European Commission Workshop

Wireless resources for Advanced Manufacturing

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Co-existence issues

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Use of Wi-Fi in the factory

example: car manufacturer

Use of Wi-Fi in the factory (example: car manufacturer)

- **Manufacturing Process**
  - Sensor nodes communicating to the central controller or infrastructure network
- **Production Control Systems**
  - To program/configure the tools or stations for the next car
- **Quality Control Applications**
  - To download checklists, description of safety critical tasks, to monitor critical functions, to record/store data from safety critical tasks (e.g. torque used to fasten the screw to mount the seat belt is recorded and stored)
- **Quality Assurance Systems**
  - To communicate w/, test or update (configure) car internal systems
- **Maintenance systems**
  - To send/ receive maintenance tasks, for remote diagnostic and inspection services
- **Enterprise Resource Planning (ERP)**
  - To order material/components/parts (internally).

    (e.g. wireless inventory (barcode) scanners communicating to the WIFI infrastructure)

Use of Wi-Fi in the factory (example: car manufacturer)

- Automatic Guide Vehicles and other automated material handling systems (Automated Warehouse)
  - To guide/control these vehicles and to re-program them for the next task
- Office type of applications
  - To access documentation on the central server for repair or maintenance of faulty machines
- Health, Safety and Environment (HSE) Management Systems
  - via real-time telemetry and location services
- Communication
  - VoIP Telephony
- Asset security
  - via integrated video surveillance and video intelligence (wireless IP cameras)

What other technologies are used in the factory?

Wireless use cases growing

Wireless Technologies used in the factory

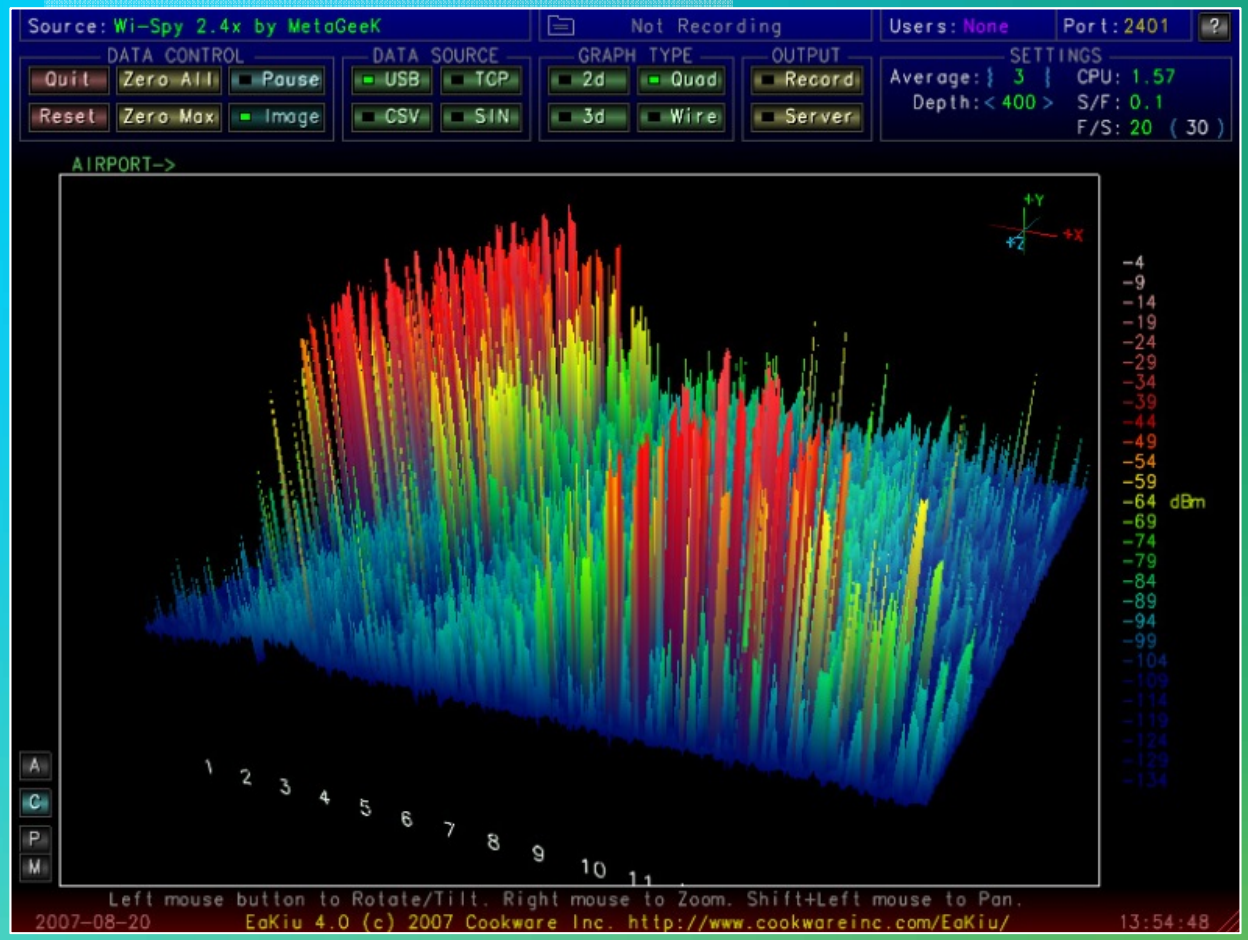
- IEEE 802.11b/g/n based technology
  - Wi-Fi
- IEEE 802.15.1
  - Bluetooth
  - Bluetooth Low Energy (new, but seems to get rapid traction for industrial applications)
- IEEE 802.15.4 based technologies
  - WirelessHART (IEC 62591)
  - ISA100.11a (IEC 62734)
  - WIA-PA (IEC 62601)
  - ZigBee
- DECT
  - DECT ULE
- Other …
  - Wireless Profibus
  - Wireless Fieldbus
  - Proprietary technologies

Technologies for Advanced Manufacturing

Similarities ..... Differences

- Most use unlicensed spectrum – to date, driven by business case
- Operate as part of the enterprise's IT deployment (little service provider presence to date) & are site specific
- Most operate at low power

- Some technologies are designed to contend for spectrum, using etiquettes to ensure that all transmitters can transmit, while other technologies lack "politeness"
- Some applications require very low latency, while others do not
- Size of the radio channel used can vary depending on the application



Spectrum Policy Choices

Available spectrum

- Spectrum choices today for European manufacturing solutions are limited
  - In Europe, only 2.4 GHz is readily available and in use
  - As a result, coexistence on available 83.5MHz becomes critical
  - In contrast, US manufacturers have a choice of 915 MHz, 2.4 GHz and 5.8 GHz

Spectrum Policy Choices

- Use existing unlicensed band, with existing co-existence requirements
  - ⇨ may foreclose technologies in support of applications that require low latency or for whom contending for spectrum is a problem
- Create specific bands to accommodate more critical applications within, for example, industrial and medical sectors
  - ⇨ where to find radio spectrum?

Which bands?

- Spectrum suitable for WIA
  - Should be in the range 1 GHz to 7 GHz
  - Lower frequency bands to be avoided because of heavily polluted (EMC) industrial environment
  - Higher frequency bands not attractive due to high indoor propagation losses
- The 1.880 – 1.9 GHz band - DECT – ULE (Ultra Low Energy)
  - Initially developed for Home Automation Network (HAN) but ongoing work will extend its application to industrial automation
- The 5.8 GHz band being considered for WIA @ 400 mW
  - This band is already available elsewhere (US)
  - Adding it to the ERC Rec 70.03 is a first step, but not sufficient
  - Will only become attractive to WIA when harmonised across Europe by adding it to the EC Dec 2006/771/EC

Coexistence

A closer look at the bands and technologies

Need for coexistence - 1.8 GHz band

- 1.880 – 1.9 GHz – DECT/ DECT ULE
  - No major coexistence issues expected

Need for coexistence - 2.4 GHz band

- 2.4 GHz @ 100 mW – Wide Band Data Communication
  - Only globally available frequency band for SRD (including WIA)
  - Most popular band, heavily used to the point of being crowded at certain locations
  - **Major Challenge: Coexistence between co-located applications using different technologies within the factory**
    - **IEEE 802.11 ⇔ IEEE 802.15.1 ⇔ IEEE 802.15.4⇔ Wireless Profibus ⇔ Wireless Fieldbus ⇔…**
  - EC Dec 2006/771/EC requires spectrum access mechanism to be used and this is the only way to allow all applications fair/equal access to this crowded spectrum in any given environment

Need for coexistence – 5.8 GHz band

- 5.8 GHz @ 400 mW – WIA (new proposed regulation for WIA)
  - **Major Challenge: Coexistence between WIA in the factory and other incumbent services outside the factory**
    - BFWA, Radar, …
    - see ECC report 206
  - No requirements for coexistence between co-located systems
  - According to draft ECC report on the 5 GHz extension bands for RLAN (EC mandate), sharing between WIA and RLAN is possible.

In support of the Wireless Factory

- What has been done already ?
- What is being done currently?
- What can still be done?

What has been done already?

- ETSI EN 300 328 v 1.8.1 - several options for coexistence
  - Manufactures can select out of a multitude of options to comply with spectrum access requirements mandated in Dec 2006/771/EC
    - FH and non-FH systems
    - Adaptive and non-Adaptive solutions
    - LBT and non-LBT based Adaptive solutions
    - Load based systems / Frame based systems
  - Specific changes made to support ISA100.11a, WirelessHART, and several proprietary technologies all used in Industrial Automation
  - An exception for having to comply with the spectrum access mechanism as requested by some was not included
    - It would have resulted the standard no longer being aligned with the spectrum regulation
    - It would result the WIFI based applications described earlier, and of key importance to support the various factory processes, would no longer work

What is currently being done?

- IEEE 802.15.4 is working (among other objectives) towards making IEEE 802.15.4e compliant with EN 300 328v1.8.1
- Current IEEE 802.15.4 defines CCA times much longer as IEEE 802.11 giving advantage to IEEE 802.11 – This need to be addressed
  - IEEE 802.15.4 will be modified to provide more flexibility w.r.t. CCA time and CCA threshold to better compete with IEEE 802.11
  - This is not an ETSI issue as both fall within the same EN 300 328 category
- IEC 62734 (ISA100.11a) has been modified to allow for compliance with EN 300 328 v1.8.1
  - ISA 100 Study Group is performing a gap analysis on ISA100.11a which may lead to a second generation incorporating additional PHYs, and support for mobility and distributed routing (6TiSCH). The work could be hosted at WCI, ISA100's compliance institute.
- IEC 62591 (WirelessHART) / IEC 62601 (WIA-PA) being modified to include an annex describing how compliance with EN 300 328 v1.8.1 can be achieved

What can still be done?

- For the 5.8 GHz band currently being considered for WIA by inclusion into ERC Rec 70.03
  - Need to discuss DFS when WIA is used indoor
    - DFS may be difficult to implement by WIA
    - 25 mW already allowed outdoor without DFS
    - Is there a power limit under which indoor WIA could be exempted for having to do DFS?
  - Need for harmonisation across Europe by inclusion into EC Decision 2006/771/EC

Thank you.