IMEC demonstrates first 5GHz Wireless Network for true low-cost, low-power broadband and wireless systems

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IMEC, Europe's leading independent nanoelectronics and nanotechnology research center, has achieved a milestone in research on smart MIMO (multiple input /multiple output) systems, which will enable optimal use of resources in wireless networks. IMEC's solution distinguishes itself from current multiple antenna techniques by optimizing multi-mode operation, including spatial transmission pre-processing. IMEC will demonstrate the technology as a solution for true low-cost, low-power broadband and wireless systems at the July 2004 IEEE802.11n standards meeting.

Next-generation WLAN (wireless local area network) services target specifications of up to 100Mbps at ranges up to 100m. This requires a drastic increase in bandwidth efficiency since channel attenuation and resource-sharing between users within a cell typically prevent current WLAN systems from achieving throughputs of 54Mbps.The use of multiple antenna transmission results in a significant boost in capacities of future WLANs without the need to increase bandwidth or transmission power.

IMEC's prototype shows how the cell capacity can be radically improved to more than 100 Mbps thanks to spatial processing. The proof-of-concept demonstrator comprises a 2-antenna access point, a dedicated MIMO front-end operating at 5 GHz, and 2 single-antenna user terminals or one single two-antenna terminal. The solution is unique

because it performs the upgrade through spatial division multiple access (SDMA) processing at the transmitter only, allowing several users with single antenna (legacy) terminals to communicate simultaneously in the same frequency band. With this solution, the multi-user capacity is effectively doubled without upgrading the user terminals. The flexible scheme also accomplishes transmission up to 108Mbit/s to one (multiple antenna) terminal and can increase the coverage range by a factor 2 to 5 thanks to spatial diversity.

The transmitter first executes digital signal processing based on channel knowledge that a specific combination of the multiple signals from each antenna can be sent. Each antenna at the terminal side receives one distinct stream, free from interference from the other stream(s). This scheme was conceived as an access point processing but it can also be used at the terminal side. The channel information is achieved based on channel estimation on the reverse link, as such minimizing the elapsed time between the estimate and the actual pre-compensation. A special calibration procedure compensates for non-reciprocity in the front-ends.

The concept is demonstrated on IMEC's proprietary PICARD (Platform for Integrated Communication Applications, Research and Demonstration) prototyping platform. The baseband and MAC processor are implemented in FPGAs. The 5GHz front-end, which is tailored for MIMO operations, will be further integrated in a system-in-a-package.

Currently, the prototype also incorporates space-time block coding (STBC) and spatial multiplexing employing receive processing. The cross-layer resource controller guarantees an optimal mode selection, trading off cost (power consumption) and performances (rate, latency).

Further research investigates the combined transmit-receive processing, and SDMA separation of MIMO terminals in which a multiple-antenna transmitter sends to several multiple-antenna receivers. This smart

MIMO technology is a building block in IMEC's multi-mode terminal program. The combination of the smart MIMO technology with a flexible air interface will enable multi-mode terminals that can seamlessly switch between different communication types, such as WLAN and cellular communications. Ultimately, this will lead to the development of a multi-hop network in which each device can be used as a terminal or access point, depending on the availability of power.