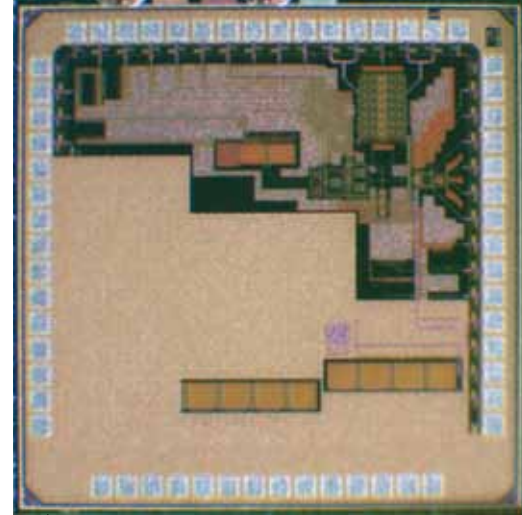




06 | Test PCB with imec and Holst Centre's wake-up receiver



07 | Die of wake-up receiver

ULTRALOW-POWER WIRELESS COMMUNICATION

Enabling tomorrow's intelligent environment

Imec and Holst Centre develop ultralow-power radio chips featuring a power consumption that is 10 to 100 times lower than the commercial equivalents (Bluetooth, ZigBee proprietary ISM radios). They are key enablers for a new generation of wireless sensor networks, to be used in wireless body area networks (WBAN), machinery, or intelligent buildings. They allow a drastic autonomy, a much smaller form factor thanks to a reduced battery size, or the inclusion of more intelligence in the sensors.

Imec's and Holst Centre's expertise

Imec and Holst Centre develop and implement the analog front-ends, the required baseband algorithms and integrate them in silicon. Also the essential features of the MAC are implemented. These different functions are integrated in small form-factor prototypes, either SoC (systems-on-chip) or SiP (systems-in-package) that can be used for demonstration purposes.

Imec and Holst Centre are currently focusing on three types of radios, each optimized for a set of applications.

Impulse UWB radios, offering a unique combination of medium to high data rate with record low power consumption, ideal for real-time streaming of a continuous flow of data.

Narrow-band radios, optimized for ultralow power WBAN, and operating in the worldwide available 2.4 GHz ISM band and suited for body-area networks.

Event-driven radios, operating in the 2.4 GHz ISM band and consuming only 50 μ W when permanently scanning the reception channel. They can be used as low data-rate radios in, e.g. active RFID applications, or a wake-up radio, i.e. a secondary radio that is used to wake up the main radio on request.

LET US TO TAKE ON THE WIRELESS CHALLENGE TOGETHER

Imec's offer?

- Imec offers a variety of business solutions and dynamic interaction models. These range from research collaboration at various levels of scope and depth to license agreements and transfer of IP and building blocks. Deliverables may include system-level models and exploration, design databases for IP components, and complete transceivers, processor and compiler solutions, design flows and approaches, case studies, and consultancy.
- In imec's collaborative research model, companies join the research programs based on a model where the cost, the risk, and the results are shared amongst the partners, giving them access to a large pool of IP at only a fraction of the cost. Typically, resident engineers from the partner companies join the research teams at imec to jointly develop new IP.

Potential partners

Imec teams up with companies across the value chain of the electronic devices market. Some use imec's know-how and prototypes to accelerate the development of their next-generation ICs. Others primarily want to get early access to system demonstrators to start the development of breakthrough end-user products before the commercial ICs for these products are available.

Target companies

Cognitive reconfigurable radio and mm-wave research programs

- IDMs, fabless, and fabless companies
- Baseband platform and processor suppliers
- Dedicated modem vendors
- Error coding vendors

Ultralow-power radio research

- IDMs, fabless, and fabless companies
- Hearing aid companies
- Biomedical BAN vendors
- Consumer BAN vendors
- Active RFID & RTLS providers

Why imec?

- Imec has pioneered low-cost, low-power, breakthrough wireless system solutions for over 15 years in the area of satellite communication, GPS, WLAN-OFDM, MIMO, turbo coding and software defined radio, and has transferred this technology to numerous companies for commercialization.
- For over 20 years, imec has developed innovative design technologies for wireless systems. These technologies have been adopted by several industrial players and have led to the creation of several spin-off companies.

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OPENING NEW HORIZONS IN WIRELESS COMMUNICATIONS



IMEC GREEN RADIOS

Building a flexible interactive world

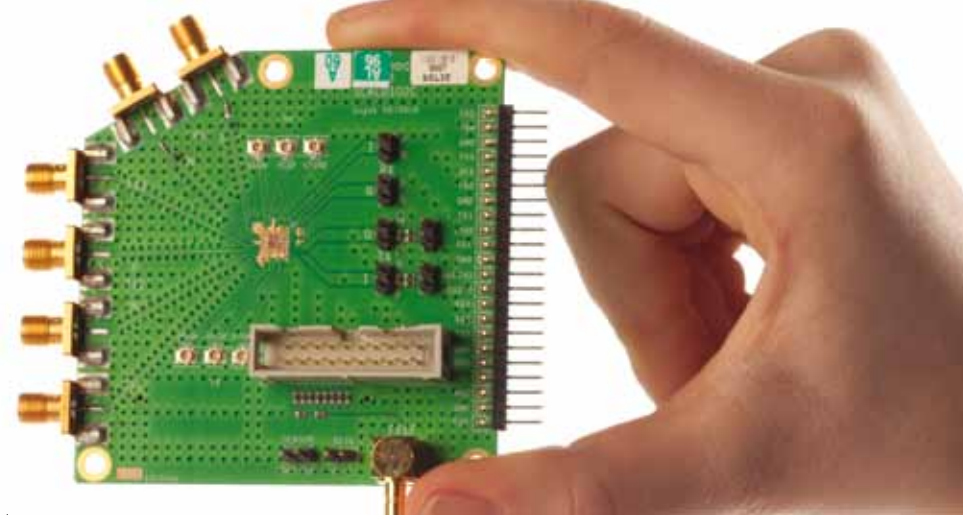




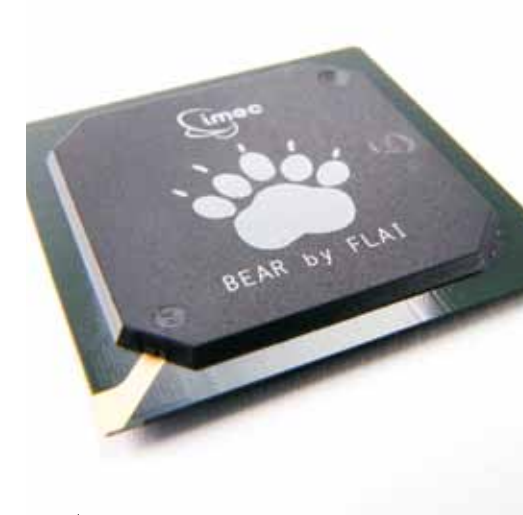
CUTTING-EDGE DESIGN SOLUTIONS FOR TOMORROW'S WIRELESS CONNECTIVITY

Imec conceives radio technologies bringing significant power and cost gains over state-of-the-art using innovative design approaches and leveraging on advanced technologies. We have demonstrated our in-house designed radio chips in wireless prototypes for data rates ranging from kbit/s to Gbit/s.

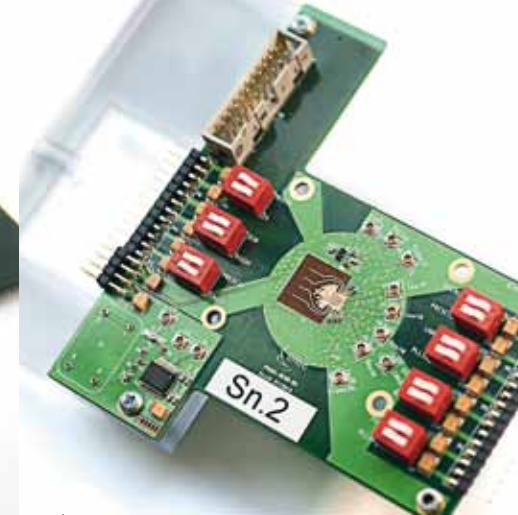
Imec is a centre of excellence in low-power radio technologies for the next-generation flexible mobile devices focusing on applications in broadband (multi-mode) access, high-rate connectivity, sensor networks, wireless audio and other ultralow-power applications as well as for base stations for femtocells.



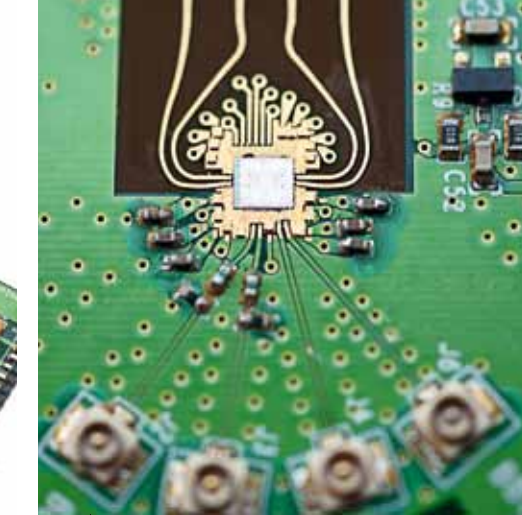
01 | Flexible multistandard transceiver in 40nm CMOS technology



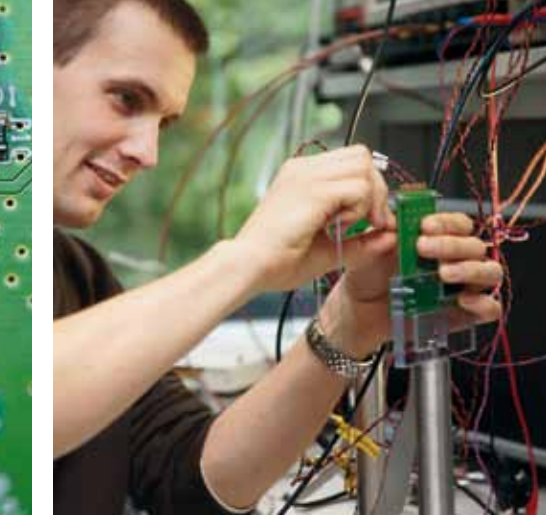
02 | Imec's first-generation SDR baseband platform



03 | Imec's 60GHz receiver module



04 | Imec's 45nm CMOS 60GHz front-end with four antenna paths



05 | Imec's 60GHz wireless demonstrator set-up

COGNITIVE RECONFIGURABLE RADIO

A revolution in flexibility, intelligence, and connectivity

Imec's expertise

Imec's research focuses on low-power solutions for reconfigurable radios. Imec's work on analog front-end and digital baseband solutions in deep-submicron digital CMOS technology has resulted in world-recognized expertise and a first generation of software-defined reconfigurable radio solutions:

- a flexible RF transceiver front-end
- a digital front-end component for low-cost and low-power spectrum sensing
- a programmable high through-put baseband platform
- scalable and low-power data converter circuits
- a flexible FEC (forward error correction) solution

Addressing the design challenges for the next generation

Ubiquitous and seamless connectivity can be achieved in a heterogeneous network if both the terminals and the network can be reconfigured to support horizontal and vertical roaming. Imec conceives reconfigurable radio's with record-low energy consumption that support seamless connectivity, at a low cost and with high flexibility.

Reconfigurable radio platforms for 4G in ≤ 40nm CMOS

To meet the insatiable demand for bandwidth at low cost and high performance, scalable solutions are needed in the newest technology nodes.

Imec's **reconfigurable radio front-end** research focuses on scalable transceivers in cost-effective digital CMOS

technology, targeting low-power, low-cost, high-linearity and multimode operation, digital RF and surface acoustic wave (SAW)-less transceivers.

Imec's **reconfigurable baseband** research focuses on a scalable, low-cost, low-power platforms that can be instantiated for multiple sets of standards and that include sensing solutions, multi-processors for concurrent multi-stream baseband processing and flexible error coding.

Cognitive radios

Imec's radio architectures allow sensing multiple channels in parallel, and flexibility in tuning the center frequency aiming at real cognitive radios that autonomously adapt their transmission parameters to the environment.

MILLIMETER-WAVE WIRELESS COMMUNICATION

Energy-efficient solutions for high-throughput communication

Imec's research program on mm-wave communication aims at developing wireless communication links at 60GHz that are able to transfer data rates of several gigabits per second over short distances, ranging from centimeters up to 10-20 meters. The 60GHz-radio technology will enable this multi-gigabit wireless connectivity among displays, PCs, consumer electronics and handheld/battery operated devices.

By leveraging on the newest CMOS and antenna technologies, we aim at developing solutions to drastically reduce the power consumption, size and cost compared to existing 60GHz-radios.

Imec's expertise

Imec has a longstanding expertise in broadband and MIMO systems, RF and millimeter-wave CMOS circuit design, and millimeter-wave integration (for antenna and antenna interface). We have demonstrated a prototype of a low-power 60GHz phased-array transceiver in 40nm low-power digital CMOS using analog baseband beam forming. This transceiver has been integrated with an antenna array, and validated for the 60GHz IEEE802.15.3c standard.

Addressing the design challenges for the next generation

In the future, we aim to develop mm-wave radio solutions for medical applications, for example for endoscopic operations, mm-waves can offer highly reliable, clean and convenient wireless connections with physically guaranteed privacy. Moreover, for chip-to-chip communications, mm-waves can provide the multi-gigabit per second rates that will be required by future systems—wirelessly. And in the industrial domain, the technology's tremendous capacity can radically change the scene for machine-to-machine applications, whereas its short wavelength can enable low-cost, high resolution sensing.