MICROSENS

WHITE PAPER

Smart Office – The new generation IP-based building management

Building automation

IP-based solutions are increasingly squeezing out conventional, autonomous automation solutions and bus-controlled installations or systems. The pioneers are modern office buildings that place so far unattained opportunities for ergonomics, convenience and energy efficiency in the employees' hands.

With classical office equipment, the various installations of the technical building equipment are separate from one another. They work independently and are controlled by either installation-specific controllers or manually.

The introduction of bus-based systems has brought about a shift from hardware to software. For the first time, switches and devices could be programmed user-specifically and reprogrammed as required, which renders extensive rewiring superfluous. At the same time, installations previously separated from one another are now logically linked together.

Bus technology offers greater flexibility compared to classical installation technology, although new programming and reprogramming are time-consuming and require the use of a specialist or a specially trained employee.

The high costs generated by the high programming complexity and the lack of compatibility of the various bus systems among themselves are obstacles for the widespread use of bus technology.

The development towards software-based building automation continues with the introduction of the Internet Protocol (IP protocol) for systems and installations in technical building equipment. Each device is equipped with its own network connection. Data acquisition, data exchange and control commands are transmitted via the universal IP protocol, which has been established as the standard information technology protocol for decades now. As a result, compatibility problems in communication are excluded.

Ethernet/IP protocol

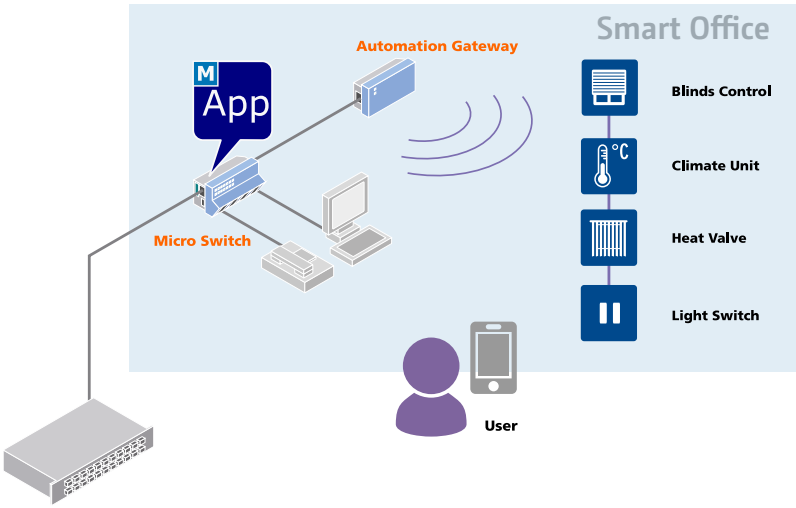
More and more technical systems are developing towards IP. Firstly, telephony became part of the data network, followed by video surveillance using IP cameras. In the meantime, admission control, time stamping, heating/ventilation, conference technology, lift control systems and lighting installations are equipped with an IP connection. This development is not limited to the interfaces for the system controllers, but also includes the individual assemblies and components, such as sensors and actuators. The term 'Internet of Things' or IoT covers all these components networked together, which also interact with each other automatically.

Building infrastructures

The classical building infrastructure

The classical office infrastructure serves a specific purpose. Each installation requires its own solution geared to its special requirements. This means that these installations can only be administrated in a unified building management system at considerable expense, if at all. The rigid, installation-specific requirements and usually centralised control hamper the adaption of the technical building equipment to individual needs. An example for this is the lighting in open-plan offices: Hardly any employee is satisfied with the general lighting; for some it is too bright, for others too dark. The lighting is either switched off or runs at the highest level. Neither the changing light conditions nor the individual needs of the employees can be taken into consideration. The same applies to heating/ventilation.

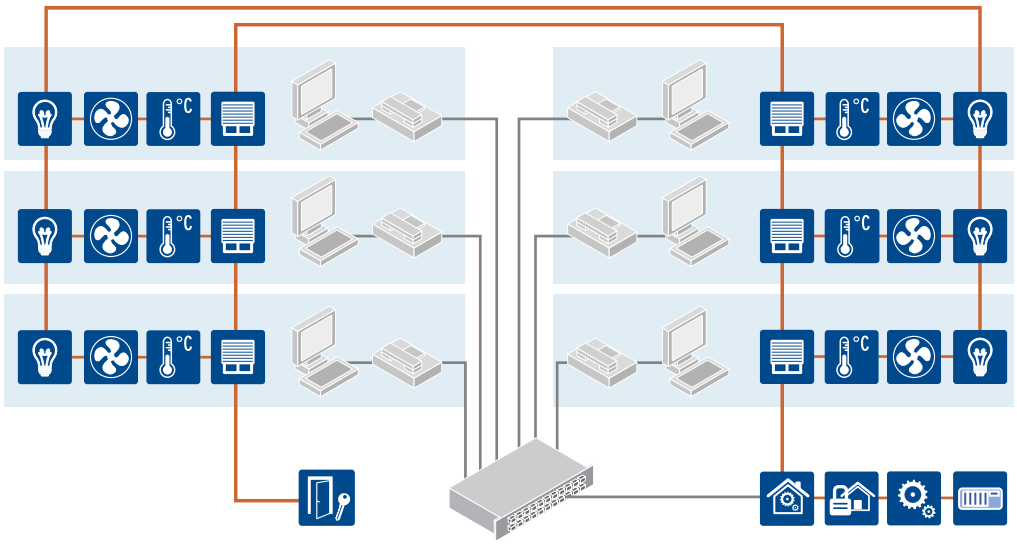
Application-specific infrastructures call for separate system solutions for different requirements. Raising an alarm in hazardous situations, due to aggressive persons for instance, requires a separate system (building alarm). This leads to a large number of different, isolated systems that either cannot be coupled with each other at all or only at great expense.
In the conventional IT infrastructure, the network security is implemented within the edge switch in the floor distribution unit or in the core area of the IT main distribution unit. An implementation at the point of network access in the user area is not possible by conventional means.



Decentralised building infrastructure

In the case of a decentralised infrastructure, the network functionalities and the network intelligence do not reside in a centralised distribution unit, but are implemented close to the user or installation instead. Micro Switches within the workplace or installation area offer IP connections and, in collaboration with the relevant automation gateways, largely take over the building automation functionalities.

In a decentralised infrastructure, status detection, data evaluation, control/regulation and the security functions are implemented in the immediate vicinity of the user and elements of the building's technical installations. On-site data evaluation at the network perimeter and the generation of the resulting control commands reduce the network load, as far less data needs to be transmitted compared to centralised solutions. The local security functions effectively prevent undesirable and unauthorised network access directly at the network connection, whereas conventional solutions can provide security functions within the network in the switches in the floor distribution unit or in the main distribution unit.
Should a decentralised component fail, only the very limited coverage area of the respective Micro Switch is affected; all other areas continue to work failure-free. In the conventional infrastructure, a far wider area is affected and up to the complete coverage area of the floor distribution unit can be disrupted.



Classical building infrastructure with separated networks for IT and building automation

The elements of the decentralised building infrastructure

A decentralised infrastructure consists of cabling, Micro Switches and software applications (apps). The possible integration of an existing classical building automation solution is assumed by an automation gateway.

Cabling

Decentralised cabling can generally be realised based on the concept of classical structured cabling with a combination of fiber optic lines in the riser shaft and copper cabling in the user area. Any structured cabling that already exists can therefore continue to be used in the decentralised infrastructure.

On account of the economic advantages, usually cabling purely based on fiber optics is realised in large buildings and new buildings with continuous fiber optic lines. In this case, fiber optic lines run from a centralised building or site distribution unit through to the user area, where they are connected to Micro Switches. To save space, the cabling can be configured with loose tube cables in the riser shaft from which breakout / compact tube cables are spliced and lead to the user area. There is an increasing shift towards pre-assembled fiber optic cables already fitted with connectors by the manufacturer, which can be routed ready for connection. All these concepts meet the relevant standards (DIN EN 50173-3).

Micro Switches

Switches have long since developed from pure data distribution into intelligent, powerful control centres. Their high computing power allows them to take on additional and far-reaching functions in building automation. An example for this is the control and management of all technical office equipment, such as lighting, blinds, heating / air conditioning, network access for IT devices and telephones, as well as security technology devices. Micro Switches take up the space of two installation double sockets used in conventional cabling.

Applications (apps)

Autonomous software modules (apps) on the switches provide wide-ranging functionalities. They enable sensor-actuator interaction throughout the network, whereby the sensors and actuators can be placed any distance apart. This allows technical building equipment to be controlled with mobile devices like smartphones, tablets and laptops. Apps link together the control commands of independent installations, for example lighting, heating and access rights and adapt them to the respective user profiles. Installation and execution of the apps require no intervention in the switch firmware. It remains unchanged. This significantly reduces the administrative workload. Several apps can run simultaneously on a switch thus providing a wealth of diverse functionalities. Rather than using existing apps, the enterprise's own IT department can also write scripts itself. The dynamic, event-controlled microScript programming language allows scripts to be created in any text editor and loaded onto the 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. Possible security gaps in the operating system cannot be used by the scripts, which takes into account the increased requirements for network security.

The room control station - MICROSENS Micro Switch with Wireless Automation Gateway

Automation gateway

If existing, classical installations and systems are to be integrated in the IP-based, decentralised infrastructure, an automation gateway takes care of the connection and manages the necessary data exchange. The connection with the systems to be integrated can be both wired and wireless.

Functions and advantages

The individual installations and systems are networked among themselves in the Smart Office. IP-based multifunction sensors take on the tasks of previously separated, installation-specific sensors. In many cases, only one multifunctional sensor is required per office or area. The evaluation of sensor data takes place on-site, as do the resulting control commands to the actuators from the various building technology components. For example, if a presence detector identifies that nobody is in the room, the lighting can be switched off, the heating/air-conditioning turned down and the network access deactivated. In conjunction with electronic time stamping, peripheral devices such as printers or small electric appliances can be switched off automatically via switchable power sockets once the employee leaves the building.

Individual adaptation through apps

In the Smart Office, the office environment can be adapted to the users' specific needs and requirements. Employees can individually configure their workplaces, which verifiably leads to higher productivity, higher motivation and lower error rates. Apps on the switches provide the necessary functionalities as independent software modules; no changes to the switch firmware are necessary. Installation and use take place simply, smoothly and cheaply based on the model of apps for smartphones and tablets.

Flexibility and scalability

The high flexibility of the decentralised concept allows changes of use to be realised quickly and without great effort. If open-plan offices are expanded or partitioned, or if individual rooms are connected together, divided or used for a different purpose, this can be achieved in sections or in each room. As a result of the decentralised infrastructure and the software-based functionalities of the Micro Switches, the Smart Office is highly scalable. In addition, it does not necessarily need an integrated building approach - a Smart Office can be built up room by room.

Coupling of different systems and installations

As apps and scripts provide network-wide sensor-actuator interaction on the basis of the universal IP protocol, the control of previously separated systems, such as IT, lighting, heating / air conditioning, conference technology, security technology, access control and time stamping, can be coupled. The integration of switchable 230 V power sockets means that classical electrical devices can also be integrated into office management.

Security

The security features implemented in the Micro Switches offer a high degree of security directly at the border of the network. Workplace and network access are only activated once the user has the appropriate authorisation. Otherwise the network port and workplace power sockets remain blocked.

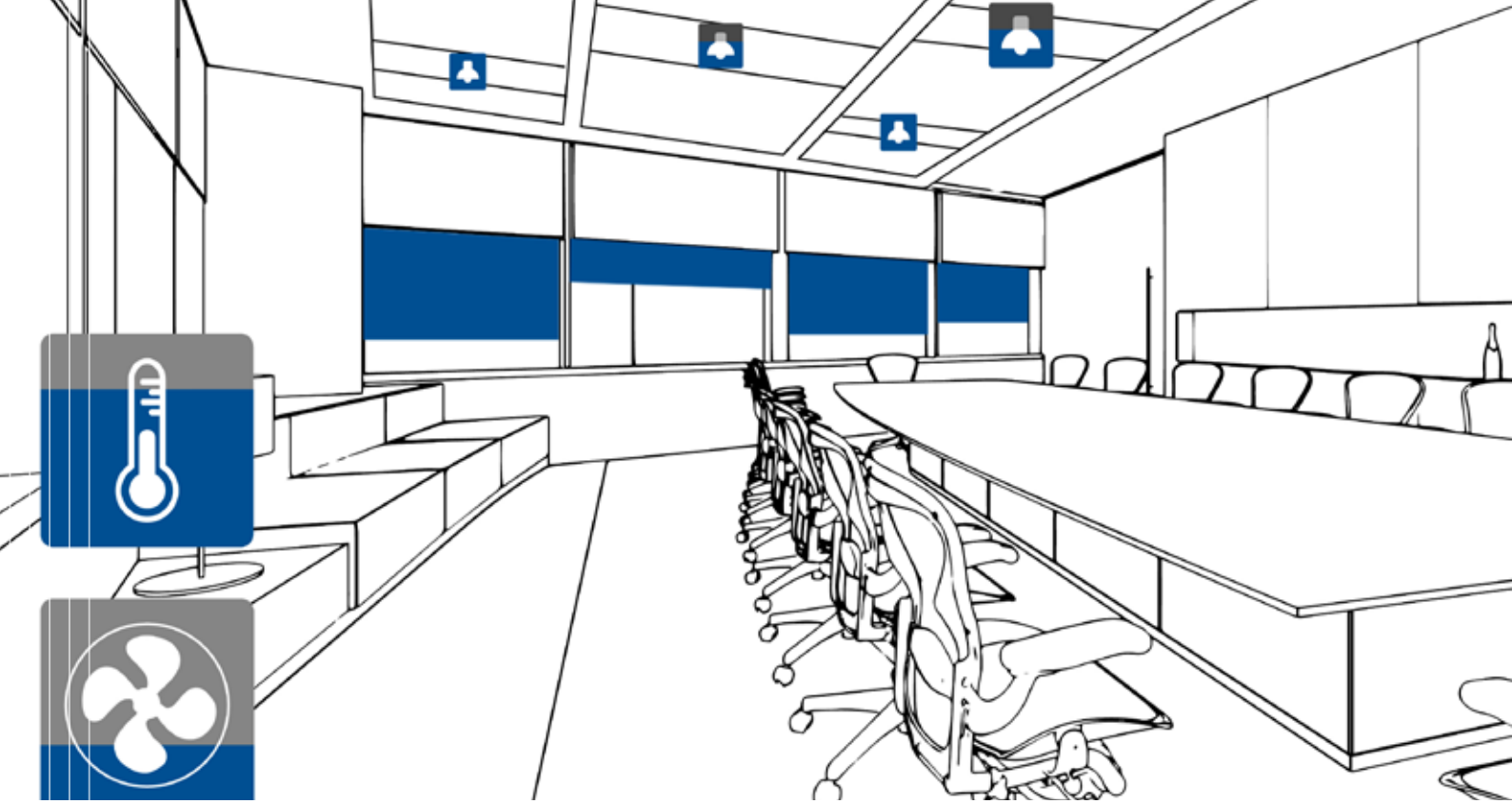
Using apps, functions for a high degree of employee safety can be implemented on the switches and therefore in the network. For instance, in the event of an alarm, doors can be unlocked and the escape and rescue routes are automatically illuminated. At the same time, systems can be switched off, such as the ventilation system in the event of a fire alarm, to prevent a fire from spreading.

As the concept of apps and scripts created with microScript means they only have access rights of the relevant user, this makes a significant contribution to network security.

The operational security of the entire network is also far higher in the Smart Office than with conventional network structures. Failure of a component only has limited implications locally, for example for one workplace or one room. Tiered redundancy in rooms with elevated security requirements is also possible, through cross-connections between Micro Switches or interconnection to form a ring, for instance.

Cost-effectiveness

The cost-effectiveness of fiber optic based, decentralised infrastructures (e.g. Fiber To The Office, FTTO) was confirmed by an expert report from WIK Consult GmbH, a subsidiary of WIK, a scientific institute for infrastructure and communication services. According to this expert report, this infrastructure concept already offers economic advantage in networks above 160 users. The cost benefits continue to increase with larger numbers of participants. The larger the network, the



Demand-actuated parameter conditioning of meeting rooms

more favourably priced is a fiber optic based, decentralised infrastructure, both in setting up, as well as in terms of ongoing operation. The expert report cites for example that for 220 workplaces a saving of around 30% is achieved, both in the short and long term. This assumes a usage period of 10 years, as is provided for in the relevant cabling standards. A device change in a 5-year cycle is also considered.

The changes in functionalities that the Smart Office offers are software-based through apps or script changes. In contrast with bus solutions, no complex programming is required, which also has a favourable impact on operating costs.

Example scenario

The function and advantages of a Smart Office are explained with a practically relevant example: Departmental manager A. arrives Monday morning at the company building slightly earlier than usual. The admission control system at the entrance recognises him and passes the information on to the Smart Office building management system. His smartphone logs into the company network and is authorised. Even as Mr. A. is crosses the entrance hall, the heating in his office starts up from reduced level into regular operation.

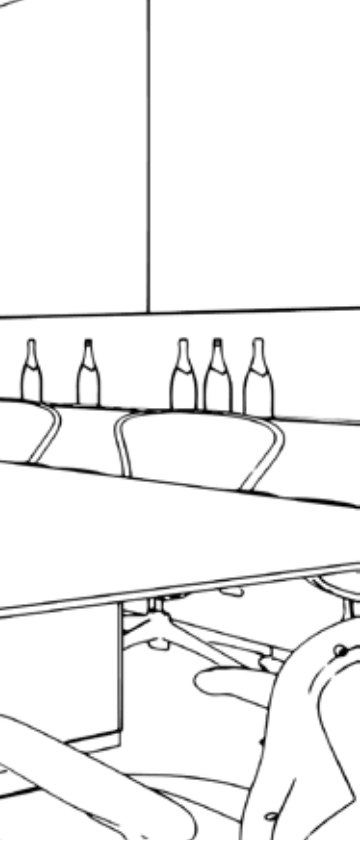
When Mr. A. enters his office, the lighting switches to the intended level of illumination in the tone of light he prefers. The network connections that were blocked during his absence to protect against unauthorised network access are activated for his laptop and Voice-over-IP phone.

He briefly wonders whether he had switched off the lighting and the coffee machine on Friday when he left the office in a hurry to keep a private appointment, but then he remembers that the Smart Office building management system automatically switches off the lighting when he leaves the office. It also switches off the 230 V power sockets when he leaves the building. The cleaners have their own admission card with which the power sockets for the vacuum cleaner are activated as long as they are in the room.

Mr. A. has called a departmental meeting for 10.00 am. The building management system is coupled to the electronic calendars of the staff and heats the conference room in good time. When the first participant enters the room, the lighting and conference technology network connections switch on and the network connections activate.

Before the introduction of the Smart Office concept, the conference rooms had to be rigidly booked, now they are prepared according to the central Outlook calendar.

The system also identifies the availability of free facilities and can issue automated suggestions, which serve to make better use of the room capacities. Special sensors detect the presence of persons in the room and continuously measure the room temperature and air quality. Whereas the productivity of



meetings used to decline along with the quality of the air in the room in earlier times, the Smart Office ensures a fresh air supply to meet requirements and even issues the corresponding information messages via an IP loudspeaker.

To prepare for the meeting, Ms. B. goes into the archive with the old building plans, which are not yet digitalised. She finds the location of the plans in the electronic directory and goes up to the upper level in the lift. Only the route she has to take is brightly illuminated, the other areas are dimmed.

Mr. C., who is quickly going through his papers before the meeting, works in a far more relaxed and productive way since the lighting is precisely matched to his CAD workplace. Should clouds drift in front of the sun, the Smart Director app on the network switches ensures that the LEDs immediately supplement the weaker daylight to achieve the required light intensity. Once the clouds have passed, it dims the lighting and forwards the lighting value measured to the building management system, which then automatically darkens the phototrophic window panes. In an older building, the blinds are controlled likewise.

The beamer switches on in the conference room when Mr. A enters. A couple of days previously, a colleague wanted to take the device out of the empty room in the evening. However, the disconnect monitoring function on the switch to which the beamer was connected can detect whether the devices are still physically connected with the network, even if they are switched off and the network connection is deactivated. A short message to the security service ensured that the incident could already be resolved before the employee entered the underground car park. His line manager had allowed him to borrow the beamer over the weekend, but this information had not been passed on. If the building had been equipped earlier according to the Smart Office concept, the theft of the PCs from the training room could have been prevented. The IT infrastructure at this time could only detect whether devices were in the network via the link status if they were switched on. Switched off devices could not be monitored.

The meeting has come to an end. Mr. A. meets his colleague Mr. D. from another department in the corridor. In the coffee corner they discuss ideas for future projects. Previously, the IT system room with the floor distribution unit was located here, as on every floor. The modern, fiber optic based decentralised infrastructure means that floor distribution units are no longer necessary. Colleague Mr. D. had the distribution room on his floor converted into a store room for office supplies and consumables. His staff no longer have to go into the basement to get paper, toner cartridges and office material.

It is now late in the day. Mr. A. closes down his laptop and goes home. His Smart Office blocks the network connection, turns down the heating to the reduced level and switches off the light. And the coffee machine that Mr. A. has once again forgotten.

Modern LED lighting fixture with multifunctional sensor

Outlook

The development towards office environments that adapt to the individual needs of the employees and the company processes has grown significantly over recent years. With the widespread introduction of building equipment installations, assemblies and components with IP connections, it has to be assumed that they will become even more prevalent in the years to come. The Smart Office, in which intelligent, distributed systems provide complex and far-reaching functionalities in a user-friendly and cost-effective way and coordinate autonomously among themselves, has already become reality. Its concept creates the basis for modern working environments and thus offers a considerably higher degree of productivity, security and economy than conventional office technology.

MICROSENS Micro Switch mounted in a cable duct

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Smart Office – the workplace becomes intelligent

Today's working world offers and demands maximum flexibility and cost-effectiveness. In modern office buildings, the workplace adapts to the employees' needs, such that they can develop their capabilities to the full. The Smart Office, the intelligent office, offers a new degree of convenience, cost-effectiveness and security. Building upon a decentralised infrastructure, the building automation systems use the IP protocol and thus become part of the data network. Applications (apps) on the network switches provide a wealth of useful functionalities, which could not, or only to a limited extent, be implemented with the previous technologies.

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