SMART SENSORS: THE ROOTS OF BUILDING CONNECTIVITY AND INTELLIGENCE

For the Internet of Things (IoT), it all starts with the sensors. In fact, one could say that a better name for the IoT would be the Internet of Sensors. But no matter the name, it is not only growing at a fast pace but also changing our conventional concept of commercial building operations and occupant experience.

Microchip-embedded sensors can be installed to monitor almost any device in a building. Their cost is low and continues to fall. Wireless sensors can avoid the cost and disruption of new hardwiring, making them a particularly attractive option for retrofits, where wiring can cost more than the sensors.

Sensors able to stream data on multiple functions have considerable smarts. For example, a sensor mounted in a ceiling luminaire can predict lighting maintenance needs and service life, diagnose faults, monitor real-time energy consumption and provide photosensor information for advanced control options like daylight harvesting. The same luminaire-mounted sensor can stream data for other building systems, including data on occupancy and motion, indoor temperature, asset tracking, and WiFi and Bluetooth networks.

With the added intelligence of a local microprocessor and memory, smart sensors can do "edge computing," providing local control without relying on other components. The software in the sensors can be updated in the field, another advantage that helps to accommodate the inevitable workspace changes.

Sensor data can stream directly to the onsite building automation system (BAS) or to the Internet cloud (see below, "Two Network Options for Sensors and BAS"). Additional processing can take place in the cloud, including analytics, integration with other building systems, and protocol conversion (e.g., BACnet, LonWorks).

SMART SENSORS AT WORK

In the real world of building operations, how does the performance of smart sensors differ from that of earlier sensors? And how do they add value for tenants, owners and facility managers?

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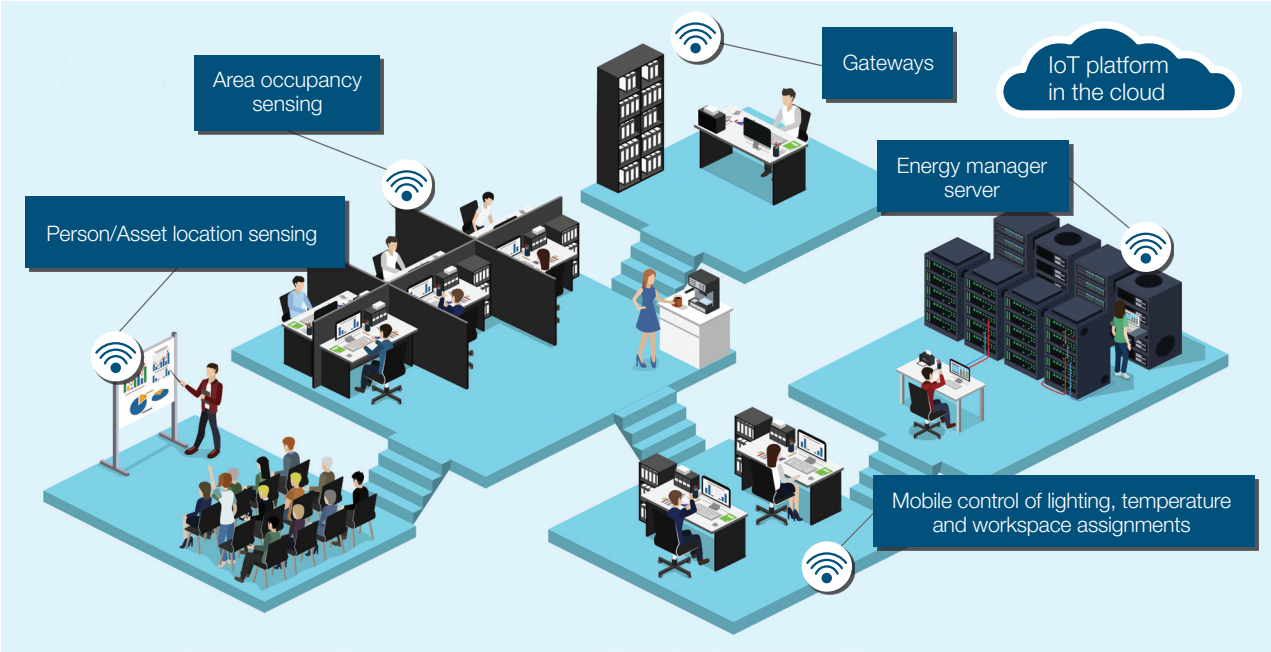
IoT System: Smart Sensors, Gateways, Energy Management, Room Control



Consider a conference room with a conventional, wall-mounted light switch with built-in motion sensor. The sensor offers efficiency by turning off the lights when no motion is detected. However, it provides no other functionality.

In the same conference room, imagine a luminaire-mounted smart sensor. The sensor can detect motion and monitor occupancy over time, creating a precise record of when the room was occupied, for how long and by how many people. An asset-tracking sensor reports what equipment is in the room and records its usage through the day. These two data streams are delivered to space utilization software that generates a dashboard of the room's daily activity.

Across a portfolio of buildings, smart sensors integrated with an IoT platform facilitate building operations while enhancing the occupant experience.

Meanwhile, a CO_2 sensor triggers demand-controlled ventilation while another sensor captures room temperature. A Bluetooth sensor allows occupants to adjust the room temperature through their cell phones. The amount of daylight coming through the room's window is monitored by another sensor that controls a motorized window shade and adjusts the LED lighting to a suitable level. The LED lighting also mimics the sun's changing light through the day, complementing the occupants' circadian rhythms and enhancing their alertness and productivity. The building automation system receives real-time data about the luminaire's energy usage, power outages and remaining service life. Third-party applications in the cloud utilize data from all sensors for additional analytics and functions.

THREE LEVELS OF EFFICIENCY AND VALUE

Using smart sensors to digitize building systems provides granular data for energy efficiency. In effect, the sensors enable real-time, continuous commissioning of building systems and operations.

But the sensors' data also enhances space utilization, maximizing the value from a firm's real estate expense. Finally, smart sensor data can also improve the wellness and productivity of building occupants by increasing their output, reducing absenteeism and boosting employee attraction and retention.

Sensor-enabled applications transform physical building space into highly productive business assets.

According to the global real estate firm JLL (formerly Jones Lang LaSalle), these three factors – energy efficiency, space efficiency and people efficiency – encompass the three components of total occupancy costs. Annual energy costs in a commercial building average $3/square foot and space costs average $30. However, employees are much more expensive – especially knowledge workers – and their average annual cost is $300/square foot.

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For more information on the occupant experience in IoT-enabled buildings, click on other articles in this series.

1 Smart Buildings and the Internet of Things: A New Concept of Operations and Occupancy Experience

2 Smart Sensors: The Roots of Building Connectivity and Intelligence

3 How to Quantify the Bottom-Line Value of Occupant Experience

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For more on the connection between the occupants' satisfaction and their productivity, see **How to Quantify the Bottom-Line Impact of Occupant Experience**.

Consequently, on a firm's bottom line, a 1% gain in employee output is worth 10 times more than a 1% savings in space costs and 100 times more than a 1% savings in energy costs (see **The Three Components of Total Occupancy Costs**). While smart sensors can help to optimize each level, it is important to manage them with an eye to each one's potential return.

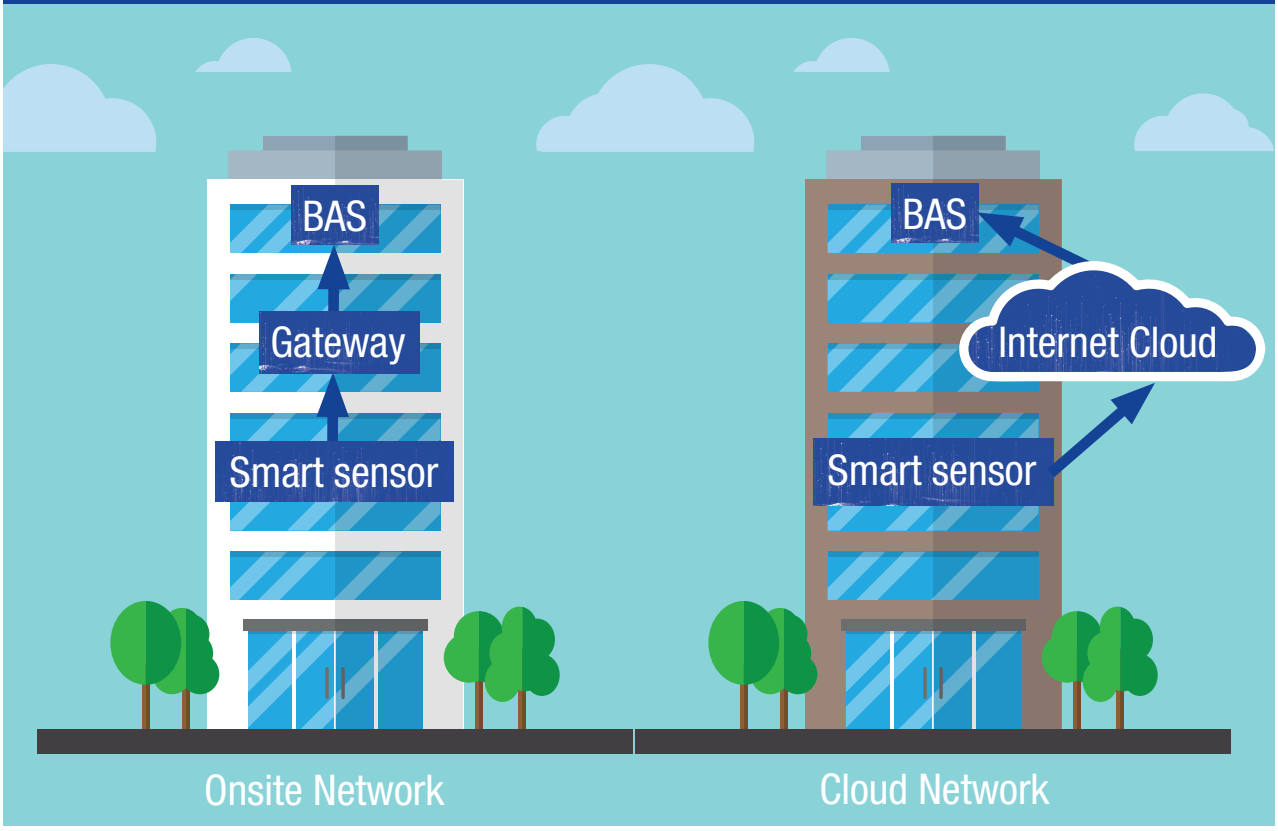
Firms increasingly recognize their need for efficient workspace that *energizes their workforce*. As a result, building owners and managers will increasingly need to view every tenant and occupant much as the hospitality industry views every guest – an individual whose satisfaction must be met. Smart sensors and building system data are a powerful means to achieve occupant satisfaction. ■

TWO NETWORK OPTIONS FOR SENSORS AND BAS

To maximize the actionable value from a smart sensor's rich stream of data, a building's BAS typically receives the data through one of two network scenarios (Figure 1).

Onsite networks are located entirely within the building. They send the data to the BAS through network links and connections that are hardwired, wireless or a combination of the two (for example, a wireless sensor connected to a wired gateway connected to the BAS). However, this approach does not leverage the benefits of an IoT platform and cloud computing.

In cloud networks, the data goes to the Internet, then to the onsite BAS. In the cloud, the data undergoes further analytics and processing, adding a layer of intelligence unavailable in the building's existing BAS. For example, the cloud can handle any necessary protocol conversion for the BAS, such as converting all sensor data to BACnet or another common protocol. Cloud-based applications can also combine historical data from the BAS with real-time sensor data and display it in a dashboard. A cloud scenario can also avoid the expense of upgrading an existing BAS in order to achieve similar functions.



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