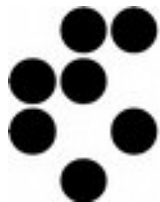


Next version of UHF band receiver for VESNA

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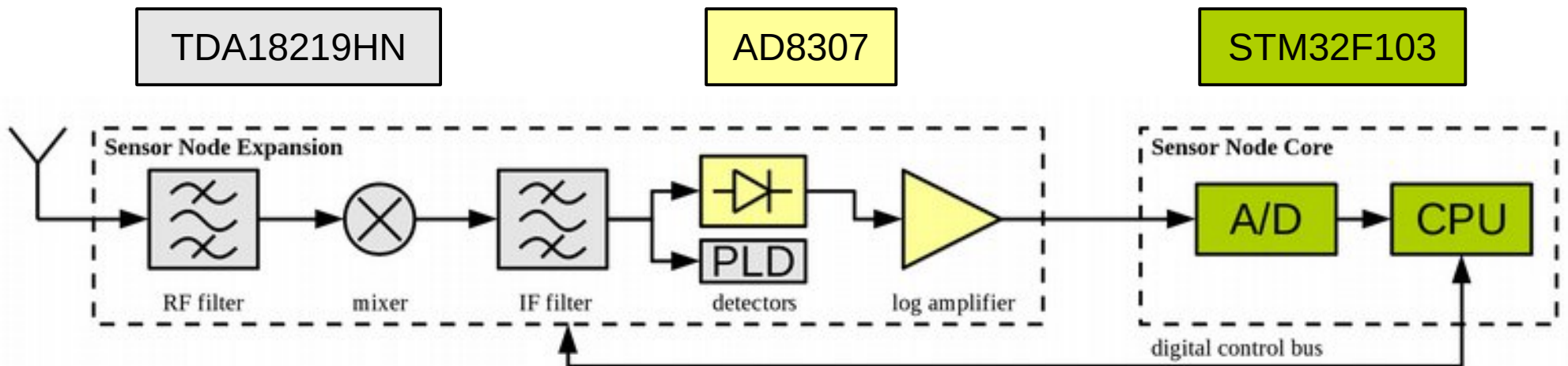
Department of Communication Systems
Jožef Stefan Institute



Story so far

Existing design

- UHF receiver for energy detection (radiometer)
- Designed in early 2011 around TDA18219HN tuner
 - central frequency 470 – 862 MHz
 - measures incident power in 1.7 or 8 MHz channel
 - 50 ms per channel sampling



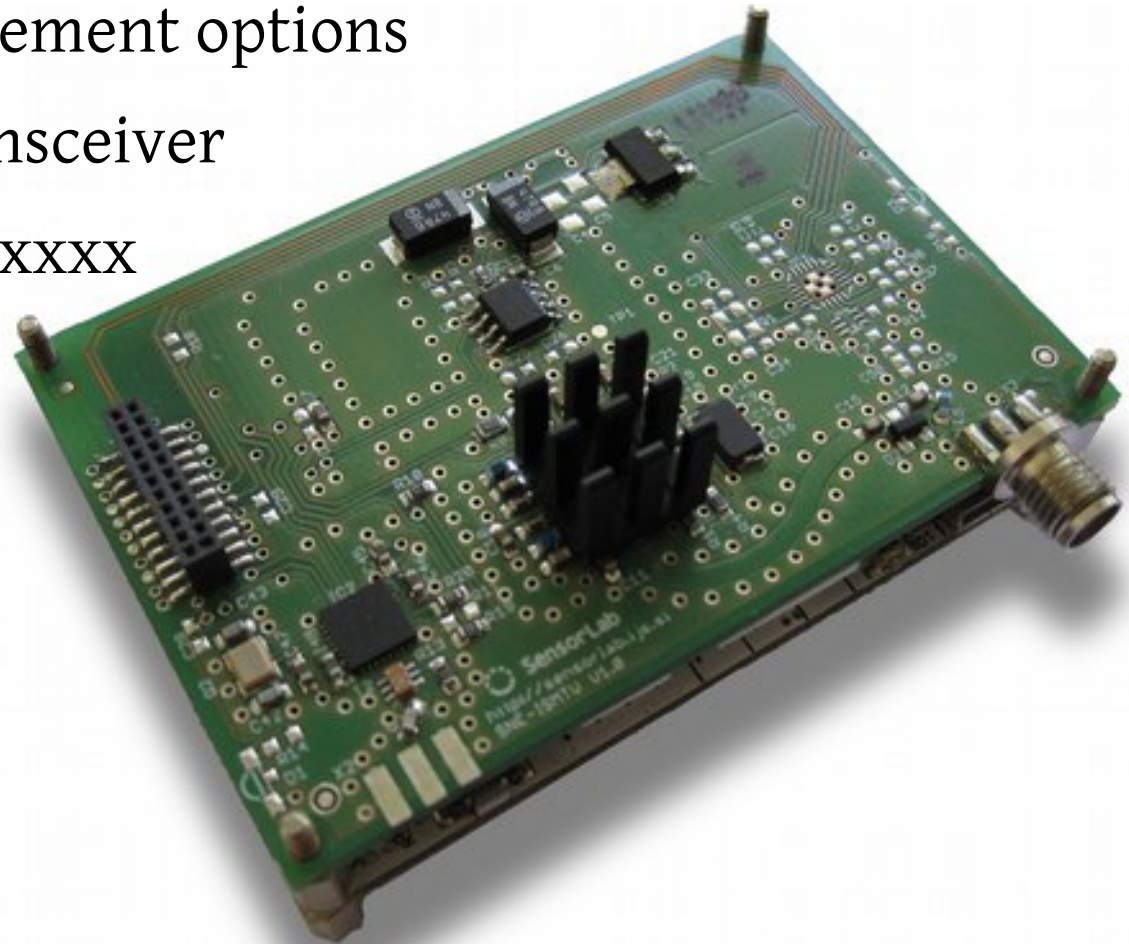
SNE-CREWTV

- Proof-of-concept board
 - designed because no TDA18219HN evaluation board was available
 - 3 prototypes manufactured
- Evaluation of noise on SNC 3.3V line due to SMPS
 - power line artifacts 36 dB above noise floor
 - added a separate linear power supply for the receiver



SNE-ISMTV-UHF

- First version of hardware for Logatec
 - deployed in June 2012
 - flexible PCB with 6 placement options
 - added IEEE 802.15.4 transceiver
 - added options for TI CCxxxx series transceivers
- Predicted heating problems in summer
 - added passive cooling for TDA18219HN



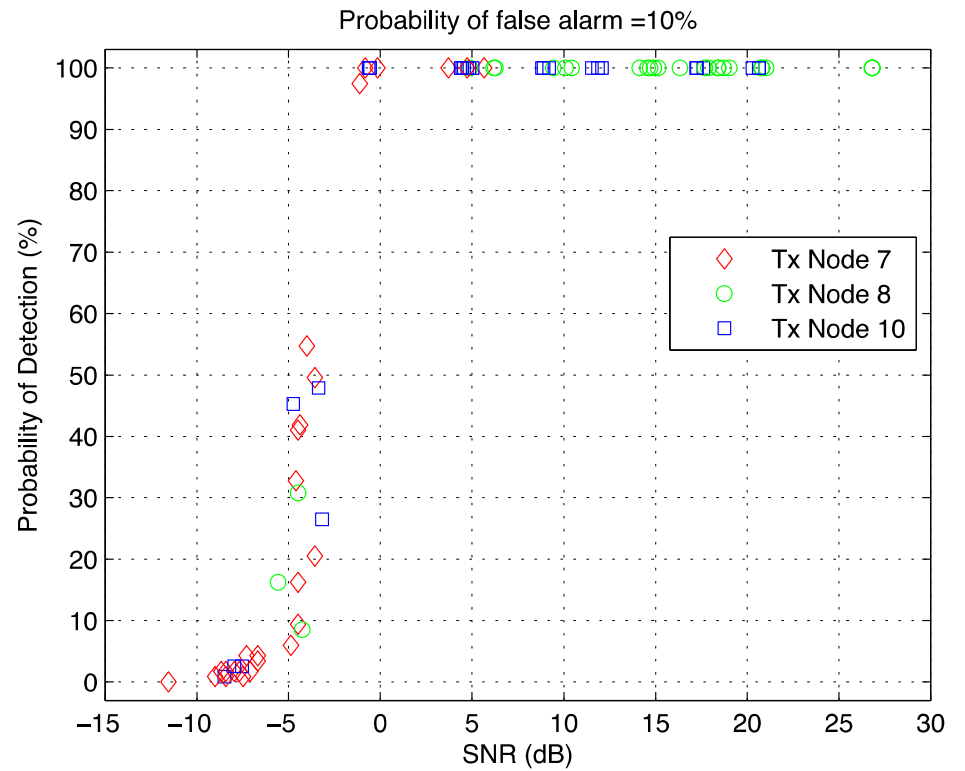
Practical uses

- 8 permanently deployed in Logatec
 - distributed sensing in CREWTV project with Instituto de Telecomunicações
 - wireless microphone detection at $\text{SNR} = -2 \text{ dB}$, $P_d = 90\%$
(Dionísio, Ribeiro, Marques: CREW project deliverable D7.4.2)
- Improvised car-mounted device
 - combined with GPS tracking
 - CREW measurements for evaluation of propagation models for TVWS and transmitter localization
(Moerman, et al.: CREW project deliverable D6.3)

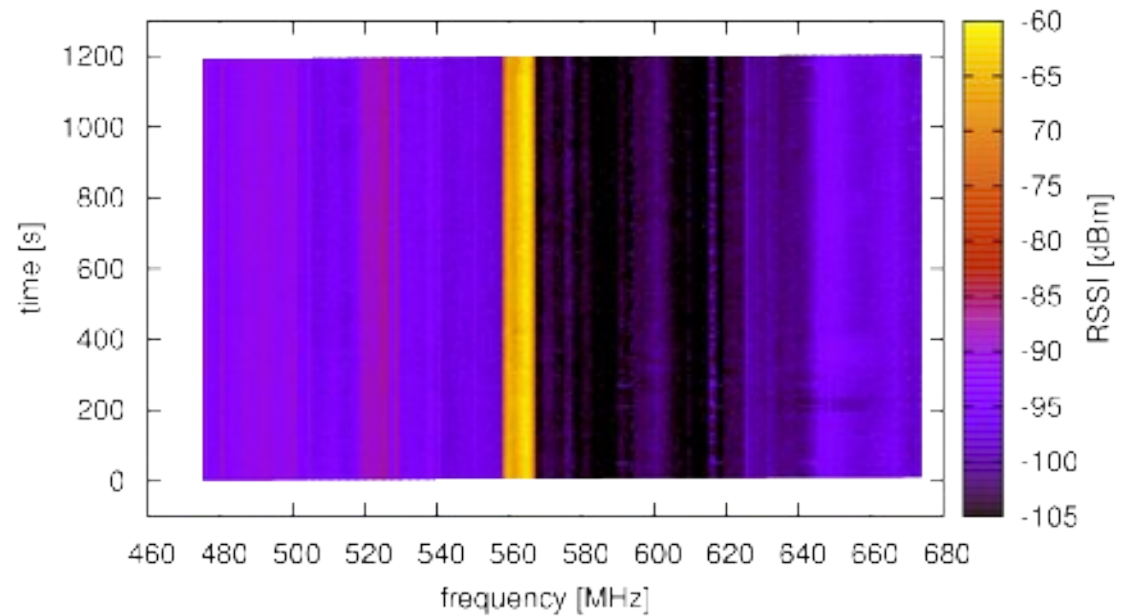


Wireless microphone
detection in CREWTV
experiment

Detection of
DVB-T multiplex



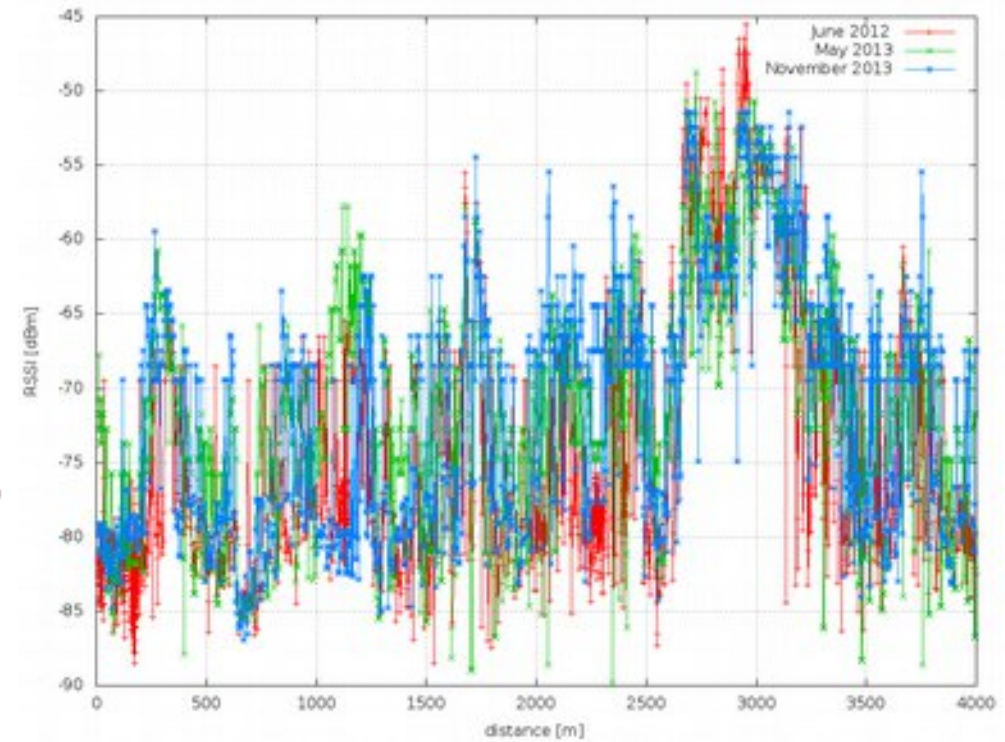
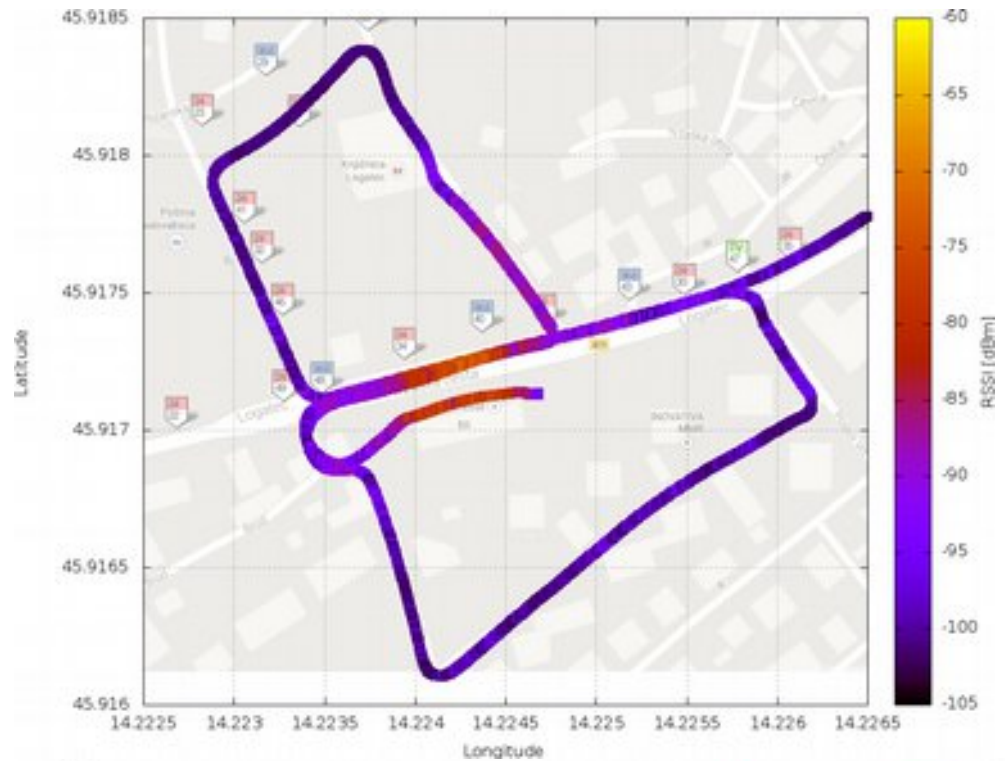
VESNA spectrum sensor, Slovenian DVB-T multiplex A at 562 MHz



Attempt at transmitter localization



DVB-T signal strength measurements



Motivation for redesign

- Experiments with advanced spectrum sensing methods
 - all require access to signal phase as well as magnitude
- Higher frequency resolution for energy detection
 - wireless microphones occupy ~200 kHz of spectrum, compared to 1700 kHz narrowest TDA18219HN channel setting.
- Practical problems
 - SNE-ISMTV antenna connector blocks micro-USB on SNC
 - EMI noise from SNC, SNR
- CSMA-MAC implementations
 - e.g. *Puschmann, et al.: Experimental-driven Optimization of Timing Parameters of Contention-based MAC Protocols*

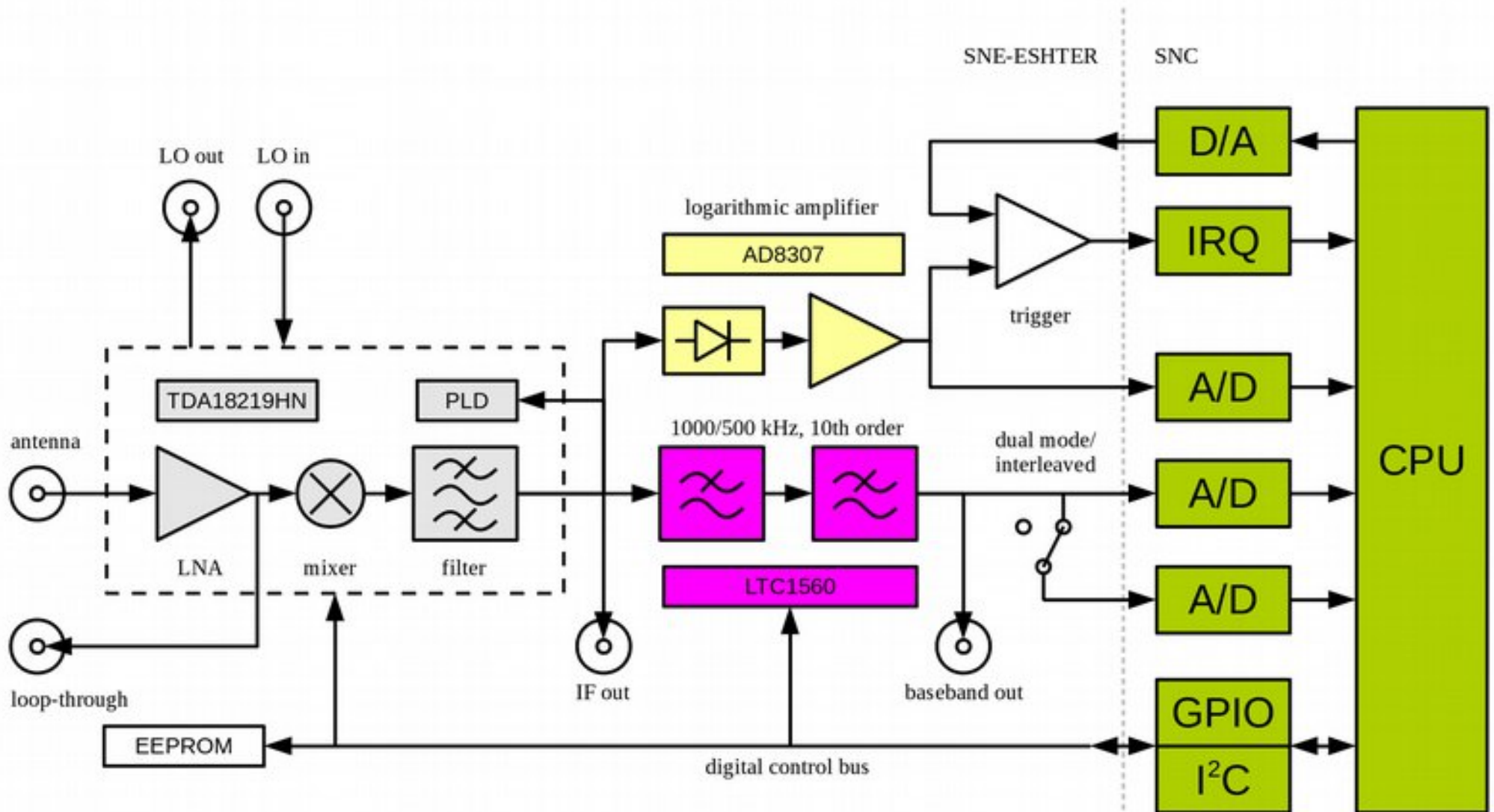
Going beyond energy detection

- Covariance Absolute Value detector
 - needs statistical processing of I/Q signal samples
 - found best for PMSE detection by COGEU project (D4.2)
- Eigenvalue detector
 - e.g. Zeng, Liang: *Eigenvalue-Based Spectrum Sensing Algorithms for Cognitive Radio*
- Information-theoretic detection
 - needs multiple coherent signal paths
 - e.g. Wang, Tao: *Blind Spectrum Sensing by Information Theoretic Criteria for Cognitive Radios*
- Compressive sensing
 - “compressing frequency domain data on VESNA does not bring any advantage with respect to our motivation”
 - *CREW project year 3 review, WP6 - experimentation results for all internal test cases, presentation notes*

SNE-ESHTER

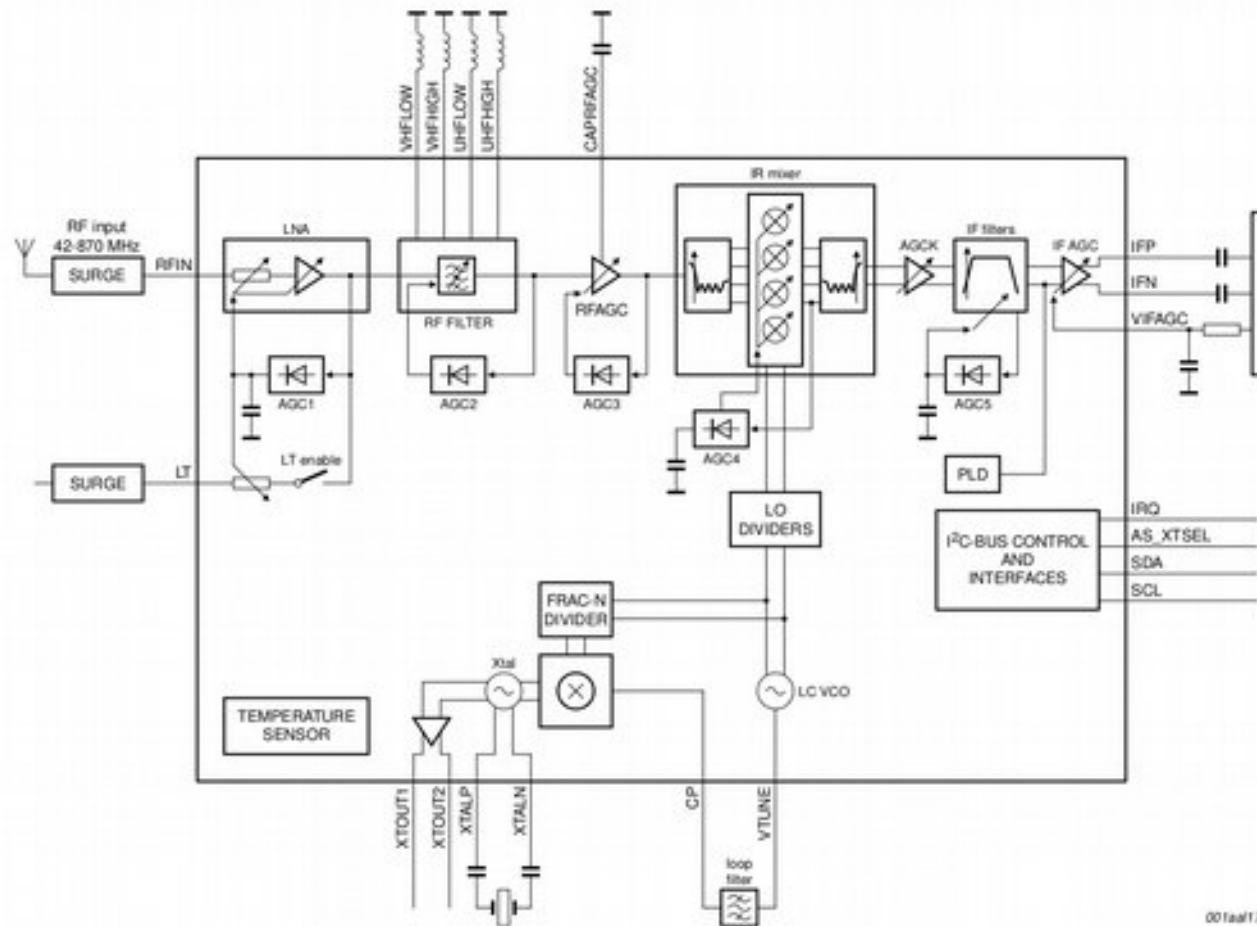
Embedded Sensing Hardware for
TVWS Experimental Radio

Block diagram



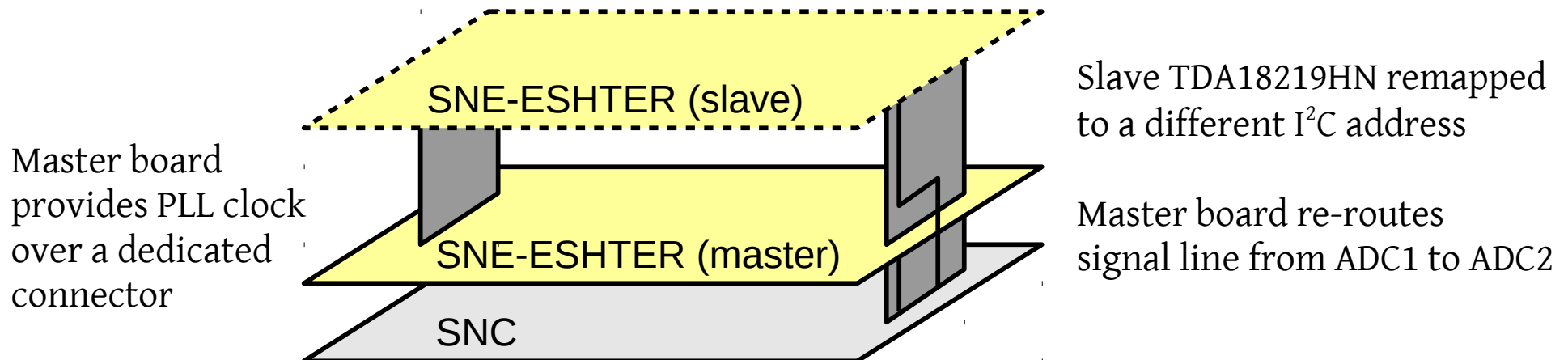
What stays the same

- Energy detection capability stays unmodified
- Same TDA18219HN RF front-end



What is new, 1

- Add selectable 1000/500 kHz 10th order elliptic filter
 - additional channel filtering after TDA18219HN for narrow band detection
 - signal at 2 Msamples/s using ADC1+ADC2 in dual-interleaved mode
(http://www.tablix.org/~avian/blog/archives/2013/10/interleaved_adc_mode_on_stm32f1/)
- Possibility of two coherent signal chains
 - each chain at 1 Msamples/s using ADC1+ADC2 in dual-simultaneous mode
 - stacking two SNE-ESHTER boards on top of each other



What is new, 2

- Trigger subsystem
 - run ADC conversion on selectable energy detector threshold
 - improved timing for CSMA-MAC protocols
- More debugging options
 - LEDs, connectors on signal pipe-line
- Better EMI design
 - metal shielding around critical components
- Remove IEEE 802.15.4/CCxxxx transceiver options
 - not enough pins on the SNE connector
- I²C EEPROM for identification, calibration tables

TDA18219HN problems

- AGC not under software control
 - “shadowing” limits how fast we can sweep the LO frequency
- Signal distortion with 1.7 MHz channel filter
 - something wrong with AGC?
- Restrictive licensing of reference implementation

3.10 Licensee shall not perform any actions with regard to the Licensed Software in a manner that would require the Licensed Software or any derivative work thereof to be licensed under Open License Terms.
- Supply problems
 - no European supplier, uncommon film-type inductors

When?

- Hardware – almost done
 - circuit design finished, still need to do PCB layout
 - make and evaluate a prototype in March-April 2014
- Software – “it's done when it's done”
 - drivers need to be extended with new functionality
 - it would be nice to support subset WINNF transceiver API or some other standard interface
- Might catch Ofcom TVWS trials
 - last update said start in March and run until December.

Questions?

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