

Mounting spectrum sensing VESNAs in London

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Introduction

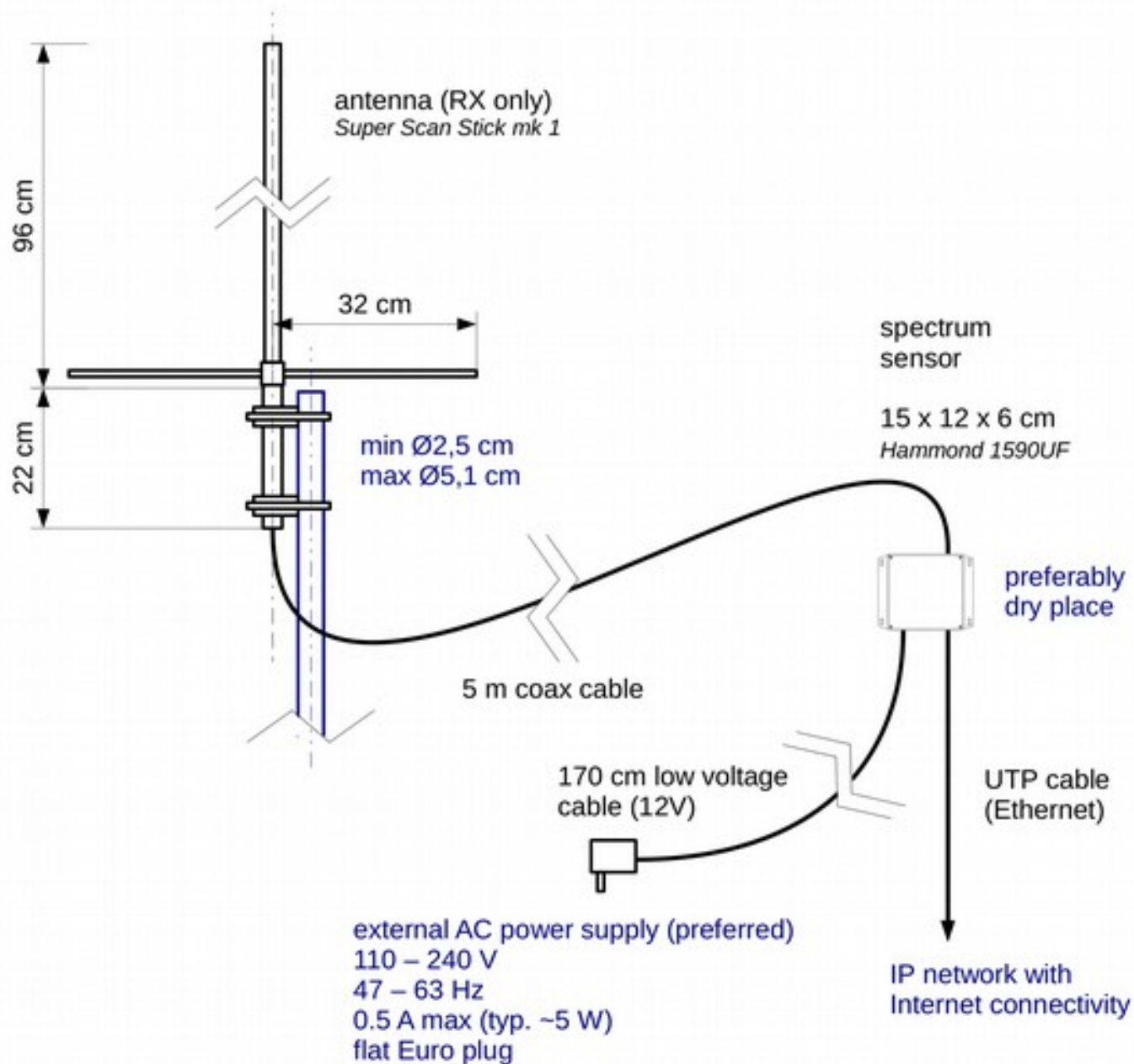
- In January I visited **dr. Oliver Holland** of Centre for Telecommunications Research, King's College London.
 - Installed and tested **2 SNE-ESHTER spectrum sensors** at two locations in London.
 - Attempted some experiments with **Carlson Rural Connect** WRAN devices.
- This was part of involvement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

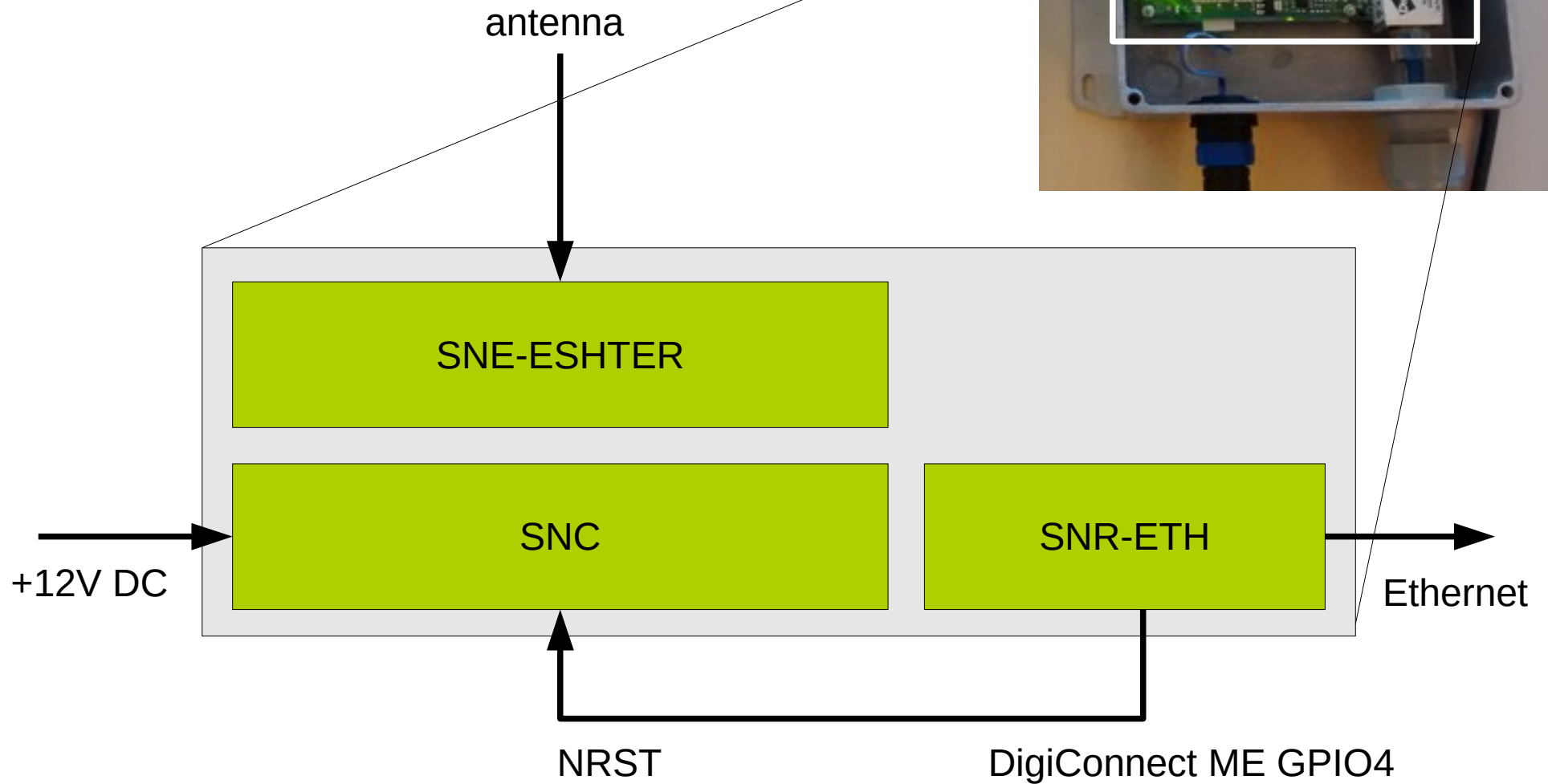
Setup



Hardware



Hardware





Digi Connect ME Configuration and Management

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Configuration

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System Information

General

GPIO

General Purpose I/O (GPIO) pins can be asserted or de-asserted if they are configured as output.

	Asserted	De-asserted
Pin 1:	<input checked="" type="radio"/>	<input type="radio"/>
Pin 2:	<input checked="" type="radio"/>	<input type="radio"/>
Pin 3:	<input checked="" type="radio"/>	<input type="radio"/>
Pin 4:	<input type="radio"/>	<input checked="" type="radio"/>
Pin 5:	<input checked="" type="radio"/>	<input type="radio"/>

Set Pins

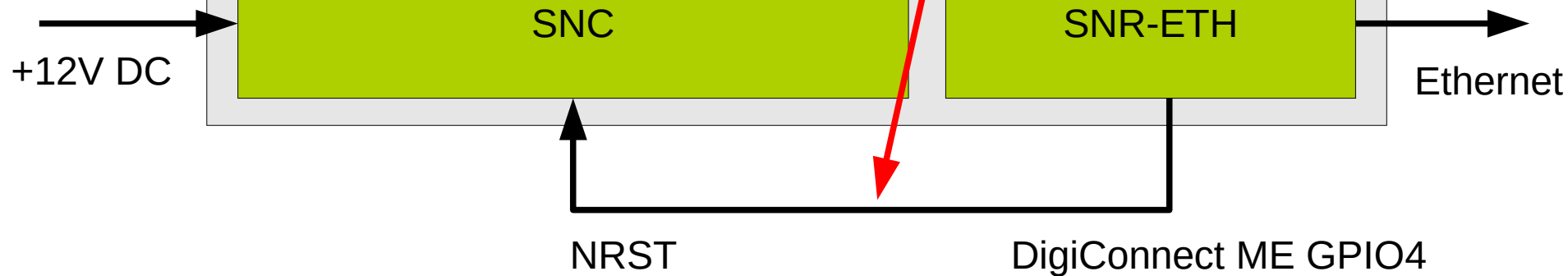
Refresh

Serial

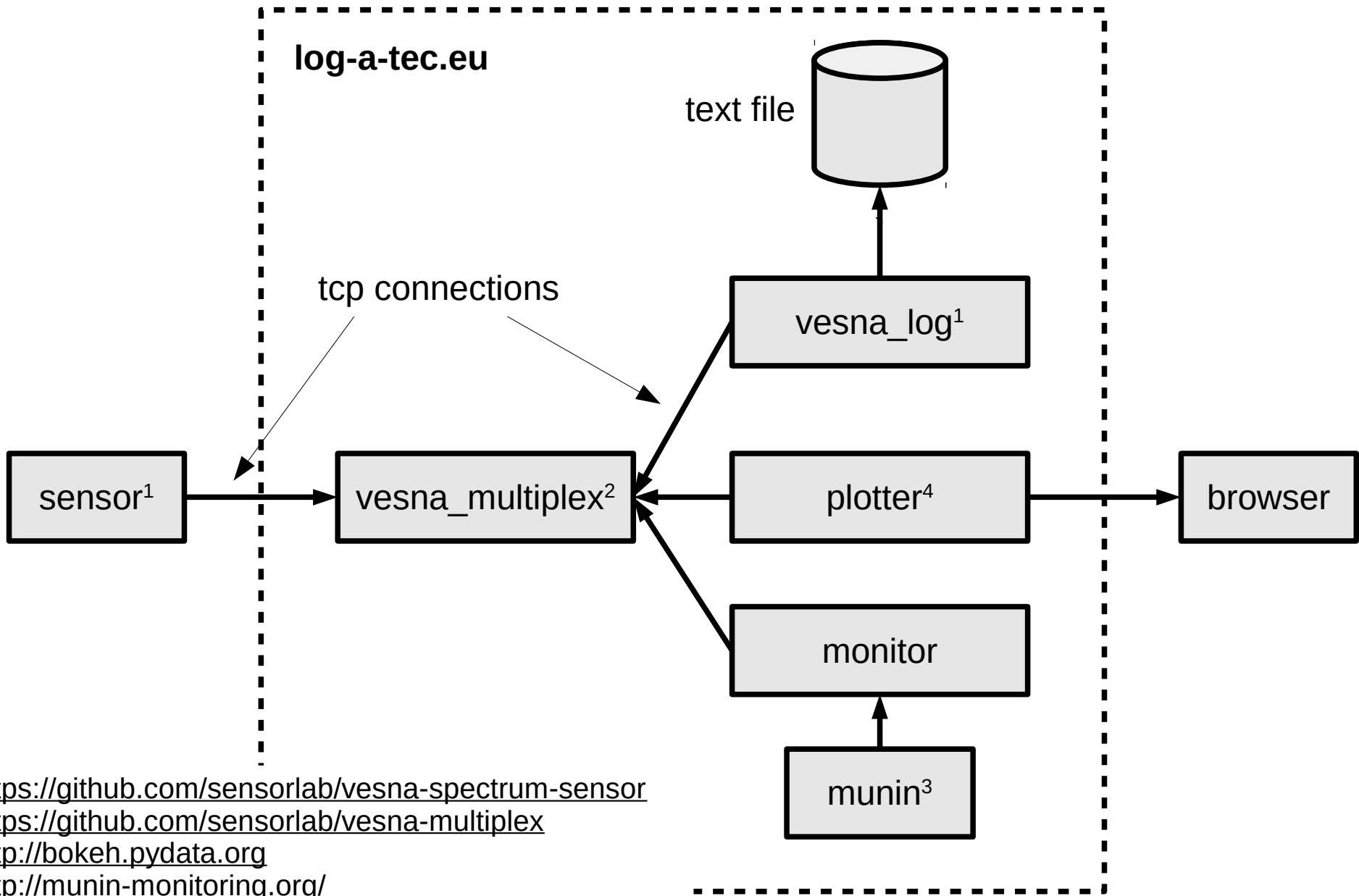
Network

Diagnostics

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www.digi.com



Infrastructure



Currently collected data

$f_c = 470 \dots 790$ MHz (in 1 MHz steps)

$f_{\text{sample}} = 2$ MHz

BW = 1 MHz

N = 25000 samples

cca. 300 ms per 1 MHz step

(tuning + sampling + covariance calculation +
sending data over Internet)

25 elements of the sample
covariance matrix

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

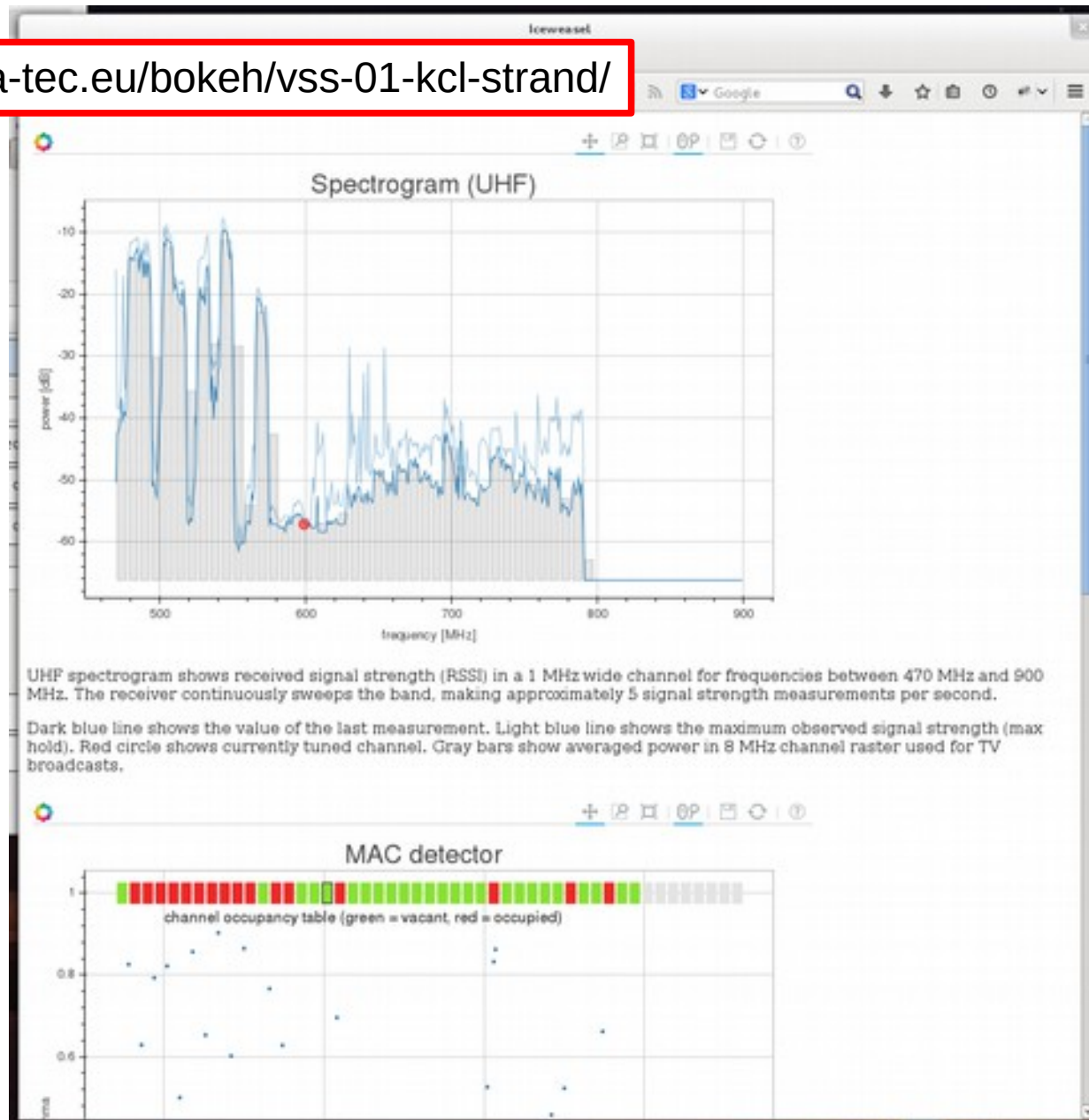
sensor timestamp

server timestamp

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

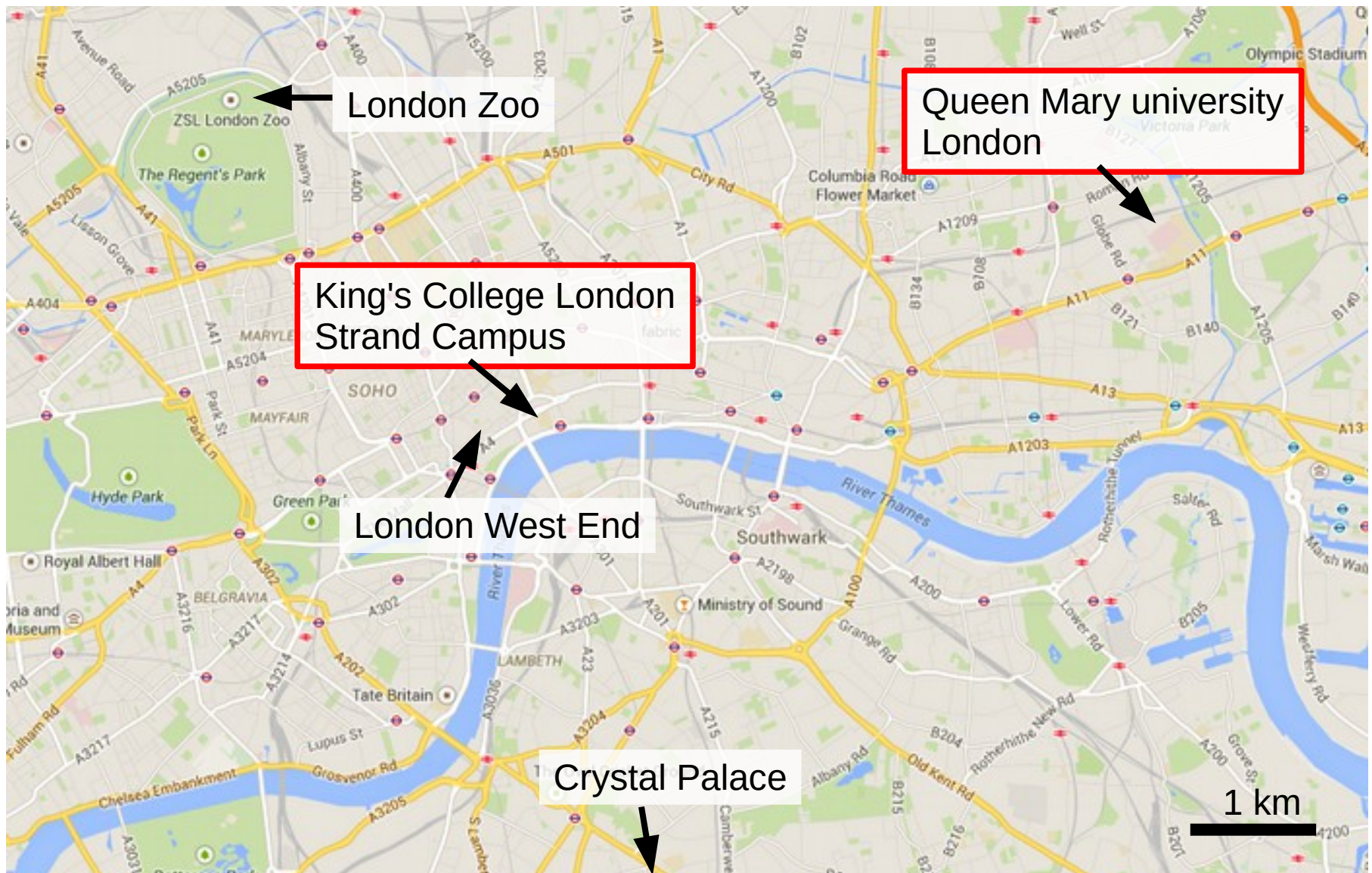
Live web demo

<http://log-a-tec.eu/bokeh/vss-01-kcl-strand/>



Installation

Location



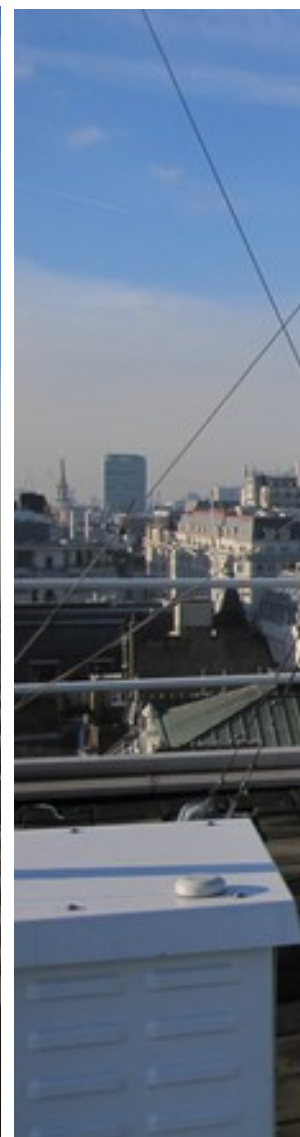
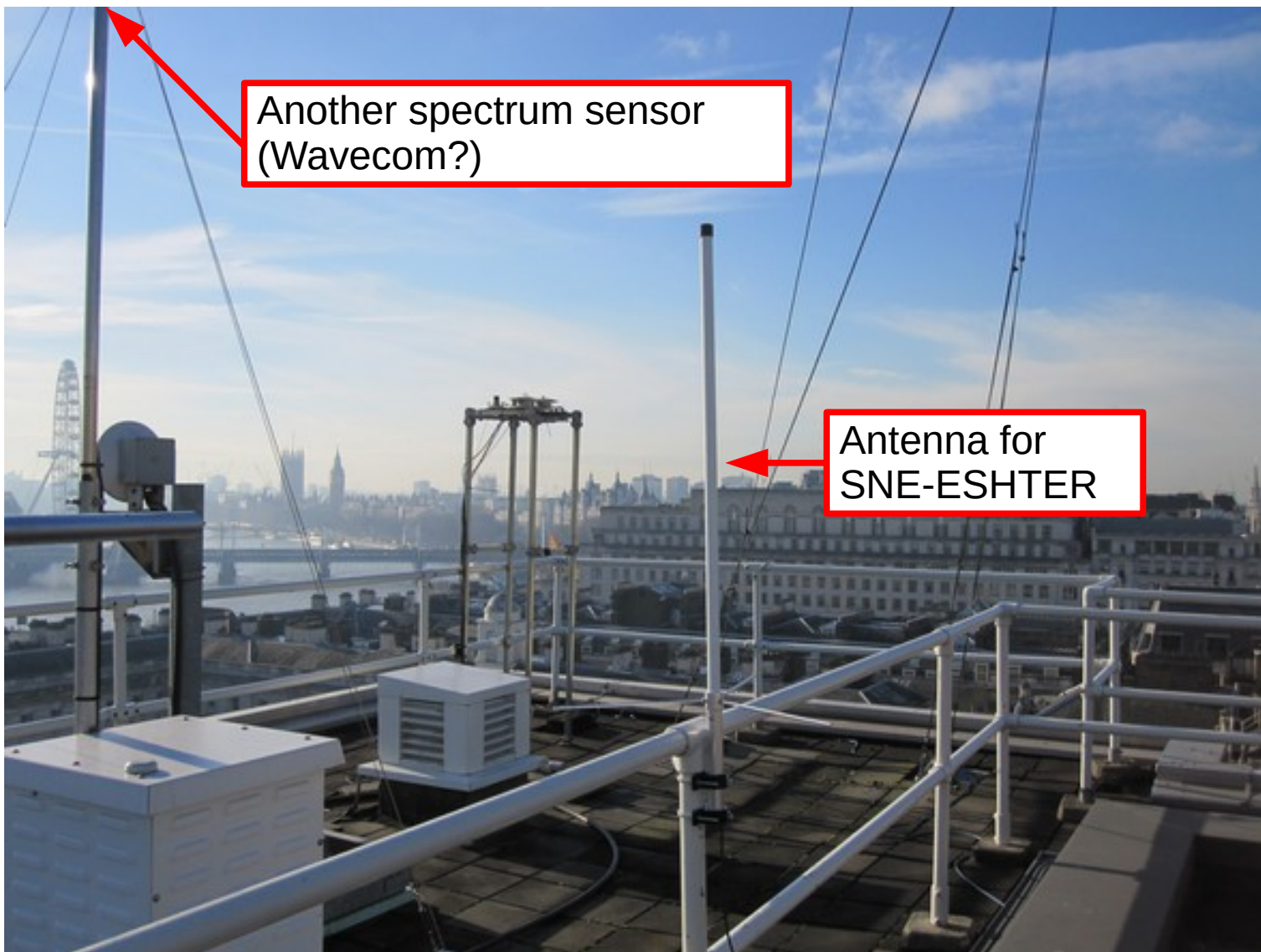
Sensor at KCL



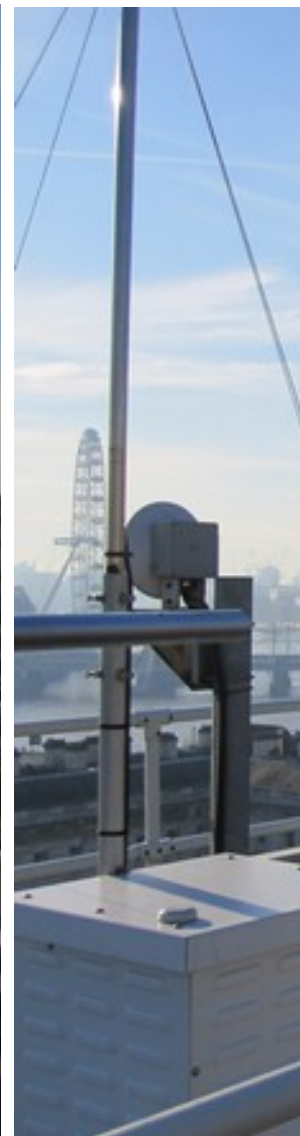
Sensor at KCL



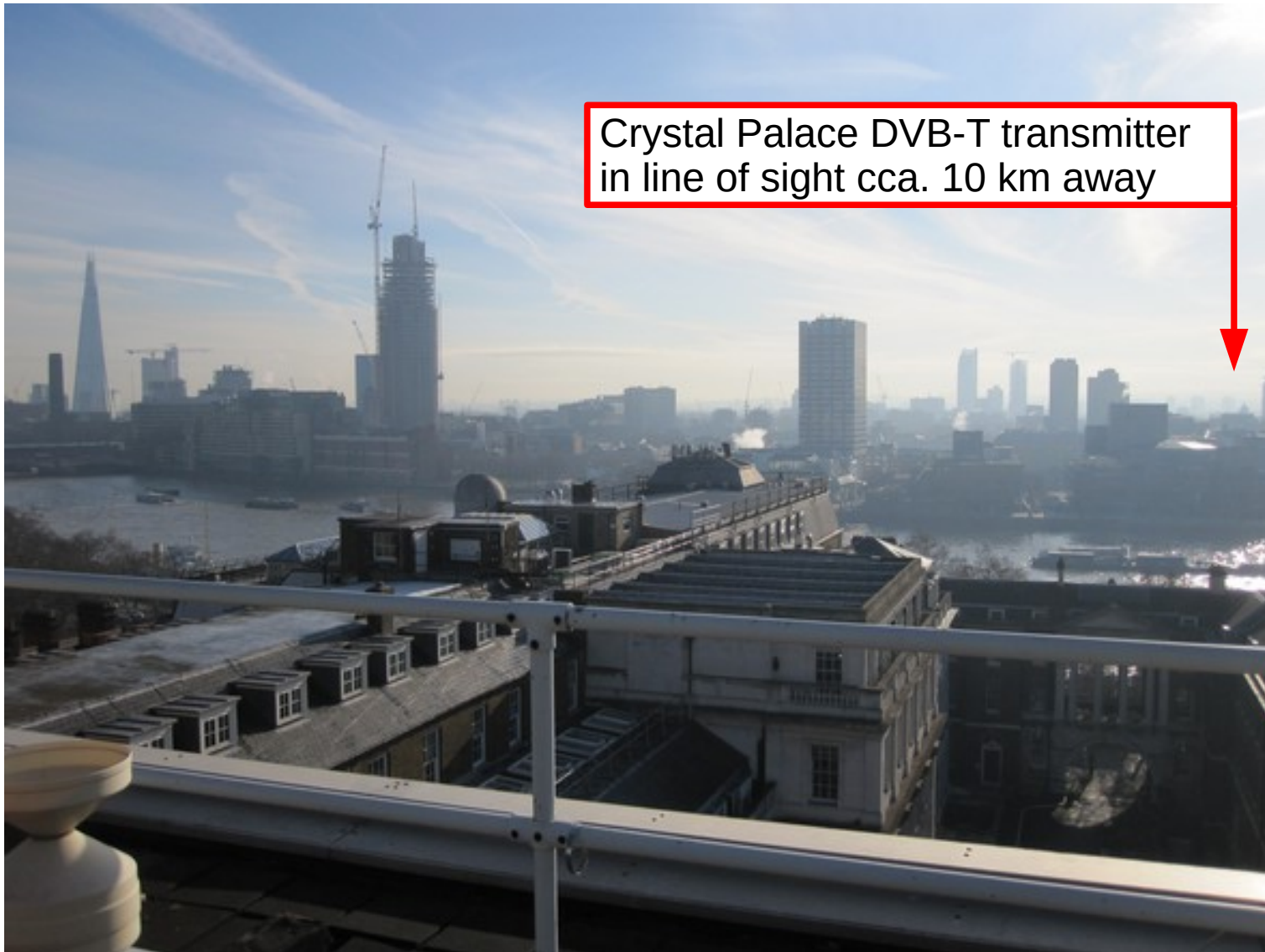
Sensor at KCL



Sensor at KCL



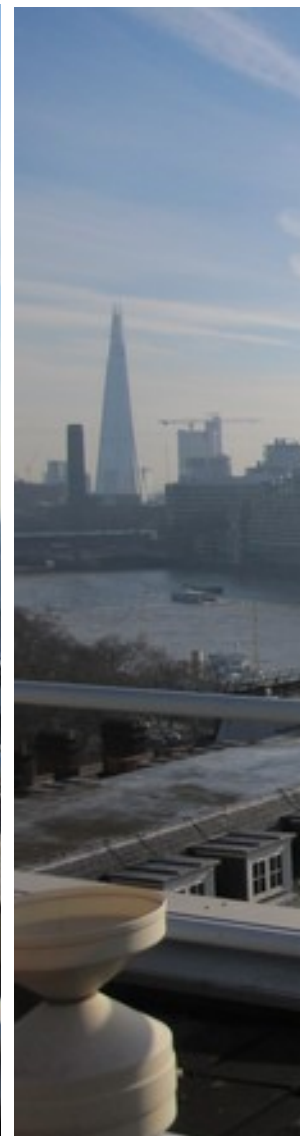
Sensor at KCL



Crystal Palace DVB-T transmitter
in line of sight cca. 10 km away



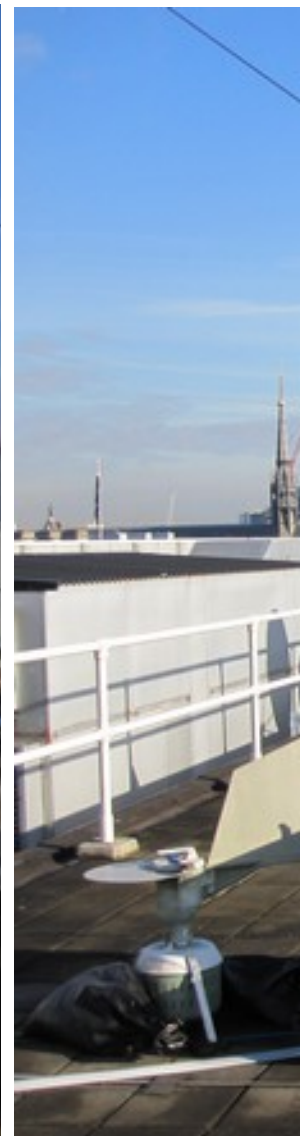
Sensor at KCL



Sensor at KCL



Sensor at KCL



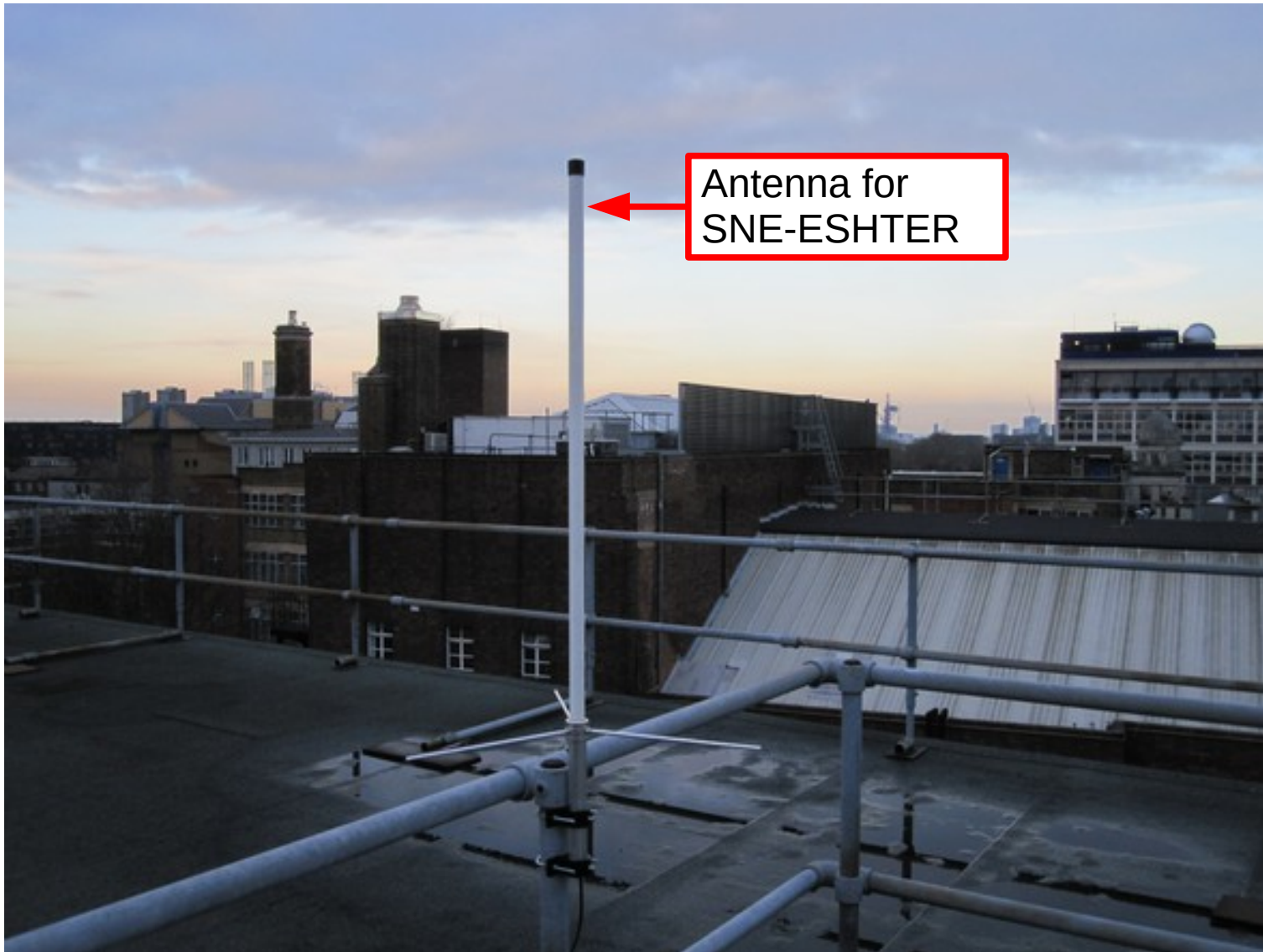
Sensor at KCL



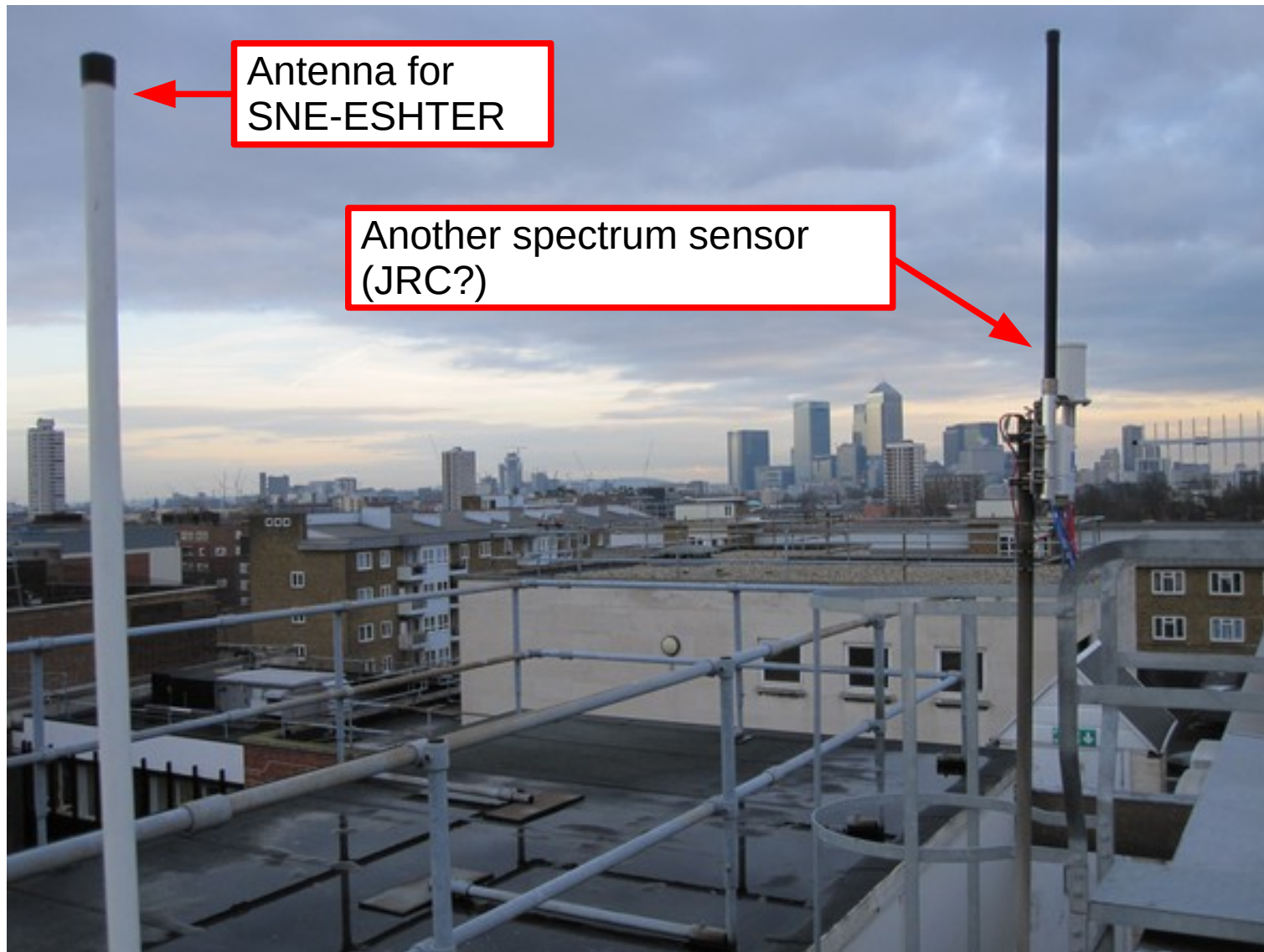
Sensor at QMUL



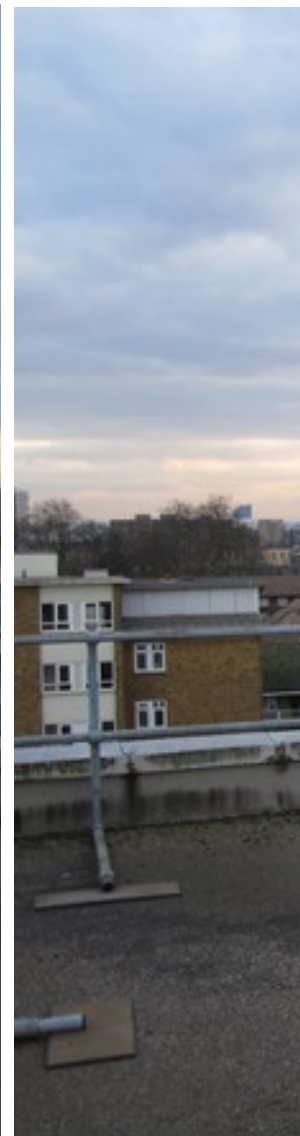
Sensor at QMUL



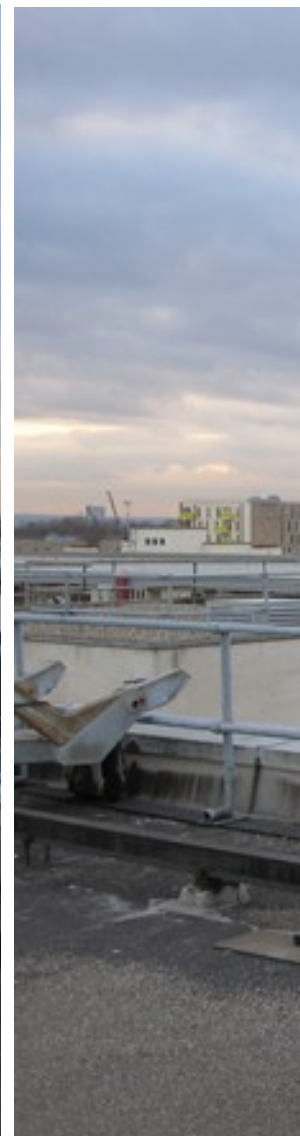
Sensor at QMUL



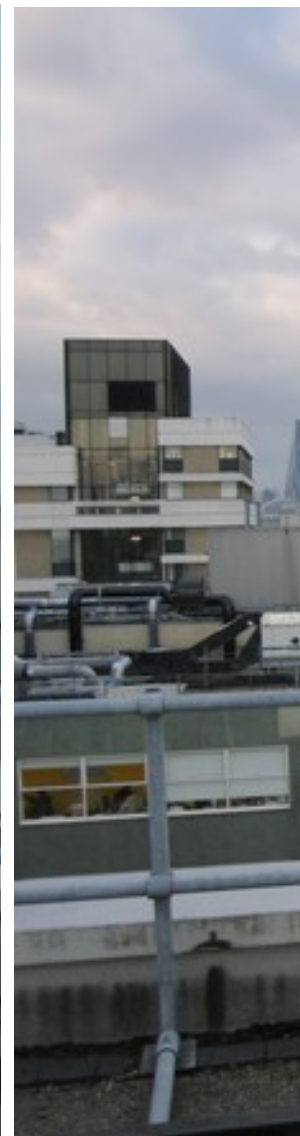
Sensor at QMUL



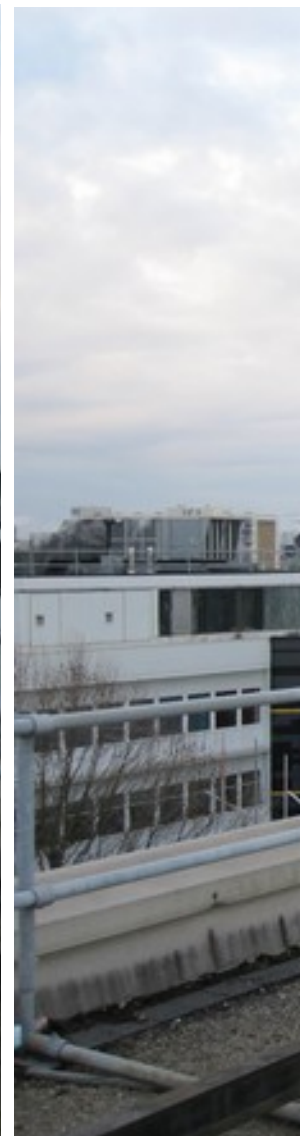
Sensor at QMUL



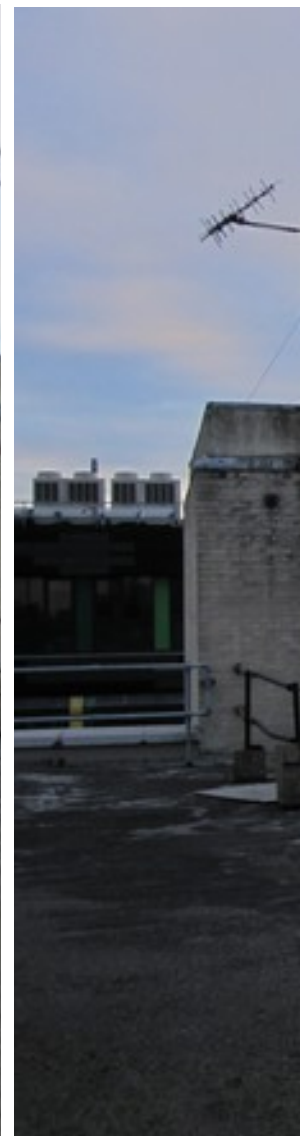
Sensor at QMUL



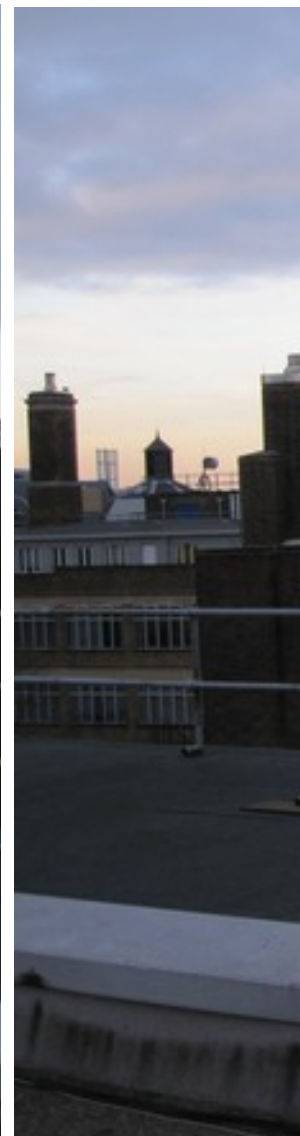
Sensor at QMUL



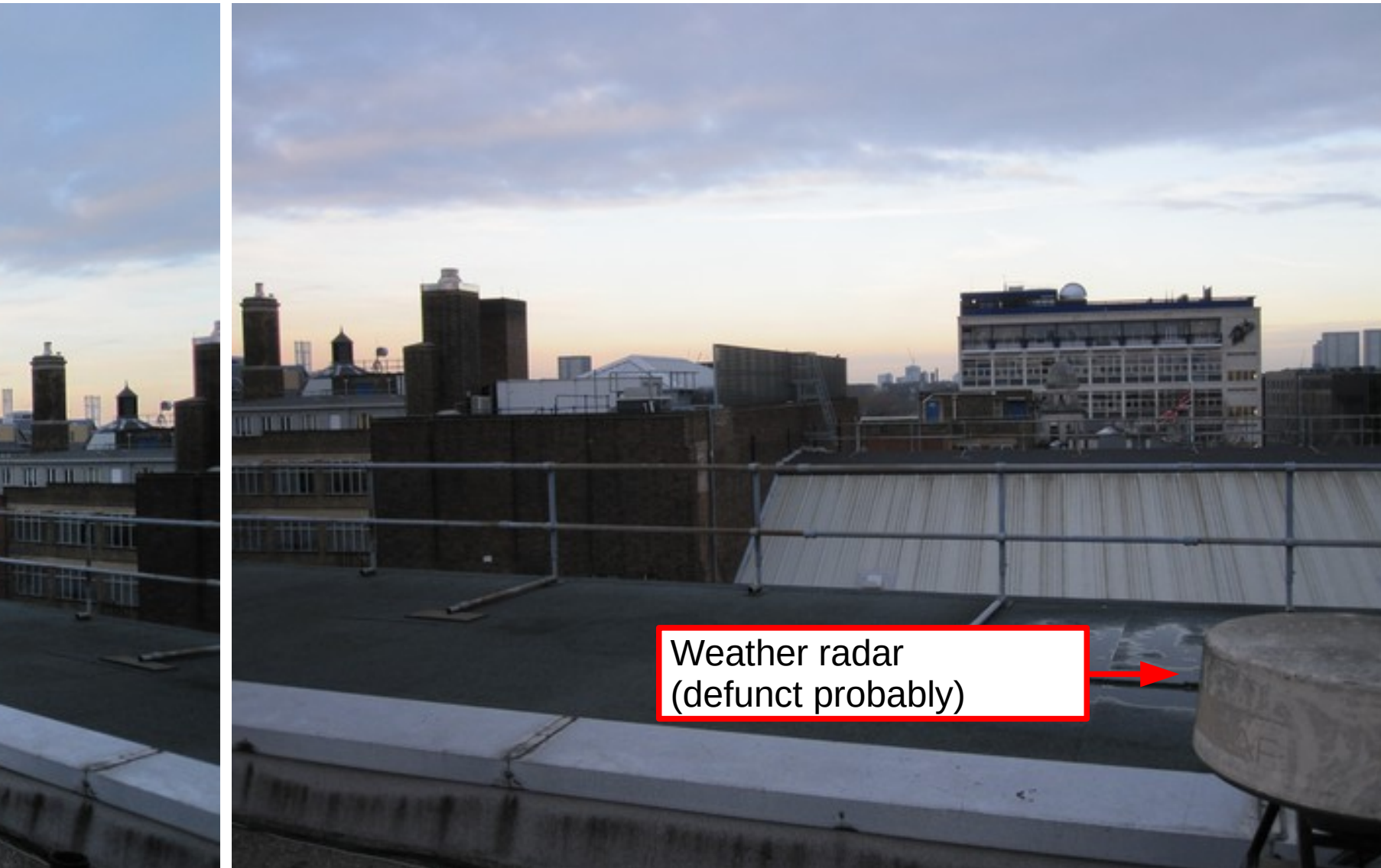
Sensor at QMUL



Sensor at QMUL

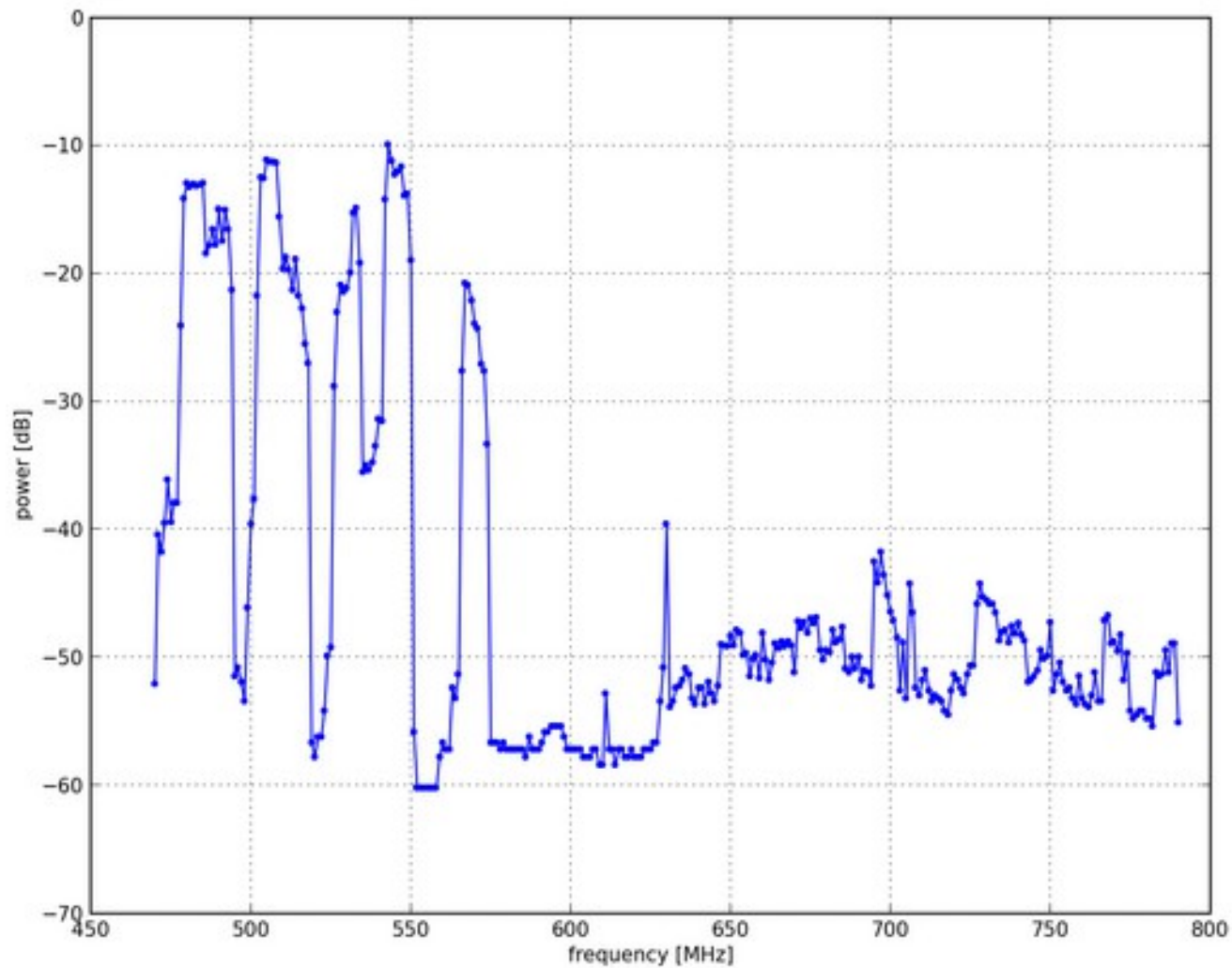


Sensor at QMUL

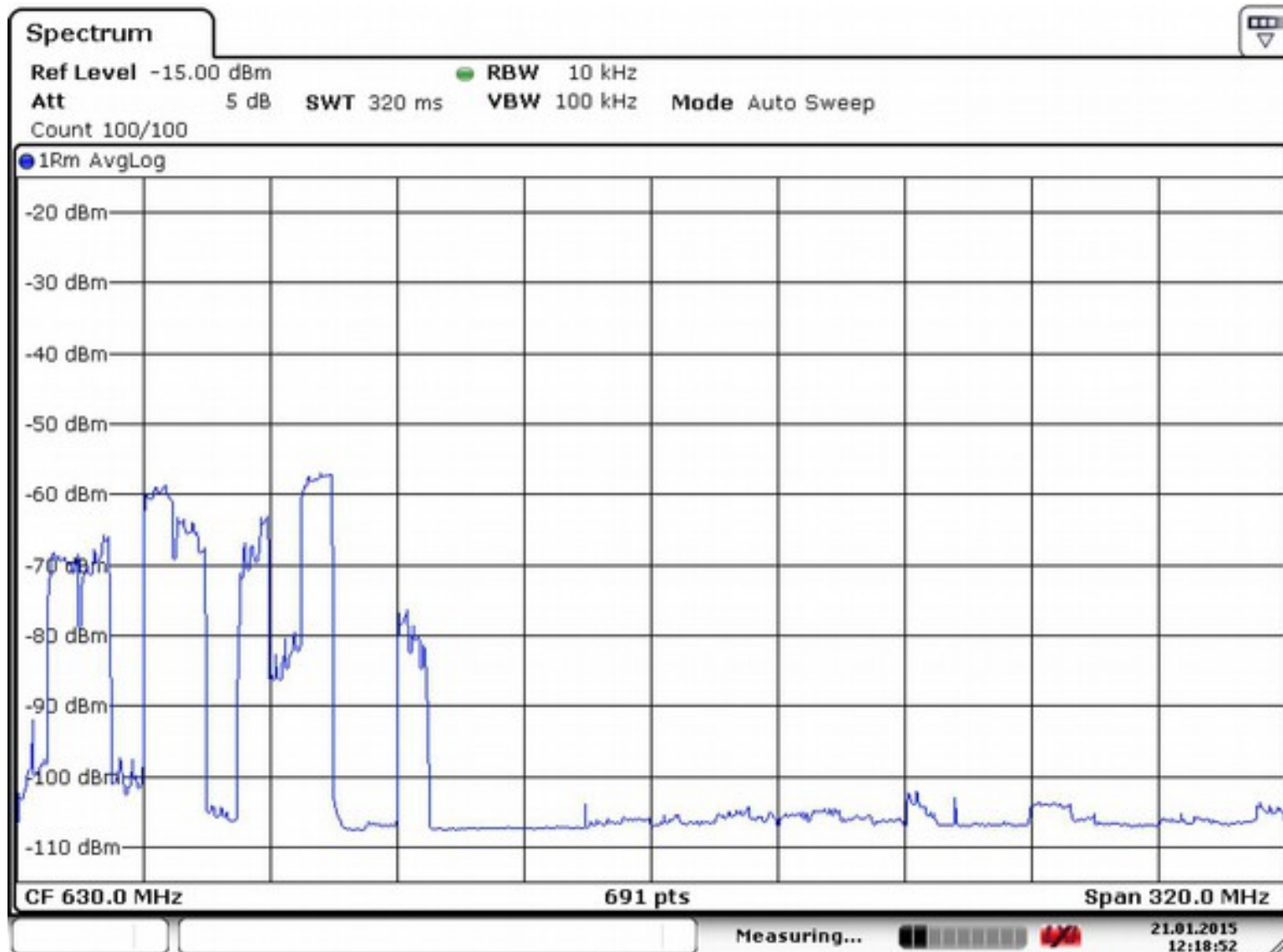


First results

KCL, first measurement

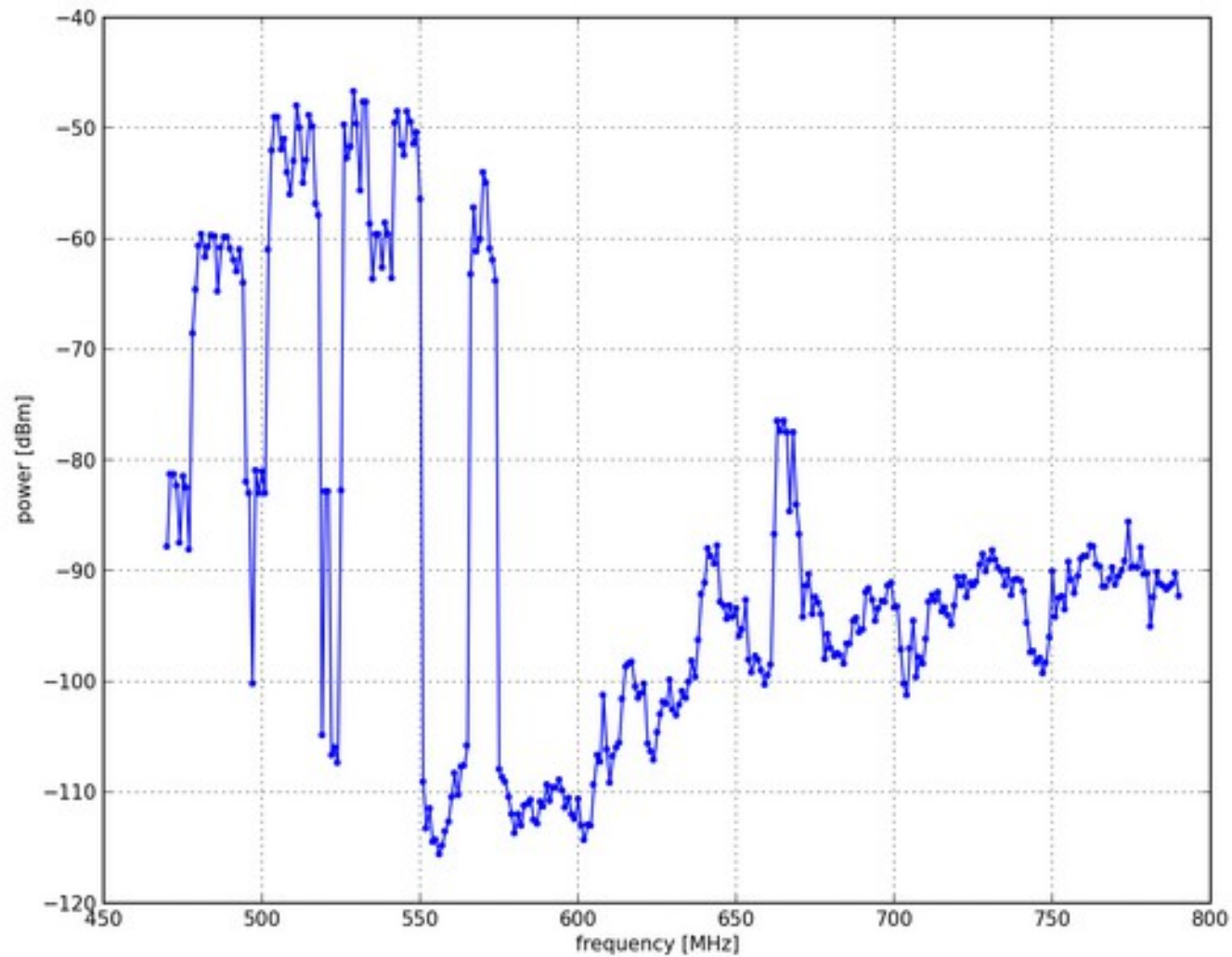


KCL, comparing with R&S FSV

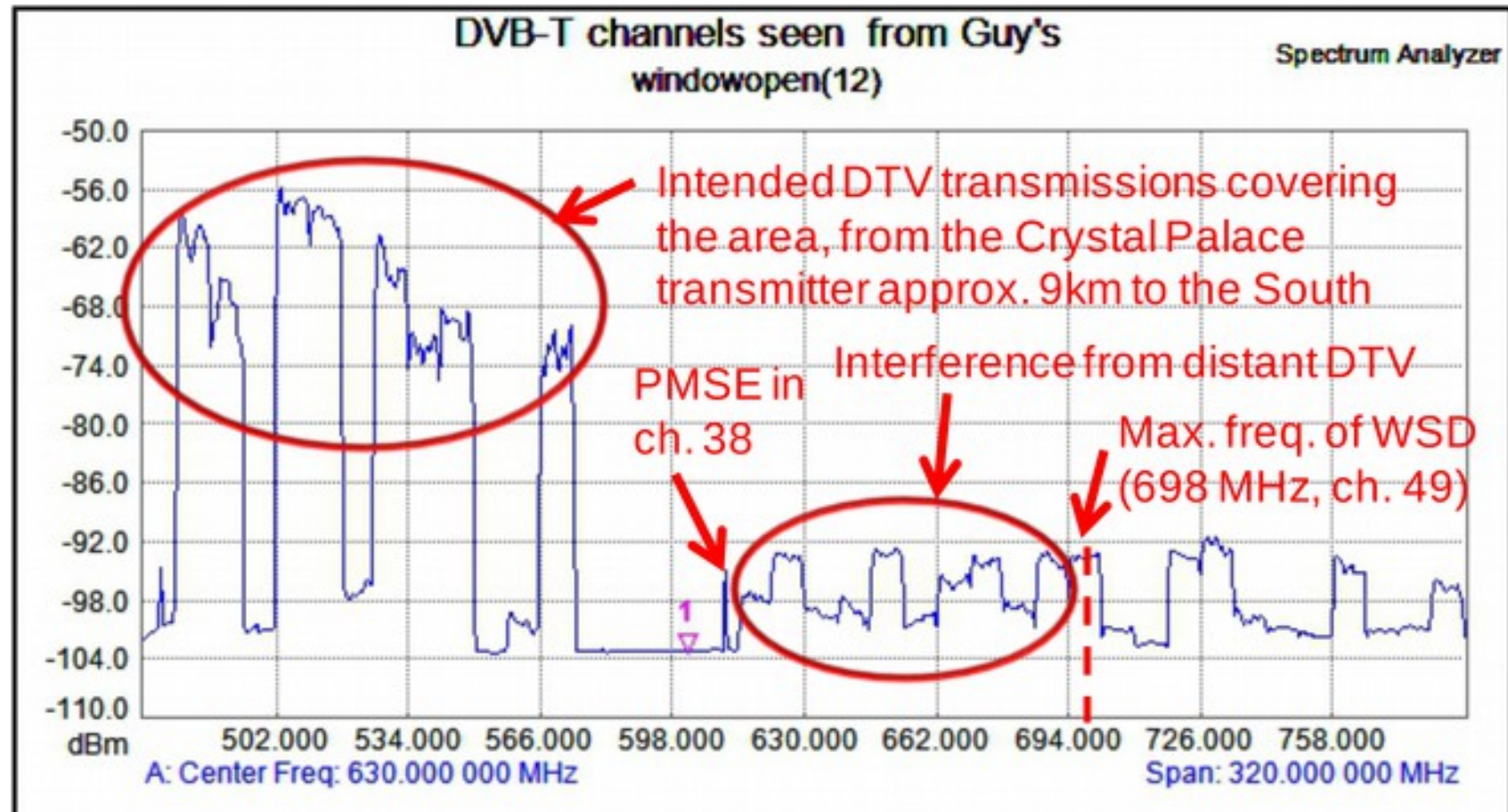


Date: 21.JAN.2015 12:18:52

QMUL, first measurement



Compare with...



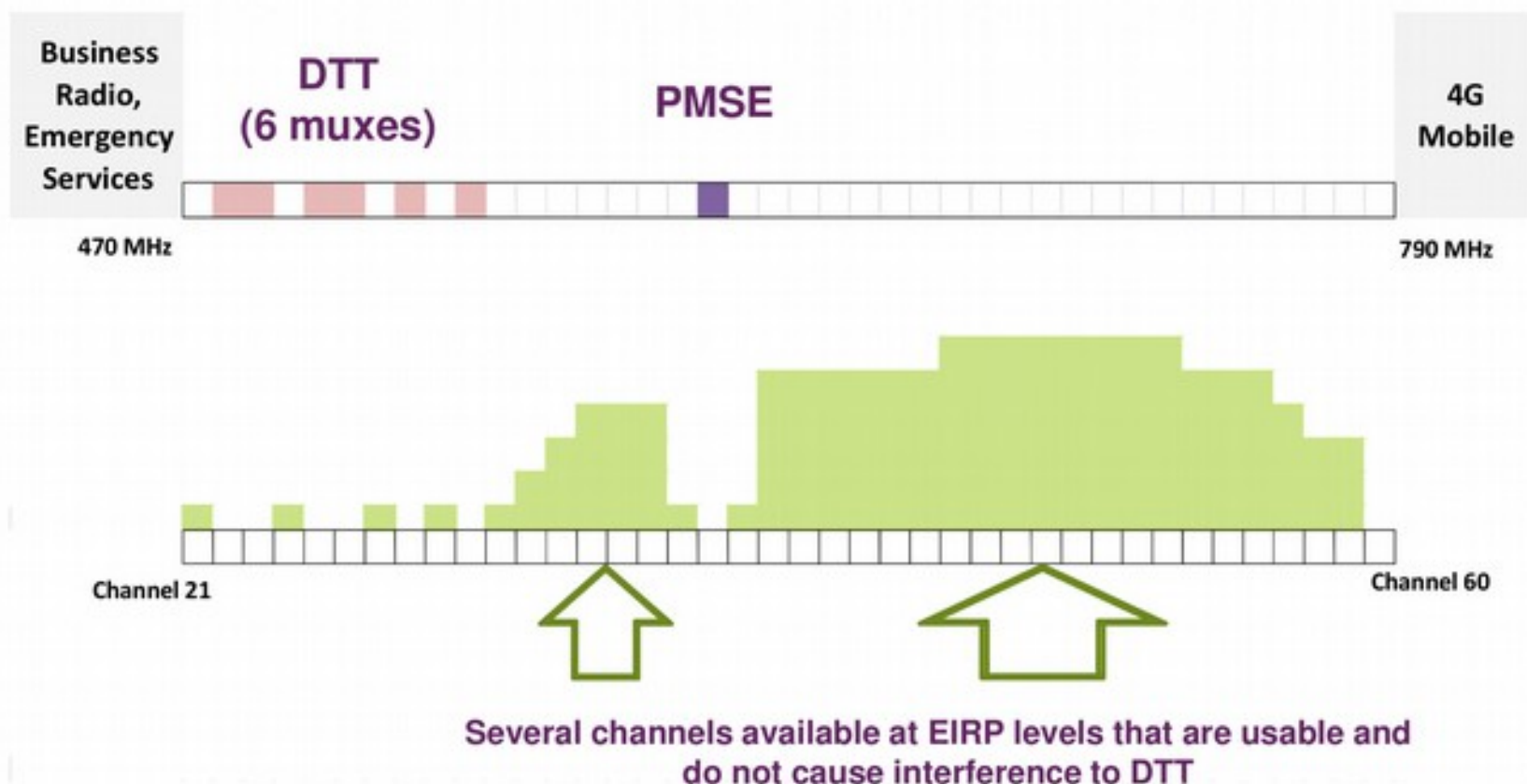
NOTE: Different location (King's College London Guys Campus hospital tower), antenna and equipment.

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?

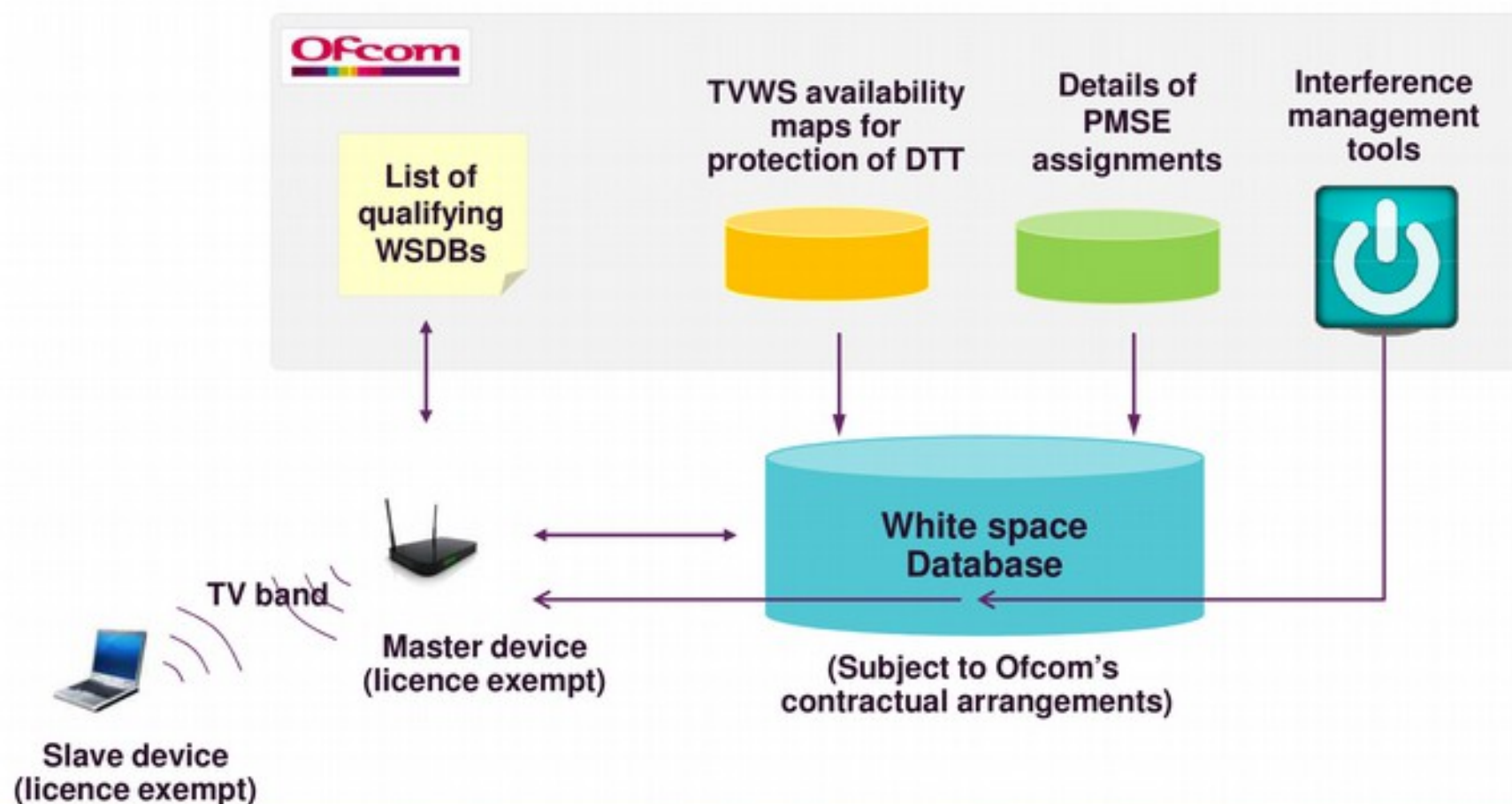


Tests with Carlson devices

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



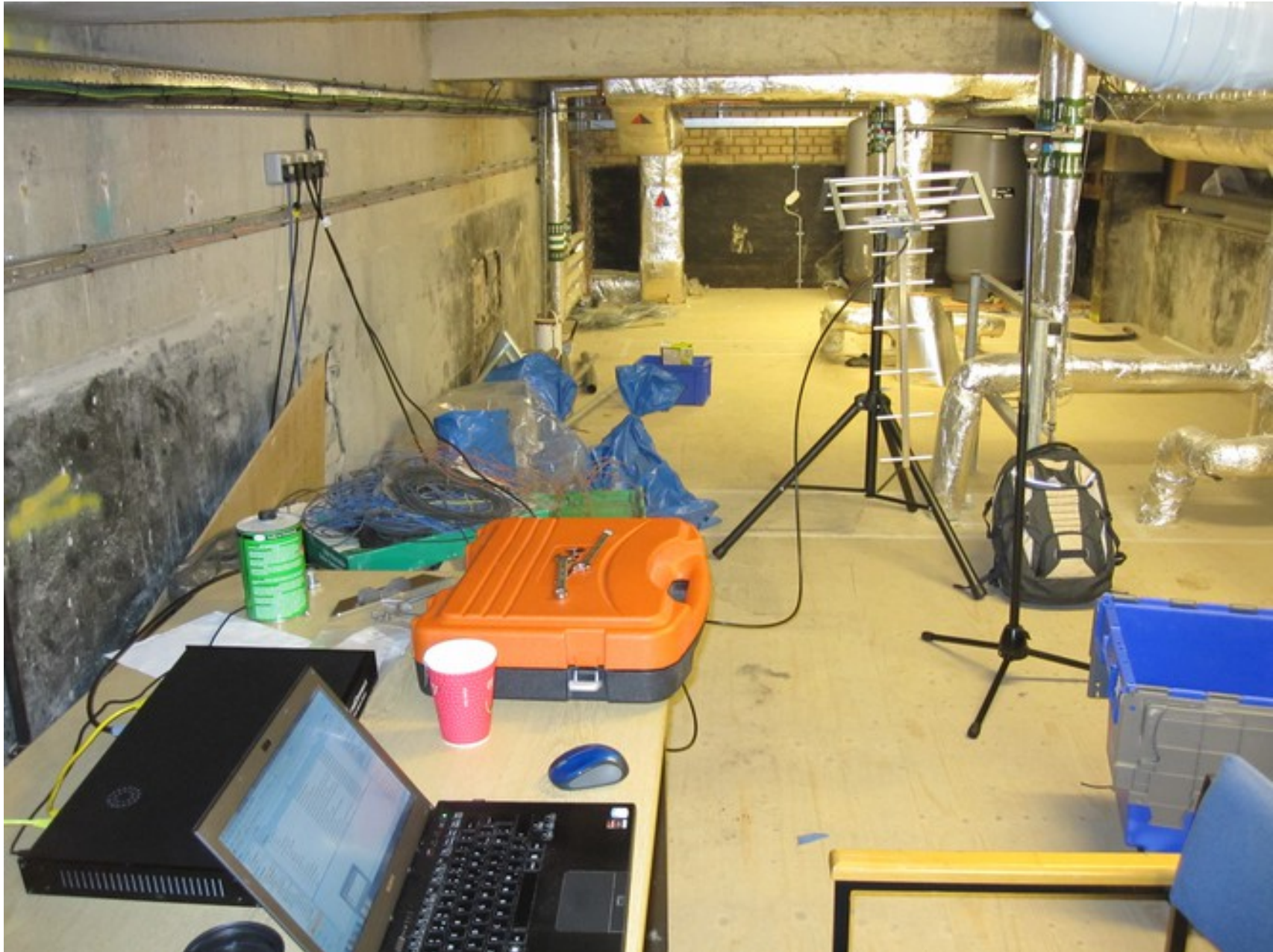


Carlson Wireless Ruralconnect

- <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

Home Page - RuralConne x WSD Log | fswsdb.com x

137.73.20.176

45.01

**CARLSON**

HomeRegistrationModulationPerformanceMapSystemAccount

CSB00800
Guid: a070271e-6c97-4dff-bd79-7f2a7cfa3a1
Id: 8628963
Bandwidth: EightMHz

Tx Freq: 522 MHz
Tx Frames: 38107
Uptime: 0 days, 1 hours, 18 minutes

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

Basestation Tx: Enabled ▾

Name	Online	Channel	Enabled	Registered	DL SnR	UL SnR	DL rate	UL rate
ACROPOLIS Trial Base Station 1	✓	✓	N/A	✓			-	-
ACROPOLIS Trial Terminal 1	✗	✓	✓	✓			-	-
ACROPOLIS Trial Terminal 2	✗	✓	✓	✓			-	-
ACROPOLIS Trial Terminal 3	✗	✓	✓	✓			-	-
ACROPOLIS Trial Terminal 4	✓	✓	✓	✓	29.8	26.5	16QAM	16QAM ¼

Refresh

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CPE



iperf doesn't work over TVWS...

The screenshot displays the Ookla Speedtest website interface. At the top, the navigation bar includes the Ookla logo, a 'SPEEDTEST' label, and links for 'ADVERTISE', 'BECOME A HOST', 'MY RESULTS', 'SUPPORT', 'SETTINGS', 'LOGIN', and 'CREATE ACCOUNT'. The main content area features a large speed test result card with a dark blue background and glowing green accents. This card displays three key metrics: 'PING 115 ms', 'DOWNLOAD SPEED 5.01 Mbps', and 'UPLOAD SPEED 2.71 Mbps'. Below these metrics is a green 'SHARE THIS RESULT' button. A central pop-up message asks, 'Are you on King's College London?' and encourages users to 'Take our Broadband Internet Survey!'. Below this, there is a section for 'GET A FREE OOKLA SPEEDTEST ACCOUNT' with a text input field for 'Your Email Address' and a 'CREATE' button. A note states, 'Being logged in would allow you to start a Speed Wave here!'. At the bottom of the result card, it shows the IP address '137.73.20.229', identifies the location as 'King's College London', and includes a 'Rate Your ISP' link with five stars. Two buttons, 'TEST AGAIN' and 'NEW SERVER', are also present. To the right of the main card, there are two informational sections: 'How Speedtest Works' with a video icon and 'Create an Account' with a user icon. The bottom of the browser window shows a standard Windows taskbar.

OOKLA SPEEDTEST

ADVERTISE BECOME A HOST MY RESULTS SUPPORT SETTINGS LOGIN CREATE ACCOUNT

PING
115 ms

DOWNLOAD SPEED
5.01 Mbps

UPLOAD SPEED
2.71 Mbps

SHARE THIS RESULT

Are you on
King's College London?

Take our Broadband Internet Survey!

GET A FREE OOKLA SPEEDTEST ACCOUNT
Your Email Address
 CREATE

Being logged in would allow you to start a Speed Wave here!

137.73.20.229
King's College London
★★★★★ Rate Your ISP

TEST AGAIN NEW SERVER

London
Hosted by
Peer Point Internet LTD

How Speedtest Works
Watch a short video to learn about our technology

Create an Account
Testing with multiple browsers or devices? Save all your results in one place

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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