Requirements for Reliable Wireless Industrial Services
draft-sofia-raw-industrialreq

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Requirements for Reliable Wireless Industrial Services

Motivation

- Wireless is being integrated into industrial environments
  - Easier onboarding of massive number of IoT devices
  - Low cost/less human intervention
  - More flexibility – adaptable production lines

- Most recent developments of Wireless Fidelity (Wi-Fi) allow the support of novel services
  - Wi-Fi 5/6/6E – promising in indoor scenarios (e.g., better transmission for nLoS)
  - Higher data rates
  - Better traffic isolation (Resource Units, OFDMA)

- Industrial Services require deterministic guarantees
  - Time-sensitive networking (TSN) in wired infrastructures provide bounded latency, zero packet loss, low jitter, to time-triggered traffic
  - The wireless region must meet at least such requirements
Requirements for Reliable Wireless Industrial Services

Draft Structure

- Wireless Industrial Services Today
  - Sources: IEEE 802.11 Nendica, IEEE 802.11 RTA TIG, IETF DetNet RFC 8578, Avnu Alliance, 5G ACIA 5G for Connected Industries and Automation White Paper, NICT report on wireless use-cases and communication requirements in factories, IEB113 report on TSN and rail metro networks, IETF RAW use-cases, ITU-R report on technical characteristics and operational goals of *Wireless Avionics Intra-communications (WAIC)*
  - Collection of 31 services, grouped into 13 different categories with objective communication KPIs (latency, packet loss, jitter, payload size, etc.)

- Debate on novel industrial wireless services
  - AR/VR Services within flexible factories
  - Decentralized shop-floor communication services
  - Autonomous airbone services
  - Debate on 3 examples of future industrial services; recommendations for wireless integration and specific communication KPIs
## Requirements for Reliable Wireless Industrial Services

### Wireless Industrial Services Today

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<tr>
<th>Use-case</th>
<th>IEEE Nendica</th>
<th>IEEE 802.11 RTA</th>
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<th>Avnu</th>
<th>5G ACIA</th>
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Requirements for Reliable Wireless Industrial Services

Collected Information

- Reasons for wireless integration
- Considerations for communication requirements
- Latency
- Periodicity - stands for whether or not the data transmission is executed in a periodic fashion
- Cycle, if available
- Transmit data size (data payload) in bytes
- Tolerance to packet loss
- Time synchronisation needs (e.g., requirement for IEEE 1588 synchronisation)
- Node density/number of nodes supported
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Examples Today, Equipment and Process Control Services

- Reasons for wireless integration: flexibility of deployment; reconfigurability; mobility; maintenance cost reduction.
- Control of machines and robots services
  - Bounded latency: less than 10 ms.
  - Periodic
  - Transmit data size (bytes): 10-400 (small packets)
  - Tolerance to packet loss: 0.
  - Time synchronisation: IEEE 1588
  - Node density: 1 to 20 (per 20 m x 20 m)

- PLC to PLC communication
  - Bounded latency: 100 us to 50 ms.
  - Transmit data size: 100-700
  - Tolerance to packet loss: 0
  - Time sync: IEEE 1588
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Additional Services Example: Decentralized Shop-floor

- **Requirements considerations**
  - A wider variety of traffic profiles MUST be supported, thus increasing the management complexity.
  - Devices communicating via ad-hoc mode MUST integrate a collaborative communication approach, e.g., relaying, cluster-based scheduling approach.
  - Low mobility MUST be supported.
  - Multi-AP coordination MUST still be integrated.
  - Frequent handover MUST be supported (ideally with a make-before-break approach).
  - Neighbour detection and coverage problem detection MUT be implemented for ad-hoc support as well.

- **Specific KPIs**
  - Latency: 20-40 ms
  - Transmit data size (bytes): 50, VBR
Requirements for Reliable Wireless Industrial Services

Summary and Next Steps

- The need for deterministic and reliable wireless integration in industrial environments is increasing and becoming urgent
  - Extensive collection of available applications (31), categorized into 13 groups, with specific KPIs (latency, packet loss, periodicity, etc)
  - Increase/improve the collected number of KPIs
  - Extend the document with additional/future envisioned wireless services, and respective KPIs (considerations for a reliable infrastructure and also objective KPIs)

- Call for WG adoption
  - The IETF RAW charter has a milestone for the adoption of a requirements document
  - Collaborate with the draft on use-cases? A single document or 2 documents
    - The current draft being proposed is focused on requirements for industrial wireless services (and not for use-cases)