The IES Collaborates with the National Institute of Standards and Technology on a New Guide

The IEEE Industrial Electronics Society (IES) Standards Technical Committee (TC), together with the IES Cloud and Wireless Systems Applications TC and the IEEE Instrumentation and Measurement Society (IMS) TC-9, has initiated and collaborated with the National Institute of Standards and Technology (NIST) to develop “Practical Guide to Industrial Wireless Systems Deployment,” and this activity is going into its second year.

The initiative started on 31 March 2016 with a conference call between the NIST and IES, laying the foundation for cooperation between the IES and industry and government entities. This was commenced by Victor Huang, IES Standards TC chair, and Kang Lee, IMS TC-9 chair, together with John Hung, IES junior past president at the time, and Rick Candell of the NIST. The objective was to see where the IES and NIST can collaborate on common technical activities in relation to industrial applications and standards. From this, the NIST was tasked with setting up “Practical Guide to Industrial Wireless Systems Deployment” and asked the IES and IMS to join it in kicking off a workshop on the topic.

On 13 March 2017, the Industrial Wireless Systems Workshop was held in conjunction with the 2017 IEEE Sensors Applications Symposium (SAS) in Glassboro, New Jersey. This workshop was organized and cosponsored by the NIST, IES Standards and Cloud and Wireless Systems Applications, and IMS TC-9. The results from the workshop formed the basis to start the Industrial Wireless Systems Technical Working Group (IWSTWG) within the NIST, with a call for participation by the NIST Intelligent Systems Division [1].

The NIST IWSTWG kicked off in May 2017 and had numerous online and face-to-face meetings that have resulted in a first draft of “Practical Guide.” IES members who participated in the initial workshop in March 2017 are also members of the technical group and contributed actively to the draft guide. A brief description of the initial workshop and a technical description of the purpose of the IWSTWG are given in the following sections.

Industrial Wireless Systems Workshop
The Industrial Wireless Systems Workshop was held on 13 March 2017, with active attendance of more than 40 industry and academic professionals. It was held in conjunction with the IMS-sponsored 2-17 SAS at Rowan University in Glassboro, New Jersey [2]. This site was chosen due to its close proximity to NIST. The organizers of the workshop were Kang Lee, IMS, and Victor Huang, IES.

The purpose of the workshop was “to explore latest and future wireless technologies for establishing best practice guidelines to help manufacturers and users make confident decisions in selecting and applying appropriate wireless technologies for their plants or factories based on their operating requirements and environments.” There were seven speakers/panelists at the workshop, all from or related to industry. Topics covered were quite relevant to preparing for the wireless guidelines for which the NIST is looking. The speakers and their topics were:

- Dr. Zhibo Pang, ABB, “Wireless Communications with Ultra-High Performances (WirelessHP) for Critical Industrial Controls”
- Dr. Al Salour, Boeing, “Wireless Networks in Aerospace Manufacturing”
- Dr. K.F. Tsang, Smart City Consortium, Hong Kong/City University of Hong Kong, “Industrial Internet of Things (IIoT) Versus IoT”
- Mark Van Horne, Boeing, “Wireless Networks in Aerospace Manufacturing”
- Sterling Rooke, X8, LLC, “Cognitive Radio and Shared Spectrum: Implications for Industrial Wireless Instrumentation”

IES workshop attendees were Dr. Zhibo Pang (IES speaker), Dr. Kim Fung Tsang (IES speaker), Dr. Allen Chen (coorganizer), Gustavo Monte, and Dr. Victor Huang (organizer). IES participants are all members of the Standards TC, and all have extensive industrial wireless backgrounds in their professional careers (see Figures 1 and 2).

The main action items resulting from the workshop were for NIST to
prepare a public announcement that a working group will be formed to develop best practices for the selection and deployment of wireless technologies for industrial environments and that monthly working group meetings be established to ensure steady progress. The following section describes this working group, the IWSTWG.

**IWSTWG**

Wireless technology has been used in industry for many years and has provided years of reliable communications for monitoring and controlling processes. However, the adoption and use of wireless technology has often been hampered by a perceived notion of the lack of reliability, integrity, and security, especially when wireless communication is often corrupted or disrupted in harsh industrial settings. The main objective of the IWSTWG is to provide best practice industrial wireless guidelines that will help manufacturers, users, and their technology suppliers to design, assess, select, and deploy secure wireless systems that would perform dependably in factory settings and conditions. At the time of this report, the IWSTWG members had completed a draft “Practical Guide to Industrial Wireless Systems Deployment” for peer review within the group.

The document begins with an introduction to industrial wireless, including different wireless technologies and networking basics, radio-frequency (RF) considerations, wireless spectrum selection and applicability, and various technical challenges. It then presents business cases for wireless. One of the key enablers of factory automation is the availability of wireless RF devices that may be applied to:
- process control
- oil and gas refineries
- pharmaceuticals
- food and beverage
- autonomous guided vehicle control
- slotted microwave guides
- pendants to control cranes and machine tools
- active and passive RF identifiers for tracking parts, tools, and consumables
- wireless bar code readers
- remote sensing of critical process parameters
- mobile telephony
- door openers
- emergency communication
- general factory Wi-Fi for Internet connectivity.

A total wireless life cycle process is then described from the objective of choosing wireless to factory surveys to candidate selections to wireless policies to deployment and monitoring. The guide points out that wireless systems may be used to enhance the safety profile within a factory operation and prevent injury through improved communication and enhanced situational awareness within the factory. Wireless safety systems may also be applied to prevent chemical-handling mishaps, heavy equipment accidents, and falls through active position monitoring and safety interconnects.

Wireless security is also addressed in the guide, for avoiding hacking into industrial systems. As the number of devices connecting to industrial networks is increasing at a rapid speed, systems are exposed to security breaches and cyberattacks. Wireless intrusion detection systems and intrusion presentation systems are in demand. The document also describes practical considerations and security assessments, reporting, and training. Last, the guide discusses best practice considerations, such as antenna placement, shadowing, metal canyons, and nonproduction emitters, e.g., microwave ovens. It also provides various detailed discussion on such topics as wireless applicability matrices and checklists.

For more information regarding the NIST–IES IWSTWG, please contact Victor Huang (v.huang@ieee.org), Allen Chen (c.j.chen@ieee.org), Zhibo Pang (pang.zhibo@se.ABB.com), or Kim Fung Tsang (ee330015@cityu.edu.hk).

**References**
