

# MICROSENS

## Smart Office Solution Brief



**MICROSENS fiber optic solutions -  
intelligent, reliable, high-performance**

## **Summary**

This document depicts the MICROSENS Smart Office solution from a technical perspective. It illustrates the architectural concept and describes the system components and typical application scenarios.

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## **1 Introduction**

Traditional automation solutions in the building management sector involve a high level of technical effort and expenditure. System components require their own, separate cabling infrastructure and have to be individually configured and serviced.

The MICROSENS Smart Office concept, on the other hand, demonstrates that introducing and operating a building management system can be achieved with comparatively little effort.

### **Smart Office**

MICROSENS Smart Office is an open, IP-based, decentralised and scalable building management system. It can be fully integrated into the data network and enables the interaction with a wide range of different sensors and actuators. The Smart Office concept offers outstanding security, efficiency and flexibility. It can be adapted in line with individual needs to provide a much improved level of user comfort and increased long-term productivity.

### **Smart Lighting**

MICROSENS Smart Lighting is a central component of the Smart Office concept. Firmware applications (apps) running on MICROSENS network switches control LED lamps through the IP network whilst simultaneously providing them with Power-over-Ethernet Plus (PoE+). Intelligent controllers, combined with high-performance sensors, provide an independent, adaptive lighting control system which even goes as far as turning off the lights in areas currently not in use. Being able to control LED lights according to the respective needs cuts the energy consumption by up to 80 %.

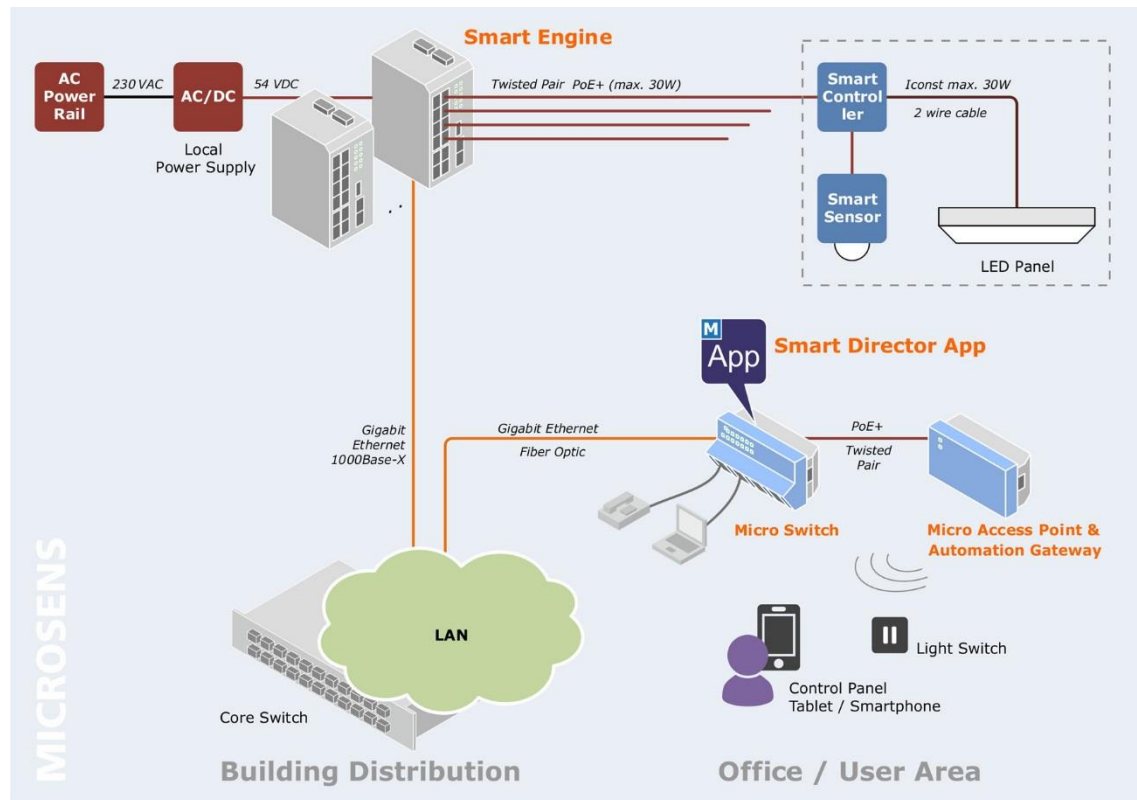
### **Decentralised Concept**

Smart Office is based on a decentralised infrastructure and distributed network intelligence concept, one which MICROSENS has been pursuing for many years. Compared to traditional, centralised approaches, this decentralised concept has been proven to offer the following advantages:

- Smart Office solutions can be introduced step-by-step according to the tried and tested "room by room concept" – without high initial investments.
- Planning the system and maintaining an overview is easy.
- The users are provided with extensive functionality and numerous comfort features.
- MICROSENS Smart Office is based on standardised communication protocols.

## 2 MICROSENS Smart Office Solution – Architecture

The following image illustrates the MICROSENS Smart Office architecture, in this case using the Smart Lighting concept as an example.



**Fig. 1: MICROSENS Smart Office architecture**

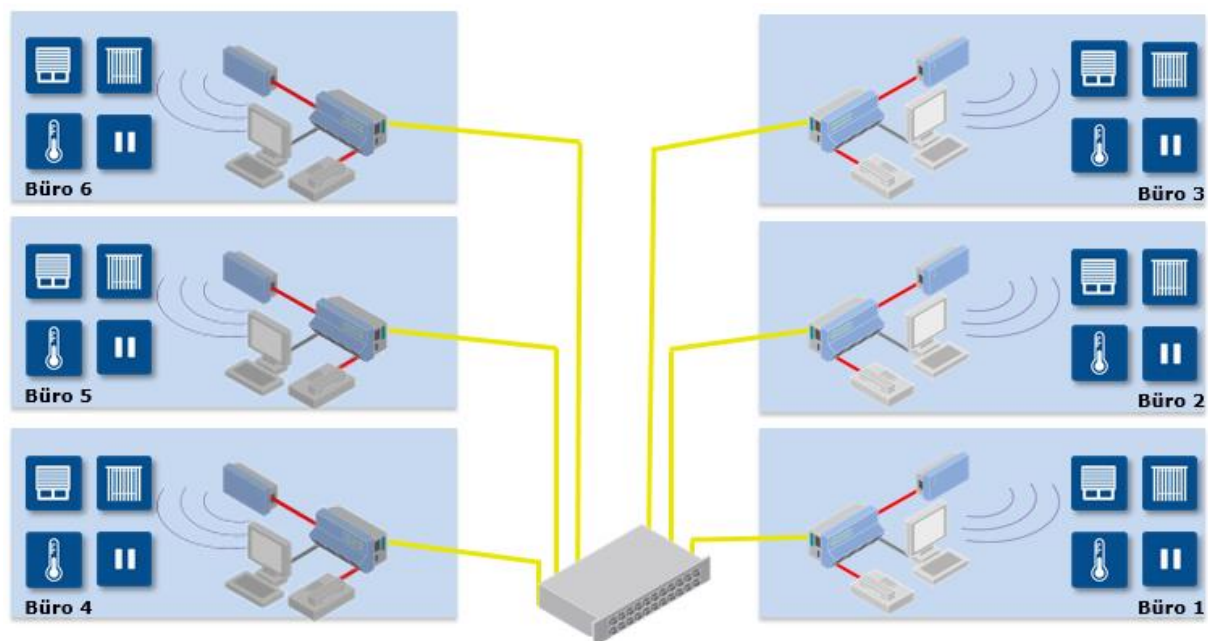
Each LED lamp (LED panel) is controlled by a Smart Lighting Controller (Smart Controller). This controller is connected to the IP network and receives commands for controlling the lamp assigned to it from the Smart Director which is also connected to the network.

The Smart Lighting Sensor measures the light intensity and room temperature and can recognise whether people are currently present in the room. The Smart Controller transfers the data collected by the Smart Lighting Sensor to the Smart Director which then evaluates the data for the lamp or group of lamps allocated to it. One Smart Sensor can be assigned to a Smart Controller; one or several LED lamps can be assigned to each individual Smart Sensor.

The Smart Director is a firmware application (app) running on the intelligent MICROSENS Generation 6 Micro Switch installed in the respective room. The Smart Director app processes and manages the information supplied by the Smart Lighting Controllers, generates the control commands and passes these back to the Smart Lighting Controllers.

In addition, the Smart Director manages the MICROSENS Micro Access Point which acts as an automation gateway. This gateway is connected to other sensors and actuators integrated in the building automation system through standard wireless connections. The Smart Director processes the data received from the sensors and controls the actuators via a wireless connection to the Micro Access Point. This allows the lighting and climatic conditions in the respective room to be monitored and controlled using standard sensors and actuators (e.g. eQ-3). Users can adjust the conditions in their rooms using wireless switches connected to the automation gateway or through Web apps installed on their tablets and smartphones.

A robust, PoE+-capable Ethernet switch serves as the Smart Engine. The Smart Lighting Controllers are connected to this switch which also supplies the Controllers, Smart Sensors and LED lamps with power. The decentrally-installed Smart Engine is supplied with power via the 230 V electrical power supply. Communication to and from the Smart Director runs through the existing (in most cases) copper or fiber optic data network.



**Fig. 2: Room by room concept – MICROSENS Smart Office**

The simplified diagram<sup>1</sup> in Fig. 2 illustrates the modular "room by room concept" of the MICROSENS Smart Office solution. This concept allows trouble-free, low cost roll-outs during ongoing business operations or the installation of a complete system in a new object or as part of a refurbishment project. The modular approach enables the "area-by-area" installation and commissioning of the system.

<sup>1</sup> For reasons of clarity, the Smart Engine, Smart Lighting Controllers, Smart Sensors and LED lamps are not illustrated in this diagram.

### 3 Smart Office – Basic Components

#### 3.1 Smart Office Control Centre: G6 Micro Switch with Smart Director

The Smart Director is a firmware application which runs on MICROSENS Generation 6 Micro Switches. To keep things simple, the whole switch will simply be referred to as the "Smart Director" in the following in all cases where it takes on the role of Smart Director via the Smart Director app.

The Smart Director is connected to the central switch via a fiber optic or copper uplink and supplied with power via an external 54 V DC power supply. Basically, the Smart Director is simply a manageable switch installed at an office workplace. It is equipped with four 10/100/1000 Base-T ports for connecting up with terminal devices. It also provides PoE-capable equipment, such as VoIP telephones, with PoE+ power.

When implemented as a Smart Director in a MICROSENS Smart Office solution, the switch works as the control centre. All the basic settings and changes to system parameters during operation are done via this switch. One of the Smart Director's tasks is to align the information supplied by the Smart Sensor with the set values specified by the user.

The sensors and actuators are organised in logical groups. The behavioural logic of these groups can be freely adjusted via a control script.



**Fig. 3: Micro Switch with Smart Director app**

Access to the Smart Director is controlled exclusively by an authentication process therefore preventing unauthorised access. The downlink port used to connect up the Micro Access Point – which also supplies the latter with PoE power – is covered over when installed.



### 3.2 Micro Access Point and Automation Gateway

The Micro Access Point is used to integrate the wireless Smart Office components into the network.



**Fig. 4: Micro Access Point**

A WLAN microcell in the 2.4 GHz band provides mobile device users with access to the management interface of the room control system through which they can adjust the room parameters to meet their personal requirements. Such microcells also reduce the burden on the campus WLAN.

At the same time, the Micro Access Point also serves as an automation gateway for integrating 868 MHz wireless sensors and actuators into the Smart Office network. In addition to its wireless interfaces, the Micro Access Point is also equipped with two input and two output contacts for controlling wired devices.

Network integration and the configuration and power supply of the Micro Access Point are all managed via the downlink port of the Micro Switch.



**Fig. 5: Installation unit, incl. Micro Switch and Micro Access Point**

## 4 Smart Lighting – Basic Components

### 4.1 Smart Engine

The Smart Engine is a network switch which takes on the job of providing power to and intelligently controlling the LED lamps.



**Fig. 6: Smart Engine**

Through its compact design and ability to run silently due to its fan-free construction, the Smart Engine can be operated directly in the room or installed in a suspended ceiling.

It provides the lamps attached to it with up to 30 W of power via PoE+ in accordance with IEEE 802.3at. It can be connected to the network using either fiber optic or copper data cables (twisted pair). Several Smart Engines can also be linked together in a ring topology.

The Smart Engine is supplied with power via a 230 V power supply with 54 V DC output. Apart from the 230 V power supplies, all Smart Office components operate at low voltage so that they do not necessarily have to be installed by skilled electricians.

## 4.2 Smart Lighting Controller

The Smart Lighting Controller serves as the interface between the Smart Engine, the LED lamp and the Smart Sensor (pls. refer to Section 4.3). It has its own IP address and is addressed and controlled directly through the network. The Smart Lighting Controller passes the information received from the Smart Sensor to the Smart Director. The Smart Engine supplies it with PoE power via a copper cable.



**Fib. 7: Smart Lighting Controller**

The Smart Lighting Controller is connected directly to the LED lamp to integrate it into the network. It is also equipped with an RJ-45 port which can be used to connect up a Smart Sensor.

## 4.3 Smart Sensor

The Smart Sensor collects new information on the brightness and temperature of the room. It also collects information on the presence of individuals. It then delivers the respective information to the Smart Director via the Smart Lighting Controller. The Smart Director then calculates and updates the respective control variables.



**Fig. 8: Smart Sensor**

The sensor is supplied with a firmly connected 0.5-m-long copper cable fitted with a RJ-45 plug. The Smart Sensor interface is only compatible with the Smart Lighting Controller.

The Smart Director's user interface allows the assignment of one sensor to several LED lamps. Within a set group of lamps the Smart Sensor can be connected up to any desired Smart Lighting Controller.

#### **4.4 LED Lamps**

The LED lamps are connected directly to the Smart Lighting Controller. The lamps recommended by MICROSENS typically require around 30 W of power. The light intensity control feature of the Smart Lighting Controller is calibrated specifically for this type of lamp.



**Fig. 9: Arrangement of LED lamps and Smart Sensors in a grid ceiling**

Alternatively, lamps supplied by other manufacturers may also be deployed. In such cases, however, the Smart Lighting Controller needs to be calibrated by MICROSENS.

#### **4.5 Light Switches**

Despite the high level of automation provided, users using a Smart Office solution do not need to miss the light switches they are used to. Upon request, classic-style light switches can be provided by way of wireless switches. These are then integrated into the Smart Office system via the wireless interface of the automation gateway (e.g. eQ-3).

A MICROSENS Smart Office solution allows for the deployment of a variety of simple wireless switch models supplied by different manufacturers as well as multi-switches with programmed switch scenarios. Users can also control the lighting via their mobile devices (tablets, computers, smartphones, notebooks).



**Fig. 10: Wireless multi-switch**

## **5 IT Security within the Building Management System**

As with all IT network interfaces, the building automation system must also be secured against unauthorised access. MICROSENS product solutions have been equipped with established, standardised mechanisms for securing network communications right from day one:

- Segmentation in logical, segregated networks (VLANs, IEEE 802.1q)
- Access protection through port-based authentication (IEEE 802.1x) limits system access to authorised persons only
- Encrypted protocols (https, SNMPv3, SSH)

Allocating the users to different user levels also provides added protection. This enables a simple, logical separation of administrators and local users (local room users). Users are only granted access to their decentralised Smart Office environment in their respective rooms. Administrators and building managers are granted extended access rights to all rooms and can also centrally control the whole system. Automatic processes can also be assigned special access rights.

## 6 Smart Office Application Scenarios

Smart Office offers a broad range of different application options. The following presents a series of application scenarios which have been implemented in practice using the Smart Office components – and in some cases additional actuators for controlling the terminal devices – described above.

### 6.1 Room Sunshades

Switch-operated electric blinds can be simply integrated into Smart Office by adding a wireless module to the blind switch. This module then communicates with the Micro Access Point. This setup can also be used to integrate several separate blinds operated simultaneously via coupling relays using just one switch into the system.

The brightness within the room is monitored by one or several Smart Sensors. The blinds are then optimally adjusted according to the desired level of brightness.



**Fig. 11: Global control of the room brightness and lighting**

Considerable value add can be achieved by combining this solution with other Smart Office scenarios. For example, if the room sunshades are logically linked to TV equipment or beamers which are already integrated in Smart Office, the blinds will automatically close to dim the room when this equipment is operated.

## **6.2 Smart Lighting**

Using LED lamps results in considerable energy cost savings. However, in many cases, the high investment cost involved pose a real obstacle to conversion.

On the other hand, intelligent lighting control, for example turning off lights in rooms that are no longer being used, also presents massive opportunities for saving energy.

MICROSENS Smart Lighting, the intelligent way to control lighting using efficient lamps, links lighting up to building's infrastructure. The clever integration of sensors and actuators allows the lights in unused rooms to be turned off; in occupied rooms the lighting is set optimally to suit each individual workplace. Through the IP network, individual lamps can be specifically addressed and controlled by evaluating the data supplied by the sensors. At the same time, the users can also intervene and adjust the lighting according to their current needs any time they want – through their PCs, smart devices or classic light switches.

Lighting via Ethernet, powered by means of PoE+ in accordance with IEEE 802.3at and controlled via the network, has been optimised for operation in office environments. Lighting solutions using MICROSENS Smart Lighting ensure that the values set down in the workplace regulations are met.

Smart Lighting offers a high degree of functionality and convenience:

- Used in combination with sunshades, Smart Lighting ensures that the desired level of illumination is always achieved: The sunshade system reduces direct sunlight whilst Smart Lighting ensures that poor lighting is accordingly enhanced. The Smart Controller controls the LED lamps on an ongoing basis according to the current level of brightness.
- The presence detection function of the Smart Sensor recognises whether individuals are present or not. This enables the automatic switch-off of lights in rooms that are not in use. The implementation of several sensors, for example in an open office environment with a number of different working islands, provides the option to partially turn off, resp. dim, the lamps.
- During a restructuring process, existing LED lamps are simply re-configured and, where required, assigned to the new light switches. This can be easily done via the system management application.
- A special role and rights allocation system ensures that only authorised persons in a room are supplied with light.

## **6.3 Heating and Air-Conditioning**

Being able to control the room temperature is an important prerequisite for work efficiency.

Classic operation only requires a wall thermostat which can also be used to manually set the desired room temperature. This thermostat is connected to the Micro Access Point which allows Smart Office to use the desired temperature setting as a control parameter.



A heating valve is then addressed via a wireless actuator in order to achieve the desired room temperature. Wireless heating actuators are available for floor and central heating systems and as radiator thermostats. Automated heating control systems are particularly advantageous for sluggish systems as they can react optimally to changes in a timely fashion. During the winter months, in particular, this solution offers a high degree of comfort coupled with high energy efficiency.

This also applies to air-conditioning systems. A room thermostat is used to record the pre-set and current temperatures. Smart Office activates the heating and air-conditioning systems according to demand so as to maintain the desired pre-set temperature.

Actuators are available for both central and decentral air-conditioning units.

## **6.4 Intercoms**

IP-capable intercom systems can be easily integrated into the Smart Office system.

As PoE-capable Smart Office IP ports are available in the room and in the ceiling area, IP loudspeakers can be installed virtually anywhere.

## **6.5 Audio Systems**

Similar to the intercom systems described above, loudspeakers in an IP audio system can also be installed virtually anywhere – making it easy to integrate them into the Smart Office system.

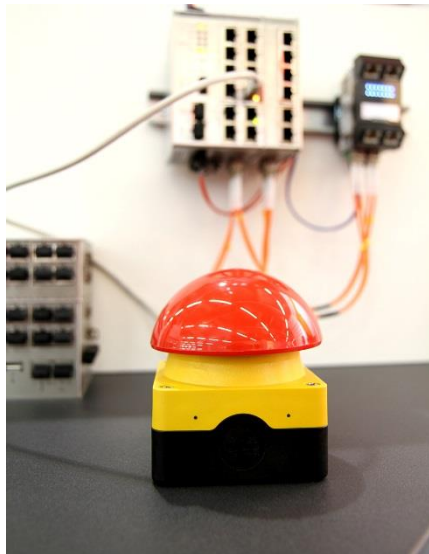


**Fig. 12: Audio system – integrated in a grid ceiling**



## 6.6 Emergency Stop Buttons

The MICROSENS emergency stop button functions completely without electricity. It is connected to the RJ-45 network port of a Smart Director via a copper data cable. If the button is pressed, it activates an event-driven scenario stored in the Smart Director which then triggers a series of pre-defined actions. These actions are then implemented via the on-board functionality of the Smart Director. The use of stop buttons for triggering emergency calls is a typical application example.



**Fig. 13: Emergency stop button**

## 7 Going from a Smart Office to a Smart Building – Extending the Room Concept to the Whole Building

The big advantage of the Smart Office concept is its open, decentralised approach. The system can first be used in a self-sufficient setup in just one room and can be referred to for planning further development. The subsequent implementation of the system throughout the building can be done step-by-step – in line with the general organisational conditions.

## Glossary

Term	Description
FTTO	Fiber To The Office
IEEE	Institute of Electrical and Electronics Engineers, Inc. ( <a href="http://www.ieee.org">www.ieee.org</a> )
IP	Internet Protocol
LAN	Local Area Network
LED	Light Emitting Diode
FO Cable	Fiber optic cable
PD	Powered Device (terminal device supplied with power via PoE or PoE+)
PoE	Power-over-Ethernet (IEEE 802.3af)
PoE+	Power-over-Ethernet Plus (IEEE 802.3at)
PSE	Power Sourcing Equipment (equipment that provides power via PoE or PoE+)
RJ-45	Standardised connectors for telecommunication cabling
TP	Twisted Pair
STP	Spanning Tree Protocol
AC	Alternating Current
DC	Direct Current
VLAN	Virtual Local Area Network
VoIP	Voice-over-IP
WLAN	Wireless Local Area Network

## Notes



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