Want to make your factory wireless? NIST can guide you

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Using a novel testbed that recreates factory environments in the lab, NIST engineer Rick Candell helps 'cut the cords' (and wires) from industrial communications networks by studying how different factory layouts affect wireless radio frequencies, and in turn, how this impacts factory performance. Credit: Earl Zubkoff

It's been called the "smart factory" and even given the lofty moniker of "the fourth industrial revolution." The manufacturing operation of the just-around-the-corner future will be one in which networked systems monitor and direct processes, machines communicate with each other and with humans at high speeds, and the factory itself makes decisions about how to optimize and facilitate production.

Knowing that it will take reliable wireless communications to make it all happen, the National Institute of Standards and Technology (NIST) has published the first-ever set of science-based guidelines to help users select the best wireless system for any specific industrial environment, custom-design the setup to make it work, successfully deploy it, and then ensure that the network performs as needed.

By eliminating physical connections such as wires and cables from a facility's communication network, wireless technology offers many manufacturing, chemical processing and utility organizations a means to run their entire operation more efficiently, more productively and at less cost. However, concerns about reliability, integrity and security have hampered the adoption and use of industrial wireless, especially when wireless communication can often be disrupted by obstructions and interference in harsh industrial settings.

Through its Wireless Systems for Industrial Environments project, NIST is working with private-sector collaborators and standards organizations to overcome these obstacles and make industrial wireless communication the first choice for factories. As part of this effort, in March 2017, NIST and the Institute of Electrical and Electronics Engineers (IEEE) organized a technical working group of experts on wireless communications from government, industry and academia to develop "a succinct yet comprehensive, easy-to-use reference guide and best practices manual for anyone, from control engineers to factory managers, to integrate a robust, safe, reliable and secure wireless system

into their unique industrial landscape," said Rick Candell, an electronics engineer in NIST's Engineering Laboratory.

Candell said that the new how-to guide walks a user clearly and thoroughly through every step needed to achieve the best wireless fit for his or her specific operation. The document provides valuable background, strategies and tools that help users:

- Understand wireless technologies and networking basics, including a glossary of terms, a review of radio frequency (RF) considerations and a list of technical challenges (such as latency, the time it takes for data to go from source to target);
- Make a business case for wireless;
- Break down the components of a complete wireless lifecycle, from the first defining of objectives to deployment and monitoring of the final system;
- Use wireless to enhance factory safety;
- Protect and secure a wireless network;
- Learn about best wireless practices such as optimal antenna placement, getting around obstructions and interference problems, and preventing redundant signal paths; and
- Follow a set of easy-to-use checklists for each element of the wireless deployment lifecycle, including evaluating the factory and its operations for communications needs, comparing available technologies, and methodically designing and deploying a working wireless system.

A series of best-practice case studies completes the guide, showing what strategies can be used to improve and optimize wireless in different factory situations.

"For example, one scenario looks at a common but often overlooked problem when using wireless communications: dealing with the RF

interference that may arise from microwave ovens, Bluetooth devices and other nonoperational items that personnel are using," Candell said. "The guide tells how to identify the sources of such interference, measure how they impact factory operations, and then use the data to choose the most appropriate solution from those described in the text."

Another case study described by the guide shows how properly deployed wireless could prevent a hazardous work environment.

"Wireless gas sensors can monitor the accumulation of poisonous or combustible gases in a work setting but only if all of the signal transmission and propagation challenges in that area are considered," Candell explained. "We use the example of a welder in a confined space whose torch is producing carbon monoxide gas, and show how successful, continuous monitoring depends on critical factors such as antenna placement and the use of multiple sensors in case one fails."

Candell said that future guides from NIST will address more advanced communications scenarios such as wireless technologies for control of mobile and collaborative robotics in the factory.

More information: Richard Candell et al, Guide to industrial wireless systems deployments, (2018). DOI: 10.6028/NIST.AMS.300-4

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