NISTIR 8174

Industrial Wireless Systems Workshop Proceedings

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NIST Disclaimer

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1.   Background

Wireless technology has great appeal to many manufacturers, in this case industrial automation systems, which include process control, discrete manufacturing, safety systems, and building automation. Applying wireless sensing and control technologies in new or existing systems for monitoring and controlling equipment and processes eliminates costly cables, enables configuration flexibility, and can improve plant operating conditions, performance, and efficiency. Before applying these technologies, companies need to determine what wireless technologies would suitable for their application in a possibly challenging industrial radio frequency (RF) environment with many potential physical obstructions and sources of interference.

To help manufacturers make these kinds of decisions, the National Institute of Standards and Technology (NIST), the Institute of Electrical and Electronics Engineers (IEEE), and the IEEE Instrumentation and Measurement Society sponsored an Industrial Wireless Systems Workshop that was held on March 13, 2017. The workshop was hosted by Rowan University in Glassboro, NJ and more than thirty stakeholders from industry, academia, and government participated in the event. The results of the workshop discussions and agreements are provided in this proceedings document.

2.   Proceedings

2.1.   Workshop Scope

This workshop was held to explore the latest and future wireless technologies for establishing best practice guidelines to help manufacturers and other users make confident decisions in selecting and applying appropriate wireless technologies for their plants or factories based on their operating requirements and environments.

2.2.   Panelists and Organizers

The following persons either organized the workshop, participated as a panel member, or both:
- From ABB: Zhibo Pang
- From Boeing: Al Salour, Bala Chidambaram, Mark Vanhorne
- From Phoenix Contact: Justin Shade
- From X8, LLC and ISA: Sterling Rooke
- From IEEE: Allen C. Chen, Kim Fung Tsang, Victor Huang, John Schmalzel
- From NIST: Richard Candell (Engineering Laboratory), Kang Lee (Engineering Laboratory)

2.3.   Workshop Report Reading Considerations

The following considerations should be taken when reading the workshop output slides:
- In most cases, the wording is taken verbatim from the notes written on the whiteboards during the workshop.
- Text shown in brackets "[ ]" was added for clarity. The original point may be underlined to add emphasis on what was recorded.

2.4. Workshop Notes

Notes from the workshop were captured as a slide presentation, and are included in the following pages. Table 1 lists acronyms used within the slides.

Table 1. List of Acronyms

Acronym	Meaning
ABB	The "ABB" corporation
BYOD	Bring your own device
IEEE	Institute of Electrical and Electronics Engineers
IES	Industrial Electronics Society
IMS	Instrumentation and Measurement Society
ISA	International Society of Automation
LLC	Limited Liability Coporation
MTBF	Mean time between failure
NIST	National Institute of Standards and Technology
POC	Point of Contact
Q&A	Questions and answers
RF	Radio frequency
SIS	Safety integrated system

Industrial Wireless Systems Workshop

March 13, 2017

NIST/IEEE IMS/IEEE IES

Rowan University, Glassboro, NJ

POC: Richard Candell, NIST

rick.candell@nist.gov

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Workshop Summary

Morning Session:

• Panelists gave short presentations

Afternoon Session:

• Panelist Questions & Answers (Q&A), Breakout/Brainstorming Sessions

• Breakout sessions were originally divided into guidelines and use cases groups. The groups were then combined because many attendees wanted to attend both group discussions.

Results:

• Consensus was Guidelines will be produced as a NIST document with standardization to be considered later.

• Participation by industry and academia is highly encouraged.

• Ad-hoc working group was recommended to be formed to develop a guidelines document. Consensus was NIST to take the lead on forming the working group. The working group will be established within two months of the workshop and will convene monthly.

• A group photo was taken

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Organizers and Panelists

ABB
- Zhibo Pang

Boeing
- Al Salour
- Bala Chidambaram
- Mark Vanhorne

Phoenix Contact
- Justin Shade

X8, LLC and ISA
- Sterling Rooke

IEEE
- Allen C. Chen
- Kim Fung Tsang
- Victor Huang
- John Schmalzel

NIST
- Rick Candell (Engineering Lab) rick.candell@nist.gov
- Kang Lee (Engineering Lab) wireless.lee@gmail.com

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Considerations when reading the notes

For the Breakout/Brainstorming Session
- In most cases, the wording is taken verbatim from the notes written on the whiteboards
- Text in brackets "[ ]" was added for clarity. Original point may be underlined to add emphasis on what was actually recorded.

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Breakout/Brainstorming Sessions

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Use Cases and Issues

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Breakout Session Discussions
Issues for Using Industrial Wireless in Factories

- Power/battery
- Multipath
- Noise
- Latency
- Security
- Life cycle costs
- Bandwidth
- Throughput
- Scalability
- Device cost
- Ease of use

- Interoperability
- Co-existence
- Size
- Integrability
- Environmental reliability
- MTBF [monitoring machine health]
- Safety
- Intrinsic safety
- Maintainability
- Legacy Interfaces (analog)

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Breakout Session Discussions

Critical Success Factors

- [Does it improve] <u>product quality</u>?
- [Does it improve] <u>product cost</u>?
- [Does it improve human] <u>safety</u>?
- [Does it increase] <u>production system reliability</u>?
- [Does it improve evidence of] <u>regulatory compliance</u>?
- [Does it enhance] <u>environmental stewardship (waste, pollution, radiation, clean air)</u>?

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Breakout Session Discussions
Types of Wireless Systems and Uses

- Monitoring, alarm, safety monitoring
- Supervisory
- Feedback
- Operational
- Materials/inventory management
- Identification
- Localization
- SIS (Safety Integrated systems)
- RF Channel diagnostics (channel sounding)

- *Hand-held detector of emergency equipment within the cabin of aircraft.*
- *Automated paint stackers*
- *Identify unauthorized staff in safety zones*
- *Taxonomy of types of industrial systems could be helpful*

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Breakout Session Discussions
Factory Floor Example Use Cases

- Gas detection for confined spaces
- Scheduling of machines
- "In-situ" monitoring
- Human safety (Fall protection-heights, slips)
- Machine health monitoring
- Wireless dimensional probes (quality)
- Wing positioning for fuselage joining (quality)

- *Hand-held detector of emergency equipment within the cabin of aircraft.*
- *Automated paint stackers*
- *Identify unauthorized staff in safety zones*
- *Taxonomy of types of industrial systems could be helpful*

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Guidelines

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Breakout Session Discussions
Suggested Document Sections #1

- Existing & Future wireless technologies
- Technology categories
- Technology selection
- Spectrum selection
- RF concerns
  - Environment
  - Site surveys
  - Spectrum selection
- Policy/Procedures for "Bring Your Own Devices" (BYOD)
- Future capabilities & concerns
- Spectrum monitoring/forecasting

Breakout Session Discussions
Suggested Document Sections #2

- Validation of new systems
- Tools/methods for testing
- Calibration of wireless sensors (analog)
- Acceptance plan for deployment
- Human Health & Safety
- Medical Device compatibility

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Breakout Session Discussions
Suggested Document Sections #3

- Control [i.e. supervisory control]
- Monitoring [for accurate and timely observation of the process]
- Feedback [for machine control]
- Operations [to improve quality and productivity]
  - refer to value proposition slide

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- Used for education internally [within companies]
- Used to give to a supplier [for informational, requirements, and supplier conformance purposes]
- Best Practices [for selection and deployment of wireless systems]
- Spur Innovation [within the industrial wireless sector]
- Version Control [of the document assuming that this becomes a living document to be maintained over time.]

INTENDED DUE DATE 9/30/2018

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Next Steps

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Working Group and Guidelines Preparation

- The consensus was that an ad-hoc working group is to be formed and led by NIST to develop NIST Guidelines on Industrial Wireless Systems
- Action items:
  - ➤ Victor Huang (IEEE IES) will email the raw notes taken at the workshop to Rick
  - ➤ Rick Candell (NIST) will prepare the notes for release
  - ➤ Rick Candell (NIST) will prepare a public announcement that a working group is to be formed to develop best practices for selection and deployment of wireless technologies for industrial environments.
  - ➤ Monthly working group meetings was agreed upon to make steady progress.
  - ➤ A mailing list will be created for interested parties.

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Group Photograph

The photo was taken after the workshop was adjourned; some participants left early.

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