Celtic-Plus
Smart Connected World

Project Achievements

ReICOvAir

ReICOvAir

Project ID: C2015/2-5

Start Date: 1 January 2016

Closure date: 31 December 2018

Partners:

CETECOM GmbH, Germany

Fraunhofer Institut für Integrierte Schaltungen IIS, Germany

Fraunhofer Gesellschaft Heinrich Hertz Institut HHI, Germany

GHMT AG, Germany

ifak e.V. Magdeburg, Germany

Kaltio Technologies Oy, Finland

Qosmotec, Germany

Sapotech Oy, Finland

Software Quality Systems S.A., Spain

Trimek S.A., Spain

University of Oulu, Finland

Verkotan Oy, Finland

Co-ordinator:

Thomas Heyn

Fraunhofer IIS, Germany

E-Mail: thomas.heyn@iis-fraunhofer.de

Project Website

www.celticplus.eu/project-reicovair

Reliable Industrial Communication Over the Air

The motivation for the ReICOvAir project is the vision to enable the widespread usage of wireless communication systems in industrial environments. This is done by creating an open, standardized verification method as well as initial testing systems relying on this method in order to qualify the reliability of wireless communication.

Main focus

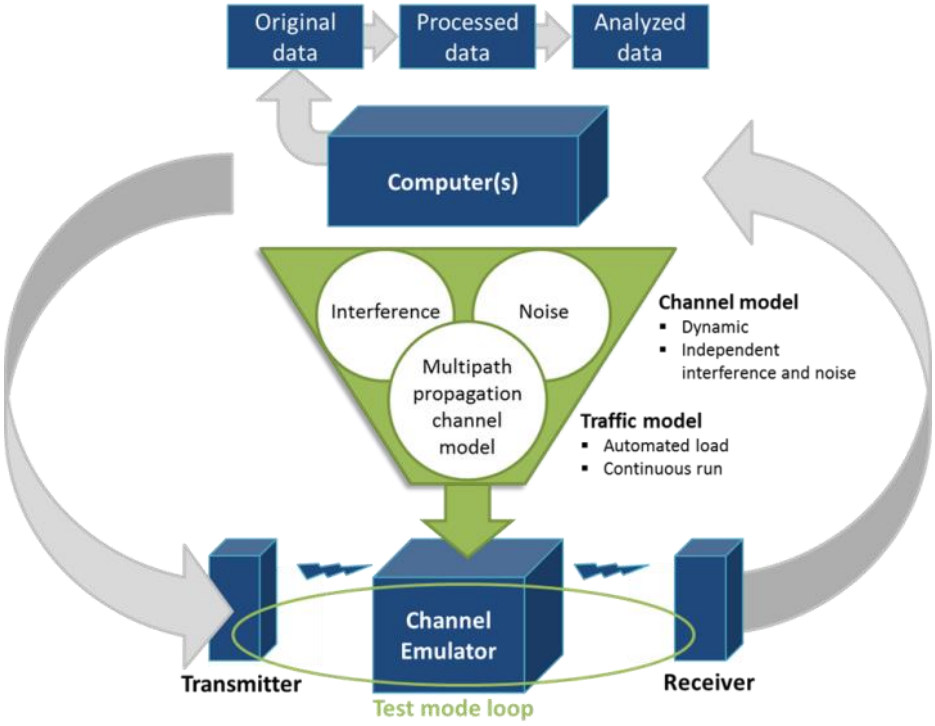
ReICOvAir concentrated on the fact that there is no common way of measuring the quality of wireless communication systems in industrial scenarios. The purpose of ReICOvAir was to change this fact and provide the required methods and testbeds to carry out quality assessment.

The State-of-the-art channel model QuaDRiGa was enhanced to enable the realistic simulation of radio wave propagation within industrial environments. The major enhancements are namely obtaining a set of propagation parameters for industrial environments, the support of a fully mobile system, where transmitter and receiver can move at the same time, as well as the establishment of a testbed that makes use of these new features. Based on these results, it is possible to simulate the wireless communication behavior of an entire factory and apply this behavior to real devices. Great care was taken to disseminate the results and provide the findings to standardization bodies.

Approach

The prerequisites to recreate the RF signal propagation characteristics from industrial environments in the lab are two-fold. Firstly, a valid database for the environment is needed containing all relevant information required by the channel model. Secondly, the channel model needs to support the relevant use cases in the factory. Therefore, great care was taken planning the channel model update and the required propagation measurements in industrial environments.

Software simulation and hardware emulation test environments were designed and implemented. They allow non-expert users to make use of the updated channel model. The test environments are used by applying the channel model to a simulation model of the wireless communication system. Another capability is the test of real devices with a channel emulator and data traffic emulator. All components of the testing environment have been validated extensively.



Achieved results

Providing the key enabling factors for proving the reliability of wireless transmission systems in industrial environments is the project's main achievement.

In a first step, the parameters of industrial environments were characterized, highlighting the differences with a typical office area environment. This is the initial step for a realistic recreation of an industrial environment in a laboratory environment. In a second step, the necessary tools for bringing these findings into practical use were developed. The core of these tools is the enhancement of the QuaDRiGa channel model that now supports the simultaneous movement of transmitter and receiver and also provides the expected correlation in reception conditions of two collocated devices. With regard to the predecessor model, by incorporating the sum-of-sinusoids method into the model, a reduction of the required processing effort was made possible making the system much more practical. The channel model is supported for software simulation and in hardware emulation environments using a commercial channel emulator. These two environments provide proof-of-concept solutions for testing services, allowing the qualification of an implementation independent software model as well as testing of real hardware. This achieves the vision of "rotating the factory around the device".

To make this approach valuable for the industry, the channel model has been released as open source thus building trust by allowing independent in-depth analysis of the model.

The project has so far generated various publications and contributed to national (VDI, DKE) and international standardization bodies (5G-ACIA, IEC, 3GPP).

From the commercial side the project now allows the consortium to provide testing services to customers.

- 5G-ACIA WI008 „5G-ACIA Report –Radio Propagation", Jan 2019
- F. Burkhardt, P. Karunakaran, D. Schulze, "Benchmarking the reliability of industrial wireless systems in a virtual factory", DeGruyteronline 2019-01, https://www.degruyter.com/view/j/auto.2019.67.issue-1/auto-2018-0058/auto-2018-0058.xml
- Risto Vuohtoniemi, Janne Lehtomäki, Veikko Hovinen, "Channel Occupancy and Duty Cycle Measurements at 2.4 GHz ISM Band in Industrial Environment", IEEE ICIAES'2019
- S. Jaeckel, L. Raschkowski, F. Burkhardt, L. Thiele, „Efficient Sum-of-Sinusoids based Spatial Consistency for the 3GPP New-Radio Channel Model", IEEE Global Communications Conference, 2018
- D. Schulze, H. Zipper: "A Decentralised Control Algorithm for an Automated Coexistence Management", 57th IEEE Conference on Decision and Control (CDC 2018), 17.-19.12.2018, Miami Beach, USA, 2018
- D. Schulze, L. Rauchhaupt, U. Jumar: Coexistence for Industrial Wireless Communication Systems in the Context of Industrie4.0. In Australian and New Zealand Control Conference (ANZCC'17), Gold Coast, Australia, December 17. -20., 2017
- D. Schulze, O. Krüger, L. Rauchhaupt, U. Jumar: Koexistenzsicherung von Funklösungen für Industrie 4.0. 13. Magdeburger Maschinenbautage, Magdeburg, Germany, September 27.-28., 2017
- D. Schulze, L. Rauchhaupt: A Control Engineering Approach for an Automated Coexistence Management. In 4th IFAC Symposium on Telematics Application (TA'16). IFAC-PapersOnLine, Vol. 49, Nr. 30, Porto Alegre, Brazil, November 6. -9., 2016, Seiten 284-289
- D. Schulze, L. Rauchhaupt, M. Krätzig, U. Jumar: Coexistence Plant Model for an Automated Coexistence Management. In 20th IFAC World Congress (WC'17). IFAC-PapersOnLine, Vol. 50, Nr. 1, Toulouse, Frankreich, Juli 9. -14., 2017, Seiten 355-362

Impact

The findings of the project pushed forward the required testing and qualification of wireless transmission as it now becomes feasible to realistically assess the behavior of wireless transmission systems. Flanked by the standardization activities, this provides the basis for certification bodies to incorporate and further enhance testing of this sort and will also enable the industry to decide from a neutral standpoint on the most suitable transmission system for the right use case. Ultimately, the results of the project will establish and enhance the confidence that the industrial sector requires to start relying more heavily on wireless transmission systems and will lead to changing the face of future factories. Additionally, it is expected that the findings will spark the development of new features and solutions for wireless communication such as 5G to enhance the capabilities where gaps are detected. The next step on the roadmap to create a commercially attractive product is the conversion of the implemented proof of concept into a lightweight solution.

About Celtic-Plus

Celtic-Plus is an industry-driven European research initiative to define, perform and finance through public and private funding common research projects in the area of telecommunications, new media, future Internet, and applications & services focusing on a new „Smart Connected World" paradigm. Celtic-Plus is a EUREKA ICT cluster and belongs to the intergovernmental EUREKA network. Celtic-Plus is open to any type of company covering the Celtic-Plus research areas, large industry as well as small companies or universities and research organisations. Even companies outside the EUREKA countries may get some possibilities to join a Celtic-Plus project under certain conditions.

Celtic Office

c/o Eurescom, Wieblinger Weg 19/4

69123 Heidelberg, Germany

Phone: +49 6221 989 381

E-mail: office@celticplus.eu

www.celticplus.eu

EUREKA