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Research Project

Systematic Investigation of Interference Immunity, Transmission, and Data Security of Industrial Wireless Technologies

Systematische Untersuchung der Störfestigkeit, Übertragungs- und Datensicherheit industrieller Wireless-Technologien (SUDIWI)

Hochschule Ostwestfalen-Lippe
Project Number: 1769X05
Project time: 01.07.2006 - 31.12.2007

Summary

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Summary

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Project Partner
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Abstract
Wireless technologies are increasingly desired in numerous innovative applications of industrial automation. Meanwhile, a great variety of commercial wireless technologies (Bluetooth, WLAN, ZigBee, nanoNET) is available which are offered as a large selection of OEM products. To avoid later disappointments technological limits should be considered early in the initial planning stage. Passive impairments, like multipath propagation and time varying channel responses due to movements, as well as active sources of disturbances have to be considered. The latter are caused by parasitic machine emissions and unintentional or even intentional other wireless systems. For the same reason decisions concerning the usage of security features and/or enhancements have to be made in the initial planning phase of an industrial wireless application, to choose solutions from a suitable set of protocols, technologies and products that support the identified security aims.
The goal of this research project was the investigation of the transmission reliability of wireless systems for industrial applications. Additionally, an assistance guide (User Manual, see Appendix) should be developed with two major issues:

- Firstly, enterprises of the industrial automation area, especially companies of small and medium size, should be given help for the development of interference resistant wireless products.
- Secondly, prospective customers shall be offered guidance for installation, and constraints for planning a wireless automation system shall be outlined.

Thus, an effort should be made in order to place the continuing industrial usage of wireless technologies on a reliable ground. Resulting from the investigations of this project we can conclude that available wireless automation systems are reliable supplements - but no substitutes - for wire based fieldbus systems.
Packet loss rates PLR < 1e–5 can be achieved with respect to passive environmental effects like multipath or channel movements. However, it is necessary, that line-of-sight communication is possible. Maximal distances of 10...30 m are possible, depending on the maximal allowed path loss. As a rule of thumb we suggest, that the theoretical path loss limit of transmitter power over receiver sensitivity shall be at least 30 dB above the intended operational path loss.
A crucial parameter is the coexistence behavior of any wireless system. We were able to show, that interference from other wireless systems is the most important source of system

degradation. We suggest system guidelines to improve and optimize the coexistence behavior. Anyway, it remains the main source of impairment and needs to be investigated very carefully.

As existing wireless systems lack information about their coexistence behavior, we further suggest the development of *standardized measurement guidelines*. They will provide important quantitative features of wireless systems in order to improve the process of *frequency management* in manufacturing companies. All wireless products should be certified according to the proposed new measurement standard.

This study reports the possibilities and limitations of state-of-the-art and widely used existing technologies. As a conclusion, it recommends further necessary research: Only collaborative systems should be used in future high density coexistence environments. Technological enhancements like ultra-wide-band systems (UWB) and multiple-input-multiple-output features (MIMO) will further improve the performance of next generation wireless PAN systems.