Pharmaceutical MANUFACTURING

To Wire... or Not to Wire

Why hasn't wireless monitoring completely replaced the traditional wired sensor?

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THERE ARE many reasons why wireless sensor communications seem to be the complete panacea for a wide area monitoring system—the impracticality of running hundreds of feet of cable throughout a warehouse, equipment continually being moved, or the physicalities of a cleanroom not allowing cable penetrations. So why hasn't wireless monitoring completely replaced the traditional wired sensor? In truth, there are times that wired systems are better—but for most scenarios, a hybrid system of wired and wireless is the ideal solution.

Warehouse temperature and humidity monitoring presents the ideal scenario for wireless sensors, but there are some common problems seen in these environments. The dynamics of a typical warehouse present ever-changing barriers for wireless signals—validation studies are typically performed on empty, half-full and full environments. This gives a confidence that the thermal and humidity levels throughout the day or seasons can be constantly met. But throw in mechanical forklifts, boxes full of foil-based packaging and fluid materials, and wireless signals can be easily blocked or severely degraded. On top of this, most wireless sensors operate either in the 915 MHz or 2.4 GHz license-free regions, as do WiFi access points, kitchen microwave ovens, mobile handsets and a myriad of other consumer devices.

Typical monitoring systems don't have to be in continual contact with the main system recording the data. Most important, though, is that any data collected during an offline period is captured, stored and transmitted during that connection period. If data rate isn't as important as redundancy, then a number of wireless connectivity scenarios are available.

Typical wireless statistics are based on line of sight, anywhere between 100 to 5,000 feet—outdoors! The line of sight within a closed environment is severely compromised. A sensor placed back-to-back, on the opposite side of a cinder block wall from the access point, has its signal soaked up like a sponge. Place that same sensor 20 feet further away along the lateral of that wall, and the signal has to pass through 20 feet of cinder sponge. The placement of access points and repeaters is essential to ensure complete wireless connectivity.

Wireless systems that use a mesh topology, in which the monitoring device is acting as both a measurement device and repeater, provide a fuller signal path for connectivity—but the tradeoff is the firmware complexity and the amount of power each repeater uses. To relay signal, the sensor must be on more often than if operating in normal point-to-point mode. Point-to-point mode works just like normal WiFi, a laptop-to-access point—low complexity, but the wireless signal can be easily blocked.

BATTERY SOURCE

Does your wireless sensor use the same battery source to measure and store the data, and send the data to the access point? Depending on the criticality of your measured data, relying on the same battery source to store and send is a business decision. Most wireless sensors will report back a timeline of battery exhaustion; this can be anywhere between four and 36 months depending on the network topology being used, data rates, packet resends, and connection times. Having a separate battery for data collection will ensure that the data will be continually measured and stored for up to ten years—even during transmitter battery change!

To return to the original question, why haven't wireless senor monitors replaced wired? If the monitoring system requires continual connectivity for fast data update rates, and the data is being used for controlling HVAC and production—then wireless may not be the correct system. If the sensors are in locations that are hazardous, dynamic or difficult to reach for continual maintenance, then a wired system may be the better option, and if the sensor requires power to operate, then you should consider running wire.

A functional monitoring system should be capable of being a hybrid of wired and wireless options—a mixture of low-maintenance battery-powered wireless and of fully wired sensors. With the correct mix of infrastructure—using either WiFi or proprietary mesh networking topologies, and wired sensors—users can get the best of both worlds, and a near maintenance-free system.