CREW

Cognitive Radio Experimentation World

Tomaž Šolc
Jožef Stefan Institute
tomaz.solc@ijs.si

SNE-ESHTER: A low-cost, compact receiver for advanced spectrum sensing in TV White Spaces

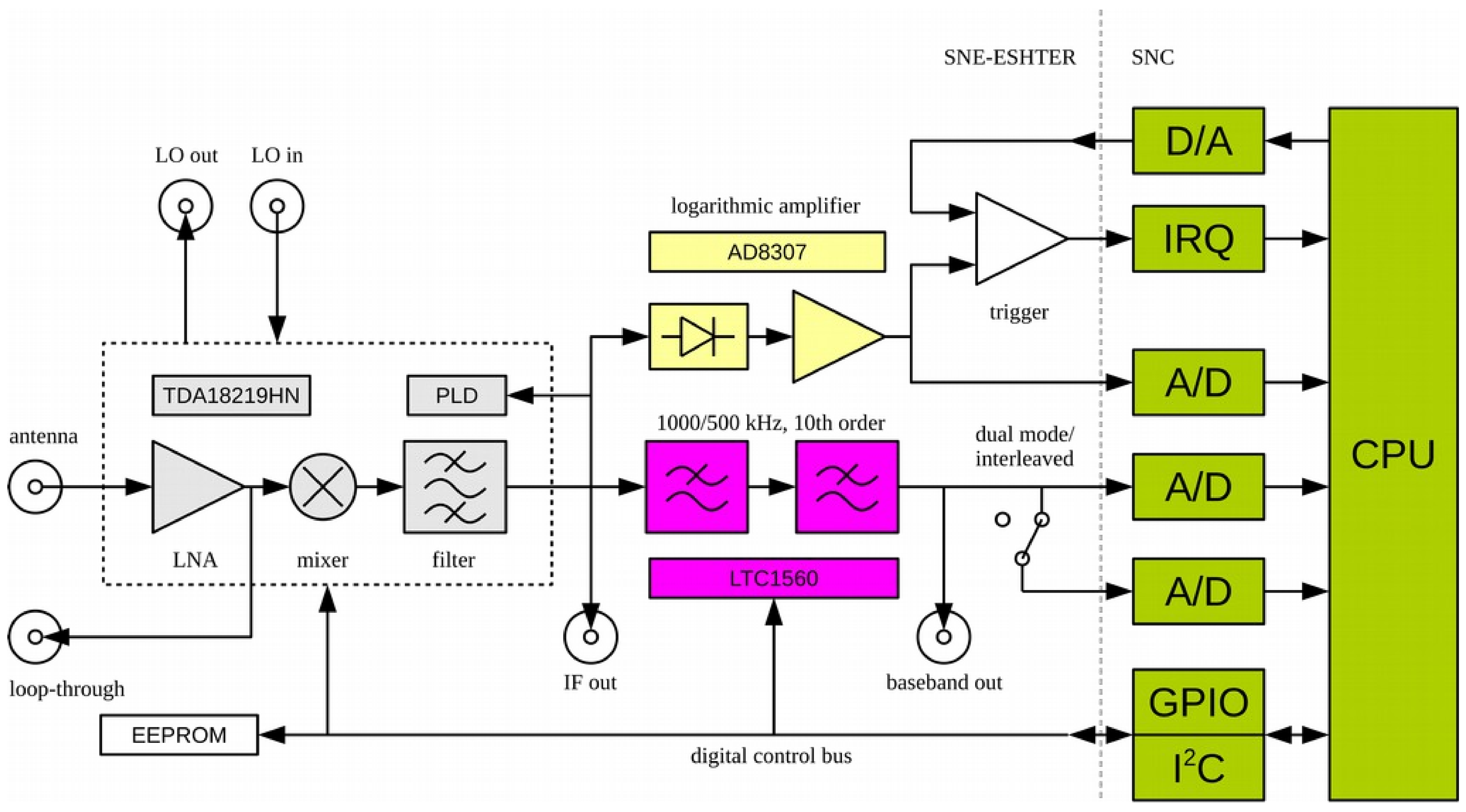
IJS

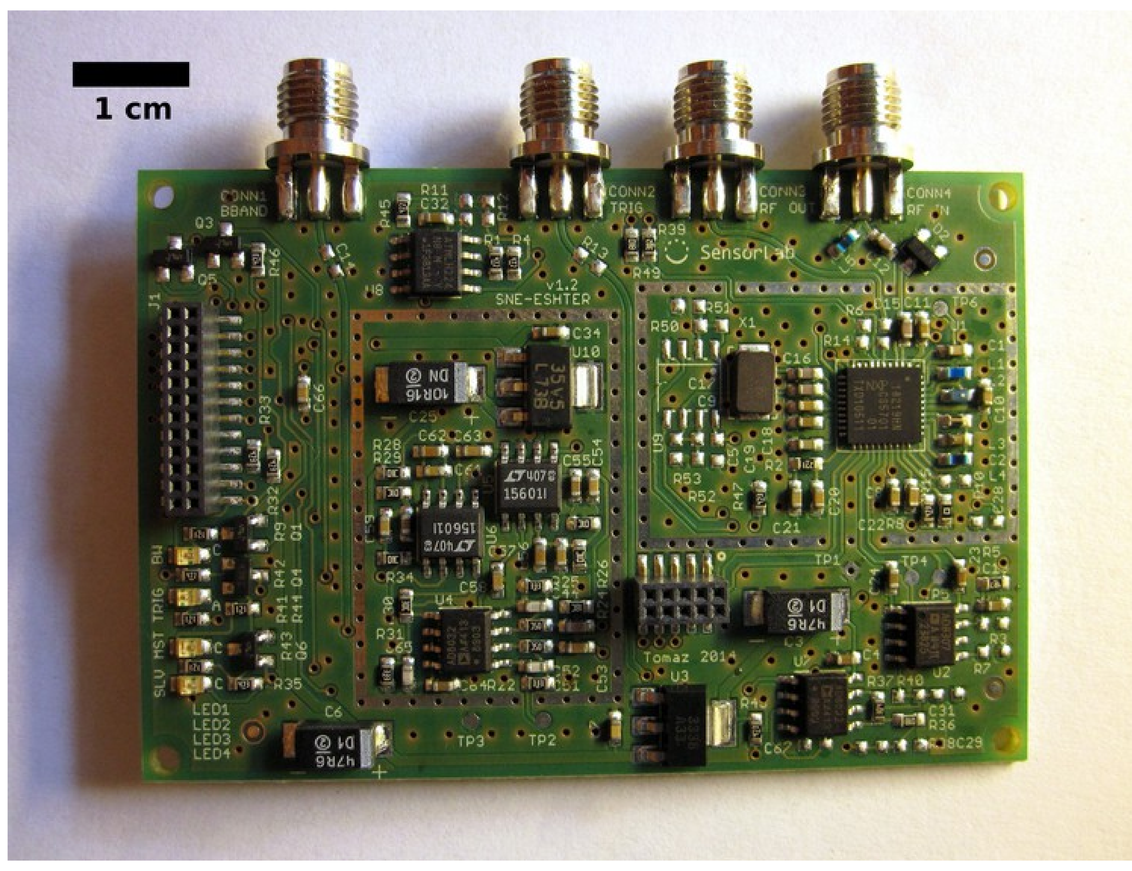
Advancing CREW Experimentation Facilities

Problem: How to enable experimentation with advanced spectrum sensing in TV White Spaces in diverse outdoor testbeds? Outdoor testbeds favor robust, compact hardware. Distributed sensing favors low cost and a large number of sensors.

Solution: **Embedded Sensing Hardware for TVWS Experimental Radio (ESHTER)** sensor node expansion deployed in CREW.

- VHF and UHF signal reception (40 – 900 MHz) including the TV broadcast band, 5 ms channel settle time.
- Baseband sampling with 500 kHz or 1 MHz bandwidth. Log-response energy detection up to 8 MHz bandwidth.
- Simultaneous synchronous sensing on two channels and/or two antennas on a single sensor node.
- Programmable hardware trigger for low-latency applications (e.g. CS-MAC protocols)





Deployment: Observing the Ofcom TVWS pilot

The UK regulator Ofcom is running trials for secondary devices using TV frequencies in preparation for commercial use of white space technology. CREW project, in cooperation with FP7 ACROPOLIS, has deployed two sensors in London to monitor the ongoing tests and their effect on the spectrum occupancy.

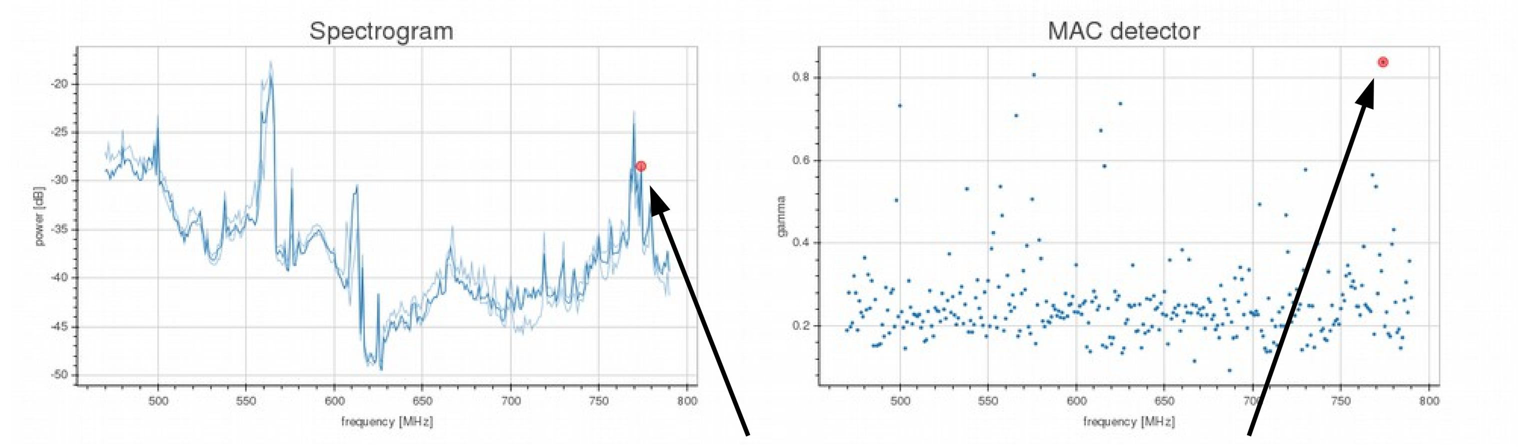
1. Receivers are mounted on **VESNA sensor node cores**, which provide an embedded 72 MHz CPU for signal processing.
2. An **Ethernet interface** allows simple distributed deployment of individual sensors with remote control over Internet.
3. Sensors deployed on roof-tops at **King's College London** and **Queen Mary University of London** record long-term statistical data on spectrum occupancy during TVWS pilot.

Experiment: Channel occupancy decision

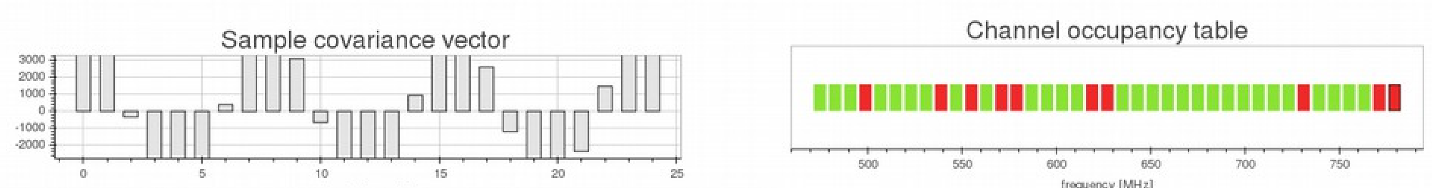
In this application, the sensor decides whether an 8 MHz UHF channel is occupied by an existing radio transmission, like a wireless microphone, or is vacant for secondary use. To make the sensor resistant to noise level changes, a covariance-based detector is used. Radio continuously sweeps available channels, calculates a test statistic based on the sample covariance vector and provides an up-to-date channel occupancy table.

weak signals cannot be reliably detected based on RSSI alone

$$\gamma = \frac{\max_{l=1}^{L-1} |\sigma_l|}{|\sigma_0|}$$



dot marks currently tuned channel



$$\sigma_l = \frac{1}{N_s} \sum_{n=0}^{N_s-1} x_n \cdot x_{n-l} \qquad l \in [0, L-1]$$

$$\mathcal{H}_0 \quad \text{if} \quad \gamma(\mathbf{x}) \le \gamma_0$$
$$\mathcal{H}_1 \quad \text{if} \quad \gamma(\mathbf{x}) > \gamma_0$$

iMinds, imec, ctvr, TU Berlin, Technische Universität Dresden, THALES, AIRBUS, IJS, Durham University, Technische Universität Ilmenau, tecnalia, University of Thessaly, NICTA, cnit, WINGS ICT Solutions, instituto de telecomunicações, CMSF Sistemas de Informação

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 258301.

PROJECT DATA
Start Date: 01/09/2010; Duration: 60 M
EU Funding: 4.885 M€

Contact:
Ingrid Moerman, iMinds, Belgium
Email: ingrid.moerman@intec.ugent.be
Web: http://www.crew-project.eu