THE IMEC SENSING ENGINE: AN INTRODUCTION

CREW TRAINING DAYS 2014, GHENT

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HANS CAPPELLE

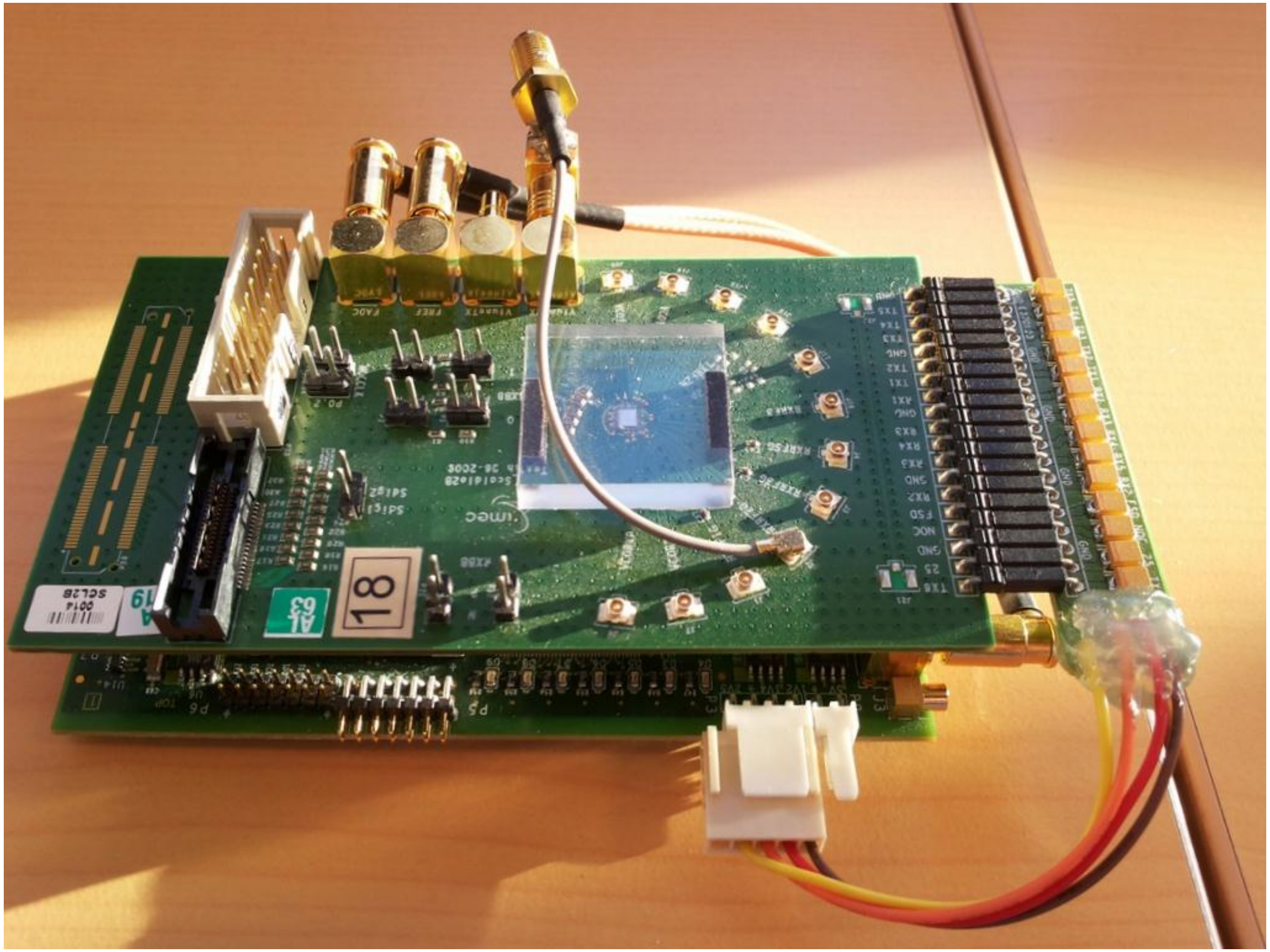
OVERVIEW

- **Introduction**
- Overview of the different components
- Different modes of operation
  - Specifications
  - Generated output
- Configuration and control
- Examples of usage
- Hands-on / demonstration

SENSING @ IMEC: OVERVIEW

- Working on SDR both baseband and analog frontend
- Focus on next-gen handheld/mobile: low-power, high throughput
- SDR ideal match for cognitive radio
- No sensing = no cognitive radio
- The imec sensing engine is an essential part of the imec SDR platform

WE BUILT A COMPACT AND FLEXIBLE SENSING ENGINE



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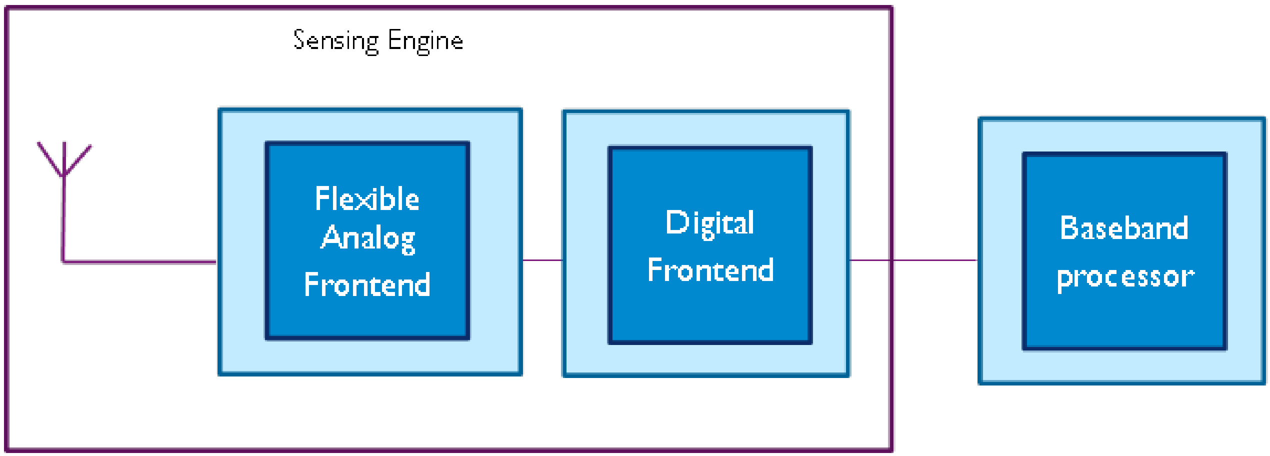
MAIN FEATURES OF THE IMEC SE

- DIFFS digital front-end
  - Small area, low power ASIC
  - Filtering, auto/cross-correlation, multi-band energy detection
- Range of analog frontends
  - SCALDIO analog front-end (imec)
    - Small area, low power
    - Highly reconfigurable, wide operating range
    - Low LO settling time
  - WARP radio interface
    - 802.11 a/b/g radio bands
- Sensing functionality
  - Basic energy detection
  - Advanced feature detection

OVERVIEW OF THE DIFFERENT COMPONENTS IN CREW OC3

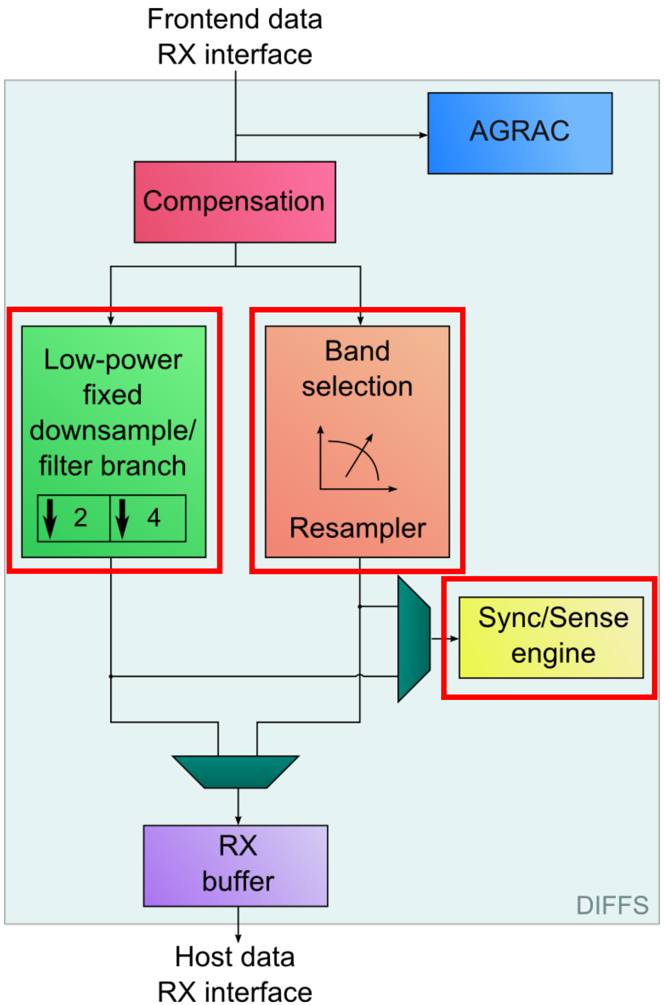
- DIFFS
- Spider
- WARP



OVERVIEW OF THE DIFFERENT COMPONENTS: DIFFS

- Digital Frontend for Spectrum Sensing

SENSING-ENABLED DFE READY FOR THE FUTURE



Low-power synchronization

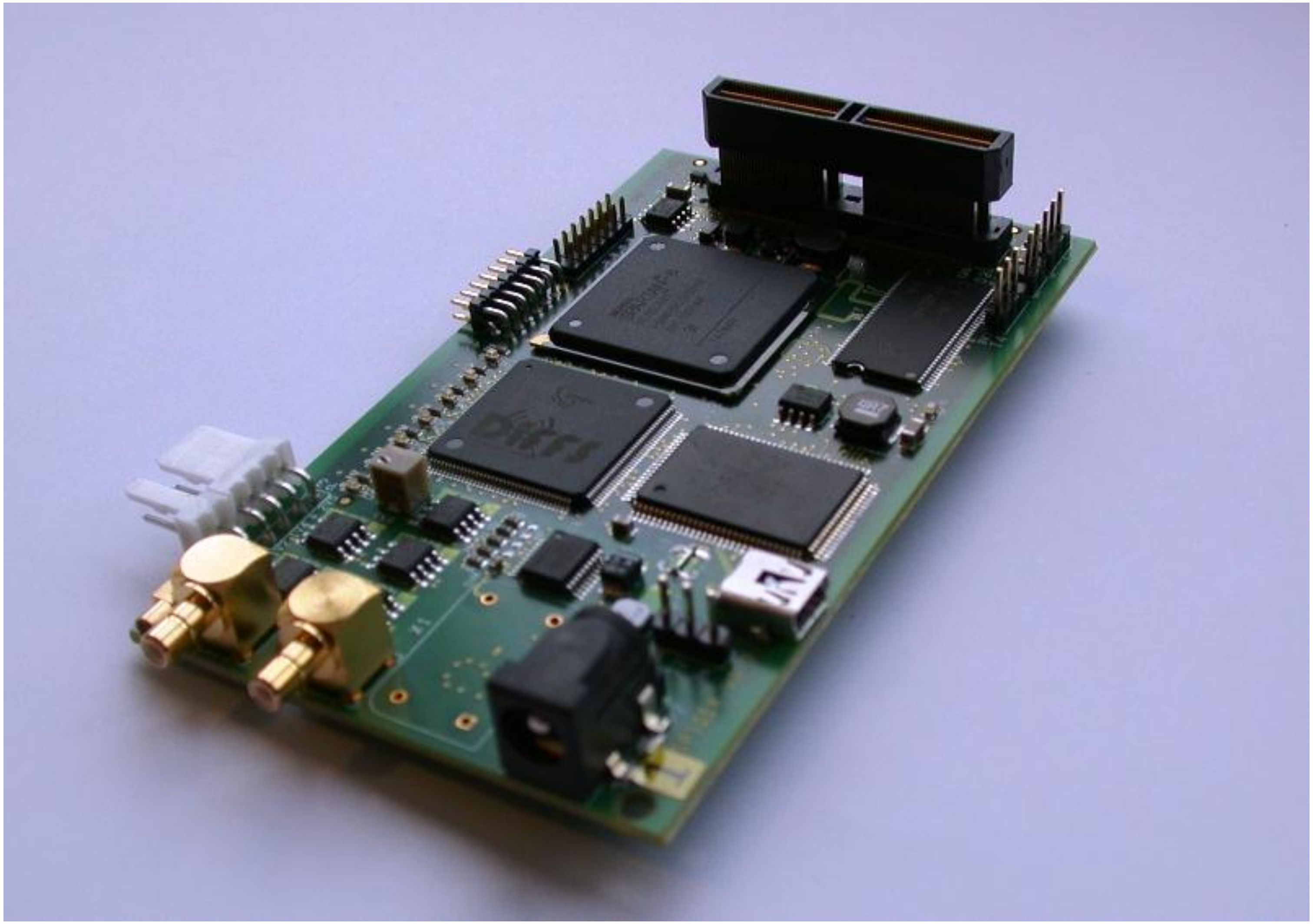
Flexible filter/mixer/resampler

- support for ΣΔ
- future standards
- concurrent reception/sensing

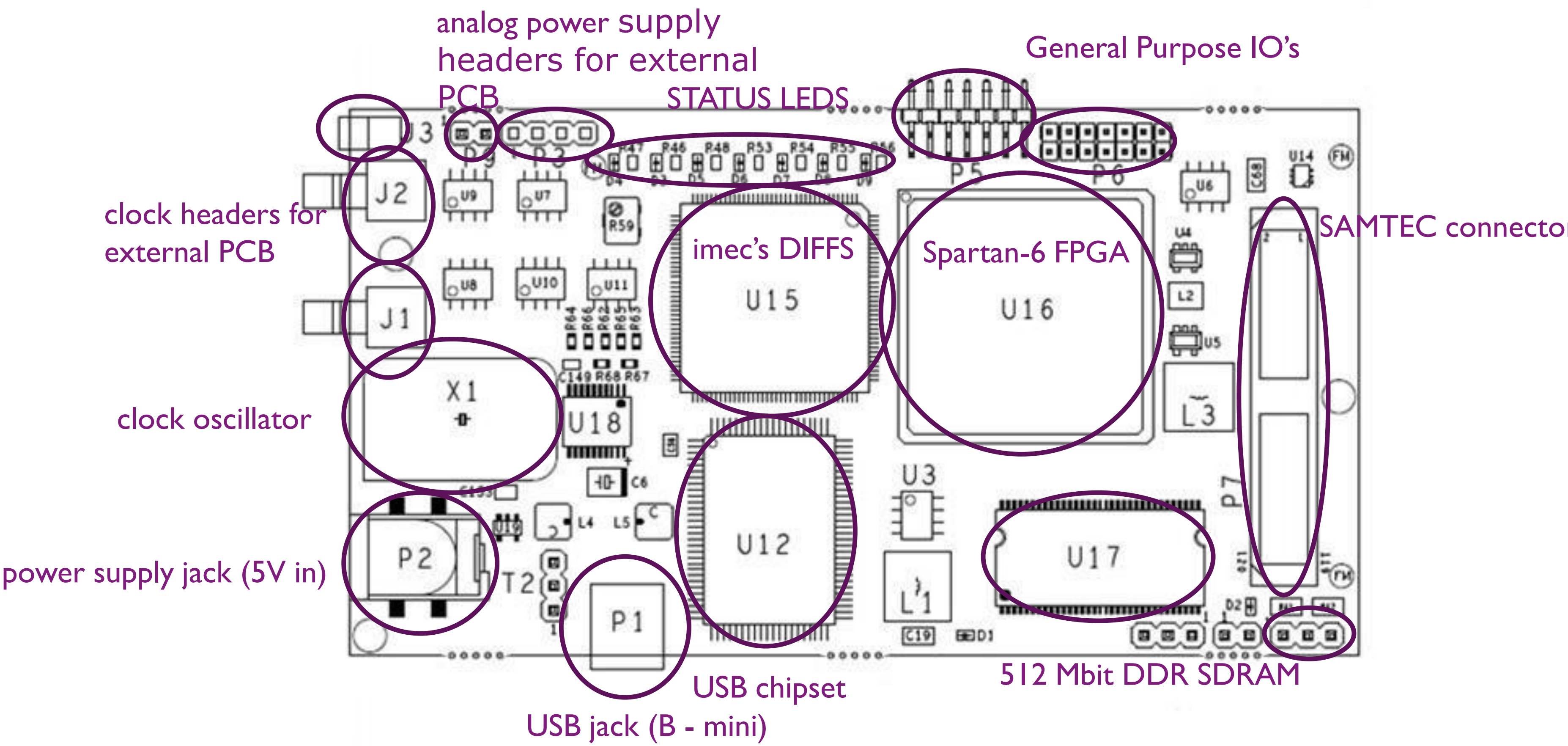
Sync/sense engine: SIMD

- dedicated accelerator cores
- capable of “sensing” + “syncing”

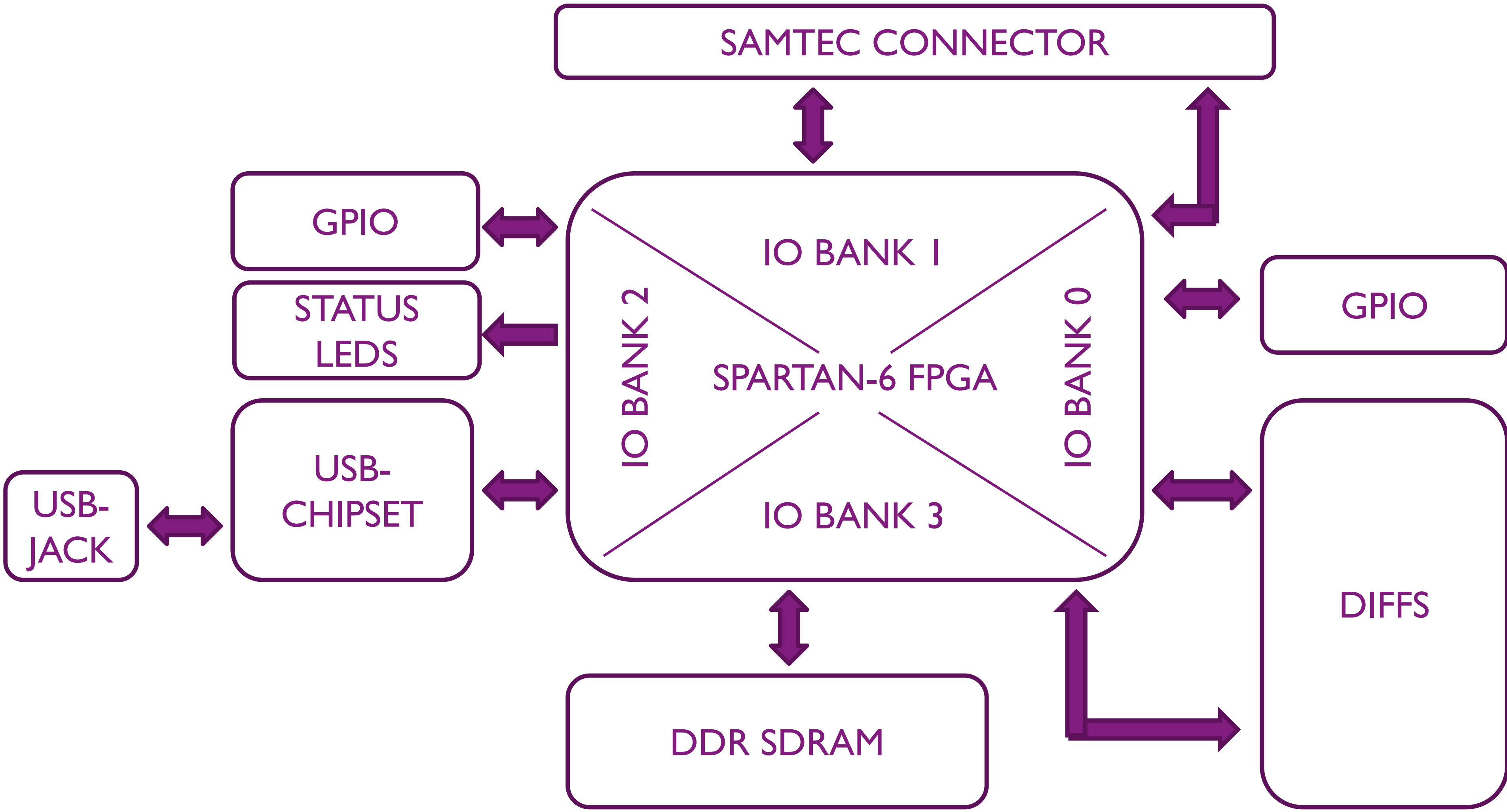
OVERVIEW OF THE DIFFERENT COMPONENTS: SPIDER



SPIDER: COMPONENTS



SPIDER BLOCK DIAGRAM

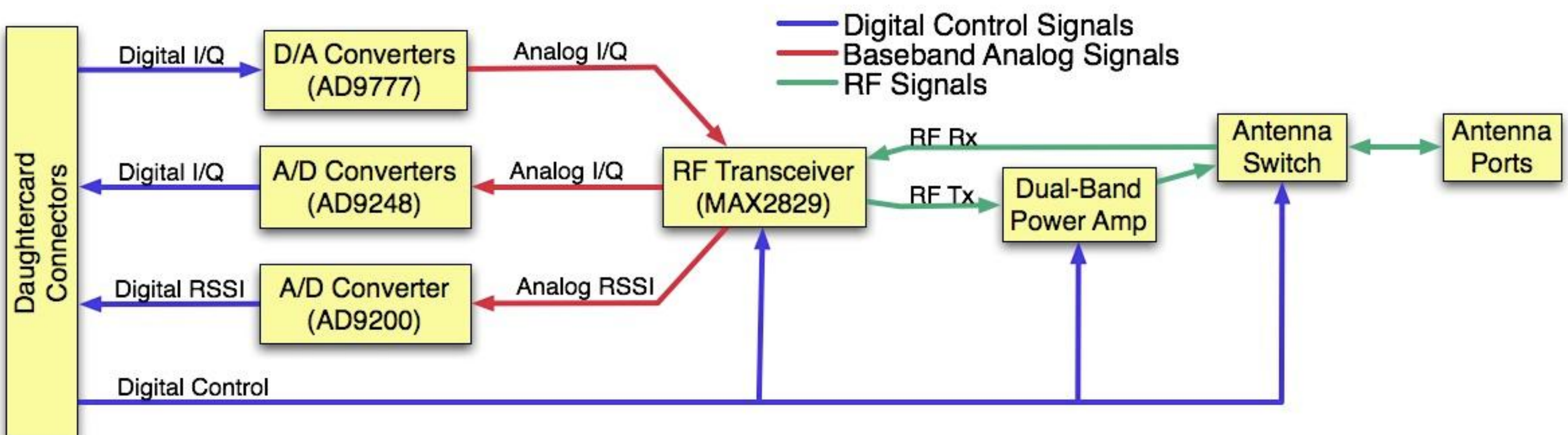


imec

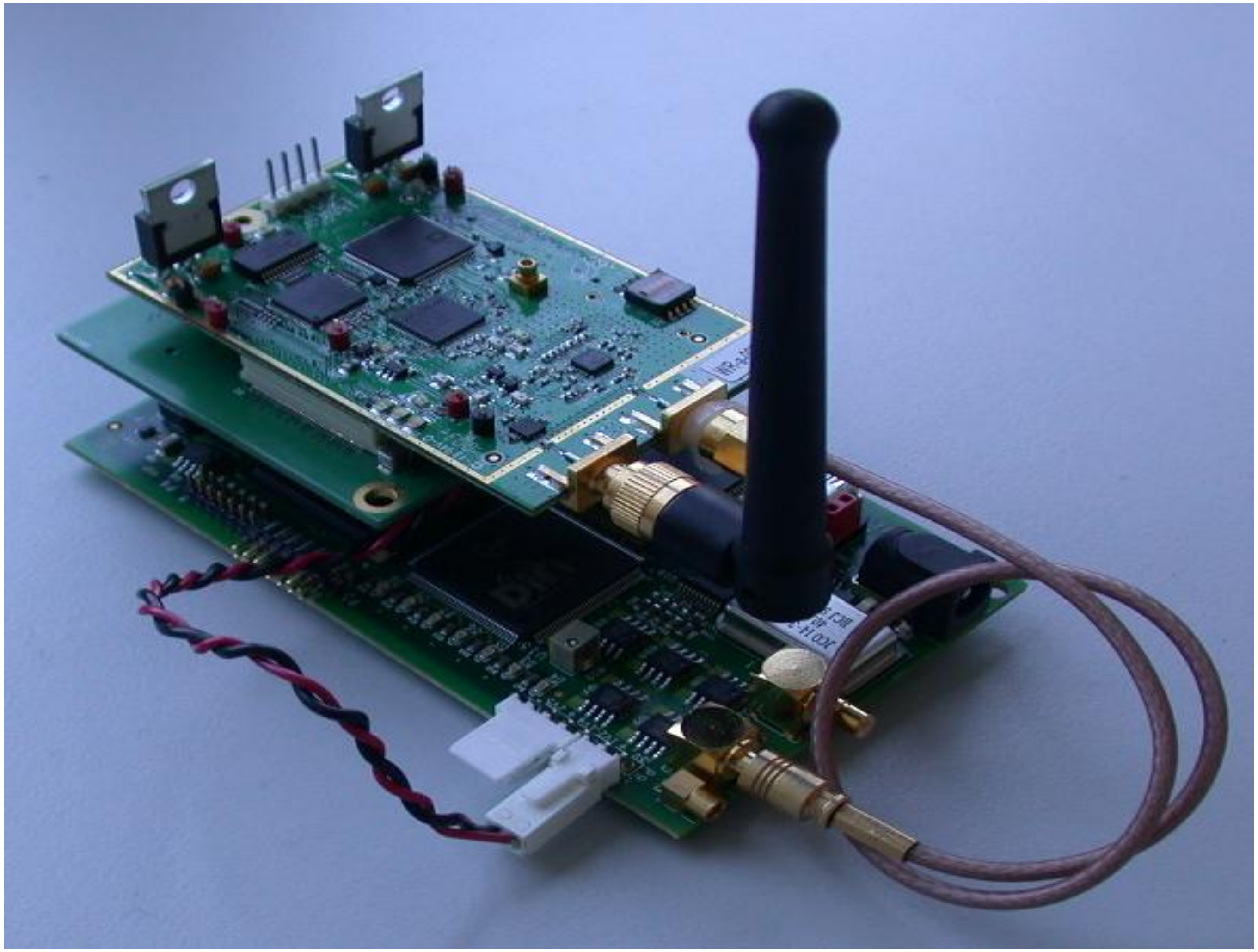
OVERVIEW OF THE DIFFERENT COMPONENTS: WARP

WARP RADIO BOARD

- Wireless Open Access Research Platform developed at Rice University
- Dual-band IEEE 802.11a/b/g Transceiver
- 2 antenna ports, MIMO capable
- On board DAC, ADC, RSSI ADC and dual band PA



SENSING ENGINE WITH WARP RADIO BOARD



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DIFFERENT MODES OF OPERATION

- FFT-sweep
  - Full Analog Frontend frequency range
    - 500 MHz – 6 GHz for Scaldio
    - 2.4 GHz – 2.5 GHz and 4.9 GHz – 5.875 GHz for WARP Radio board
  - 128-points hardware accelerated FFT for each 20 MHz subband (“channel”)
  - Programmable RX gain

- Output:
  - Power value in dBm
  - 128 bins per channel

DIFFERENT MODES OF OPERATION

- WLAN-G
  - IEEE 802.11g power assessment
    - 14 channels
    - Accumulated power value for x samples
  - Fast reconfiguration and "processing"
  - Programmable RX gain
  - Programmable threshold

- Output:
  - 1 power value per channel
  - Binary comparison to threshold

DIFFERENT MODES OF OPERATION

- WLAN-A
  - IEEE 802.11a power assessment
    - 23 channels
    - Accumulated power value for x samples
  - Fast reconfiguration and "processing"
  - Programmable RX gain
  - Programmable threshold

- Output:
  - 1 power value per channel
  - Binary comparison to threshold

DIFFERENT MODES OF OPERATION

- Zigbee
  - IEEE 802.15.4 power assessment
    - 16 channels
    - Accumulated power value for x samples
  - Fast reconfiguration and "processing"
  - Programmable RX gain
  - Programmable threshold

- Output:
  - 1 power value per channel
  - Binary comparison to threshold

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CONFIGURATION AND CONTROL

See the imec sensing engine manual:

http://www.crew-project.eu/portal/imecdoc

How to use it in wilab2:

http://www.crew-project.eu/content/imec-sensing-engine-w-ilabt-zwijnaarde-testbed

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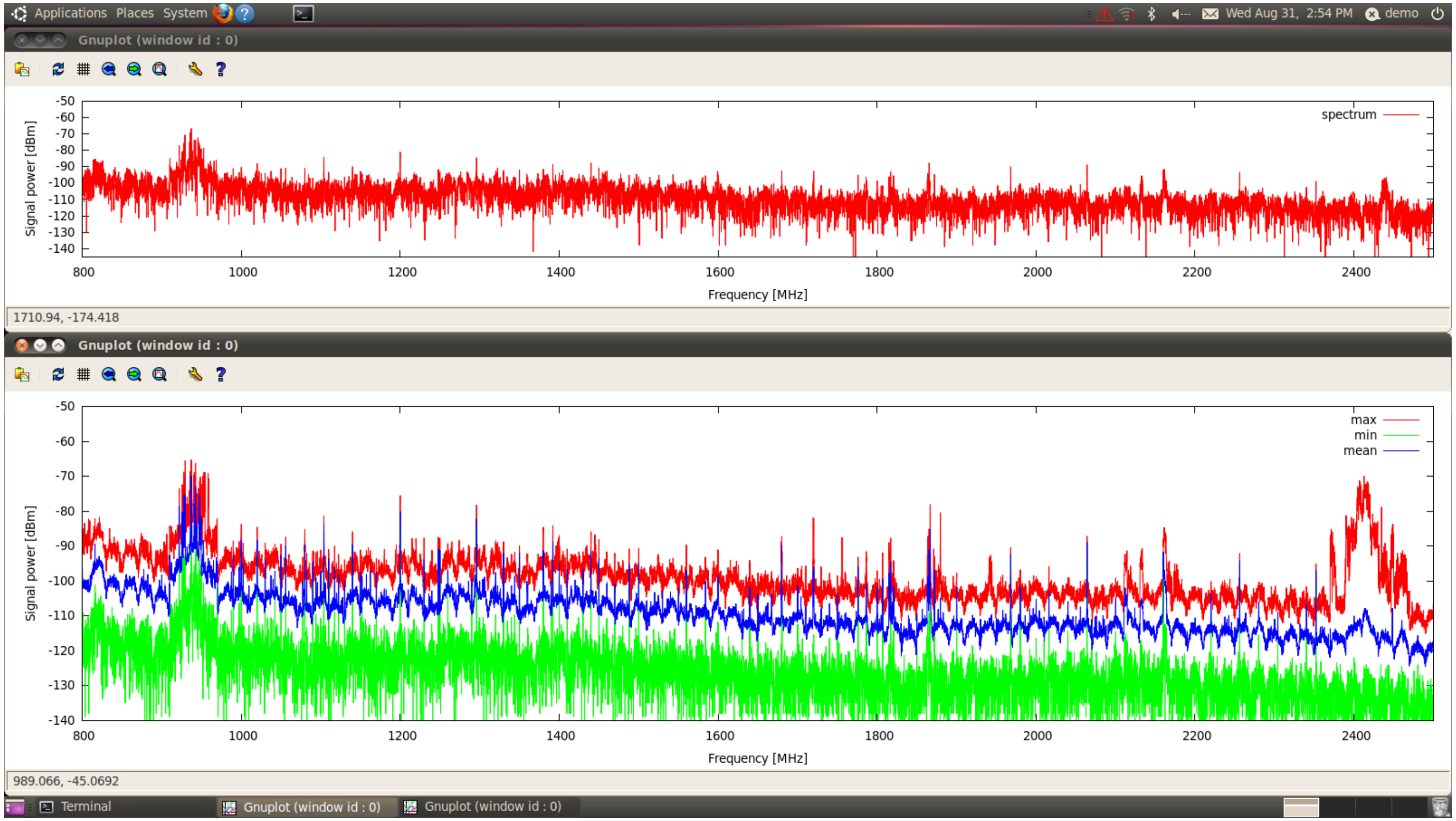
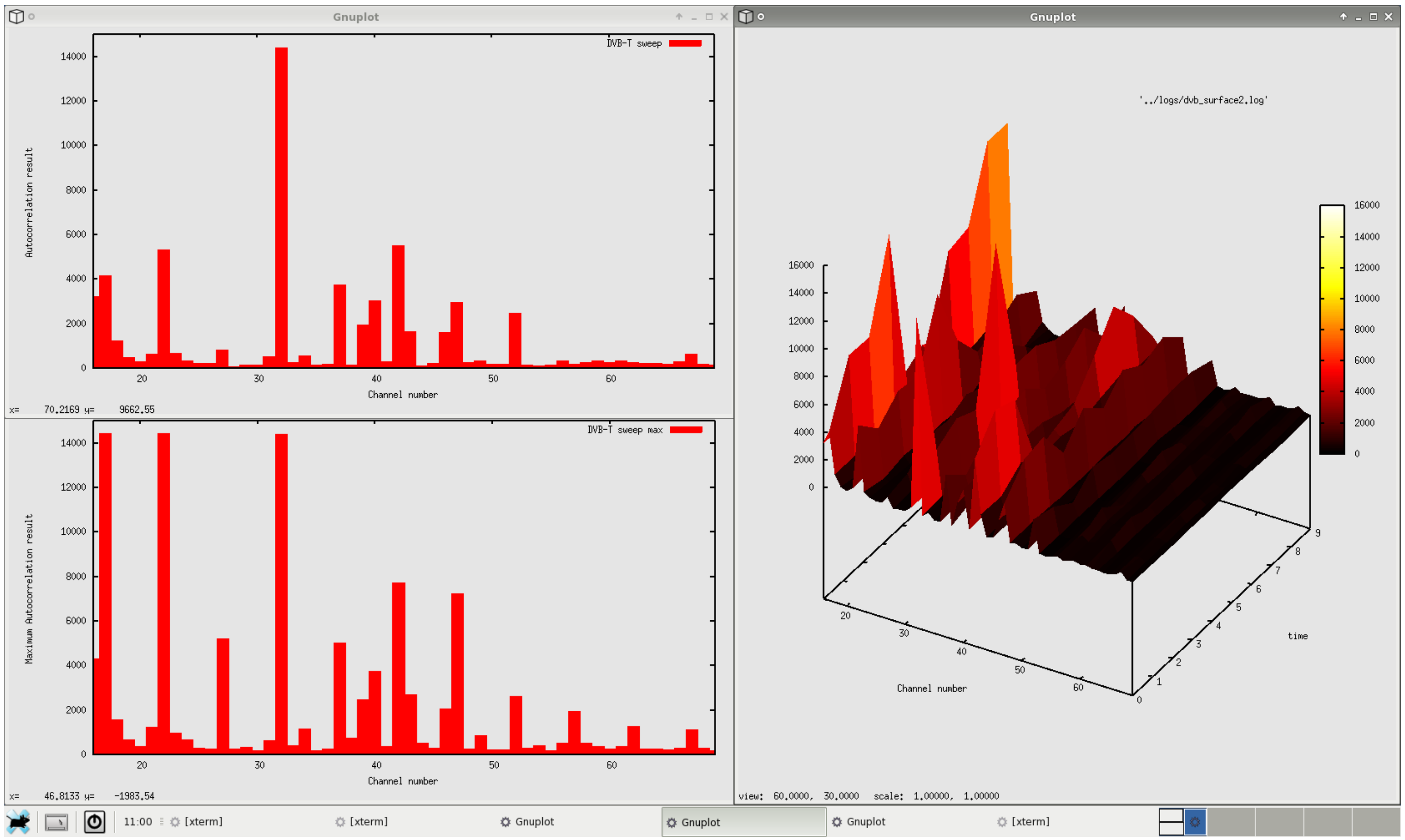
STANDALONE DEMO I SPECTRUM SWEEPING

Wide-range frequency running on DIFFS and SCALDIO



STANDALONE DEMO 2
DVB-T SENSING

DVB-T band sensing running on DIFFS and SCALDIO (multiple DVB-T modes 2k/8k)



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HANDS-ON / DEMONSTRATION

Will be demonstrated as part of the iMinds training section in the next session.

THE IMEC SENSING: AN INTRODUCTION

QUESTIONS?

REMARKS / FEEDBACK

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