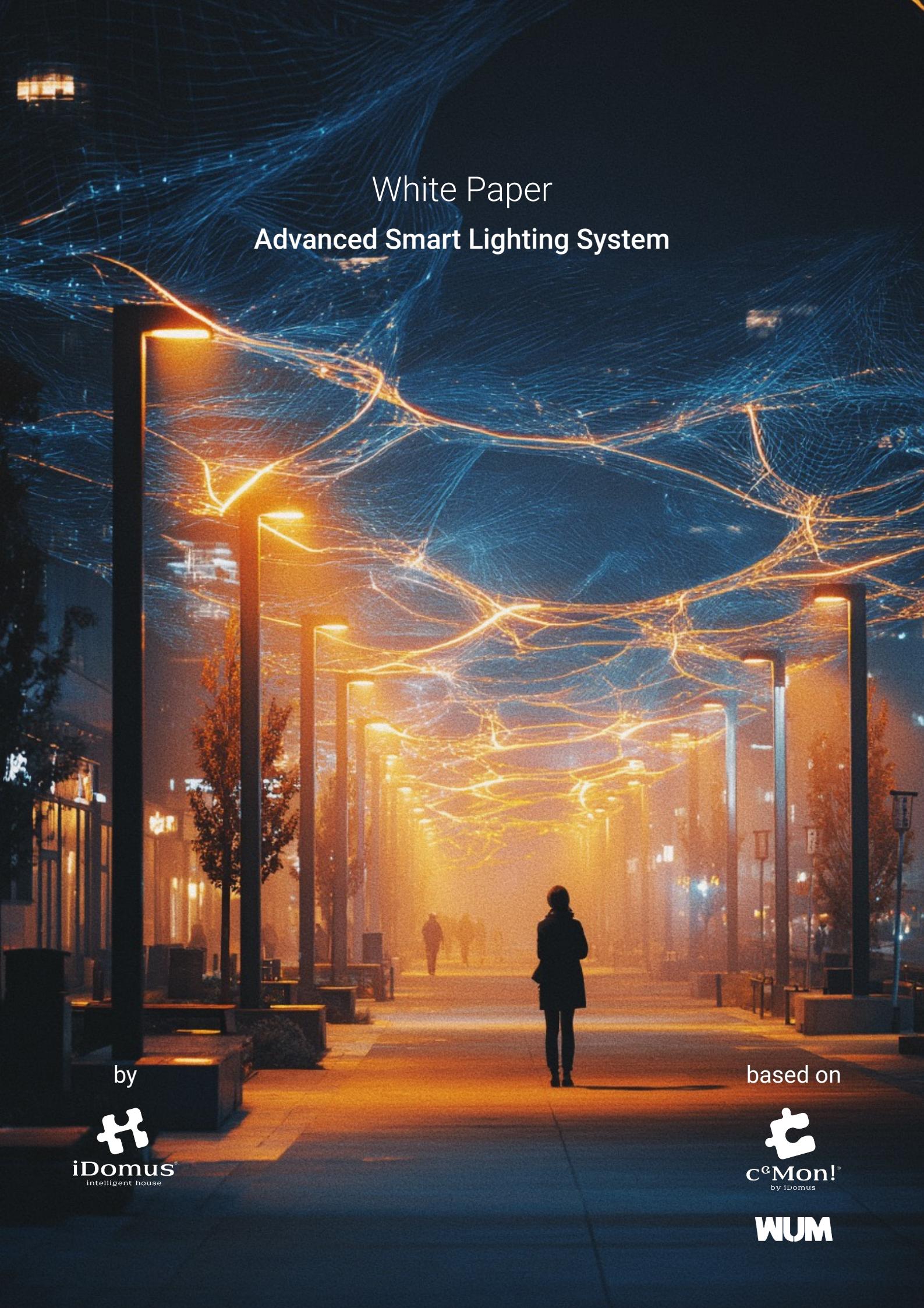


White Paper

Advanced Smart Lighting System



by

iDomus
intelligent house

based on

c^eMon!
by iDomus

WUM

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01 INTRODUCTION

Modern cities, enterprises, and residential communities are increasingly focused on improving energy efficiency, automation, and intelligent infrastructure management. Lighting systems are becoming one of the key areas for such transformation.

iDomus offers an advanced Smart Lighting solution that integrates our proprietary IoT platform – C&Mon! Center combined with the WUM Firefly LED lighting controllers, developed and manufactured in-house on our own SMT production line.



At the core of the system lies the **proprietary LoRa Mesh communication protocol**, which ensures reliable long-range wireless connectivity even in dense and challenging urban environments.

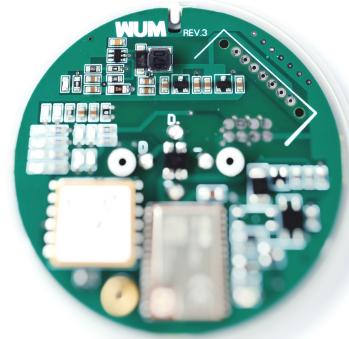
Support for open standards such as **DALI** and **ZHAGA** guarantees compatibility with both existing and future lighting systems and infrastructure.

SOLUTION ARCHITECTURE AND KEY COMPONENTS

The iDomus Smart Lighting solution is built on a modular, scalable architecture, which incorporates lighting control devices, a cloud platform for centralized monitoring and management, and communication gateways.

1. LED-controller WUM Firefly

These are compact and high-tech devices designed for controlling LED lighting in urban and industrial environments



Key Features:

- ✓ **Manufactured on our own SMT production line** - high quality and full control over the component lifecycle.
- ✓ **Support for the DALI** (Digital Addressable Lighting Interface) protocol - precise addressing and dimming of light units.
- ✓ **Compatibility with the Zhaga standard** – easy installation, replacement, scaling, and maintenance of lighting points.
- ✓ **Integrated sensors** (optional): light level, motion, and temperature.
- ✓ **Integrated energy monitoring and self-diagnostics** - improved system efficiency and reliability.



2. Communication Protocol: LoRa Mesh

The wireless infrastructure is built on iDomus's **proprietary LoRa Mesh protocol**, which combines the advantages of LoRaWAN with the flexibility of mesh networks:



- ✓ **Mesh Architecture:** multi-hop data routing between nodes extends coverage area with no need for additional gateways.
- ✓ **Low Power Consumption:** essential for autonomous power sources and long device lifespan.
- ✓ **High Signal Penetration:** Especially relevant in dense urban environments and indoors.
- ✓ **Built-in Mechanisms:** For network self-healing and traffic prioritization

3. IoT Platform C&Mon! Center

C&Mon! Center is a cloud-based solution for the centralized monitoring, management, and analytics of all elements within a lighting system.

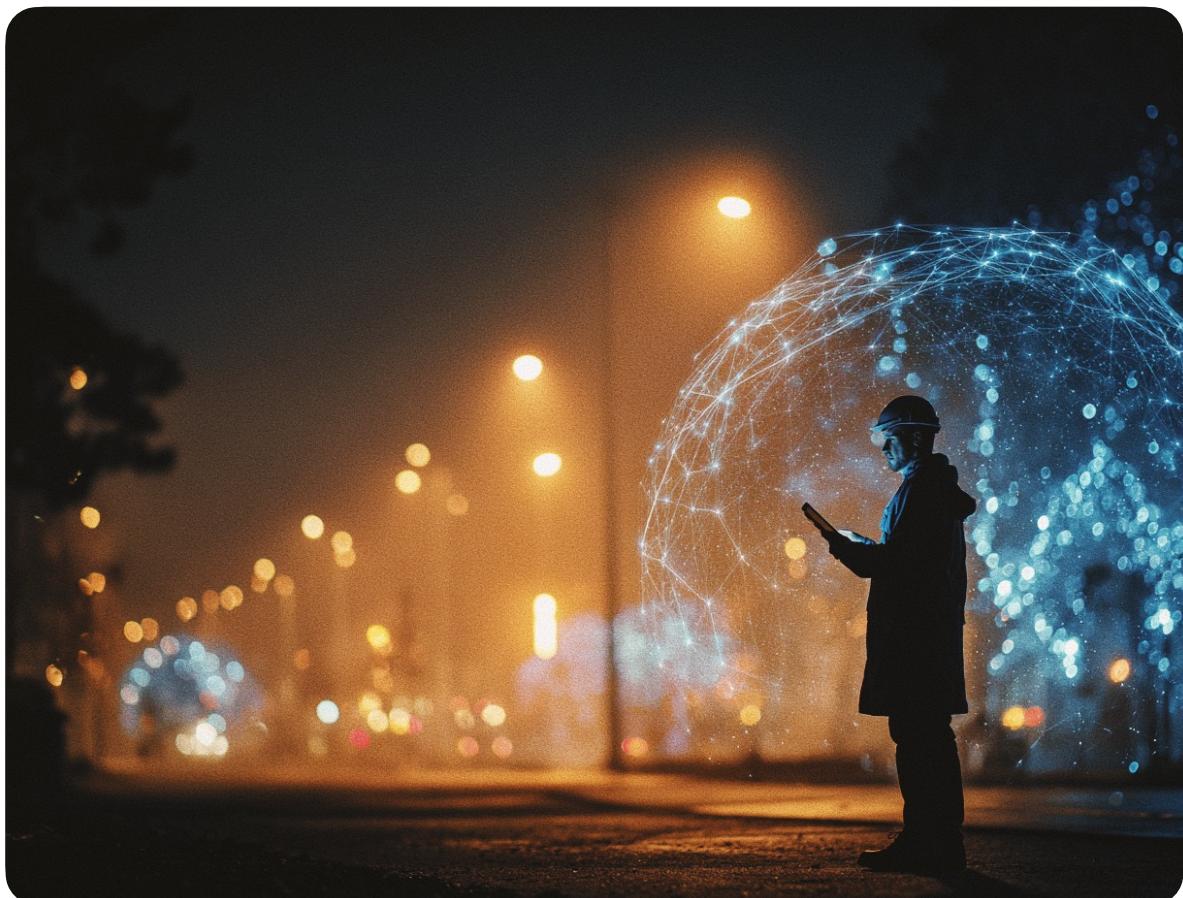


The platform provides:

- ✓ **Real-time dashboards:** Displaying light levels, energy consumption, and the technical status of nodes.
- ✓ **Flexible configuration of control scenarios:** based on time, events, or external APIs.
- ✓ **Integration via REST API and MQTT:** For interoperability with BMS, SCADA, and Smart City platforms.
- ✓ **Analytics and reporting:** Automated reports on SLA compliance, energy savings, and operational metrics.
- ✓ **On-premises deployment:** For closed or highly secure facilities.

4. Security and Fault Tolerance

The system was designed according to the principles of secure architecture, ensuring a high level of cybersecurity, resilience against external threats, and stable infrastructure operation. Encryption, authentication, redundancy, and auditing mechanisms are built in at all levels and guarantee reliability throughout the entire lifecycle.



- ✓ End-to-end data encryption at all levels.
- ✓ The ability to establish redundant communication channels.
- ✓ Comprehensive logging and auditing of all system actions.

03 AREAS OF APPLICATION

The **iDomus intelligent lighting system** is built as a flexible and scalable platform, capable of adapting to a wide range of scenarios – from modernization of urban infrastructure to automating lighting at industrial and remote facilities.

Its architecture enables seamless integration with existing infrastructure, enhances energy efficiency and system reliability, and establishes a solid foundation for future digital services.

The following section outline the main application areas, typical tasks, proposed solutions, and measurable outcomes of implementation.

Areas of Application	Tasks	iDomus Solution	Results
Smart City	<ul style="list-style-type: none">• Improving energy efficiency• Reducing operational expenses• Building a Digital Urban Infrastructure	<ul style="list-style-type: none">• Management of streetlights based on schedules and sensor• Integration with city's BMS and Geographic Information Systems (GIS)• Predictive maintenance using telemetry data from WUM Firefly	<ul style="list-style-type: none">• Up to 60% reduction in electricity consumption• Fewer maintenance visits• Improved illumination levels and public safety.
Industrial Facilities	<ul style="list-style-type: none">• Lighting control in workshops, hangars, and warehouses• Integration with warehouse automation and security systems	<ul style="list-style-type: none">• Use of DALI dimming for adaptive lighting• LoRa Mesh communication, with no need for cabling in hard-to-reach or remote areas• Integration with motion and light sensors	<ul style="list-style-type: none">• Optimized energy consumption with no negative effect on operational efficiency• Reduced deployment and maintenance costs• Enhanced workplace comfort and safety for personnel

Areas of Application	Tasks	iDomus Solution	Results
Housing and Communal Services	<ul style="list-style-type: none"> Automate lighting in building grounds and parking areas Monitor energy consumption and equipment status 	<ul style="list-style-type: none"> A decentralized system with autonomous controllers Support for lighting schedules based on time zones or sensors Centralized control through C&Mon! Center 	<ul style="list-style-type: none"> Improved quality of housing services Fewer complaints and service requests from residents and tenants Digital transformation of property management companies and homeowners' associations
Areas with restricted communication (military facilities, airports, logistics)	<ul style="list-style-type: none"> Creating a reliable lighting system with no dependency on cellular or Wi-Fi networks Enhanced requirements for autonomy and security 	<ul style="list-style-type: none"> LoRa Mesh provides communication over dozens of kilometers with minimal infrastructure Local gateways with offline operation capability Secure channels for management and diagnostics 	<ul style="list-style-type: none"> Operation even when isolated from external networks Flexible scalability as facilities expand Compliance with fault tolerance and cybersecurity requirements

iDomus intelligent lighting system delivers reliable performance in various operational environments and effectively meets lighting control challenges for facilities of all sizes and types.

Its modular design, distributed architecture, and use of standard protocols ensure compatibility with existing infrastructure, enhance fault tolerance, and enable seamless future system expansion without significant capital expenditures.

COST-EFFICIENCY AND RETURN ON INVESTMENT (ROI)

The implementation of intelligent lighting using the **C&Mon! Center** platform and **WUM Firefly** controllers delivers not only technological but also economic benefits.

The iDomus system achieves a rapid return on investment by significantly reducing operational costs, lowering energy consumption, and enhancing transparency of lighting management process



UP TO 60%
ENERGY SAVINGS



-70%
IN UNSCHEDULED
MAINTENANCE COSTS



SCALABILITY
WITH NO NEED FOR
ADDITIONAL CABLES



PAYBACK PERIOD
1-4 YEARS

1. Energy Savings

- Up to **60%** savings compared to traditional light sources (e.g., mercury and sodium vapor lamps).
- An additional **40%** in savings through intelligent control (dimming, schedules, sensors).
- Ability to manage peak load and participate in energy service contracts (ESCO model).

2. Reduction in Maintenance Costs

- Remote diagnostics and predictive maintenance.
- Reduction of unscheduled technical maintenance by up to **70%**.
- Minimization of downtime and human error through automation.

3. Flexible Scalability Without Network Capital Expenditures

- **LoRa Mesh** does not require laying cable infrastructure, reducing the cost of connecting new nodes.
- WUM Firefly controllers can be added in stages, starting with a pilot zone.
- Support for DALI/ZHAGA standards simplifies integration with existing light units.

4. Fast Payback Period

Facility Type	Average Payback Period
Street Lighting	2–3 years
Industrial Facilities	1.5–2 years
Municipal & Residential Areas	1–2 years
Isolated/Remote Facilities	2–4 years (depending on logistics)

5. Direct and Indirect Benefits

- Enhanced safety level due to stable and adaptive lighting.
- Improved environmental metrics, enabling participation in ESG programs.
- Increased customer loyalty and strengthened image of innovative management.

ADVANTAGES OF PLUG & PLAY AND GPS IN WUM FIREFLY CONTROLLERS FOR URBAN LIGHTING

The WUM Firefly controllers are developed to meet the requirements of municipal utilities, support Plug&Play installation, and are equipped with automatic GPS location. This enables direct installation on streetlights without preliminary configuration or on-site addressing. Once connected, the device is automatically recognized by the system, providing a range of operational and economic benefits.

1. Minimizing Installation and Commissioning Costs

- Installation requires no specialized staff training.
- Controller automatically connects to the network and registers on the C&Mon! Center platform.
- No addressing errors associated with manual configuration.

2. Automatic Mapping of the Lighting system

- Each device determines its GPS coordinates and sends them to the system.
- The platform generates a digital map of devices without additional site visits or manual measurements.

3. Simplified Operation and Maintenance

- The system always knows the exact location of each controller.
- Rapid localization of failures and maintenance planning based on operational data.

4. Scalability Without Project constraints

- Scaling of the system does not require individual projects for each new point.
- Rapid system expansion to new districts, streets, or populated areas.

5. Geofencing and Location-Based Management

- Lighting management based on actual geographical limits (streets, blocks, parks, etc.).
- Automatic scenario assignment by geozones without manual addressing.

6. Integration with Urban GIS Platforms

- GPS data enables immediate system integration with existing GIS, BMS, and SCADA systems without additional configuration.

7. Enhanced Reliability and Faster Recovery

- If replaced, the new controller automatically acquires the position of the previous one with no need for manual programming.

8. Reduced Administrative Workload

- No need for paper and Excel registers – all data is automatically stored and updated in the platform.

9. Smart City Compliance

- The solution meets modern digitalization and automation requirements specified in tender documents and government programs.

BENEFITS OF SCENARIO-BASED DIMMING WITH WUM FIREFLY

Intelligent scenario-based dimming enables precise regulation of illumination levels based on time of day, road activity, and weather conditions. This delivers direct economic benefits, reduces equipment load, and enhances environmental metrics of the urban environment.

1. Direct Energy Savings

- Energy consumption scales linearly with the dimming level.
- A 50% reduction in output delivers an equivalent reduction in electricity consumption.
- Flexible dimming during nighttime and low-traffic hours enables sustainable energy savings while maintaining required lighting levels.

Calculation Example (100 W lamp, 8 h/day):

Operating Mode	Duration	Power	Consumption
100%	3 h	100 W	300 Wh
50%	5 h	50 W	250 Wh
Total	8 h	550 Wh instead of 800 Wh – 31% savings	

2. Reduction of Light Pollution

- Reducing luminous flux at night decreases skyglow and improves the ecological environment.
- Compliance with IDA requirements and international standards for light pollution control.
- Enhanced resident comfort through reduced light spill into windows.

3. Extended Equipment Lifespan

- Operation at reduced output lowers thermal stress.
- Slows the lumen depreciation.
- Increases light unit life by 20–30% or more.

4. Flexible Management Scenarios

- Fixed nighttime level reduction (30–50%).
- Dimming during off-peak hours or based on weather conditions.
- Adjustments based on traffic and illumination data.
- Differentiated zonal dimming: residential areas, main roads, parks, etc.



5. Enhanced Road Safety

- Reduced driver glare during off-peak hours.
- Dynamic brightness increase upon detection of pedestrians or vehicles.

6. Centralized Management and Flexibility

- Scenario configuration via C&Mon! Center without on-site visits.
- Rapid adaptation to changes in urban environment.

7. Support for ESG Programs

- Reduction of carbon footprint and light pollution.
- Simple integration of metrics into ESG reporting.

The implementation of scenario-based dimming enables a shift from static lighting control to a dynamic model, driven by objective data and algorithmic management. This approach ensures precise distribution of lighting resources, optimizes light unit operating modes, and reduces infrastructure load—especially critical for large-scale urban projects. Centralized control and use of standardized protocols simplifies integration with existing management systems, reducing deployment complexity.

Economic and operational benefits are complemented by systemic effects: increased process transparency, improved control over the urban environment, and simplified planning for maintenance and monitoring. This creates a sustainable foundation for long-term lighting modernization and ensures compliance with contemporary requirements for energy efficiency, digitalization, and environmental standards.

STREET LIGHTING MANAGEMENT AT MDU LEVEL

Modern urban lighting systems require not only addressable control of individual light units but also comprehensive digital management at the level of main power distribution lines. These lines power entire streets, districts, and industrial zones, making their automation a critical component of a complete lighting management system. **iDomus** provides a solution for automating main distribution units (MDUs) with full integration into the **C&Mon! Center** platform, enabling unified control of the entire upper-level infrastructure.

Management Infrastructure



The **C&Mon! Center** platform enables automation of MDUs using the **C&Mon!** device series:

- **Relay Modules URM-4450 și URM-2250** – for remote power line control (ON/OFF, scheduled scenarios, emergency shutdowns).
- **Measuring Modules UMM-66VC și UMM-33VC** – monitor voltage, current, power, phase imbalances, leakage currents, and other key parameters.
- **WUM Data Concentrators and Gateways** – local data aggregation and primary logic (edge processing), integrating grid automation into the overall IoT network using LoRa Mesh, Ethernet, LTE, or RS-485.

Automation Functions

- **Monitoring and control of MDU:** by each line and phase, with logging of all events and faults.
- **Flexible ON/OFF scheduling**, including astronomical timekeeping, seasonal adjustments, and weather-based changes.
- **Automatic detection of faults: including breaks, overloads, short circuits, etc.** – with immediate notification dispatch.

Integration with C&Mon! Center Platform

- ✓ Registration of MDUs as intelligent nodes with association of GPS coordinates.
- ✓ Visualization on city map and scenario synchronization with individual light unit function.
- ✓ Support for binary logging and auditing required for municipal contracts and energy accounting.

iDomus Approach Advantages

Modularity

iDomus solutions can be deployed in stages, with no need to replace existing MDUs or infrastructure. Individual modules can be easily integrated into already installed systems, reducing capital expenses and making it easier to upgrade projects of any scale.



Data Transmission Versatility

A single system supports various communication channels – **LoRa Mesh, LTE, Ethernet, and RS-485**. This enables flexible adaptation to site conditions, using existing communications infrastructure, and reliable connectivity even with limited infrastructure capabilities.



Energy Efficiency and Metering

Automated data acquisition and analysis from MDUs reduces technical losses, optimizes consumption, and allows integration with smart meters. This approach ensures transparent and accurate real-time energy accounting.



Unified System Architecture

The entire network – from main power lines to individual lights – is managed through a unified **C&Mon! Center** platform. This simplifies overall management of the system, ensures coordinated operation across all system levels, and creates the foundation for further digitalization of urban infrastructure.

ADVANTAGES OF URBAN STREET LIGHTING NETWORK MANAGEMENT WITH iDOMUS SOLUTIONS

The iDomus system approach enables full-scale management of the urban street lighting network – from main distribution units to individual lights. The C&Mon! Center platform consolidates control, monitoring, analytics, and integration with other municipal systems within a unified architecture.

1. Unified Platform for Complete Lighting Network Management

- **Centralized control and monitoring** of both **main power distribution units** and each individual light unit through a single platform – **C&Mon! Center**.
- The entire lighting network is visualized within a **single interface**, mapped to the city's layout and **geographical coordinates**.

2. Power Supply Control of Entire Districts

Full control of MDUs using:

- ✓ C&Mon! relay modules (switching lighting lines on/off).
- ✓ C&Mon! metering modules (energy metering, diagnostics).
- ✓ WUM gateways (communication with the central platform).

3. Individual Control of Each light unit

Complete control of the operating parameters of each lamp via WUM FireFly controllers:

- ✓ Switching on/off.
- ✓ Scenario-based dimming.
- ✓ Acquisition of operational and consumption data.
- ✓ Self-diagnostics and status monitoring.

4. Flexibility in Creating Scenarios at Any Level

- Separate scenarios for individual zones, streets, districts (main/trunk level).
- Scenarios at the level of individual light units (pinpoint configuration).
- Fast reconfiguration without on-site visits.

5. Digital City Lighting Map

- Automatic map creation with all devices linked by GPS coordinates.
- Real-time visualization of status and energy consumption.

6. Instant Failure Detection at All Levels

- Notifications of overloads, line breaks, and outages at the main distribution level.
- Notifications on individual lights malfunctions.
- Logging of all events for reporting and analysis.

7. Improved Energy Efficiency and Transparency

- Energy metering for each MDU and each light unit.
- The ability to implement various operating modes for different city zones.
- Support for energy service contracts (ESCO) based on accurate data.

8. Reduction of Operational Costs

- Fewer maintenance visits due to remote diagnostics.
- Optimization of light unit operation based on time, motion, and weather conditions.
- Extended light fixture lifespan through controlled dimming.

9. Integration with other City Systems

Open APIs (REST, MQTT) for integration with:

- ✓ City BMS/SCADA.
- ✓ Smart City platforms.
- ✓ Security and video surveillance systems.

10. Improved Urban Environment Quality and Safety

- Optimal lighting balance across different zones.
- Reduction of light pollution.
- Increased comfort and safety for citizens and drivers.

Comprehensive management of the city lighting network using **iDomus** solutions creates an integrated, transparent, and easily scalable system. The centralized platform, distributed architecture, and modular approach ensure the coordinated operation on all infrastructure levels—from main distribution units to individual lights. This enhances system reliability, simplifies operation, and makes urban lighting management a predictable and controlled process.

Due to its configuration flexibility, open interfaces, and support for main standards, the system easily adapts to the specifics of any city or region. This solution lays the foundation for **the development of smart urban infrastructure**, where lighting becomes not a separate subsystem, but an integrated element of the digital environment, capable of supporting strategic objectives in energy efficiency, sustainable development, and improving the quality of urban life.

The implementation of the **iDomus Smart Lighting system** can be carried out either in stages, starting with a pilot zone, or as a comprehensive deployment within a city or enterprise.

The project structure covers the entire system lifecycle: from pre-project survey and engineering design to commissioning, maintenance, and further development.

Stage	Key Tasks	Results
1. Pre-Project Survey and Pilot	<ul style="list-style-type: none"> Audit of the existing lighting infrastructure Definition of target zones, automation levels, and equipment list Deployment of a pilot zone (5–50 lighting points and 1 main distribution unit) 	Accurate real-time data on illumination, communication, and energy consumption
2. Design and Equipment Configuration	<ul style="list-style-type: none"> Development of a layout plan for WUM Firefly controllers, LoRa Mesh gateways, and C&Mon! modules Selection and adaptation of control scenarios for specific tasks (e.g., automated switching based on GPS and weather) Configuration of the C&Mon! Center platform and integration with the corporate/municipal IT infrastructure 	A completed project design and system configuration
3. Installation and Commissioning	<ul style="list-style-type: none"> Step-by-step equipment installation (starting with main distribution units) Commissioning procedures, functional and load tests Personnel training and handover of documentation 	A fully operational system
4. Maintenance and Development	<ul style="list-style-type: none"> Post-warranty maintenance, software and firmware updates System further deployment: adding new zones, integration with other smart city modules SLA support and 24/7 technical support (optional) 	Reliable operation and scalable growth

The **iDomus** Intelligent Lighting System - is not just a lighting control technology, but a comprehensive digital infrastructure that creates a foundation for smart cities, energy-efficient enterprises, and sustainable utility services.

By combining reliable **WUM Firefly** controllers, the scalable **C&Mon! Center** IoT platform, the innovative **LoRa Mesh** protocol, and the modular **C&Mon!** system for MDU automation, the system allows to:

- ✓ Reduce electricity and maintenance costs.
- ✓ Increase transparency and control over assets.
- ✓ Integrate lighting into the overall digital ecosystem of a city or enterprise.
- ✓ Rapidly scale the system without capital investment in cable infrastructure.

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