

Coexistence and Safety of Wireless Systems In Mining

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Collaborative Partnership NIOSH and NIST (Interagency Agreement)



NIST
**National Institute of
Standards and Technology**
U.S. Department of Commerce
(Shared Spectrum Metrology Group¹)

Definition of Wireless Coexistence

The ability of a wireless system to *satisfactorily perform* its intended function(s) in a shared environment with other wireless systems





Research Background

Research Goal

- Mining industry adopting complex wireless systems for critical applications
 - Concerns that systems with inabilities to coexist could pose a threat to safety and health
- Develop mining sector specific guidance for evaluation and management of wireless systems to ensure safe coexistence

Common Questions

- Aren't there regulations to prevent coexistence problems?



- **Licensed bands** – yes, heavily regulated but...
 - Underground wireless systems are exempt from some of the regulations³
- **Unlicensed bands** – very little regulation³
 - No out of band interference
 - In band interference that may cause undesired operation must be accepted



- What about standards, e.g., 802.11xx or 802.15xx?

- No regulatory requirements to follow standards in unlicensed bands
- Some wireless system protocols are only “based” on a standard



- Can't wireless systems simply be separated?
 - Yes, but by how much?
 - And... separating systems may not be an option

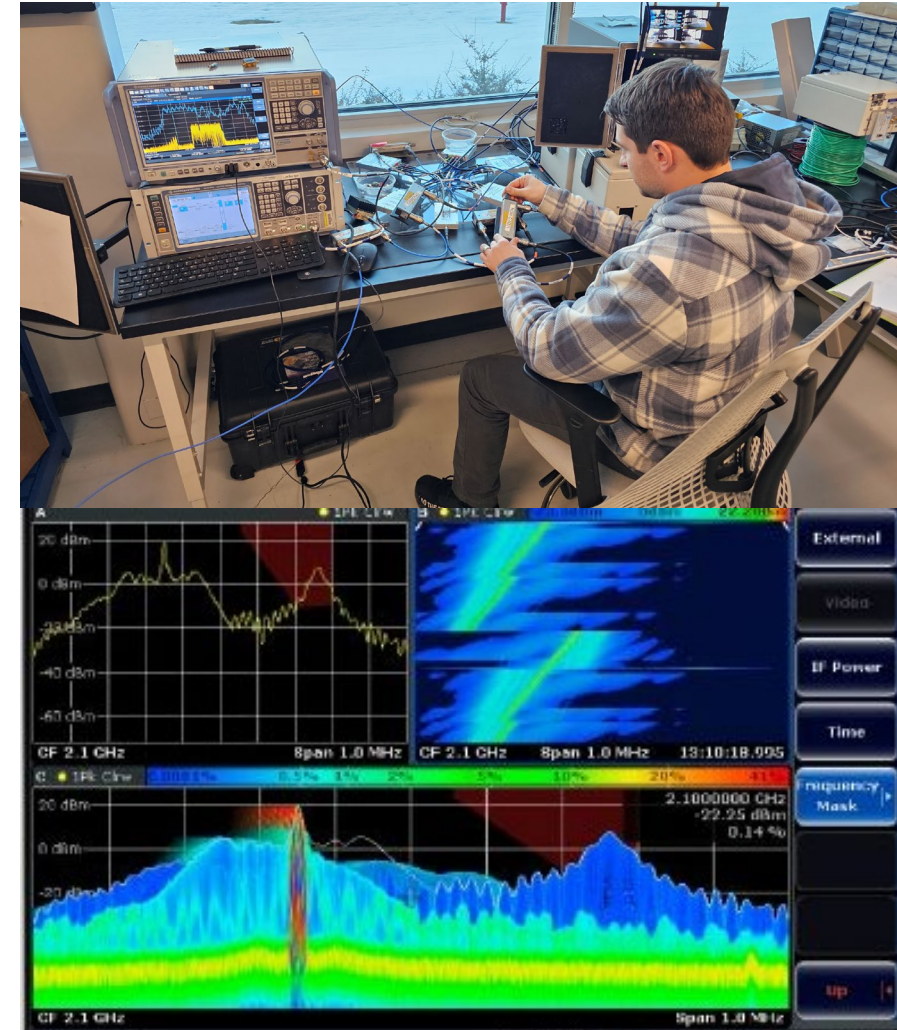
Wireless Coexistence Case Studies

- **Demonstrate wireless systems inability to coexist**
 - Wireless systems with a mining application
 - Impact on safety
- **Assess evaluation methodology**
 - ANSI C63.27 – American National Standard for Evaluation of Wireless Coexistence
- **Three wireless systems operating in 2.4 GHz unlicensed band**
 - Emergency stop (e-stop)
 - Tele-remote
 - Video monitoring
- **Interfering wireless system**
 - Wi-Fi



Case Study Findings

- **ANSI C63.27**
 - Relevant to mining wireless systems
- **Systems were susceptible to Wi-Fi interference**
 - Certain conditions, e.g., high data rate, separation distance
- **Wireless e-stop & tele-remote**
 - Unintended (nuisance) e-stop trips
- **Wireless video**
 - Heavily pixilated frames
 - Screen black out
 - Unknown loss of link



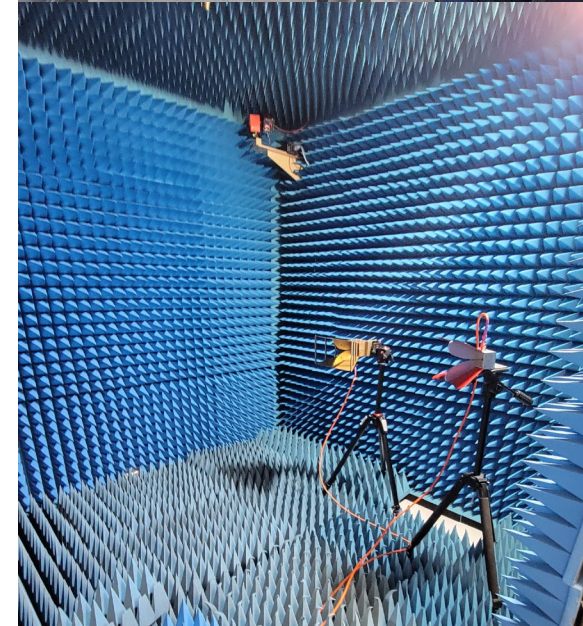
Upcoming Case Studies

- **Wireless e-stops operating in 915 MHz unlicensed band**
 - Interfering wireless system – HaLow Wi-Fi (IEEE 802.11ah)



But Remember...

- **Wireless coexistence evaluations are application specific**
 - One size does not fit all
 - Systems may coexist in some applications but not others



Ongoing Literature Review

- **Evaluation**

- ANSI C63.27 – Evaluation of wireless coexistence
- AAMI TIR69 – Wireless coexistence risk assessment

GAP – Impact of wireless coexistence on system adoptability

- **Management**

- IEC 62657 – Wireless industrial networks
- VDI/VDE 2185 – Management for wireless coexistence
- EPRI – Guidance for wireless coexistence management in nuclear power facilities
 - Potential model for mining sector guidance

Moving Forward – Guidance Documents

Determining Indirectly Critical Performance Metrics For Wireless Coexistence

Mining Sector Specific Guidance For Wireless Coexistence Management

Final Thoughts – Resources

- **Wireless technology innovators/integrators – Coexistence evaluation**
 - ANSI C63.27 – Evaluation of wireless coexistence
 - AAMI TIR69 – Wireless coexistence risk assessment
 - FDA – Estimating the likelihood of wireless coexistence
- **Mine owner and operators – Management of coexistence**
 - VDI/VDE 2185 – Management for wireless coexistence
 - EPRI – **Guidance for Wireless Coexistence Management in Nuclear Power Facilities**

With appropriate management practices and system evaluations, concerns about coexistence should not be a barrier to adopting wireless technologies!

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2025 SME ANNUAL CONFERENCE & EXPO

CMA 127th National Western Mining Conference

NOSH BOOTH DEMONSTRATION



Questions?

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