

Wireless in nuclear -Enabler or challenge?

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[Link to feasibility study](#)

[Link to seminar documentation](#)

[Link to report summarizing presentations at seminar](#)

Introduction and scope

- Wireless technology has traditionally not been used in nuclear applications, mainly due to restrictions in safety and security.
- The development of wireless applications has been strong during the last years, and the technology is widely used in other industries.
- Lately, wireless has been used to some extent in the nuclear sector, in non-safety applications, for example in condition monitoring and in temporary installations during outages.
- ENSRIC has performed a feasibility study to map:
 - Which technologies are available today and tomorrow
 - Applications in nuclear industry
 - Applications in other safety critical industries
 - Pros and cons with using wireless technology
- An international seminar was also arranged on the same subject

Tablet connected to wireless network in plant at Exelon.



Results/takeaways

- Cyber security can be solved
 - Hands on examples in the U.S.
 - Thick concrete walls can be an advantage from this perspective
 - Apply AI and machine learning to cyber security
- U.S. are ahead of the Nordic plants with examples from utility Exelon and service provider AMS corporation.
- Wireless can easily be retrofitted into existing plants. Even analogue gauges can be read and data transmitted wirelessly.

Current and future state at U.S. utility Excelon

Truth in Numbers – Think Applications

Current State

Wireless radios



Mobile Workers (electronic work packages)



Temperature sensors



Vibration sensors (limited)



Future State

Current State plus:

More vibration sensors

Dosimetry

Gauge readers

Valve position sensors

RFID tags

Structural Health Monitoring



We could add over 1,000 sensors
per unit











 Exelon Generation.

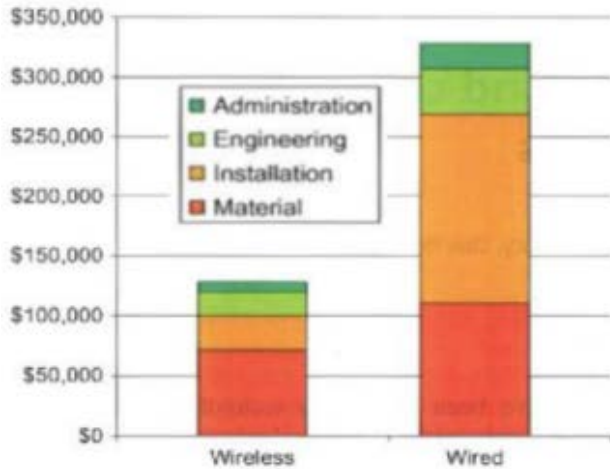


Wireless technologies

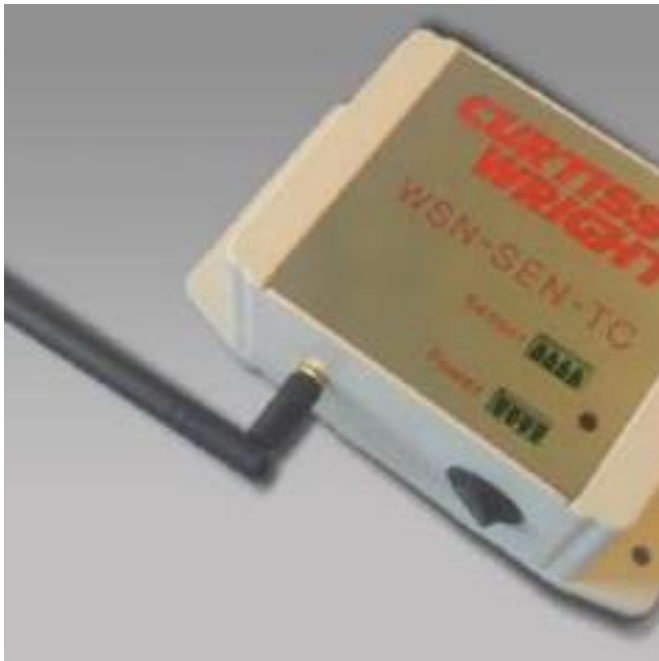
- Any signal can be transferred by any technology
- There are a number of different wireless technologies that can be used depending on the prerequisites of the site, for example penetration through thick walls, multiple mode communication or long sensor battery time required.
- 5G will bring capacity for a large number of IoT units, real time communication, better coverage, broad band of frequencies and improved energy efficiency.
- DAS – Distributed Antenna Systems – is an interesting technology since it can bring good coverage inside buildings and structures.

Technical expectations of 5G

 Peak Data Rate	1 - 20 Gbps	 Connection Density	10k - 1m devices / km ²
 User Experienced Data Rate	10 - 100 Mbps	 Network Energy Efficiency	×1 - ×100
 Spectral Efficiency	×1 - ×3	 Area Traffic Capacity	0.1 - 10 Mbps / m ²
 Mobility	350 - 500 km/h	 Availability	99.999% (of time)
 Latency	1 - 10 ms	 Battery life	10 years*



Wired vs Wireless Sensors
Oak Ridge National Lab, P. Fuhr, 2016



Impact/conclusions

- Wireless technology can enable structural health monitoring and predictive maintenance of a number of components.
- As of today, wireless transmission is only allowed in non-safety applications.
- Major advantages with wireless:
 - Lower installation- and maintenance costs
 - Rapid deployment
 - Feasible in existing plants
- Major disadvantages
 - Cyber security, eavesdropping, unauthorized use
 - Information is widely spread, requires control of spectrum
 - Lower communication speed
- Wireless can be combined with wired in the existing infrastructure in the plants.