Gantry cranes at the Industrial Wireless LAN

Seamless integration of the crane control systems in process control

Frankfurt/Main. Communication via Industrial Wireless LAN in an industrial environment is no trivial matter. Especially when it involves the control of a crane, which has to be seamlessly integrated into the ongoing process control. During the construction of a 12,000-tonne open-die forging press, wireless communications proved itself reliable, even under critical process conditions.

The Völklinger Saarschmiede GmbH open-die forge, a wholly-owned subsidiary of Saarstahl, has for years been among the world’s leading manufacturers of components for the aviation and aerospace and general engineering, and especially of turbine and generator shafts for power plant construction.

In May 2010, Saarschmiede inaugurated a new production facility at its premises in Völklingen, one of the most modern open-die forges in the world. The existing capacity has been expanded in a huge hall 530 m in length and 60 m in width. The forging activity is mainly focused on the production of large shafts for energy machine engineering and other high-quality forged products in the areas of »General Engineering/Tool Steel« and »Special Materials«. This includes turbine shafts for the so-called 700 °C technology. This will make it possible in future power plants to achieve an efficiency of around 53 % with a 30 % reduction of carbon dioxide. The required material properties, however, can only be achieved by open-die forging with special know-how and the latest equipment technology. These requirements can be met by the Saarschmiede, Figure 1.

A 12,000-tonne press is used for forging parts in the middle of the building. Two portal cranes are available for the handling of the workpieces. They are not only used for transport, but also for holding the workpiece in position during forming, Figure 2.

Dead spots unwanted

Since the cranes are an integral part of the production process, seamless integration into process control of the forging press is also required. A challenging task, which Saarschmiede accomplished by relying on Industrial Wireless LAN (IWLAN) from Siemens. This built on positive past experience from Saarschmiede, and also on experience with other wireless applications from the parent company, Saarstahl AG.

The particular challenge involved uninterrupted radio contact between the press control and the two cranes, which, are never allowed to break off despite the extremely harsh conditions of an industrial area with its high metal content.

When a workpiece is machined by the press and held there in place by one of the cranes, the deforming forces are so great, that additional strong loads that may occur can exceed the maximum capacity of the crane. Such a situation must not only be
Technology for safe interaction

The current load of the crane is continuously recorded by sensors and transmitted in short time intervals to the press control. When increasing load is detected, the press is immediately stopped.

The technology behind this consists of two Simatic S7-300 controllers for the cranes and a Simatic S7-400 controller for the press. The controllers are interconnected via a Profinet I/O coupling. Profinet is considered the leading industrial bus standard, which has proven its reliability in the field of industrial processes around the world.

The I/O coupling used at Saarschmiede Völklingen enables update times of 16 ms, thereby fulfilling the communications requirements for ensuring fast and reliable response to the threat of system overload.

The connection of the crane control to the forge control is made via IWLAN. This wireless solution, especially conceived for industrial applications, was designed for maximum reliability and provides reliable communication system for mobile plant units. In contrast to every other fixed-cabled solution, it is extremely resistant to wear and is thus characterized by minimal maintenance costs and downtime. Even under the extreme environmental conditions of this open-die forge, IWLAN presented itself as the optimal solution for seamlessly and securely connecting the cranes and the press as communicating functional units. But what appeared to be logical and plausible during the planning, in practice proved to be a complex task requiring extensive research and selective fine-tuning.

Seamless, wireless communications

A production facility in which workpieces weighing tonnes are processed, of course, must have a solid steel construction and components. These have a serious negative effect on the propagation of radio waves. Full and uninterrupted radio contact had to be ensured for all locations, especially for the two mobile cranes. The reason for the safety concern was not only the massive metal components of the building structure, but also the machines contained therein, which could cause strong deflection or even full blockage of the radio waves.

Optimally positioned Scalance W788-1RR access points with omni-directional antennae provide complete radio coverage over the entire route of the cranes as well as seamless connection of the IWLAN to the Profinet. In order to obtain a sufficiently stable radio field despite the rough transmission conditions, antenna diversity was used at both ends of the communication line. Two omni-directional antennae for each transmitter or receiver were installed especially for this radio network configuration in order to reduce the interference effects resulting from the transmission. Because the cranes are mobile, the access points have a rapid roaming function, which uses the Industrial Point Coordination Function (iPCF) and thereby enables extremely fast handover. This »iFeature« – i.e. a function especially designed for industrial use – ensures that the fast response time of the Profinet I/O system is maintained under all operating conditions.

Proven communication freedom

Wireless communication creates new application possibilities and freedom in process control. However, a secure wireless connection requires the expertise of specialists and clear verification of trouble-free operation prior to startup. IWLAN specialists from Siemens, therefore, in collaboration with engineers of Saarschmiede, performed comprehensive radio coverage and spectral measurements using the planning, simulation and configuration software, Sinema E, to establish optimum coverage and avoid interference from neighboring wireless networks. In addition, detailed tests were performed with the cranes to document trouble-free operation of the IWLAN connection prior to final commissioning of the application.

For the department involved, the electromechanical maintenance staff of the Saarschmiede company, this was not the first experience with IWLAN. Relying on the same good cooperation, several projects have already been successfully designed and implemented in the areas of IWLAN and LAN. The company therefore continued to rely on the long-standing relationship with Siemens for its new forge in Völklingen, and thus on secure wireless data communications – without cumbersome cable guides, wear and maintenance costs.