Standards Aid Reliability

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One of the first questions asked by potential wireless device users is, “How reliable are they?” The answer, “Transfer reliability is greater than 99 percent,” is acceptable for some; others may ask, “How can you make that claim?” or “Can I expect to achieve that level of reliability?” Reliability is the most important factor in adopting any new technology. But wireless is no longer new. Frequently, measurement devices with attached transmitters are employed as monitors in remote or hard-to-reach locations. Emerson’s Smart Wireless has proven its mettle in such applications.

For example, one chemicals manufacturer became an early wireless innovator when it placed temperature transmitters atop railcars to monitor for dangerously high internal temperatures. Wireless was the only viable solution, other than workers climbing onto cars to record temperatures, which was both time-consuming and a safety hazard. Transmissions from wireless devices were much more frequent, and their quality was unaffected by railcar location in the plant—even when a car was being moved. Reliability was 100 percent.

This and other successful wireless applications in various industries motivated the HART® Communication Foundation to adopt a wireless standard in 2007 that incorporated the basics of self-organizing wireless mesh technology. The WirelessHART™ standard uses IEEE 802.15.4-compatible radio signals operating in the 2.4-GHz industrial radio band. This technology has proven effective in field trials and plant installations worldwide, and it is still the only industry-recognized standard for wireless.

WirelessHART simply adds another reliable way to communicate, so instrument technicians familiar with HART can more easily understand wireless instrumentation or work with field networks. It also helps overcome the main limitation of wireless—line-of-sight—and uses several built-in features (like redundant routing, channel hopping and time-synchronized communication) to ensure reliable communications in plant environments.

Multiple paths of communication are typical of wireless mesh networks, so if one device fails or is blocked, another path can be taken. Each device on the network can also serve as a router for messages from other devices, so a given transmitter is not required to communicate directly to the gateway: Its messages can be forwarded through another device. Even though the maximum distance for one transmission is about 200 m, total distance can be much longer if data is relayed through intermediate devices, while redundant communication routes increase reliability. As with the Internet, if a message is unable to reach its destination, it automatically reroutes to follow a risk-free corridor without data loss.

A device called the network manager configures the network by scheduling communications between devices, managing message routes and monitoring transmission integrity. Generally integrated into the gateway, the network manager determines the redundant routes for greatest reliability, no matter the obstacles between each transmitting device and the gateway. Repeaters, which are not measuring devices, may be installed at certain locations throughout dense plants to facilitate message routing. The mesh design also makes adding or moving devices easier. There was no problem transferring devices at the aforementioned plant, and as long as a device remains within range of the network, it can communicate.

This was additionally well-demonstrated at an Australian chemical terminal where eight wireless temperature transmitters were strung along a 900-m (L), 8-in. heat-traced pipeline used for unloading bitumen. Wireless was selected for its reliability in ensuring that the electric heaters were operating properly. If a heater were to fail, a cold spot could form, causing the bitumen to solidify. Immediate notification when the temperature in one segment began to drop enabled operators to act quickly to prevent plugging.

An electronic technique called channel hopping or “frequency diversity” also aids reliability. If an assigned frequency is jammed, or compromised by noise or other interferences, the wireless transmitter senses the problem and automatically hops to another channel. Conveniently, the IEEE 802.15.4 radio standard defines 16 channels to be used for wireless transmissions. All network transmissions are synchronized in a pre-determined window of time. These fixed time slots enable the network manager to create and operate the network for any application without user intervention, and new devices can be added without further human input.

Wireless devices, which are battery-powered, may operate on a one-minute schedule, remaining at rest most of the time and coming to life just long enough to transmit an update. This can be done more often if required, yet with a corresponding reduction in expected battery life. This is a distinguishing characteristic between wired and battery-powered devices (that additionally provide an estimate of remaining power life, so replacements can be scheduled accordingly). While wired instruments send a constant stream of real-time data, wireless devices send intermittently.

The self-organizing mesh network is an important contribution to process operations, in part because of its inherent reliability. For this reason, in addition to the well-known economic advantages, we believe that within five years, you will see plants in which 20 percent of the signals are WirelessHART.