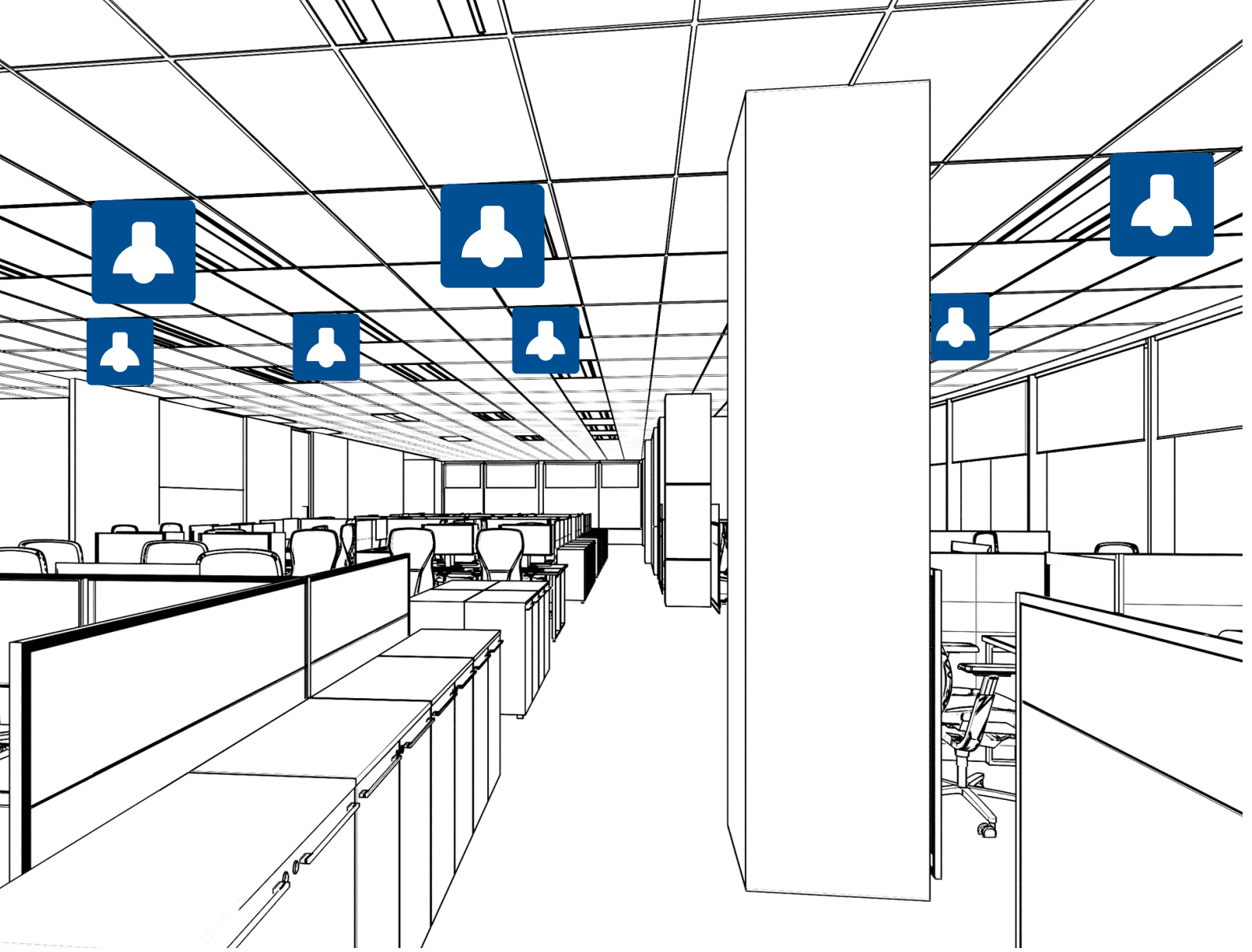
MICROSENS

WHITE PAPER

Smart Lighting - Light provided by the network



LED lighting on the rise

LEDs are increasingly replacing conventional light sources in the workplace. Particularly in modern office buildings in which special emphasis is placed on ergonomics, convenience and energy efficiency, LED lighting solutions are indispensable.

Fluorescent lamps were first used over 80 years ago. The concept of UV light created from a gas discharge converted into visible light by means of a fluorescent material is even older, dating back almost a hundred years. Lamps and their ballast units have continued to develop over the course of time. They became dimmable and are now integrable in bus systems thus allowing various lighting scenarios at the press of a button. However, the programming for such bus systems is complex compared with configuring IP devices at the click of a mouse.

Modern LED light sources offer numerous advantages over traditional lighting. The light they emit largely corresponds to natural daylight, which makes for pleasant light perception.

LEDs are continuously dimmable such that lighting can also be adapted without problems to frequently changing requirements.

Above all, LEDs are characterised by unrivalled energy efficiency, however. They need no high ignition voltage like conventional fluorescent lamps and can be operated at low voltage with energy supplied by Power-over-Ethernet (PoE) or Power-over-Ethernet Plus (PoE+), depending on the design.

Lighting through Power-over-Ethernet

The energy supply to terminal devices using Power-over-Ethernet is standardized worldwide. In contrast to classical electrical engineering, there are no national differences. The power supply is provided via the data connection and utilises the proven principle of remote supply of terminal devices with DC voltage

Two variants are currently available:

Power-over-Ethernet (PoE) in accordance with IEEE 802.3af works with a DC voltage of 48 V. A maximum power of 12.95 W is available at the terminal device.

Power-over-Ethernet Plus (PoE+) in accordance with IEEE 802.3at typically works with a DC voltage of 54 V. A maximum of 25.5 W is available at the terminal device.

As the power supply to PoE-enabled devices comes directly via the data connection, a 230 V connection is not required. The use of low voltage means that a qualified electrician is not required for installation and maintenance, either for the devices or for the necessary infrastructure. Lighting is fully integrated in the infrastructure for distributed building systems and so becomes part of the IT system.

Power limitation of the devices supplied (power sourcing equipment or PSE) and the LED lighting smart engine provide an extra measure of safety. If the engine is backed up with a UPS, as is otherwise common in IT, the lighting also works in the event of power failure.

User-friendly and convenient: light control from a tablet or smartphone

Modern LED panel with integrated controller and sensor

Modern LED lighting solutions

The systems used in building technology are developing inexorably towards IP. Telephony led the way, followed by video surveillance and now there are evermore technical equipment systems and building automation: Devices used for admission control and time stamping are available with an IP connection, and increasingly also sensors and actuators that were previously mainly connected via bus systems. The internet of things (IoT) has now become the state-of-the-art in smart buildings Modern LED lighting systems consist of just a few components: the lamp with the LED light source, a smart lighting controller for communication and integration of lamps and sensors in the IP network, a sensor to measure the environmental parameters, a smart engine to supply lamps with power via PoE+, a network switch as the intelligent control center for the lighting system, and an app on the switch as a mini program to provide the necessary functionalities.

System Components

Smart Engine

The smart engine takes care of the energy supply to the lamps with Power-over-Ethernet Plus. It uses suitable, standard data lines, as are also used for the IT infrastructure.

The smart engine can be accommodated in a data processing cabinet or electrical control box, but also directly decentralized, e.g. installed in a suspended ceiling. The number of engines is determined by the scope and expansion of the lighting system.

MICROSENS Smart Engine supplies the lamps with power

Sensors

Sensors close to the lamps measure the environmental parameters. Presence detectors identify whether persons are present in the room. Often a brightness and a temperature sensor are also integrated in the detector housing. Such combination sensors reduce installation costs as compared with the use of individual sensors and make data available for other systems, such as heating and air conditioning. When no one is in the room, the light switches off automatically and the heating or air conditioning is kept in the reduced standby mode.

Within the scope of the smart office concept, sensors from other completely separate systems can be integrated using a gateway (e.g. Homematic, EnOcean, KNX, IP500 etc.).

Smart Lighting Controller

The Smart Lighting Controller represents the link between the LED lamp and the IP network and manages the data traffic between the network and sensors/lamps. It is usually integrated in the lamps, but may also be mounted as a separate assembly near the lamp.

Network-Switch

Because of their high computing power, network switches have long since developed from purely forwarding data packets to become intelligent control centers in networks. Based on a robust Linux operating system, they undertake additional tasks, such as controlling the LED lamps.

Applications (Apps)

Autonomous software modules or apps on the switches provide wide-ranging functionalities. The Smart Director app, for example, takes the entries from the user's smartphone or tablet and forwards the corresponding control commands to the particular smart lighting controller of the lamps. Configuration and management of the lamps takes place without any complex, expensive software package.

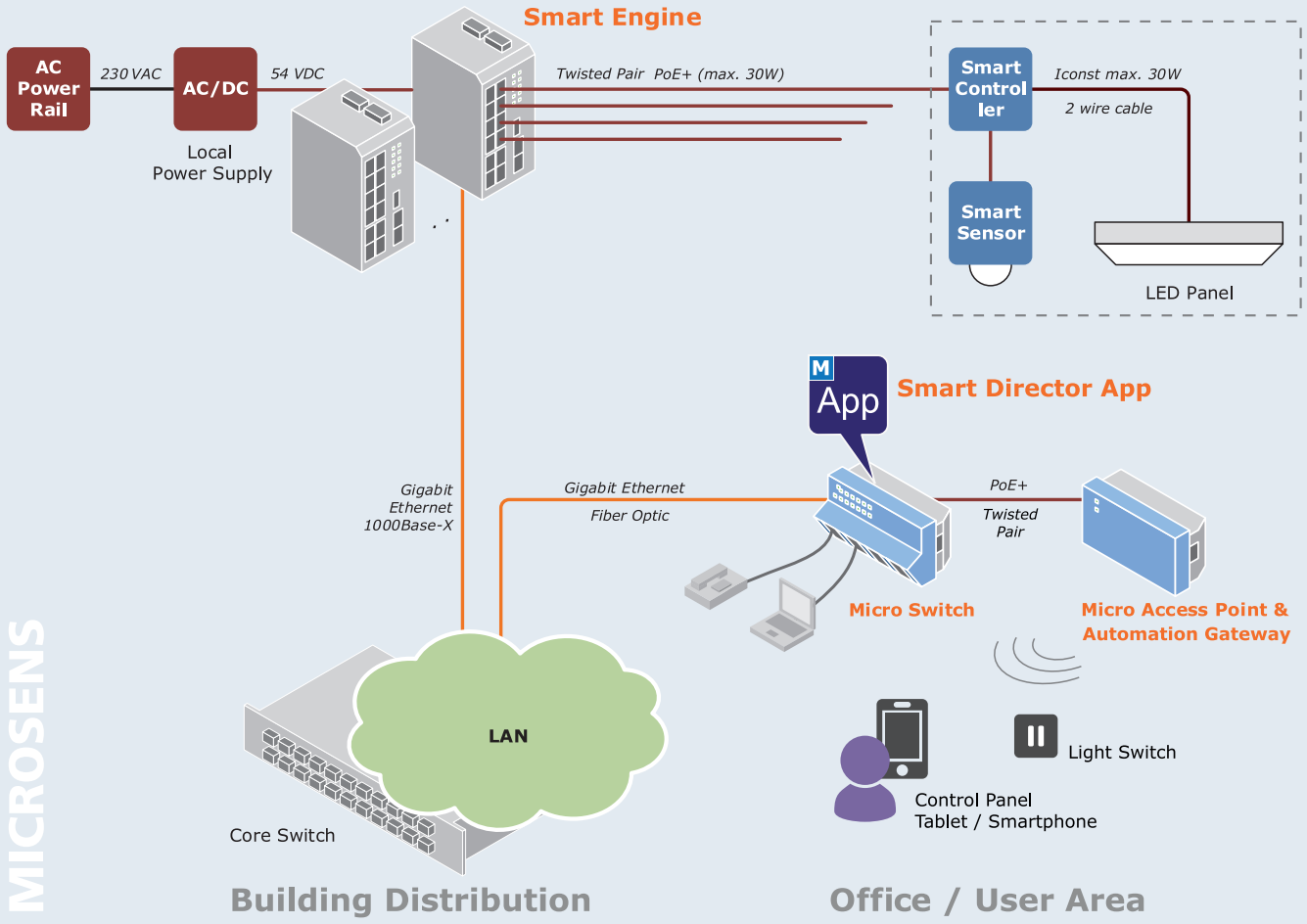
Installation and execution of the apps requires absolutely no intervention in the switch firmware. It remains unchanged, which significantly reduces the administrative workload.
Several apps can run simultaneously on a switch thus offering a wealth of different functionalities.

Innovative interaction

Interaction between the individual components can be briefly explained with a simple example: The presence detector recognizes a user entering the office or living room and switches the lighting on. The brightness sensor measures the momentary light intensity and dims the lamps such that exactly the required brightness is achieved.
If the user wishes to change the brightness or the light colour, they move the slider on their smartphone or tablet. The Smart Director app on the network switch sends the relevant commands to the Smart Lighting Controller, which regulates the lamps such that the desired specifications are met. Once the user leaves the room, the lighting switches off immediately or after a predefined waiting time..
The procedure is just a very simple example to illustrate the basic function. High performance network switches and intelligent apps enable far more extensive functionalities for greater convenience and higher energy efficiency.
With daylight harvesting, the LED lighting supplements the incident daylight to achieve the desired level of illumination. The setpoint value can be specifically preset for each workplace and each area. Additionally, the lighting can be adapted to individual requirements and preferences at any time.
Light tracking means that only frequented areas are illuminated. Areas in which no one is present – such as corridors or underground car parks – are illuminated in economy mode or

stay dark. Linking this with admission control means the areas the employee first enters are illuminated ahead of them.
Using presence detectors, light is switched off automatically in conference rooms, basements and archives once the employee has left the room. The office lighting switches off automatically in the evenings and at weekends provided no one is present.
Consistent implementation and combination of these measures enables savings of up to 80% in electricity consumption.
As part of a Smart Office concept, interaction with other systems, such as heating and air conditioning, is possible and practical, as is coupling with an electronic calendar. The heating or air conditioning go into rated operation in good time for the start of a meeting, the network connections are enabled and the lighting switches when the first participant arrives. Once the last person leaves the room at the end of the meeting, the network ports are automatically blocked, the lighting and the conference technology shuts down and the heating or air conditioning system work in standby mode. This paves the way for a previously unattained energy efficiency and network security.

Smart Lighting



The innovative MICROSENS Smart Lighting solution. LED lights are supplied with power by means of PoE+ over a non-conforming cabling according to DIN EN 50173-6. Sensors next to the lights provide data on the brightness, temperature, and on the presence of persons in the room. The Smart Director app on the Micro Switches controls the lighting according to the needs of the users.

Decentralized network architecture for smart buildings

Lighting control is mentioned explicitly in DIN EN 50173-6 for distributed building services. Decentralized solutions simplify planning and implementation of lighting projects, as they can be installed room by room.
Cabling with a decentralized switching architecture, such as Fiber To The Office (FTTO), have proven itself over many years as cost-efficient in-house networking. High-performance data lines are routed through to the user area. Here a Micro Switch is installed as an active element to provide flexible copper connections for the terminal devices. This allows monitored, manageable devices to be deployed in the user area.
Centralized overall control is not required, but is certainly possible. A hierarchical structure can be achieved by using the Network Management Platform (NMP). The Smart Director app on the network switches controls the lighting decentrally in the individual rooms; as the central application, the NMP, controls the room controller as required.

Normative Background

Standards are in place on a national and international level that define the infrastructure for smart lighting. The most important standards are listed below according to their scope of validity.

European standards

DIN EN 50173-1:2011-09
Information technology
– Generic cabling systems – Part 1: General requirements; contains the general specifications for generic cabling infrastructure for information technology.

DIN EN 50173-2:2011-09
Information technology
– Generic cabling systems – Part 2: Office premises; contains the specifications for the IT cabling in office buildings including decentralized network design, such as Fiber To The Office (FTTO).

DIN EN 50173-6:2014-05
Information technology
– Generic cabling systems – Part 6: Distributed building services; contains the specifications for the IT cabling for distributed building services, such as lighting.

DIN EN 50174-2:2015-02
Information technology
– Communication cabling installation – Part 2: Installation planning and installation practices in buildings; contains the specifications for planning and installing IT cabling in buildings.

International standards

ISO/IEC 11801-6
Information technology
– Generic cabling for customer premises – Part 6: Distributed Building Services; in preparation; international standard for cabling infrastructure for distributed building services; based on the European standard DIN EN 50173-6.

IEEE 802.3af-2003IEEE
Standard for Information Technology
- Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements -
Part3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI); enthält die Vorgaben für Power-over-Ethernet (PoE).

IEEE 802.3at-2009IEEE
Standard for Information technology
- Local and metropolitan area networks - Specific requirements -
Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements; enthält die Vorgaben für Power-over-Ethernet Plus (PoE+).

Futher standards

ANSI/TIA-862-A, 2011
Building Automation Systems Cabling; contains the specifications for cabling of building automation in the USA.

The switching center – MICROSENS Micro Switch including the Micro Access Point

Greater protection through decentralized intelligence

Decentralized solutions with distributed intelligence offer enhanced protection against failure. In contrast to centralized systems in which failure of a central network component has far-reaching consequences, only small sub-areas are affected by a possible fault in the case of decentralized architectures. Simple measures – for instance if two neighbouring decentralized components are also connected to one another – restrict failures to a minimum or avoids them altogether.

Decentralized systems also offer advantages in network security: Micro Switches in the workplace environment bring security features to where they are needed: to the edge of the network, directly at the workplace. Authentication of the user takes place here directly; unknown or unwanted users do not even enter the network, but are blocked directly at the point of network access.

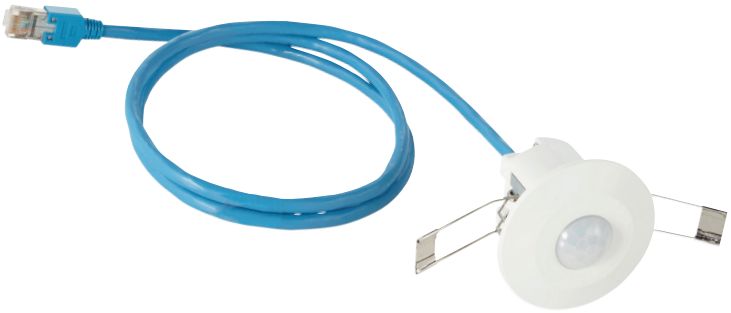
The cabling itself also offers safety advantages: Thanks to their lower conductor diameter, the fiber optic lines used to connect the decentralized components give rise to a smaller cable bundle, which reduces the fire hazard. The non-metal structure of the fiber optic lines excludes the possibility of potential transfers via the data line.

Ergonomics and convenience

Decentralized network architectures allow the users to design their workplace environment individually and to fully adapt it to their personal requirements. This applies to heating and air conditioning and especially for lighting. Light intensity and light colour have a direct influence on employees' well-being, which is proven to lead to higher productivity and lower absenteeism. With individual, decentralized solutions, each employee can adapt their workplace environment to suit their needs, even in open-plan offices. Adapting temperature and lighting to one's personal needs in just one aspect of "customizing". This collective term is understood as the adaptation of a technical system to the individual preferences and special needs of the user. The corresponding functions are provided by apps. If no apps are available for special applications, the required functionalities can be provided by individual scripts. The dynamic, event-controlled microScript programming language allows scripts to be created in any text editor and loaded to the network switch. Scripts that have been created with microScript run on a level above the operating system and only have the access rights of the user who executes them. No security gaps in the operating system can be exploited for the scripts – a decisive contribution to network security.

Outlook

It is expected that the development towards decentralized IP networks will strengthen even further in the years to come. The Smart Building, in which intelligent, distributed systems autonomously execute extensive building system technology tasks and are networked together, has long since become reality. These systems ensure greater security and economic efficiency and, as a result of individual adaptation at the workplace, more convenience and higher productivity.



MICROSENS Smart Sensor detects presence of people in the room. In addition to measuring brightness and temperature.

Literature

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Smart Lighting has become reality

Abstract

Technical building infrastructure systems are developing towards the IP protocol. Now for the first time, lighting, an area hitherto the reserve of the classical electrical engineering, is becoming fully integrated into the IP network. This is made possible through the use of LEDs with their low voltage and low currents. However, to make the most of the technical and economic advantages offered by LED lighting solutions, a powerful infrastructure with intelligent network switches is needed. Applications (apps) on the switches allow extensive functionalities and thus make a significant contribution to the Smart Building

www.microsens.com/smart-lighting