Swiss researchers test high-speed WLAN network

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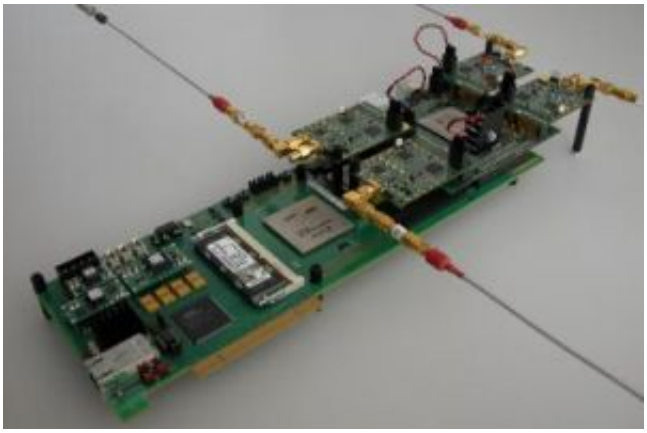

A prototype of a MIMO station with four antennas. 25cm high by 12cm wide. Credit: Photo: Group Prof. Boelcskei/ETH Zurich

According to the communication theory, only a limited amount of data can be transmitted within a given bandwidth for wireless communication. Ever since these limits were revealed 60 years ago, we have been trying to reach the boundaries determined by physics as efficiently as possible. In light of the growing significance of cellular phone networks and WLAN connections, scientists are seeking new ways to transfer more data than ever before – after all, transmission capacities are in short supply and, therefore, a valuable commodity.

Thanks to so-called MIMO technology, which stands for “Multiple Input Multiple Output”, it is possible for several transceivers to communicate

with each other on the same bandwidth at the same time. Transceivers have several antennas. “It is as if several people are communicating with several other people”, explains Helmut Bölcskei, profes-sor at the Communications Technology Laboratory at ETH Zurich. “At face value, it just seems like an incomprehensible babble. If the listeners skillfully combine the hubbub, however, they can filter out the original messages.” In terms of wireless communication, this means you can transfer far more information than with existing procedures.

ETH Zurich researchers had already furnished proof that MIMO technology works in a similar test facility three years ago – albeit with only one user. However, until recently it was still unclear as to whether and how the increase in capacity could be implemented in complex networks with several users. This is the aim of the European research pro-ject “MASCOT” (Multiple-Access Space-Time Coding Testbed), in which ETH Zurich is involved with its Communications Technology Laboratory and Integrated Systems Labo-ratory. It was with this in mind that the prototype developed at these two institutes was enhanced.

For the first time, the Zurich-based researchers were able to demonstrate that the principle of multiple antenna systems is actually feasible for use in complex wireless net-works both theoretically and using their test facility. In doing so, they succeeded in constructing a compact multi-user system, currently with three stations in a bench scale, where every station transmits or receives via four antennae. This meant that the utiliza-tion of the frequency range for each of the three users could be up to four times higher than with present-day WLAN networks.

One crucial point of the research project was the development of procedures to unscramble the jumble of signals in the receiver as efficiently as possible. This presented the researchers with a problem: the more antennas and participants the system has, the more data that can in principle be transmitted; however, this also means that its

demodulation is all the more difficult. As the antennas are meant to be installed in inexpensively manufactured equipment, the signals have to be decoded with as inexpensive a chip as possible, i.e. a small one. The smaller the chip, however, the smaller its computational power.

Thanks to a deeper understanding of the theoretical principles of multi-antenna systems, the researchers were able to develop efficient decoding algorithms that require a much smaller chip area. The receivers developed at ETH Zurich are currently so efficient that the new MIMO technology can easily be installed in commercially available laptops and WLAN stations.

It may be some time before MIMO technology is used in cellular phones as the antennas on hand to date require a certain distance for reliable data transfer. Consequently, the antennas have to be improved first.

ETH Zurich researchers used the real-time demonstrator of a MIMO WLAN network to test the practicality of their theoretical algorithms under real conditions. The test envi-ronment currently consists of 3 stations, each equipped with four antennas to transmit or receive. This enables the overall data rate of 54 Mbps (megabits per second) in modern WLAN systems to be increased to up to 216 Mbps with only one antenna for each station.

Source: Swiss Federal Institute of Technology