SIEMENS

Technical article

Overhead monorail via Industrial Wireless LAN?

Which form of communication between the mobile and stationary sides is the best for an overhead monorail? A German carmaker decided on Industrial Wireless LAN solutions for the vehicle assembly and entrusted Siemens Professional Services for Industrial Networks with their planning, commissioning and fine-tuning. A more complex follow-up project at another site speaks for a satisfied customer.

Overhead monorails represent the logistical backbone of every automotive plant. They transport entire car bodies as well as various attachments and mounting parts in sequence through the production – longer disturbances or, worse, failures would massively affect the processes. Consequently, a high overall availability is a must; a crucial factor for it: lasting, reliable communication between the circulating hangers and the stationary "land side". Conventional slip ring systems for this are naturally subject to wear and therefore require more maintenance than wireless solutions.

Professional Services involved early on

To sustainably ensure the availability and productivity, a renowned carmaker has modernized and expanded its existing heavy-load overhead monorail. As general contractor and system integrator, Siemens employed its proven electrified monorail systems (EMS) for this. Following the same pattern, a new engine overhead monorail for the engine transport was constructed alongside it. The circular heavy-load overhead monorail route is more than 1,700 meters long and – in its maximum configuration – designed to carry up to 200 heavy-load hangers;

the engine overhead monorail is approximately 400 meters long and designed for a maximum of 70 engine hangers.

But which form of communication is best for this? To clarify this, specialists from Siemens Professional Services for Industrial Networks were consulted as early as the planning stage. These specialists developed various possible solutions and discussed them with the operator. In the end, the persons in charge were won over by a tried and tested approach based on Industrial Wireless LAN (IWLAN) components from the SCALANCE W product family – with wireless communication via RCoax leaky-wave conductors

Professional support for a failsafe IWLAN

The longer and more complex an overhead monorail route and the larger the number of hangers, the more important becomes sound network and channel planning, especially since the communication must run failsafe, i.e., deterministically with mandatory (channel) exclusivity. Thus, a solution with PROFINET communication via the PROFIsafe protocol in the less frequented 5 GHz band was put into place.

In the first step, the IWLAN specialists from Siemens created a rough design. Following the first concept presentation and reconciliation at the customer, a detailed design was produced and suitable hardware selected. To assess the structural and, in particular, wireless requirements, and then define suitable mounting locations for the access points as well as leaky-wave conductors, a site survey was conducted. To avoid possible interference from other wireless communication in the surrounding area, a spectral analysis was performed along both overhead monorail routes. As a result, occupied channels could be identified and – with the collaboration of the operator's IT department – six interference-free channels be made available. The designers distributed these channels among the access points and RCoax segments so that they can be used several times along the route without affecting each other. This keeps the channel count low and thus the polling cycles short. At the same time, the required overlaps at each two adjacent segments were accounted for.

For reliable communication, 21 SCALANCE W788-2 M12 IWLAN access points with RCoax antenna segments up to 96 meters in length were installed along the heavy-load overhead monorail route; another six access points cover the overhead monorail route carrying the engines. Carefully mounted, the maintenance-free leaky-wave conductors provide a precisely oriented and defined wireless field.

The initial 240 hangers at both overhead monorails were each equipped with a SCALANCE W748-1 M12 IWLAN client module and an antenna of the type ANT793-4MN. The clients are connected to the corresponding EMS controller via PROFINET, and all access points are networked with the land-side main controller.

Determinism and rapid roaming with iPCF

The chosen access points and clients support the iFeature "industrial point coordination function", iPCF for short, a Siemens-developed IWLAN procedure for deterministic communication and rapid switching between two access points (roaming).

Core components of the IWLAN solution for the heavy-load overhead monorail, designed and implemented by Siemens Professional Services, are 21 SCALANCE W788-2 access points along the route and, in its maximum configuration, 200 SCALANCE W748-1 client modules with an ANT793-4MN antenna each at the hangers.
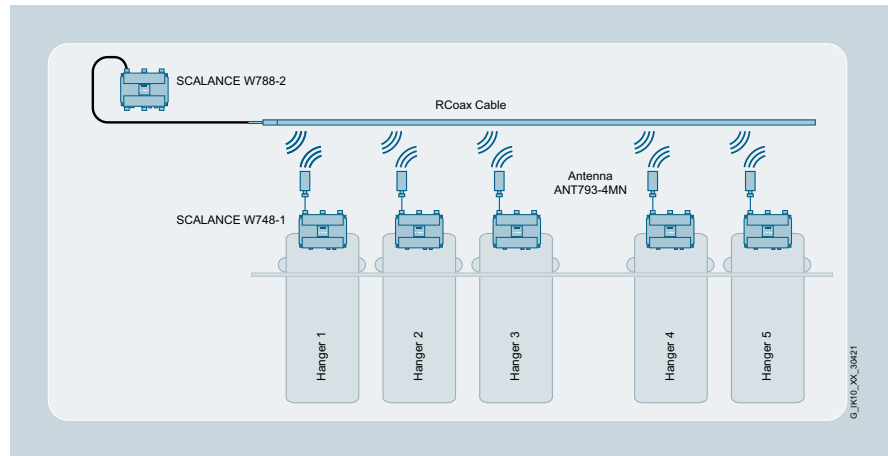
With it, a failsafe PROFINET/PROFIsafe communication or CIP Safety/ Ethernet/IP is also possible over WLAN.

The central goal of the planning is to avoid communication breakdowns. Thus, the deterministic behavior is controlled by the respective access point, which queries all client modules in its wireless field at cyclic intervals. Thank to the short polling cycle times, a client very quickly determines whether the connection to its access point still exists or not. If the contact has been lost, the client can respond within a very short and predictable time, and establish a connection to an alternate access point. In iPCF mode, both the search for a new access point and the login to this access point are optimized in terms of time. Handover times well below 50 milliseconds are achieved. In addition, the process is optimized to the effect that it can be deterministically completed within the configured PROFINET update time. This makes possible PROFINET update times as fast as 16 milliseconds. In the case described, sufficient 64 milliseconds were realized on PROFINET and in the iPCF cycle.

The intelligent additional functionalities (iFeatures) of the SCALANCE W devices are easily unlocked via so-called keyplugs, which also contribute to the high availability of the overhead monorails. The plug-in storage media contain the latest device configuration and can simply be used in the new device following a device replacement, which minimizes downtimes.

IWLAN performance brought to a high level

Even before the scheduled production stoppage, the access points were premounted along the routes, wired, and the client modules preconfigured on all hangers.

The iPCF IWLAN protocol enables rapid, reliable roaming and deterministic, also failsafe, PROFINET communication in guided, linearly structured applications with RCoax leaky-wave conductors.

After mounting the IWLAN devices and leaky-wave conductors, a specialist from Siemens checked the installation and put all devices into operation. To this end, he uploaded the latest firmware, assigned IP addresses and WLAN channels, and adjusted the transmission power. With the aid of the signal recorder function of the SCALANCE W client modules, the signal characteristic was recorded during a round trip of a hanger, and then analyzed and fine-tuned. Through continuous network pings, it was determined that latencies at the heavy-load overhead monorail amounted to less than 10 milliseconds during subscriber-to-subscriber data transfers over IWLAN – indicating an excellent connection quality.
A concluding spectral analysis ultimately confirmed "clean" wireless conditions – the overhead monorail systems could thus be handed over fully operational within the stipulated time frame.

Satisfied operator awards follow-up order

The operator is very pleased with the IWLAN solution. The installation can be expanded by additional hangers up to its intended maximum configuration, and be maintained with minimal effort.

The first spin-off of the successful implementation is a follow-up order for the design and commissioning of an even more complex overhead monorail at another production site of the carmaker with – EMS and IWLAN technology from Siemens.

Professional Services: Comprehensive support in all aspects of industrial communication networks

An Industrial Wireless LAN is more challenging than a conventional WLAN: The industrial operation makes much higher demands than the office world; often these vary from industry to industry and from country to country, and whether it takes place indoors or outdoors. This requires both comprehensive and very specific expertise. When it comes to wired and wireless networks, the specialists from Siemens Professional Services for Industrial Networks are always on the ball. The team was established to support manufacturers and operators of machinery and equipment with network technology from Siemens and other suppliers in every life cycle phase – from design to service. The know-how has also been passed on to specially certified solution partners – making these services available worldwide.