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IEEE802.11ah Wi-Fi HaLoW RADIO IN TSMC 40nm CMOS

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DESCRIPTION

IMEC's ULPWIFI Radio is a pre-standard design for the upcoming IEEE 802.11ah standard (draft D5.0) and supports the mandatory 1MHz and 2MHz channel modes, optimized for low-power as well as extended range. OFDM-based BPSK/QPSK/QAM16 modes are supported. It achieves excellent performance at ultralow-power consumption and operates in the sub-1GHz industrial, scientific and medical (ISM) and short-range devices (SRD) bands, from 863MHz to 930MHz.

The design focuses on the mandatory low-power modes in the IEEE 802.11ah standard foreseen for low-power sensor node devices. Hence, it is optimized for ultralow-power consumption, large link budget, as well as robustness to interference. It has been designed and taped out in 40nm LP CMOS technology.

The Rx AFE comprises a complete ultralow-power zero-IF receiver chain from LNA to ADC. The Tx AFE contains a highly optimized class-D power amplifier, all-digital PLL for carrier generation and modulation, digital front-end and XO-based clock generation. A peak-to-average-power reduction technique is im-plemented to achieve a combination of excellent power efficiency and EVM. The FPGA digital baseband / PHY comprises complete framing / de-framing functionality (OFDM modulation / demodulation, synchronization, channel estimation, error correc-tion, etc.) and is also optimized for low-power and low-area implementation. It provides third party MAC interfacing and seamlessly integrates with the MCU system by AMBA bus.

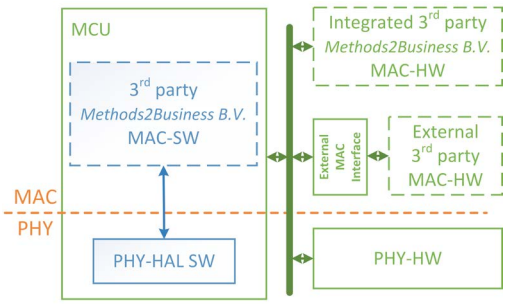
KEY FEATURES

Standard	IEEE 802.11Ah (Draft D5.0)
Power consumption (Afe+dbb spec. For 40nm lp @ 1.0V)	Rx: < 6.0mW Tx: < 8.5mW
Frequency band	863-930 MHz
Modulation	OFDM-based BPSK, QPSK and QAM16 (SISO modes)
Data rate (phy)	150kbps—3.9Mbps
Channel bandwidth	1MHz & 2MHz
Tx evm (for all supported modes)	< -27dB
Tx output power	0dBm average (8dBm peak)
Rx sensitivity (10% Per, mcs10)	-104dBm
Rx adj. And alt. Channel re-jection	34dB and 50dB
Tolerable out of band blocker power	-20dBm
Nominal supply	1V
Technology	TSMC 40nm LP CMOS

Note: Preliminary specifications.

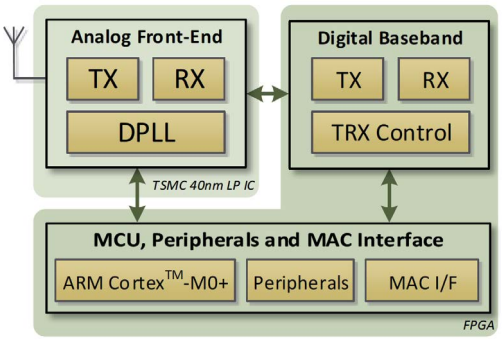
The ARM™ Cortex™-M0+ based system enables SW development and testing of the analog front-end and digital baseband features. It includes 128kB of memory and peripherals like SPI, I2C and UART.

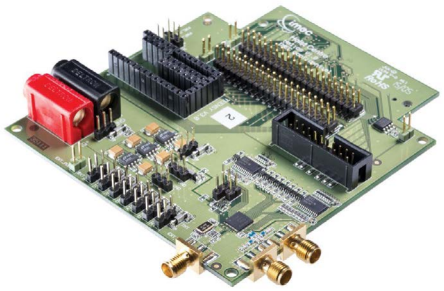
For demonstration, the PHY implementation is combined with a 3rd party 802.11ah MAC from Methods2Business B.V. The MAC adapter is comprising internal / external hardware as well as software interfaces. The ULPWIFI SW provides a hardware abstraction layer (PHY HAL) to get access to the basic functions of the AFE transceiver such as packet receive, transmit, set channel, etc. as used by the MAC SW stack layer.



Internal/external MAC-PHY HW/SW interfacing and integration with 3rd party MAC, e.g. Methods2Business B.V. MAC

BLOCK DIAGRAM ULPWIFI RADIO





Helios AFE evaluation board

KEY FEATURES

- IEEE 802.11ah (Sub-1GHz) Wi-Fi support
  - 1MHz / 2MHz channel support
  - OFDM BPSK, QPSK & QAM16 (SISO modes)
  - 0.15-3.9Mbps PHY data rates
- TX/RX Analog Front-End (AFE)
  - Tuning range: 863-930 MHz
- FPGA Digital Baseband / PHY (DBB)
- Ultralow-power consumption (AFE)
  - Rx: < 4.0mW
  - Tx: < 7.5mW for 8dBm peak output power
- Integrated microprocessor platform
  - ARM CortexTM M0+ core, w. memory and peripherals (SPI, UART, GPIO, IC)
- Third-party MAC integration ready
  - MAC–PHY interface (PHY_SAP, PLME_SAP)
- Designed for 1V nominal supply

APPLICATIONS

- Low-power wireless sensor networks
- Machine-to-machine
- Extended range Wi-Fi
- Internet of Things

EVALUATION BOARDS

Imec provides evaluation boards on request to prospective customers and partners interested in licensing imec's radio designs and IP.

HELIOS PCB + ARTIX7 FPGA BOARD

Enables complete evaluation of the ULPWIFI IEEE802.11ah radio and further development and testing of DBB/PHY features.

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