Mounting spectrum sensing VESNAs in London

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Introduction

• In January I visited dr. Oliver Holland of Centre for Telecommunications Research, King's College London.
  • Installed and tested 2 SNE-ESHTER spectrum sensors at two locations in London.
  • Attempted some experiments with Carlson Rural Connect WRAN devices.

• This was part of involvement of the CREW project in the Ofcom TVWS pilot.
  • previously IT Portugal (CREW OC2 partner) also did some DVB-T signal measurements.
About King’s College London

- One of the top 25 universities in the world (Times Higher Education 2008)
- Fourth oldest in England
- 19,700 students from more than 150 countries
- 5,400 employees
- In the top group of UK universities for research earnings overall annual income of approximately £450 million.
About the sensors
Setup

- **Antenna (RX only)**: *Super Scan Stick mk 1*
  - Min Ø2.5 cm
  - Max Ø5.1 cm

- **Spectrum sensor**: 15 x 12 x 6 cm  
  *Hammond 1590UF*

- **5 m Coax Cable**

- **170 cm Low Voltage Cable (12V)**

- **External AC Power Supply (Preferred)**
  - 110 – 240 V
  - 47 – 63 Hz
  - 0.5 A max (typ. ~5 W)
  - Flat Euro plug

- **IP Network with Internet Connectivity**

- **Preferably Dry Place**

- **UTP Cable (Ethernet)**
Hardware
Infrastructure

log-a-tec.eu

tcp connections

sensor¹

vesna_multiplex²

vesna_log¹

plotter⁴

monitor

munin³

browser

¹ https://github.com/sensorlab/vesna-spectrum-sensor
² https://github.com/sensorlab/vesna-multiplex
³ http://bokeh.pydata.org
⁴ http://munin-monitoring.org/
Currently collected data

\[ f_c = 470 \ldots 790 \text{ MHz (in 1 MHz steps)} \]
\[ f_{\text{sample}} = 2 \text{ MHz} \]
\[ \text{BW} = 1 \text{ MHz} \]

N = 25000 samples

**cca. 300 ms per 1 MHz step**
(tuning + sampling + covariance calculation + sending data over Internet)

**frequency channel**
\( (f_c = 40 \text{ MHz} + n \times 1 \text{ kHz}) \)

**sensor timestamp**

**server timestamp**

**25 elements of the sample covariance matrix**

TS 1421943705.955069 0.001000 CH 550000 DS 102.0 -12.0 -18.0 -10.0 0.0 -5.0 ... 0.0 DE
Live web demo

Installation
Location

- London Zoo
- Queen Mary University, London
- King's College London, Strand Campus
- London West End
- Crystal Palace
Sensor at KCL
Sensor at KCL

Antenna for SNE-ESHTER
Sensor at KCL

Another spectrum sensor (Wavecom?)

Antenna for SNE-ESHTER
Sensor at KCL
Sensor at KCL

Crystal Palace DVB-T transmitter in line of sight cca. 10 km away
Sensor at KCL
Sensor at KCL
Sensor at KCL
Sensor at KCL
Sensor at QMUL

Antenna for SNE-ESHTER
Sensor at QMUL

Antenna for SNE-ESHTER

Another spectrum sensor (JRC?)
Sensor at QMUL
Sensor at QMUL
Sensor at QMUL
Sensor at QMUL
Sensor at QMUL
Sensor at QMUL
Sensor at QMUL

Weather radar
(defunct probably)
First results
KCL, first measurement
KCL, comparing with R&S FSV
QMUL, first measurement
NOTE: Different location (King’s College London Guys Campus hospital tower), antenna and equipment.

From: “Some Initial Results and Observations from a Series of Trials within the Ofcom TV White Spaces Pilot”
The TV White Spaces opportunity

What does the TV band occupancy look like at a random location in the UK?

Several channels available at EIRP levels that are usable and do not cause interference to DTT.
Tests with Carlson devices
Overview

- Tried to establish an IP link over TVWS using Carlson Rural Connect devices.
  - Base station on the roof of the KCL Strand Campus.
  - CPE on floor lower.
- Run some tests on the link
- See if the link can be detected with the VESNA spectrum sensor on the roof
  - wasn't done because of lack of time.
Framework for access to TVWS in the UK

- List of qualifying WSDBs
- TVWS availability maps for protection of DTT
- Details of PMSE assignments
- Interference management tools

White space Database

TV band

Master device (licence exempt)

Slave device (licence exempt)

(Subject to Ofcom’s contractual arrangements)
Carlson Wireless Ruralconnect

- [http://www.carlsonwireless.com/ruralconnect](http://www.carlsonwireless.com/ruralconnect)

- Built for US market, but adapted to operate under Ofcom/ETSI rules in terms of database (and database of databases) communication, channelization, etc. Variable powers and frequency range currently not adapted

- Our trial will use at least 2 base stations and 5 terminals (perhaps different sets at different times)

- Deployment scenarios include the public protection and disaster relief cases

- Also broadband provisioning cases, and to test longer-distance point-to-point links
Base station
**Base station**

![Base station interface](image)

### Table: Base station information

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<th>Online</th>
<th>Channel</th>
<th>Enabled</th>
<th>Registered</th>
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<th>UL SnR</th>
<th>DL rate</th>
<th>UL rate</th>
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</table>

*Guid: a070271e-6c97-4dff-bd79-7f2a7cafa3a1*

*Id: 8628963*

*Bandwidth: Eight MHz*

*Tx Freq: 522 MHz*

*Tx Frames: 30107*

*Uptime: 0 days, 1 hour, 18 minutes*

*Thu Jan 22 2015 15:45:24 GMT+0000 (GMT Standard Time)*

*Base station Tx: Enabled*
CPE
iperf doesn't work over TVWS...
Conclusions...

- Deployed SNE-ESHTER sensors work...
  - low noise floor compared to R&S FSV,
  - ~2 weeks of data already collected from sensor at KCL
- but...
  - Sensor at QMUL still hasn't called home
    (will hopefully get network access in March)
  - Sensor at KCL already required a hard reset after
    log-a-tec.eu server rebooted (not sure why)
- Apparently there are still problems with TVWS
  geolocation databases.
Questions?

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