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

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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

Wireless Industrial Services Today

Use-case	IEEE Nendica	IEEE 802.11 RTA	IETF DetNet	Avnu	5G ACIA	NICT	IEB113	IETF RAW	IIC	ITU-T WAIC
Equipment and processes control	x	x	x	X	X	x		x	X	
Quality supervision	x					x			X	
Factory resource management	x	x				x			X	
Display	x					x				
Human Safety	x					x			X	
Industrial systems	x	x				x			X	
Mobile Robots	x	x		x	X	x			X	
Drove/UAV control		x						x	X	
Power Grid control			x							
Communication based train networks							x			
Mining Industry			x							
Connected Cabin				x						X
Wireless Avionics Intra-communication										X

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.
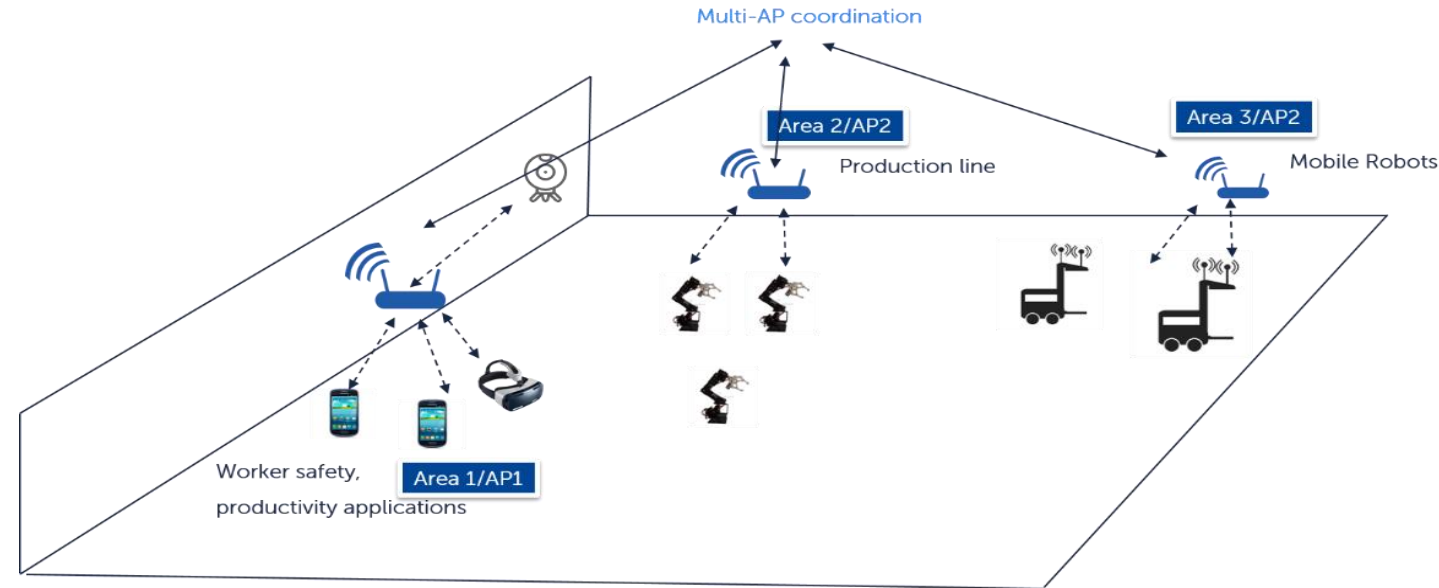
- **Specific KPIs**
- Latency: 20-40 ms
- Transmit data size (bytes): 50, VBR

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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)