

IMEC develops low-cost low-power 60GHz solutions in digital 45nm CMOS

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Picture of IMEC's 45nm 60GHz ICs: power amplifier.

At this week's International Solid State Circuits Conference, IMEC presents a 60GHz front-end receive chain, phase-locked loop and power amplifier in 45nm digital CMOS technology. These building blocks pave the way to second-generation 60GHz radios by 2010 which will rely solely on plain CMOS, true one-chip solutions. IMEC also demonstrated multi-gigabit per second wireless communication with its 60GHz module that integrates IMEC proprietary antenna and antenna interface with its 45nm multiple antenna RF front-end chip.

IMEC is developing single-chip 60GHz radios using advanced digital CMOS technology. The RF part optimally benefits from the speed advantages of chip technology scaling. 45nm Digital CMOS also allows to achieve the high speed, low power consumption and low area specifications for the digital part. By developing beamforming solutions with a phased antenna array approach, IMEC overcomes the low signal-to-noise performance from which 60GHz silicon-based radios typically suffer.

A first major breakthrough, presented at ISSCC, is the realization of a digitally controlled 57-66GHz receiver RF front-end in 45nm digital CMOS with a noise figure of only 6dB. Its small area of only $150 \times 150 \mu\text{m}^2$, its low power consumption of 19mA at 1.1V supply voltage, and full-digital control makes it highly suitable for phased-array systems.

Next, IMEC presents a fully integrated 57-66GHz phase-locked loop (PLL). The PLL, which outperforms all previous designs in terms of tuning range, is the first to provide quadrature output phases at mm-wave frequencies, such that it can be readily used in a zero-IF architecture. The circuit consumes only 78mW at 1.1V supply voltage.

“Based on the presented results we can realize uncompressed high definition video distribution with 16 antenna paths over 10 meter range with a power consumption of only 1.6W for the complete receiver” said Rudy Lauwereins, Vice President Smart Systems Technology Office at IMEC.

Finally, IMEC reports a world-first mm-wave power amplifier in 45nm digital CMOS with state-of-the-art output power and adequate ESD protection. The push-pull power amplifier features a 1dB compression point of 11dBm between 50 and 67GHz at 1.1V supply voltage.

“Industry is reluctant to design 60GHz circuits due to the major challenges related to this mm-wave part of the RF spectrum. These excellent, first time right, 60GHz designs in 45nm CMOS show IMEC’s expertise in 60GHz design and the potential of our design methodology;” said Rudy Lauwereins. “We invite industry to join our 60GHz research program to benefit from this knowledge and from IMEC’s advanced heterogeneous integration technologies enabling second generation real single-chip 60GHz radio solutions by 2010.”

What’s more, IMEC has also integrated its 45nm multiple antenna RF front-end chip together with IMEC proprietary antennas and antenna interface using PCB technology. The performance of this module has been demonstrated in a wireless setup validating IMEC’s baseband processing algorithms for IEEE15.3c compliant reception.

Provided by IMEC

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