The trend in wireless communication where terminals give their users ubiquitous access to a multitude of services drives the development of reconfigurable radios in deep-submicron CMOS. This is enhanced with the advent of LTE Advanced, a standard that is inherently so flexible that a reconfigurable radio is the most economical implementation. The single-chip reconfigurable transceiver ‘Scaldio’ technology provides an answer to this need.

**TECHNOLOGY DESCRIPTION**

Imec’s reconfigurable radio front-end, named SCALDIO (scalable radio), is programmable to operate with all current and future cellular, wireless local area network (WLAN), wireless personal area network (WPAN), broadcast and positioning standards in the frequency range between 174MHz and 6GHz. The unique architecture of the flexible RF front-end achieves a power consumption, performance and CMOS chip area competitive with current state-of-the-art single mode radio front-ends.

Imec has several generations of SCALDIO radio transceivers with proven silicon performance: SCALDIO-2 significantly reduces the bill of materials, footprint and cost due to its unique SAW-less architecture and has been realized in a digital system-on-chip (SoC) 40nm CMOS technology. SCALDIO-3 is the next generation leveraging on 28nm CMOS technology to realize a giant leap in performance, power and area. It covers all key broadband communication standards including next generation cellular and connectivity standards such as LTE advanced and next-generation WiFi (802.11ac).

**SCALDIO-2 SPECIFICATIONS:**

- RF tuning range: 100 MHz – 6GHz
- Signal bandwidths supported: 200kHz – 40MHz
- Digital 40nm CMOS, no analog or RF technology options
  - 1/2.5V supply
  - 5mm²
  - 50-200mW, depending on configuration
- Transmitter out-of-band noise of < -160dBc/Hz at 20MHz offset from carrier frequency, C-IM3 > 65dBc
- Receiver out-of-band linearity of +10dBm at 20MHz offset from carrier frequency (in receiver high gain mode)
- Performance optimized for cellular (GSM, UMTS, WCDMA, 3GPP-LTE, LTE Advanced)
- Compatible with SAW-less LTE-A

**MORE INFORMATION:**

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**NEXT-GENERATION WIRELESS ACCESS ASKS FOR RECONFIGURABLE RADIOS**

The trend in wireless communication where terminals give their users ubiquitous access to a multitude of services drives the development of reconfigurable radios in deep-submicron CMOS. This is enhanced with the advent of LTE Advanced, a standard that is inherently so flexible that a reconfigurable radio is the most economical implementation. The single-chip reconfigurable transceiver ‘Scaldio’ technology provides an answer to this need.

**SCALDIO-2: A 5 MM² 40NM CMOS 6.1 – 6GHZ SAW-LESS RECONFIGURABLE RADIO TRANSEIVER**

SCALDIO-2 is a highly-linear and low-noise reconfigurable radio transceiver eliminating the need of surface acoustic wave (SAW) filters. The unique approach is a major breakthrough towards fully reconfigurable radios by relaxing the requirements of antenna filters which suffer today from limited flexibility due to the high filtering specs. As a result, the bill of materials and board space and thus the cost of mobile devices can be significantly reduced.

SCALDIO-2 consists of a single-chip reconfigurable receiver, transmitter and 2 frequency synthesizers in 40nm digital CMOS technology. It is fully software configurable across all channels in the frequency bands between 100MHz and 6GHz. Its properties (such as the RF carrier frequency, channel bandwidth, noise figure, linearity, filter characteristic)
can be adapted to the requirements of the standards that are used. The highly linear receiver tolerates 0dBm blockers with acceptable noise figure, avoiding the need of SAW filters and consequently enabling a simplified antenna interface. It achieves high sensitivities and low phase noise for cellular standards. The flexible transmitter reaches very low out-of-band noise, making it also compatible with SAW-less operation. SAW-less transmitters become more and more important with the evolution towards future standards such as LTE Advanced where transmitters will need to operate in multiple FDD (frequency division duplex) bands. The transceiver is further characterized by a very low power consumption and an extremely small chip area of only 5mm². Therefore, it is competitive to state-of-the-art single mode radios in mobile devices – handsets, smart phones, PDAs, PC cards, USB dongles, etc...

SCALDIO-3: NEXT-GENERATION RECONFIGURABLE RADIO TRANSCEIVER IN 28NM CMOS

The SCALDIO-3 delivers breakthrough performance, power and area by combining innovative circuit and architecture design with advanced 28nm CMOS chip technology. It consists of a digital transmitter bringing a close to 50% power reduction compared to a classical direct conversion architecture. Further, the digital transmitter is widely programmable covering existing and emerging cellular standards (from 2G up to LTE Advanced) and connectivity standards (802.11a/b/g/j/n/ac) supporting signals bandwidths in excess of 160MHz. The 0-6GHz low-noise frequency synthesizer supports 256-QAM modulation up to 6GHz and at the same time also meets the very stringent GSM phase noise requirements. Finally, the 28nm receiver operates from 400MHz up to 6GHz and supports reconfigurable RF channel bandwidths up to 100MHz. It operates at a low standard supply of 0.9V, while maintaining +5dBm of out-of-band IIP3 and tolerating 0dBm blockers. It achieves noise figures down to 1.8dB, occupies an active area of 0.6mm², and consumes less than 40mW. Its high-performance, ultra-low power and low-cost features make the transceiver suited for next generation of mass volume mobile SoCs.

AVAILABLE FOR TRANSFER, PARTNERING FOR NEXT GENERATION SCALDIO

Imec licenses the mature SCALDIO IP to industry in a package including:

- Design database
- Evaluation board
- Documentation (design reports, measurement reports,...)
- Training and support (including tutorial & hands-on workshop,...)

In its green radio program, imec partners with industrial players to design low power and compact high-performance reconfigurable RF transceivers leveraging on state-of-the-art CMOS technology (28nm & beyond) and targeting all key broadband communication standards including next generation cellular and connectivity standards such as LTE Advanced (Rel. 12&13), WiFi (802.11ac), as well as new transmission schemes for 5G.

EVALUATION PLATFORM

The SCALDIO-technology can be evaluated as part of a workshop. The workshop includes hands-on session and support in evaluation and testing of the reconfigurable radio transceiver prototype.

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