# Supplemental Use Cases in Industrial Apps

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# Abstract

Provide supplemental use case including the industrial and infrastructural (I&I) applications of wireless network to help standardization effort.

While it has long been a limited challenge of I&I usage of wireless network to achieve an enhanced reliability, like as the critical plant instrumentation, is getting to be more generic requirement among variety of applications today than ever.

To this end, the affinity between 11ah and 802.15.4g OFDM could hopefully be considered to complement each other.

# Preserve fundamental WLAN architecture

- CSMA/CA with virtual CS be maintained as is.
  - NAV/RAV and RTS/CTS (1 or 2)
- IEEE802.11i/RSN security suite be kept persisting still.
  - “Break before make” key management.
- Broadcast/Multicast be kept available as well as RSN.
  - Robust Management frames with BIP.

- Proven architecture may only be eligible for a sort of applications like critical instrumentation of life lines, e.g. Smart Grid Trunk, Nuclear plant, and so on.

# Enhanced Reliability with Sustaining bit/s

$1/2^n$ clocking without extra-degradation beneath $1/2^n$ bit/s.

- While indoor Coherence BW might be as wide as 2.5MHz, at least Channel Switch helps, even if no channel hopping.
- Before channel switching, STBC, antenna selection or eigen BF should deserve, due to sub-GHz features below;
  - **Limitation of the available BW in sub-GHz bands.**
  - **Preferable Outdoor Propagation Characteristics.**
- Reliability is the first place in I&I applications

# Co-existence and Combination with 15.4g

- IEEE802.15.4g provides a link for lower traffic leaf sensor with battery power constraints.
- IEEE802.11ah is going to provide an appropriate feature as a backhaul link to accommodate;
  - **the aggregated traffic of leaf sensors,**
  - **and stream of camera images or surveillance videos.**

- IEEE802.11ah hopefully **performs without degradation of throughput and reliability, even if co-existing** with 15.4g.
- I&I applications do expect the well managed co-existence.

# Existing mechanisms to avoid interference

- IEEE802.11 provides;
  - CSMA-CA,
  - Radio Resource Measurement services,
  - and Channel Switch functionality (DFS).

- IEEE802.15.4g OFDM may be used with MAC features of ;
  - FH functions including slower hop with optional CCA
  - and Channel blacklisting and whitelisting. (15.4e TDMA)

- Possible gaps between each 11ah channel for 15.4g OFDM.

# Hypothetical International Common Band

- A potential global operating class of 915-921MHz in future;
  - in US, a portion within 902-928MHz ISM band,
  - and potential wider BW channels within 915-921MHz for SRD with less than 25mW Tx power, shared with RFID, in EU. (So far, 400kHz BW 0.1W channels might have only been proposed in ESTI TR 102 649-2 )
  - and 915MHz to 923MHz LE band may be considered for SRD in Japan, if current 950MHz band has to move.
- Above may require any assessment, for instance;
  - possible void of 915-921MHz usage by 11ah,
  - or any 11ah option to be accommodated in 915-921MHz.

# Mesh

- Longer interference radius in sub-GHz bands be considered;
  - Throughput degradation due to interference from nodes within same MBSS has to be well managed.

- Resilience by mesh path diversity is instrumental in I&I applications.

# MIMO

- Diversity gain have to be utilized more for the reliability in I&I applications, than the multiplexing gain to enhance bit/s.
- Possible MIMO scheme to mitigate the interference within mesh and to prevent the degradation of multi-hop throughput does deserve in I&I applications.

End