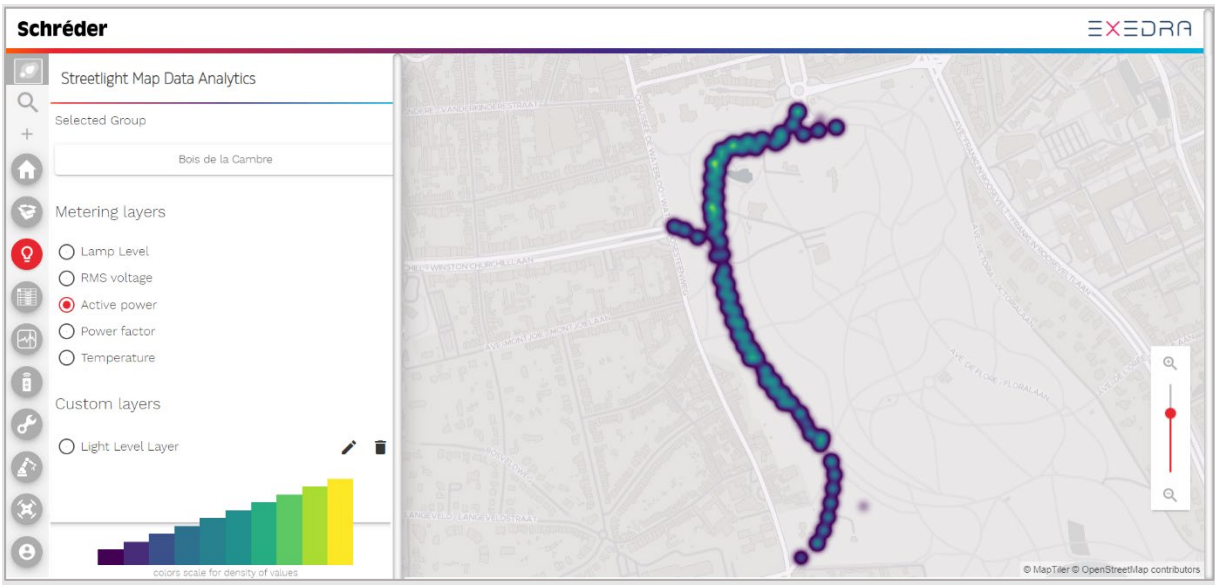
Reports centre– energy overview report

Additionally, the **Streetlight map data analytics** 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

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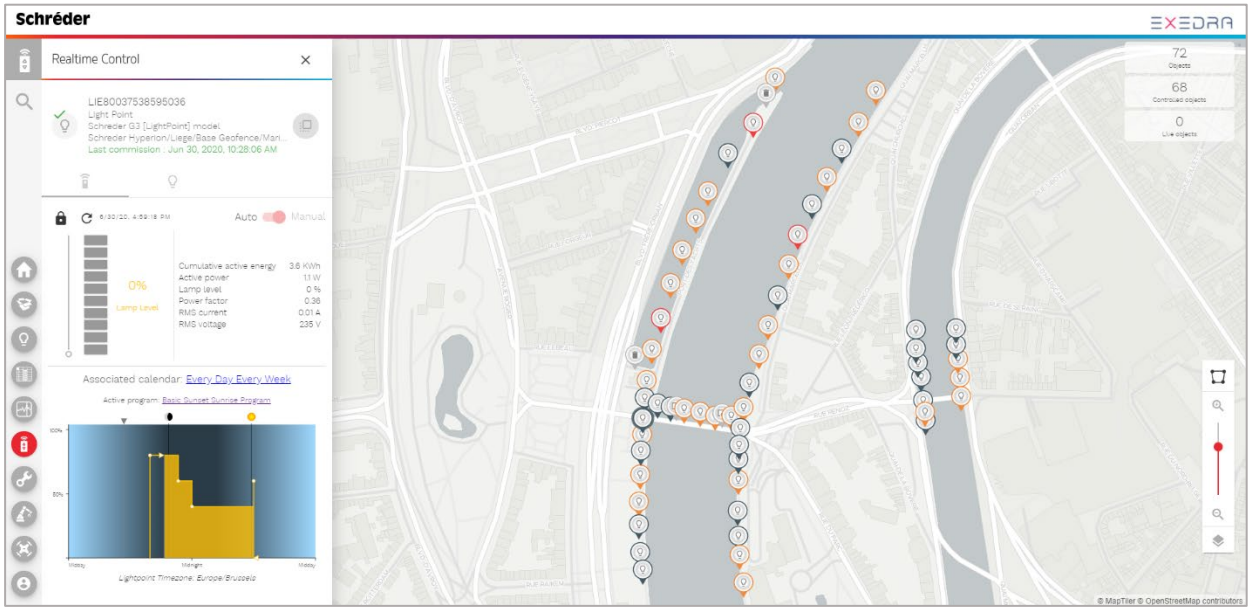
6.7 Surveillance, monitoring & real-time control

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

- Send a manual override command to a single or a group of luminaire controllers with a specific timing (e.g. switch a 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

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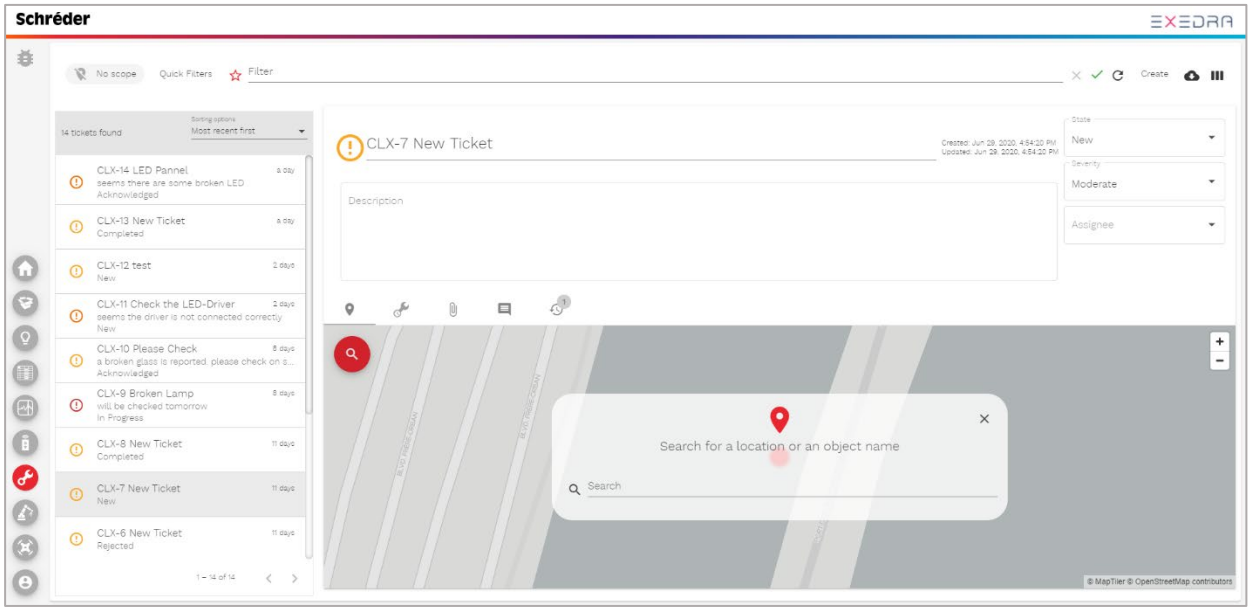
6.8 Asset maintenance & ticket centre

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 centre** 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 with a ticket along with a state, severity, assignee, description, optional comments and attached file (e.g. photo).



Tickets centre – ticket management

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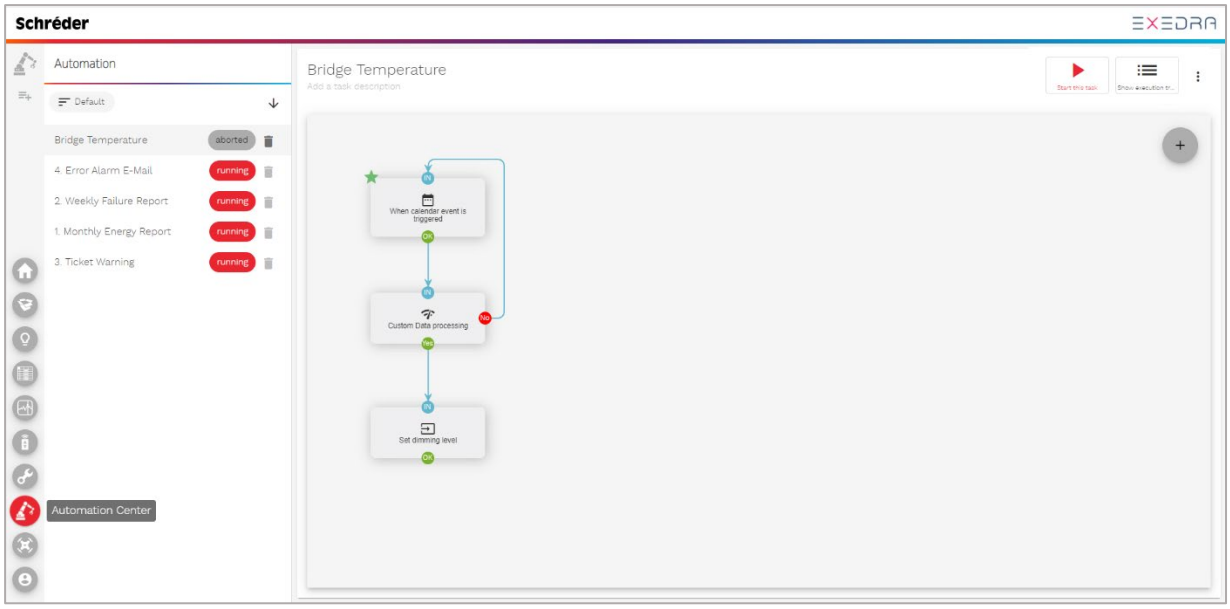
6.9 Automation centre

The **Automation centre** 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 execution of these tasks can be constantly monitored by the customer, and tasks can be scheduled as required.



Automation centre – alert management

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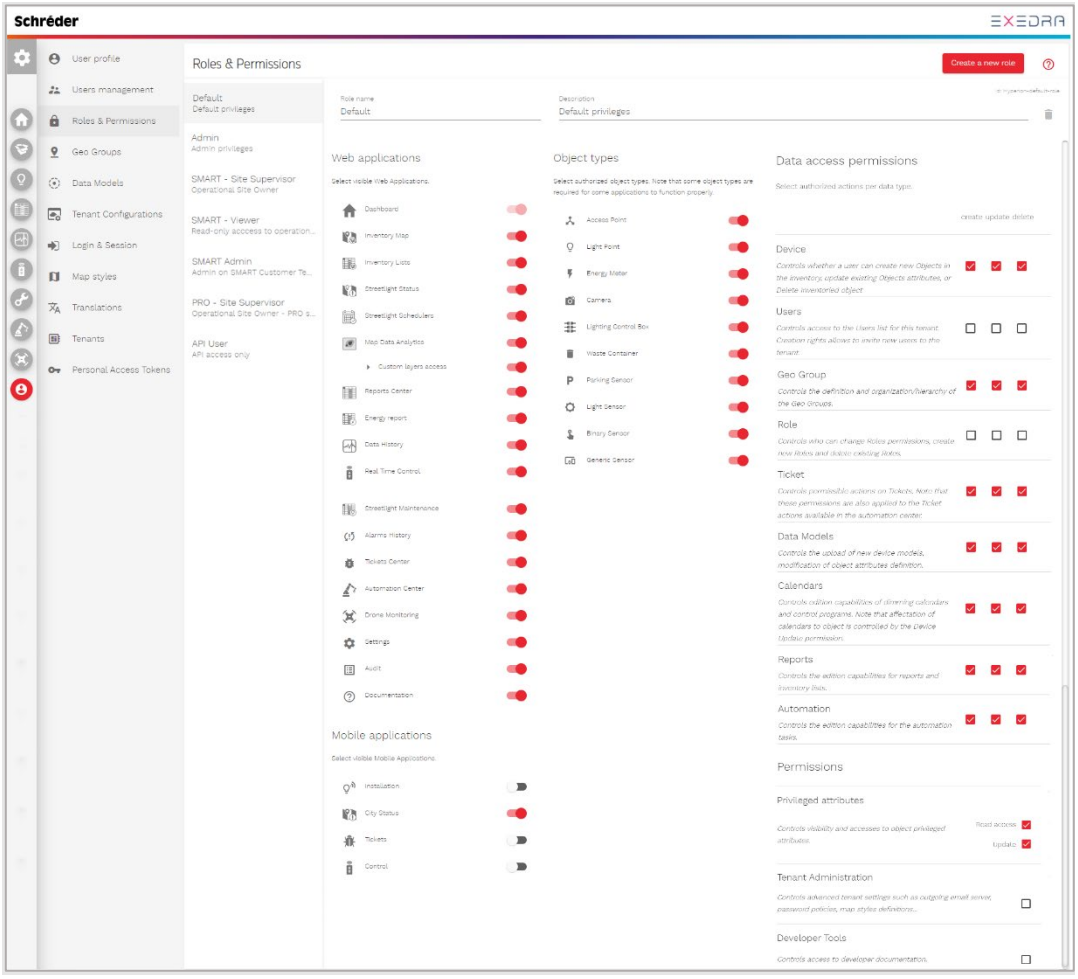
6.10 User management – roles & rights

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

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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 Schréder EXEDRA.

Auto-commissioning – Process that guarantees that a Schréder luminaire controller is automatically registered and configured as an asset on 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.

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ISO 27001 – An international standard issued by the International Organization for Standardization whose purpose is to implement an Information Security Management System that preserves the confidentiality, integrity, and availability of information.

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

Network – The network and connectivity elements of Schréder EXEDRA, enabling 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 and configuration settings, and updating encryption keys to devices.

OWLET Luminaire Controllers – Hardware devices and their embedded software components designed to monitor and control luminaires based on electronic drivers and sensors.

uCIFI – A non-profit alliance of individual companies, cities & IoT leaders committed to standardising 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.

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