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Roaming Wireless Safety Emergency Stop

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Motivation

Modern manufacturing relies on a high degree of automation, where human intervention is kept minimal but is crucial during malfunctions or maintenance. In such an environment the need for secure, reliable, fast and flexible wireless communication solutions is ubiquitous. This research is part of the "Digital Sensor-2-Cloud Campus Platform" (DS2CCP) project [1], which aims to demonstrate reliable wireless communication between the industrial shop floor and the edge cloud. The goal is to provide a portable emergency stop that operates safely across multiple automation cells. Therefore, the system integrates IO-Link Wireless (IOLW) with IO-Link Safety with a focus on roaming features [3] to IOLW Safety (IOLWS).

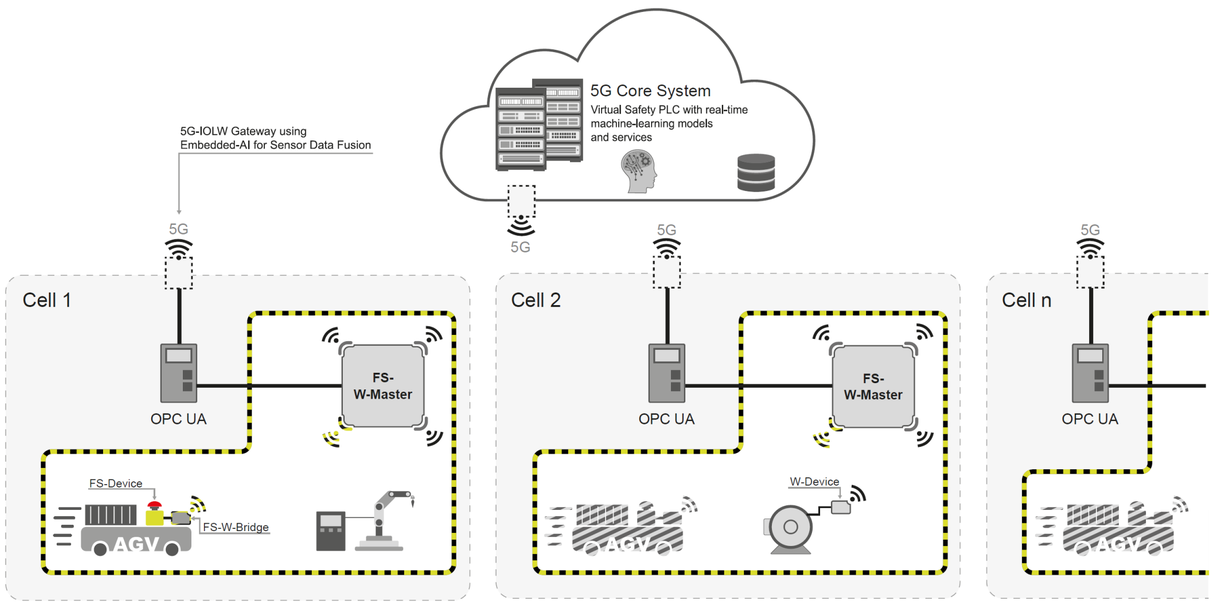

Fig. 1. Modular sensor-2-cloud automation topology, based on [2].

Measurement Setup

The simplified setup for reproducible measurements is wired and shielded, consisting of two (FS-)W-Masters, connected to a (FS-)W-Device using a power splitter/combiner and variable/programmable attenuators. Two key scenarios are evaluated with multiple attenuations: measuring the connection times during roaming (re-)connection (black) and measuring the time for an entire handover (black and grey) both with and without activated safety layer.

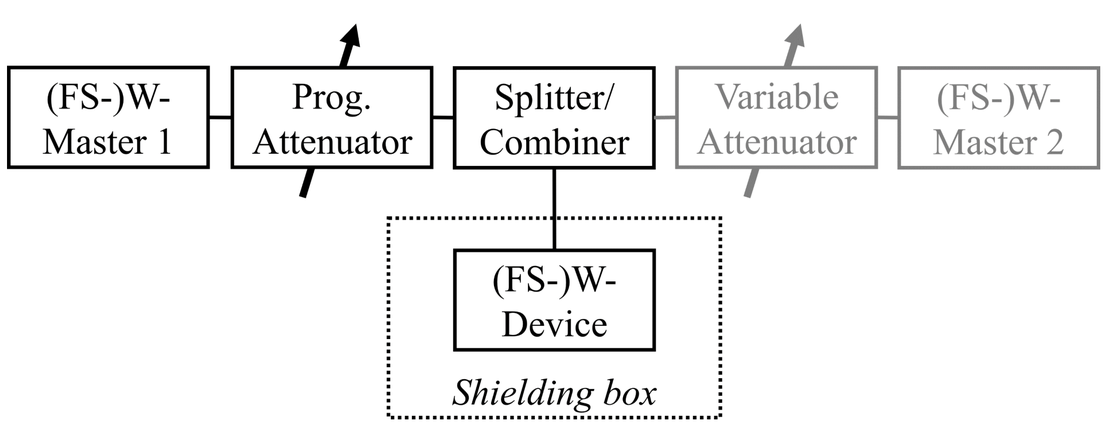

Fig. 2. Measurement setup.

Results

The Results are presented as empirical Cumulative Distribution Function (CDF). The mean handover duration for good conditions with an RSSI of -37 dBm is 0.539 ms for IOLW and 0.565 ms for IOLWS. Under weak link conditions with down to an RSSI of -80 dBm, safe link establishment and handover can be achieved in less than one second with a success rate of over 99%. These conditions are equivalent to the free-space path loss at a distance exceeding 67 m, while IOLW is rated for a maximum range of 10 m in industrial environments with multiple active (FS-)W-Masters. Using IOLWS instead of IOLW adds a nearly constant offset of 25 ms and thus enables the usage of a functional safe wireless communication protocol in every use case IOLW roaming is suitable.

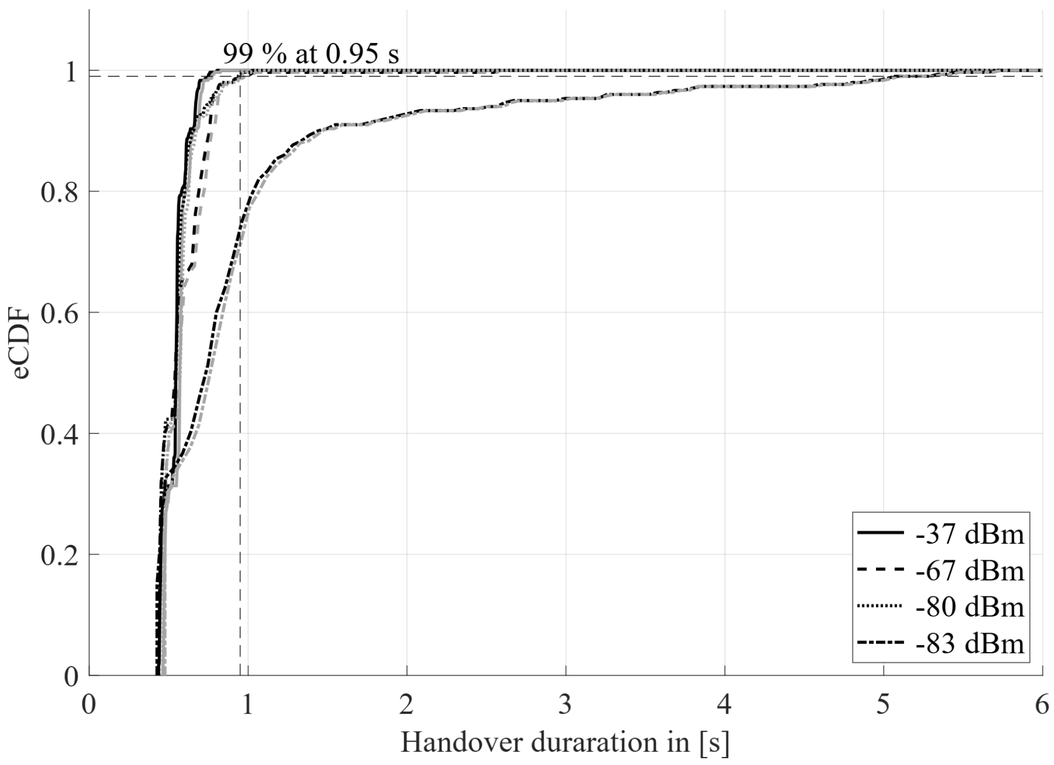

Fig. 3. Duration for handover in non-safety (black) and safety (grey) mode for the given RSSI.

References

[1] Helmut-Schmidt-University, "DS2CCP – Entwicklung einer digitalen Sensor-2-Cloud Campus-Plattform," dtec.bw Project website: http://dtecbw.de/home/forschung/hsu/project-ds2ccp.
[2] T. R. Doebbert, H. Beuster, G. Scholl, F. Fischer, and D. Merli, "Testbed for Functional Safety-Relevant Wireless Communication Based on IO-Link Wireless and 5G," (2022), dtec.bw-Beiträge der Helmut-Schmidt-Universität – Band 1, pp. 147-152.
[3] M. Rentschler, "Roaming in wireless factory automation networks," (2017) 22nd IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), pp. 1-4.

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