Coexistence Management in Wireless Automation - VDI/VDE Guideline 2185

WIRELESS FACTORY WORKSHOP
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Research topic "Wireless Industrial Communication"

**Assessment** of wireless technologies and solutions with respect to industrial automation applications

**Integration** of wireless technologies and solutions into automation communication networks
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1. Working Group "Wireless Communication" of the VDI/VDE-Society of Measurement and Automatic Control

2. VDI/VDE Guideline 2185

3. Further Activities and Summary
VDI/VDE Society of Measurement and Automatic Control (GMA)

Technical Working Group FA5.21
"Wireless Communication (Funkgestützte Kommunikation)" was founded in 1999

Tasks:

- Bridging two disciplines - radio transmission and industrial automation
- **Definition of industrial automation requirements on wireless communication**
- Providing information about wireless technologies, its possibilities and restrictions
- **Guideline VDI/VDE 2185 "Radio based communication in automation"**
- Public promotion for wireless industrial communication
- Discussion forums at trade fairs
- **Annual Conference "Wireless Automation"
  8th Conference 11th and 12th March 2009, Lemgo, Germany**
Members represent following companies:

- ABB
- Agilion
- Amber Wireless
- Beckhoff Automation
- BMW
- DEKRA
- GHMT
- Hirschmann
- Knick Elektronische Messgeräte
- lesswire
- Panasonic
- Phoenix Contact
- Schildknecht
- Siemens
- Stollmann E+V
- Wago
- WERMA Signaltechnik
<table>
<thead>
<tr>
<th>Title:</th>
<th>Funkgestützte Kommunikation in der Automatisierungstechnik</th>
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<tbody>
<tr>
<td></td>
<td><em>Radio based communication in industrial automation</em></td>
</tr>
<tr>
<td>First draft:</td>
<td>June 2002</td>
</tr>
<tr>
<td>First edition:</td>
<td>December 2003</td>
</tr>
<tr>
<td>Second edition:</td>
<td>September 2007</td>
</tr>
<tr>
<td>Title Part 2:</td>
<td>Koexistenzmanagement von Funklösungen</td>
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<td></td>
<td><em>Coexistence management of wireless solutions</em></td>
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<tr>
<td>Draft:</td>
<td>August 2008 (comments until 31st January 2009)</td>
</tr>
<tr>
<td>First edition part 2:</td>
<td>expected in July 2009</td>
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</table>
Motivation for Part 2 of the VDI/VDE Guideline
"Coexistence management of wireless solutions"

Picture sources: ABB, GHMT, Hirschmann, Schildknecht, Siemens
Objective of Part 2 "Coexistence management of wireless solutions"

Guideline on

- **Coexistence** and **efficient spectrum use**
- Identification of risks
- Assessment of coexistence
- Derivation of technical and organisational measures

Target group

- Designers and persons in charge of manufacturing and process systems
- System integrators
- Machine builders
- Manufacturers of industrial wireless components
Main contents of the VDI/VDE Guideline 2185 Part 2

- Scope
- Terms and Definitions
- Necessity to introduce frequency management
- Frequency management within the system's life cycle
- Frequency management measures
  - Constraints
  - Interference potential
  - Assessment of coexistence
  - Analysis and measurement
  - Practical tips to establish coexistence
  - Installation and approval
  - Documentation
- Application of tools
Definition of the Terms
‘Coexistence of Wireless Solutions’ and ‘Interference’

Coexistence

- is a **state** within an environment (not a characteristic of a wireless solution)
- means that **all wireless solutions** involved fulfil their tasks
- depends on the requirements of the **automation application**
- can be assessed using **characteristic parameters**
- is a **dynamic state**
- has to be **planned, monitored and maintained**

The coexistence state is left if all of the following conditions are fulfilled for any wireless solution:

- the signals overlay in frequency domain with other systems **and**
- the signals overlay in time domain with other systems **and**
- the signal to noise ration is below the required level.
Definition of the Term ‘Frequency Management’

Frequency management

- is used to plan, monitor and maintain the coexistence state
- is not only frequency planning but also planning of positions (power level) and timings (duty cycle)
- includes technical and organisational measures

*Source: www.ZVEI.org*

*Brochure "Coexistence of radio systems in automation - explanations for reliable parallel operation of wireless solutions"*
Basic Measures to Introduce a Frequency Management

- Establishment of a coexistence board with persons of all relevant divisions of the company (Purchasing, IT, Automation, Facility Management etc.)
- Nomination of a coexistence management representative for the company or business location
- Inventory of all installed wireless solutions and if possible of all planned solutions
- Consideration of coexistence during planning and purchasing phase
- Establishment of a compulsory registration for all new wireless solutions or for extensions
- Release of wireless solution after approval
- Periodic audit
- Trouble shooting and maintenance
## Decision Criteria "Application Class"

<table>
<thead>
<tr>
<th>Category</th>
<th>Class</th>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>0</td>
<td>Emergency action</td>
<td>(always critical)</td>
</tr>
<tr>
<td>Control</td>
<td>1</td>
<td>Closed loop regulatory control</td>
<td>(often critical)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Closed loop supervisory control</td>
<td>(usually non-critical)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Open loop control</td>
<td>(human in the loop)</td>
</tr>
<tr>
<td>Monitoring</td>
<td>4</td>
<td>Alerting</td>
<td>Short-term operational consequence (e.g. event-based maintenance)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Logging and downloading/uploading</td>
<td>No immediate operational consequence (e.g. history collection, sequence-of events preventive maintenance)</td>
</tr>
</tbody>
</table>

Source: ISA SP100
Assessment of Coexistence

Transmission Delay without Interferer

Transmission Delay with Interferer

Sample size: 1.000.000 packets
## Histograms of Transmission Delay with Application Related Limit

<table>
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<tr>
<th>Transmission Delay without Interferer</th>
<th>Transmission Delay with Interferer</th>
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- **Transmission Delay without Interferer**
  - Sample size: 1,000,000 packets

- **Transmission Delay with Interferer**
  - Sample size: 1,000,000 packets
Histograms of Update time with Application Related Limit

Update Time without Interferer

Update Time with Interferer

Sample size: 1.000.000 packets
Effort for Coexistence Management

Source: VDI Guideline 2185
Further Activities

German Electrical and Electronic Manufacturers' Association (ZVEI)
Working Group "Wireless Automation" was founded in 2005

Tasks:

- Providing confidence in the reliability of industrial wireless communication solutions
- Theoretical analysis interferences between wireless solutions using the 2.4 GHz frequency band
- Practical investigation and assessment of interferences between wireless solutions using the characteristic parameters defined in the VDI Guideline 2185
- Brochure "Coexistence of radio systems in automation - explanations for reliable parallel operation of wireless solutions"
Summary

- Coexistence is a key problem which has to be solved in order to provide reliable wireless communication in industrial automation.

- Coexistence management is independent of a certain frequency spectrum.

- Basic definitions and a guideline to establish and maintain coexistence are available. The English edition will be available in summer 2009.

- **A common international view on coexistence management would improve the confidence in wireless automation.**