Routing Concept from EnOcean

Compared to hardwired systems, wireless systems are much more convenient to install and present more flexibility of course. In some applications you nevertheless come up against the range limits of wireless. This is where routing methods are generally used, in other words the wireless telegrams are conducted to their destination through a network of wireless components. In the simplest case the latter will be repeaters, forwarding all received telegrams, whilst in more complex cases the optimal routes are calculated in advance and held as tables in the memory of the individual wireless nodes.

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Routing principles

Fig. 1 shows possible ways of expanding the coverage of a wireless-based supervision or automation solution. Basically this can be done by means of a gateway to an established, wired automation bus (routing to the data backbone).

The other wireless-based routing methods are explained more fully in what follows. An important boundary condition is that all wireless nodes within the range of reception must share the wireless channel. Collision of wireless data "in the air" must be minimized by appropriate system architecture.

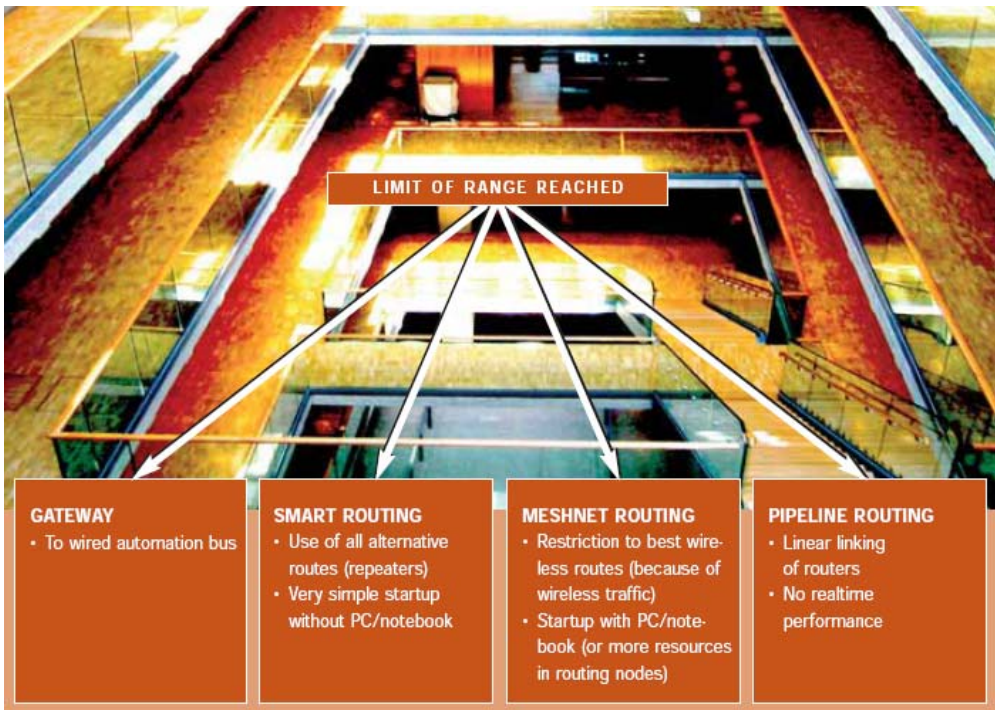

Fig. 1:
Overview of features of different routing methods

MESHNETS for supervising areas larger than 500 sqm

MESHnets originated in the USA from the wish to compensate the poor range and material penetration of 2.4 GHz wireless systems. There is no need for their use in building automation at frequencies below 1 GHz because the signal attenuation is very much less. A practical application for MESHnets

on the other hand is the supervision of areas larger than 500 sqm, for example agricultural terrain or airport terminals where a wired automation bus or data backbone is ruled out because of inaccessibility or high retrofit costs.

MESHnet routing, the areal arrangement of routing nodes, is restricted to the best wireless routes. This method is necessary to limit the wireless traffic occurring with more than three hops. Because of increasing system complexity, the memory needs of the routing nodes increase considerably with the number of hops.

So, in practice, a commercial MESHnet is generally limited to five hops. The system complexity also means that a PC or notebook is always required to both start up and expand a MESHnet, and the software and hardware investment in the routing nodes is comparably high.

PIPELINE ROUTING for meter reading in high-rise buildings

A pipeline, a linear arrangement of routing nodes, may have far more than five hops. The powered sensors or actuators each operate as routers. Typical applications are the actual supervision of pipelines or the billing of heating costs in a highrise building, where the figures read from upper levels have to be transported down through all levels for registration in the basement. This concept exhibits the longest signal propagation time of all wireless methods, so there should be no special demands for realtime response.

SMART ROUTING for residential building

Smart routing always uses all possible alternative routes for each wireless transmission. All received and valid wireless telegrams are transmitted. This kind of routing is also called repeating, and in smart routing the repeaters also communicate with one another. The method makes sense for one or two routing nodes (three hops) because of the increased risk of telegram collisions with greater wireless traffic. This is where the extremely short EnOcean wireless telegrams are an immense advantage. A major benefit of smart routing is the very simple system startup without a PC or notebook.

In solutions with bidirectional actuators the particular repeaters in the system will in future also be able to configure themselves. Consequently the user need not select the repeater nodes manually. That prevents the user from unintentionally degrading system performance true to the motto "doing more helps more". Smart routing is currently the clear favorite for use of EnOcean technology in buildings. The setup effort, the realtime response and the costs are more favorable than complex routing for application in residential and commercial building.

Application in commercial building

With almost 100,000 wireless components already installed primarily in commercial buildings, EnOcean has now gathered extensive experience. The wireless range is typically restricted by the solid walls of the fire cut-offs. One or two wireless gateways with the wired automation system (LON, EIB, TCP/IP, etc), centrally placed in a fire compartment, have become an established installation procedure for EnOcean technology. For the alternative, direct driving of wireless actuators by wireless lights or blinds switches, as in use of the WINSTA and gesis systems for example, there is no need to overcome long wireless ranges. In planning to achieve the critical range, a remedy was easily produced by retrofitting repeaters.

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Application in residential building

For applications restricted to one or two rooms, like retrofitting a switch or blind, the direct wireless range is always sufficient. When applications go through the house, you have to differentiate. In small accommodation units with up to three walls to penetrate or a ceiling, i.e. one- or two room apartments, or one or two town house levels, a signal amplifier is seldom required for wireless coverage. In dwellings, town houses and single-family detached homes up to about 400 sqm, a repeater should be provided upwards of three rooms per unit and three or four levels.

The reliability of transmission is much improved by multipath propagation. The positioning of the repeater is not critical but should be central. If the ceiling is heavily reinforced or there is some other kind of shadowing, a second repeater is easily retrofitted. A separate wireless system should be implemented for each unit in apartment houses and high-rise buildings. Gateways may be provided for a link to a superordinate automation system (LON, EIB, TCP/IP, etc). In short, none, perhaps one, or occasionally two centrally located repeaters or routing nodes may be needed for reliable wireless coverage of a typical accommodation unit.

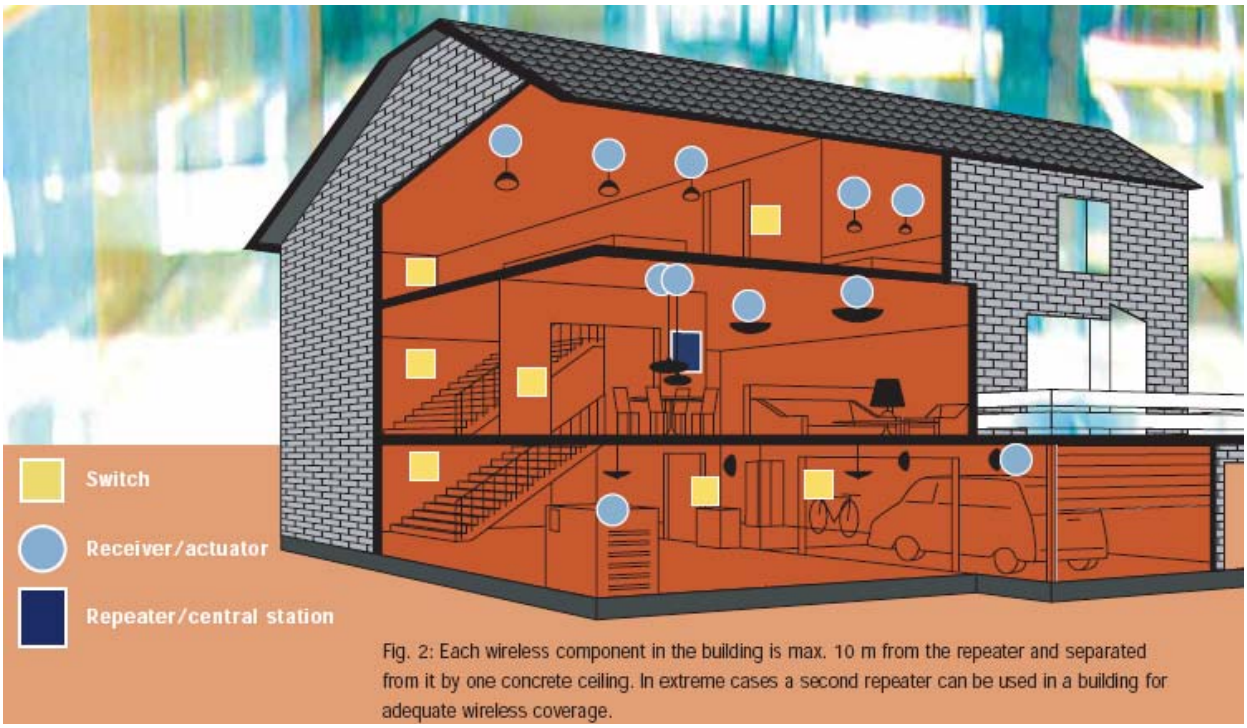

Fig. 2: Each wireless component in the building is max. 10 m from the repeater and separated from it by one concrete ceiling. In extreme cases a second repeater can be used in a building for adequate wireless coverage.

More routing nodes than necessary degrade system performance

It is important to remember that the performance of a wireless system can degrade seriously if more routing nodes are used than are really necessary:

- Transmission reliability is reduced because more hops increase the wireless traffic and thus the probability of telegram collision.
- Realtime response decreases because more hops extend telegram propagation time.

- Startup of the system becomes more elaborate – upwards of three hops a PC/notebook will be virtually essential because of the complexity of the system.

- More hops mean more computing and memory capability in the routing nodes, which adds to the system costs.

Summary

Of the different routing concepts, EnOcean clearly prefers smart routing for house building. This works with a minimal number of signal amplifiers, and all possible alternative routes are always used for wireless propagation. The EnOcean repeater serves as the routing node. The convenience of start-tup without a PC or notebook, the assurance of extremely fast response and the cost all speak in favor of smart routing for residential building and commercial building.

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