Smart Automation

Summer 2020

The latest in Smart Technology Solutions

Which technology is best

Wireless standards for building automation and control

Which technology is best?

A structured approach narrows down the options when choosing wireless standards for building automation and control by Graham Martin, Chairman & CEO EnOcean Alliance

Smart buildings are becoming the "new normal", with increasingly sophisticated automation and control systems that deliver cost savings, comfort, and convenience across the board. From individual homes and multi-occupancy buildings, through educational and healthcare facilities, to workplaces and corporate headquarters, enhanced building automation solutions are delivering value-added service features thanks to linkage with IT-based systems and even artificial intelligence.

Such possibilities rely on transferring greater or lesser amounts of data around buildings and their interior spaces. The requisite data are easily gathered and transmitted wirelessly: but which wireless technologies and standards are the most suitable? And how do we go about identifying the best solutions? Prof. Dr. Michael Krodel from the Institut für Gebäudetechnologie (Institute of Building Technology) in Ottobrunn, Germany, has given some invaluable insights.

It depends on the use case

In Krodel's White Paper "Smart Building trends – a comparison of wireless standards for automation and control" he says that the first step is to identify the processes or systems that need to be automated. The starting-point is to list the requirements for room-automation and facility automation on the one hand, against the requirements for "Smart Buildings". The most suitable wireless technology can only be identified, case by case, according to the relevant application and its "use cases".

Typical room-/building-automation use cases include individual room temperature regulation according to human presence and window status; room ventilation and cooling depending

on air temperature, air quality (CO2 and/or VOC loads) and humidity; and lighting, where illumination levels can be dimmed when areas are not in use. In the latter, switches can control individual lights or groups of lights as required.

Artificial light intensity can also be adjusted in accordance with natural light intensity depending on the weather and time of day. In addition, sun blinds and shutters can be deployed automatically to darken the room when it is warm or let the sunshine in when the space is cool. With battery-free technology, switches and dials for illumination and external light shading can be placed anywhere on partitions or walls, according to users' requirements and convenience. Handheld remote controls can also be employed.

Use cases for the home are complemented by an extensive list of automation scenarios spanning heat and cooling requirements energy systems' operation, management and fault reporting.

Smart office buildings expand the possibilities to many more use cases: from the smartphone-based dynamic booking/release of conference-room facilities and workplaces in open-plan offices, to optimal facility management through occupancy sensors. Meetings finishing ahead of schedule and unoccupied workplaces can be identified and adjusted accordingly for optimal facility management.

Further analysis of usage patterns enables the flexible allocation of employee workspace. Under-used areas can be set to energy-saving mode, thereby lowering the cost and workload of heating, cooling and power plant. A graphical display of building occupancy – typically rendered as "Heat Maps" or "Moving Trails" - provides for zone planning purposes. This can be applied to optimise workspace size and location; even to optimise individual workspaces to users' preferences.

As well as detecting people, sensors within the building automation network monitor pumps, cleaning machines, HVAC systems, lifts and more, then report any malfunction in real time for better fault-finding and more efficient preventative measures.

Categorising wireless standards and their suitability for automation and control

With Prof. Dr. Krodel's analysis, the use cases are cross-referenced with characteristics of the leading candidates for radio-frequency data transmission. In particular, wireless network standards are characterised by the frequency bands in which they operate, the power of the radio signal, and the protocols and modulation schemes that they use.

Relevant criteria are as follows:

- Suitability of the frequency band: the use cases considered, largely feature small data packets (10-100 bytes), latency times from 0.1 to 1 second and a range from 10 to 100m. The suitability of the frequency band is of decisive importance – described as a "KO-criterion" or knockout factor. Any functional limitation, even a partial one, would disqualify the wireless standard in question for this type of application.
- Manufacturer dependence: in the best interests of the user, wireless standards should be available from as many suppliers as possible. In addition, wireless technology should allow for maximal interoperability between technologies and devices produced by different suppliers
- Infrastructure: ideally, devices should not require their own. This is a given when signals can be transmitted over greater distances and is particularly relevant when sensor network density is low. A better score is awarded

to infrastructure consisting of cable-connected antennas and gateways, allowing for meshed communication.

- Integrability: wireless standards should be widely supported by multiple manufacturers of commercially available controllers and gateways, with proven reference project information.
- Broad availability of the necessary hardware components: all the necessary sensors must be freely available on the open market.
- Measurement and testing: appropriate fault-finding equipment and user documentation should be available.
- Power supply: one of the main advantages of wireless technology consists of the free positioning of sensor devices. Cabled power supplies represent barriers to the required flexibility. Ideally, sensors should be self-powered. Battery-powered devices sit in-between these options, because of the need for maintenance and the costs – including environmental cost – of replacement and disposal. Low power consumption and long lifetime are key considerations.
- Data encryption: data security and integrity must be guaranteed by encryption technology.

Losers and winners

Analysis based on the broad matrix of use cases and technical suitability makes it clear that Wide Area Networks are unsuitable for current and future Smart Building applications. The White Paper concludes that WANs are "better suited to integrating wireless devices into public areas, i.e. where it is impossible to establish one's own infrastructure. In modern buildings, however, setting up an own infrastructure or establishing mesh networks presents no problems and makes excellent sense in consideration of the density of the sensor networks."

In contrast to WANs, local area wireless technologies prove applicable to Smart Building automation, albeit to varying degrees. Options to incorporate wireless devices (especially sensors) into building automation system could be especially relevant, for example alongside controllers and direct digital control-systems.

The use-case analysis concludes that support for specific wireless technologies offered by controller manufacturers plays an important role. There is huge merit to being able to source compatible components on the open market. Even greater advantages are offered by wireless devices that do not require batteries or mains power.

Two wireless technologies lead the field, as Krodel concludes that "... the EnOcean and Z-Wave wireless standards appear to be ideal for use in "Smart Buildings". EnOcean achieved a mean score of 1.9 points on the suitability index followed by Z-Wave with 1.5 points. "

But the difference between these front-runners lies in their market focus. Commercially, Z-Wave is better suited to "DIY" Smart Home consumer-level retrofit applications. By contrast, EnOcean features higher levels of interoperability and caters for professionally installed integrated systems, most typically in Smart Home and non-residential building sectors. Nevertheless, the EnOcean Alliance is broadening its focus and will have increasing appeal as consumer-level home automation spreads.

For further information please visit **www.enocean-alliance.org**