Fraunhofer
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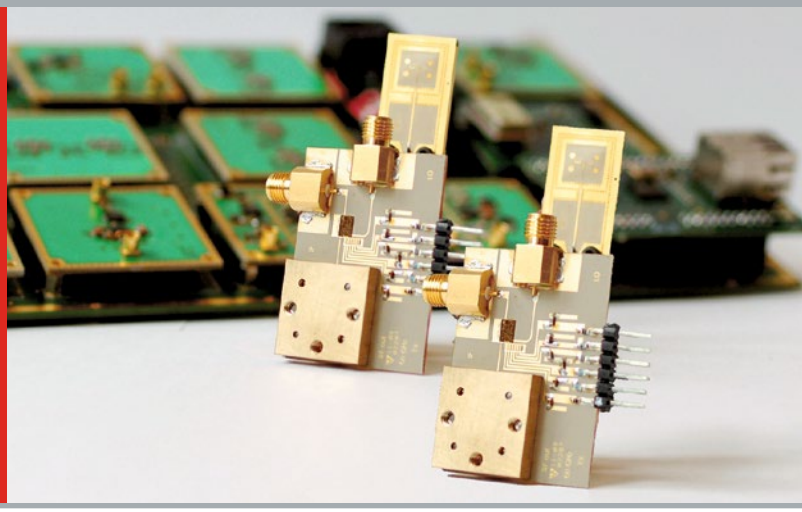
60 GHz MIMO Transmission

HIRATE Implementation Examples



The future of broadband wireless local area networks lies in 60 GHz. Exploiting the capabilities of the High Performance Digital Radio Testbed HIRATE, Fraunhofer HHI showcases the huge potential of 60 GHz broadband transmission. In particular, a MIMO configuration with space-time signal processing is used to establish a robust wireless link, even under NLOS conditions.

HIRATE
high performance digital radio testbed

Benefits

- Up to 9 GHz bandwidth for future multi-cellular, ultra-high-capacity wireless indoor networks
- Robust, non-directional broadband wireless links feasible by deploying powerful, efficient signal processing techniques
- Fully integrated, low-power 60 GHz Tx/Rx MMICs for development of marketable products

Background

Indoor broadband radio communication is increasingly being integrated in our everyday lives, typically in the form of broadband multimedia applications. Current systems operating in the 2 and 5 GHz frequency band will fail to meet the extreme requirements of wireless short-range high-rate communication in the long term.

60 GHz radio is the solution. The millimeter-wave band provides up to 9 GHz unlicensed bandwidth, enabling support of ultra-high data rates in combination with a huge numbers of users.

Challenges

In spite of its tremendous potential, 60 GHz radio still poses considerable technical challenges. As state-of-the-art technology and regulations impose constraints on the transmit power level, it is crucial to compensate for high path loss and channel dispersion by a precise system design that blends robust modulation with efficient signal processing.

Demonstrator Basis

The demonstration shows that it is worth accepting the challenge. The setup is based on HIRATE – a modular testbed developed at the Fraunhofer Heinrich Hertz Institute. It enables the implementation of various wireless transmission concepts and signal processing algorithms. The system combines flexible FPGA-based high performance digital signal processing capabilities with wideband RF front-ends in a compact 19” chassis.

HIRATE transceiver board equipped with plug-on modules

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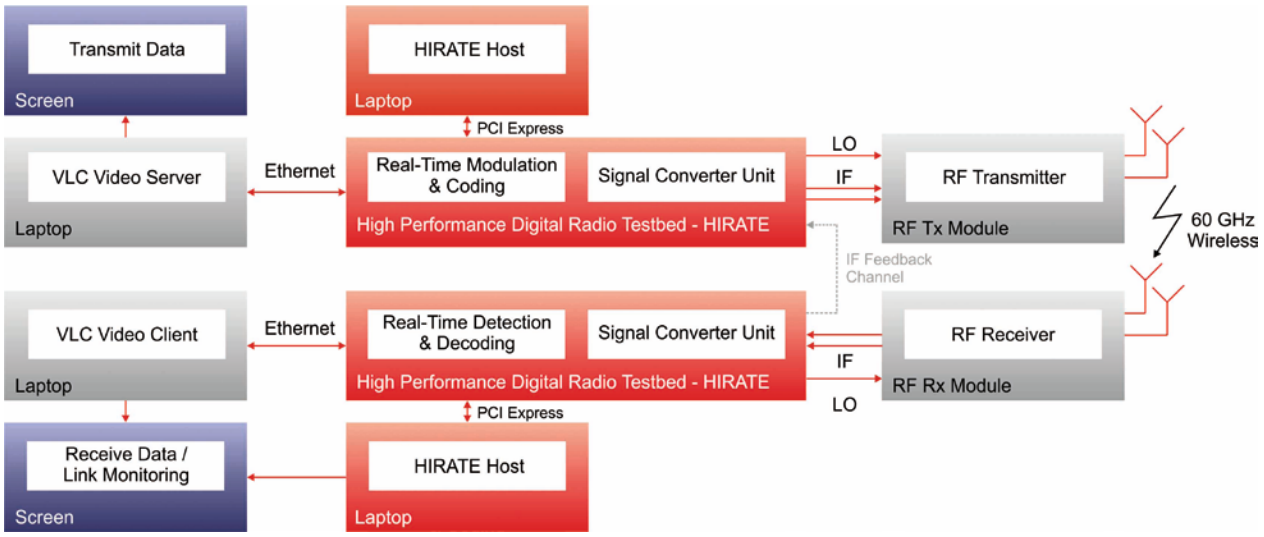

Real-time video transmission over a 60 GHz MIMO link

Application Description

The demonstrator setup establishes real-time transmission of a continuous video stream on a 60 GHz non-directional wireless link. Besides showing the video itself, a screen gives technical insight into signal processing and propagation effects by displaying instantaneous channel state information, received modulation symbols and transmission key parameters.

The setup exhibits the resistance of our MIMO system to strong multipath propagation and vast power fluctuations during the transition from LOS to NLOS conditions.

System Configuration

- Setup based on High Performance Digital Radio Testbed HIRATE equipped with suitable plug-on modules
- Scaleable, modular 2×2 MIMO setup with real-time signal processing
- 250 MHz system bandwidth
- QPSK multi-carrier transmission with frequency domain spreading
- Space-time coding and channel equalization
- Variable code rate, data rate up to 444 Mbps
- Multifunctional Tx/Rx MMICs in III-V technology
- 10 dBm transmit power

The current setup is a further development of the first STC-MIMO NLOS 60 GHz demonstrator presented at the International Conference on Communications (ICC) in Dresden in 2009. It has been developed in collaboration with the Microwave Electronics Laboratory (MEL), which contributed the 60 GHz front-ends. The MEL is a part of the Department of Microtechnology and Nanoscience of the Chalmers University of Technology.

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