

# Wireless Communication System for Smart Bits on Horizontal Drilling Machines



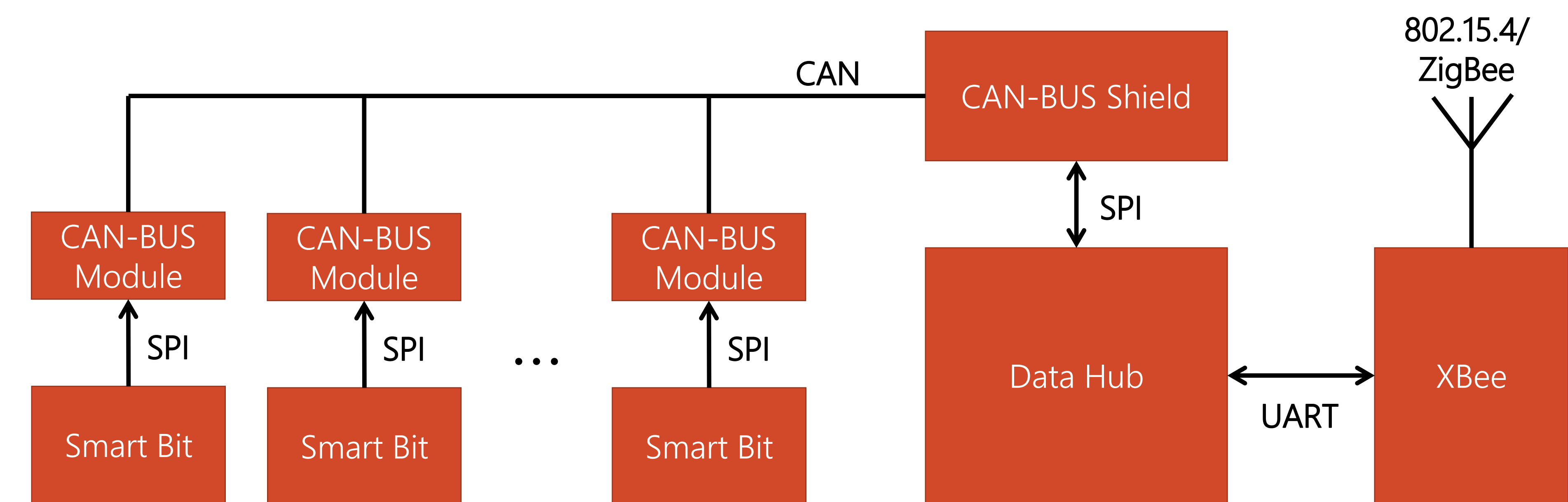
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## Introduction

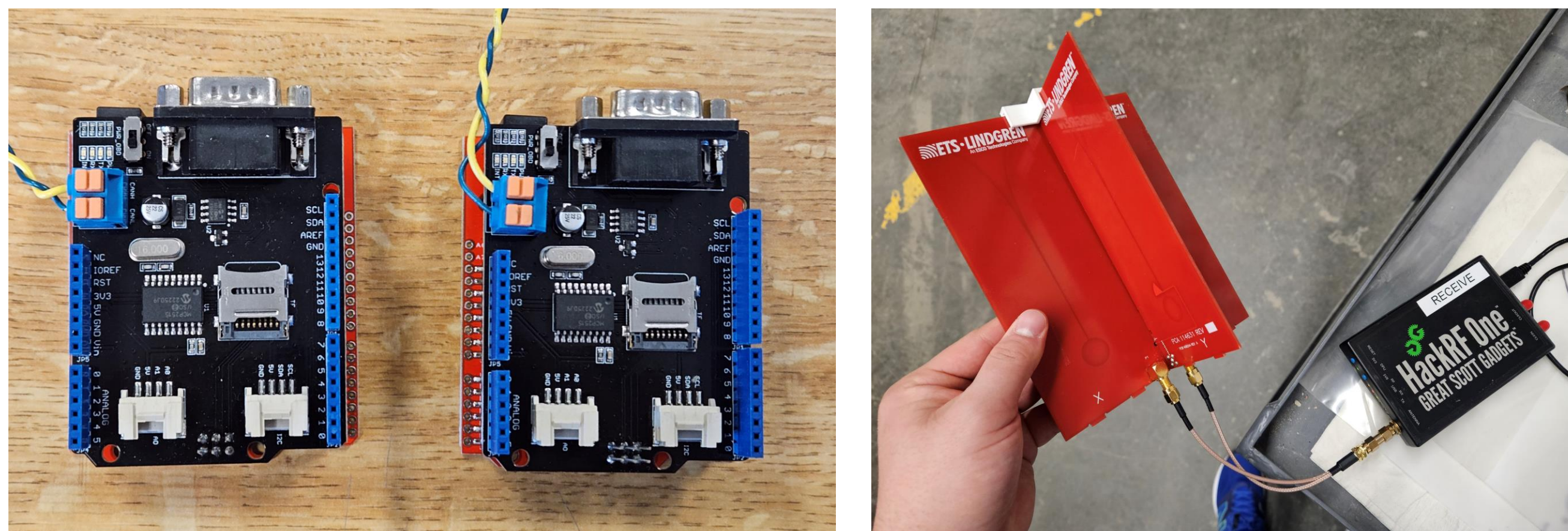
- Characterization of bit wear and type of rock being excavated is an ongoing study to reduce the amount of dust produced during operation
- A data communication system was developed to convey instantaneous data (rock type and bit wear) between Smart Bits on a rotating drum and base stations where data processing and decisions can be made
  - The system uses the wired CAN-BUS protocol to transmit data between Smart Bits and a centralized data collection hub
  - The system uses IEEE 802.15.4-compliant wireless communication to transfer data from the data hub to base stations located off of the drum
- This system allows a polling rate of approximately 200 Hz from a single Smart Bit

## On-Drill Communication System Topology



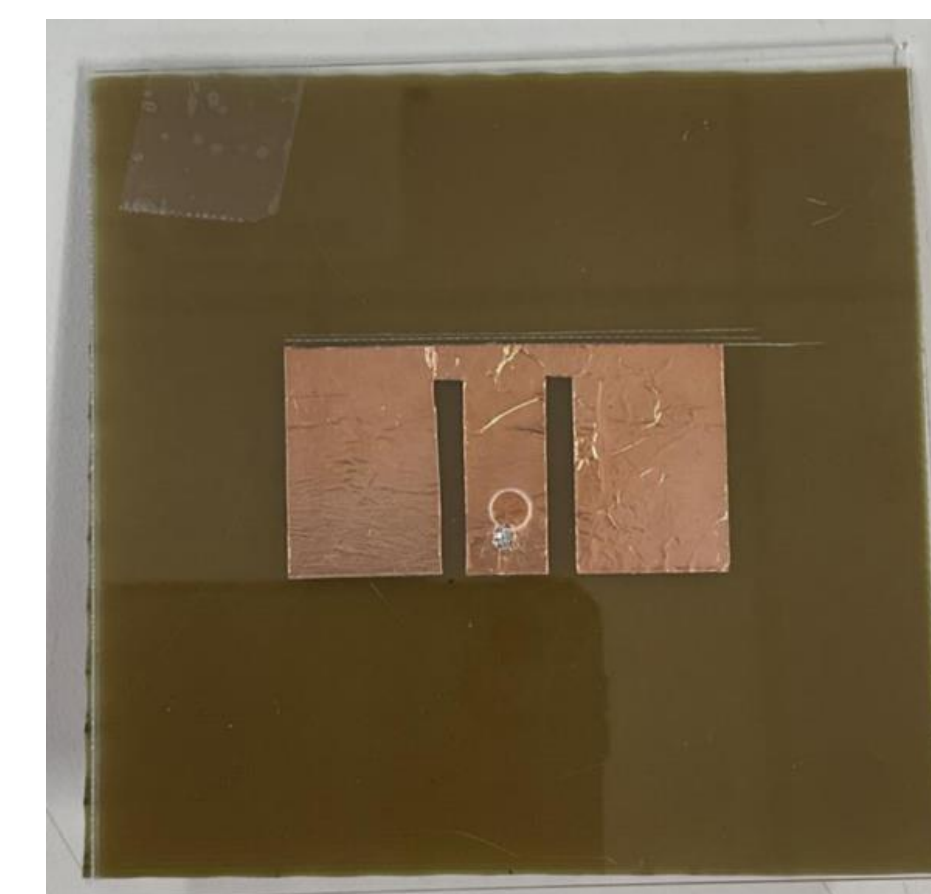
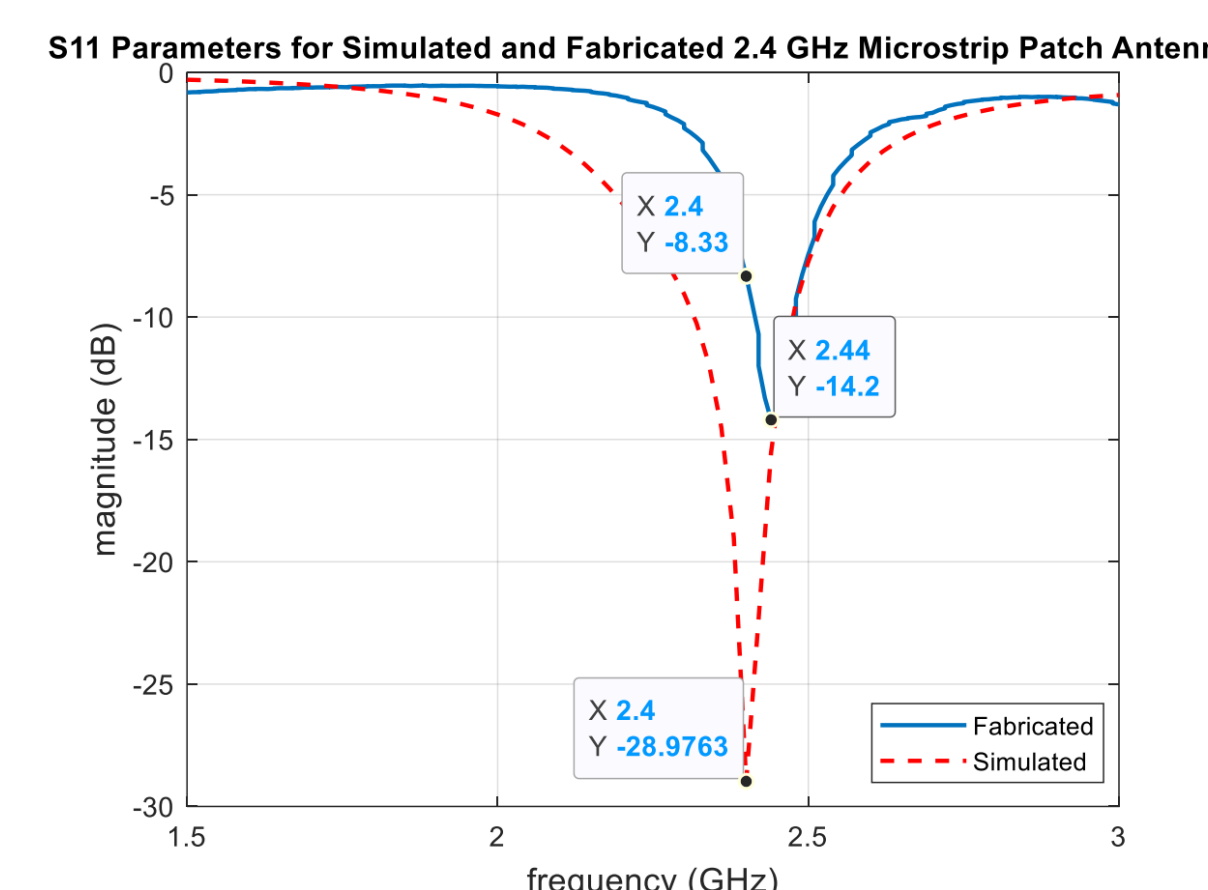
## Results

- Wired Communication System
  - Communication between multiple boards established at 500 kbps, can reliably receive data
- Wireless Communication System
  - Xbees were just purchased following incoming stock after microcontroller shortages
  - Antenna is still being designed and simulated
- Electromagnetic Noise Characterization
  - EM Signal Analysis completed between 2.405-2.465 GHz, no noticeable change in noise from rock cutting machine running.



## Conclusion and Future Work

- Conclusions
  - Wired communication can be reliably maintained between Smart Bits over CAN-BUS
  - Wireless communication should be viable for use on horizontal drilling machines
- Future Work
  - Further design, test, and characterization of antenna to work in rock and water sprays
  - Adapting Smart Bit hardware to integrate CAN communication



## References

- "Demystifying 802.15.4 and ZigBee - White Paper." [Online]. Available: [https://www.mouser.com/pdfdocs/digi-wp\\_zigbee.pdf](https://www.mouser.com/pdfdocs/digi-wp_zigbee.pdf)
- B. Behzadnezhad, B. D. Collick, N. Behdad, and A. B. McMillan, "Dielectric Properties of 3D-Printed Materials for Anatomy Specific 3D-Printed MRI coils," *J Magn Reson*, vol. 289, pp. 113–121, Apr. 2018, doi: [10.1016/j.jmr.2018.02.013](https://doi.org/10.1016/j.jmr.2018.02.013).
- IEEE, "IEEE Standard for Information Technology–Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks–Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications," *IEEE Std 802.11-2020 (Revision of IEEE Std 802.11-2016)*, pp. 2764–2765, Feb. 2021, doi: [10.1109/IEEESTD.2021.9363693](https://doi.org/10.1109/IEEESTD.2021.9363693).

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