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Open or proprietary?

Wireless networks for industry

When selecting wireless networks for their industrial production, many factory planners favour open rather than proprietary networks. However: this apparent contradiction begins to blur, the closer one looks. A comparison of the two systems shows why.

Fig. 1: The future of intralogistics is flexible and requires wireless communication networks

Wireless networks are designed to facilitate communication from a large number of terminal devices (sensors) within an enclosed space and in unfavourable (transmission) conditions. The stability of the signal transmission plays a crucial role, as does the integration potential in the superordinate IT infrastructure. Investment and running costs, as well as fitness for the future, are further essential criteria, as are independence from individual providers and the desire to use a solution which is as universal as possible.

Wireless networks are gaining popularity

These are all prevalent criteria influencing decision-makers when selecting wireless networks for industrial production. Such networks are used in an increasing number of factories, especially for intralogistics. One reason for this is that state-of-the-art logistics increasingly demands flexibility. Planners are therefore beginning to eliminate stationary conveyor systems and fixed racks, and the automotive industry is currently demonstrating how this can work: in most modernised factories, cars are moved through the production halls by automated guided vehicles (AGV), while smaller AGV supply new materials to

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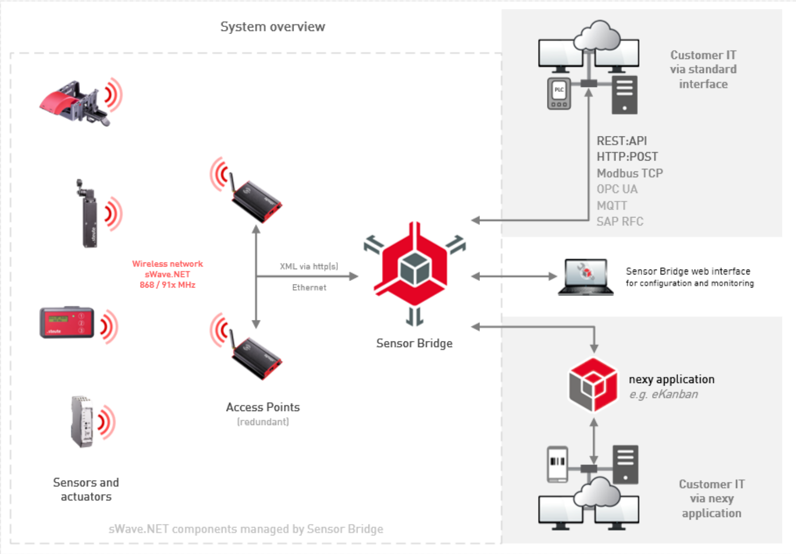

Fig. 3: Access Points bundle sensor signals in the field

Fig. 2: In one sWave.NET network, several hundred – and in practice to date up to 2,000 – sensors can be integrated

assembly points, and small parts are provided by mobile eKanban racks (Fig. 1).

In such scenarios, cabled communication is not an option – hence the increasing demand for LPWAN (Low Power Wide Area Network) wireless networks. Different systems are available, and they can be divided into the categories "open" versus "proprietary".

The benefits of open systems

Of the protocols which are based on open standards, LoRaWAN (Long Range WAN) has a good market position. This protocol was originally developed for applications in public spaces and offers a long range. Various manufacturers are active in the LoRa Alliance, and the assortment of network-compatible devices is correspondingly large (www.lora-alliance.org).

At first sight, (nearly) everything speaks for an open system. The user is not forced to work with one provider, can use devices from different manufacturers, and remains independent. In addition, the probability is greater that an open system will be continually developed because several companies and user groups rely on it.

In practice, proprietary systems dominate

However, in practice – at least as far as steute is able to assess – proprietary systems are nearly always used for intralogistics. This seems to be a contradiction, but the explanation is that customer specifications demand high transmission reliability and availability in industrial environments. Since LoRaWAN was not developed primarily for such operations, the transmission protocol is usually adapted to fulfil the desired requirements as well as possible. But then it is no longer an open system, and instead an individual application which no longer has any advantages over a system which was proprietary from the outset. Users should remember this when choosing a system.

A comparison between two wireless network systems for intralogistics

Here it is possible to conduct a systems comparison "on a level playing field" – i.e.

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independently of whether a system is open or not – between LoRaWAN and the sWave.NET proprietary wireless network developed by steute, which also has been widely installed in intralogistics applications.

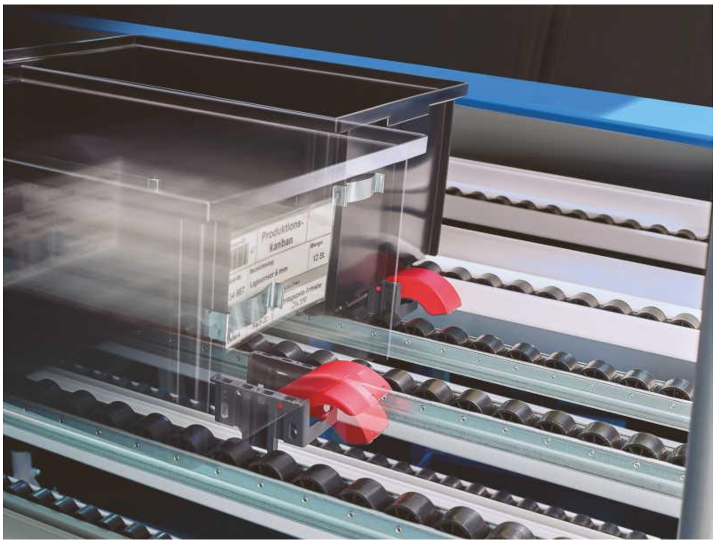

Fig. 4: This device (tilting sensor) was developed especially for eKanban applications

LoRaWAN is a wireless network with a star-shaped architecture which transmits on different frequencies – in the ISM and SRD wavebands. The standard was originnally developed for networks of wireless sensors which are distributed across several square kilometres, have to communicate across long ranges, and which seldom transmit wireless telegrams.

sWave.NET was developed with the aim of providing a wireless network for industrial applications featuring high availability and extremely low power consumption. Several hundred sensors can be integrated in an sWave.NET application in a confined space (Fig. 2). Access Points (Fig. 3) bundle the communications from the sensors in the field; a Gateway as a media converter connects the wireless sensors and actors with TCP/IP networks. A Sensor Bridge serves as a service manager and connects to the IoT (Internet of Things) via various protocols.

Both systems are licence-free and can be used all over the world – on different frequencies depending on the country in question.

Power consumption / battery lifetime

Both LoRaWAN and sWave.NET terminal devices generally have low power consumptions when they are not in use. In the direct comparison between the systems, however, LoRaWAN requires a sixfold transmission time and considerably more receiver performance than sWave.NET. In a comparative test in the steute laboratory, the power consumption during transmission and reception in the LoRaWAN system was twelve times higher on average than with the sWave.NET system (components and conditions used in the comparison: Semtech SX1211 with sWave.NET settings and SX1272 with LoRaWAN settings in accordance with the LoRa Alliance). The battery lifetime of the sWave.NET sensors is correspondingly longer.

Range

The LoRaWAN ranges typically reached are up to 2 km (in urban areas) or 15 km (in rural areas). The sWave.NET range with guaranteed reliable signal transmission is up to 60 m (indoors) or 700 m (outdoors). This is considerably shorter than with LoRaWAN, but completely sufficient for normal industrial applications.

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Latency and power-up

In many industrial applications, the response and reaction times of the (wireless) network play a crucial role. An sWave.NET sensor communicates with an Access Point, which confirms reception of the wireless protocol of the switching information within 50 ms. A LoRaWAN sensor also transmits its data to an Access Point, but the response is generated by the back end. The sensor must wait for its reception time slot, aiming at 1.0 (maybe even 2.0) s after transmission. This makes the response time with sWave.NET considerably shorter.

Collision probability

This factor provides information about how strongly the signals are impacted within a wireless system. A comparative calculation of the collision probability (www.wireless communication.nl/reference/chaptr06/ra_sg.htm, retrieved on 8th May 2020) for cases where 200 sensors transmit one 20-byte telegram per minute returned the following results.

LoRaWAN:
- G_{Uplink} = 200/32,000,
$P_{UplinkLoss}$ = 100 % - e-2G = 1.2 %;
- $G_{Downlink}$ = 200/4,000,
$P_{DownlinkLoss}$ = 100 % - e-2G = 9.5 %.

sWave.NET:
- G = 200/6,000,
$P_{LinkBlocked}$ = 100 % - 1/(1+G) =
G/(1+G) = 3.4 %.

sWave.NET thus repeats 3.4 % of its frames due to LBT blocking (Listen Before Talking), yet does not lose any information. LoRaWAN, on the other hand, loses nearly every 10th packet on its downwards connection, leading to delays and repetitions when information is lost. With a high installation density of the nodes (e.g. 1,000 nodes/ 30,000 m^2) and a high number of telegram repetitions, the power consumption increases considerably.

Due to a transmission time which is at least six times longer than with sWave.NET, a LoRaWAN gateway reaches its duty cycle limit at least six times faster, provided that many switches are switching within a short period of time. LoRaWAN here achieves approx. 40 telegrams à 20 bytes per minute and Access Point, whereas sWave.NET achieves approx. 250. In order to increase the duty cycle limit for LoRaWAN, the number of Access Points would also need to be increased. Or the receiver confirmation would have to be deactivated, which could lead to undetected packet losses.

Coexistence and immunity to interference

Various operational measures increase the immunity to interference in both systems, also from other wireless networks. With sWave.NET, for example, every wireless telegram sent by a transmitter must be confirmed by the Access Point in question. If there is no response, the transmitter repeats the telegram up to 30 times at random intervals within approx. 13 s. Twenty out of these thirty repetitions use an LBT mode which means that the sensor in question checks before transmitting a signal whether or not the intended channel is free. LoRaWAN does not use LBT. Therefore, there is a higher risk that collisions of wireless signals will remain undetected, even when several uplink channels are used.

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Scalability
LoRaWAN was developed, amongst other things, for use in smart cities and infrastructures and is highly scalable. sWave.NET is aimed at applications in industry, especially intralogistics, with several hundred or even thousand wireless switching devices and sensors in an enclosed space, for example a production hall. Here, too, there is scalability, especially because different applications (eKanban, AGV ...) can be operated within one and the same network.

Product range
For LoRaWAN there is a comprehensive product range of sensors, switching devices and actors available. In contrast, sWave.NET uses sensors and switching devices from the steute Wireless range. They include sensors which were developed especially for individual applications – for example the detection of containers in mobile eKanban systems (Fig. 4). Since the wireless modules can be integrated in sensors from other manufacturers, sWave.NET is open to expansion, however, to include additional terminal devices and functions.

There is no standard solution
The comparison leads to the following conclusions: when selecting network solutions for industrial applications, customers must do without "out of the box" solutions with open standards. Instead, users need to opt for a system which is adapted to suit their individual application(s) as closely as possible. And then the contest may begin. A fundamentally open, yet usually still modified network such as LoRaWAN offers advantages when e.g. a hybrid private/ public network is desired. A proprietary system like sWave.NET features high stability and immunity to interference in industrial applications. Pre-configured applications already exist (eKanban, AGV, Andon etc.), and it has special features such as a "deep sleep / wake-up" mode for low-energy operation, which is especially beneficial in intralogistics (e.g. for AGV control).

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