VDSL – RF Interference (RFI) Update

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RSGB VDSL Survey of Amateurs
Drive by mapping of RFI levels
Here and There Comparison
Lelantos VDSL to background measurements
Testing with Ofcom engineers

RSGB VDSL Testing since June 2017

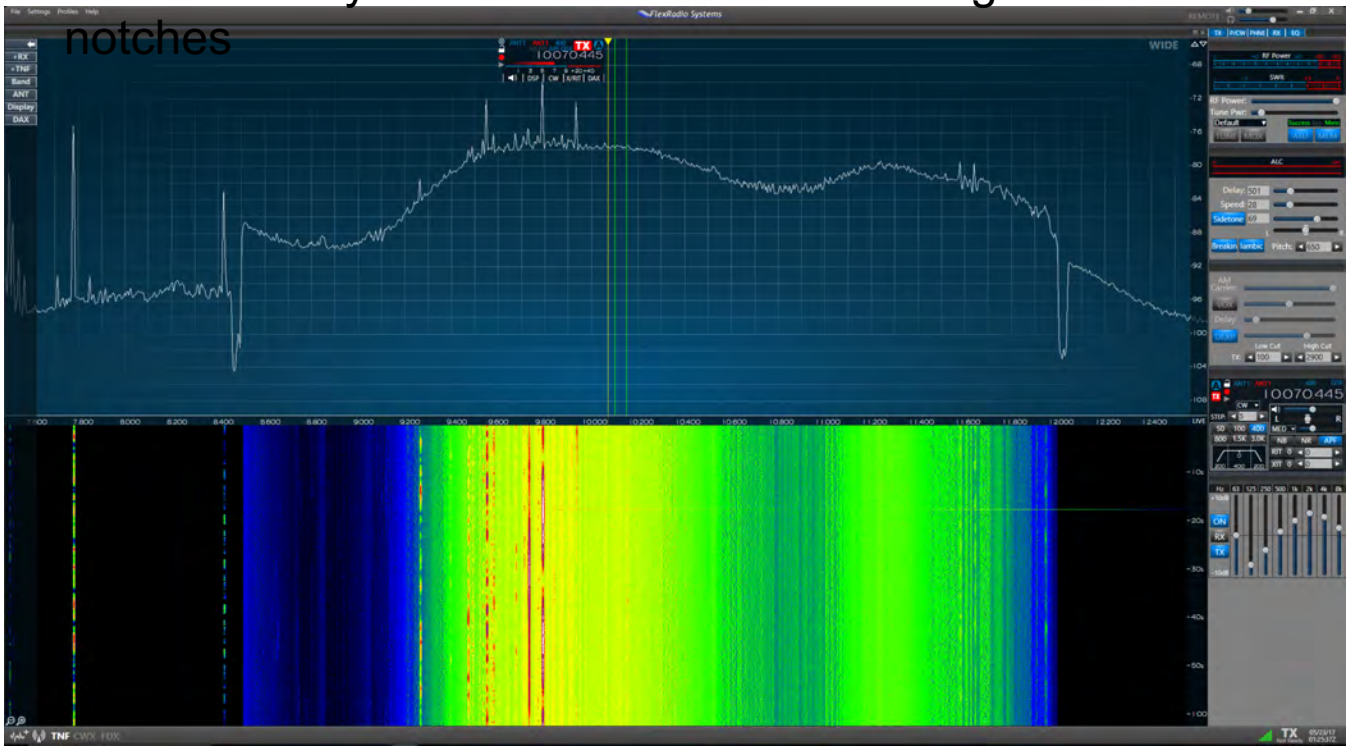
- We wanted to find out how many amateurs were impacted so conducted a **survey of members** – 1300 responses
- We wanted to quantify variation in levels nearby – so constructed **driveby** recorders and heatmap displays
- We wanted to find out how many signals were being obstructed by VDSL so used two identical recorders one at problem location and another at a nearby quiet location from driveby **"Here & There"**
- We wanted to prove the signals we measured were VDSL so developed **Lelantos** software which exploited nature of VDSL coding to measure VDSL signals present
- **Joint VDSL measurements with Ofcom** at 6 locations

VDSL Survey September 2017

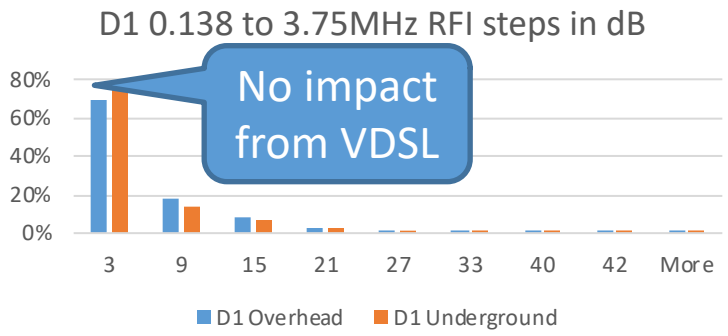
- One VDSL signature is the change in level at upstream downstream transition frequencies - VDSL noise normally drops in the guardband and rises on either side this can be measured with signal strength or ‘S’ meter
- Clearly visible using spectra (or waterfalls) to show mean level of VDSL RFI noise
- We only use the difference in levels at nearby frequencies which eliminates variation between receivers, antennas and S meters

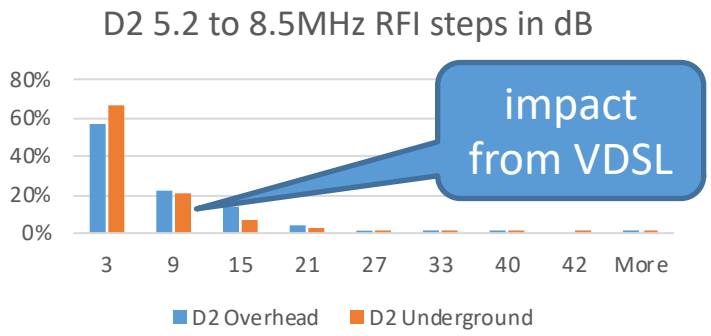
Upstream 2 Downstream 2 / 3

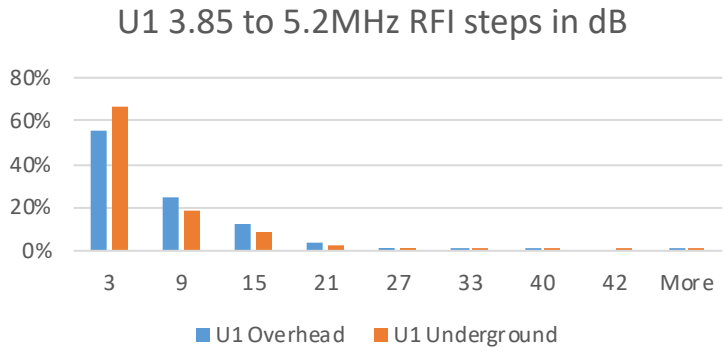
D2<U2>D3 by 17dB and 25dB above background in notches

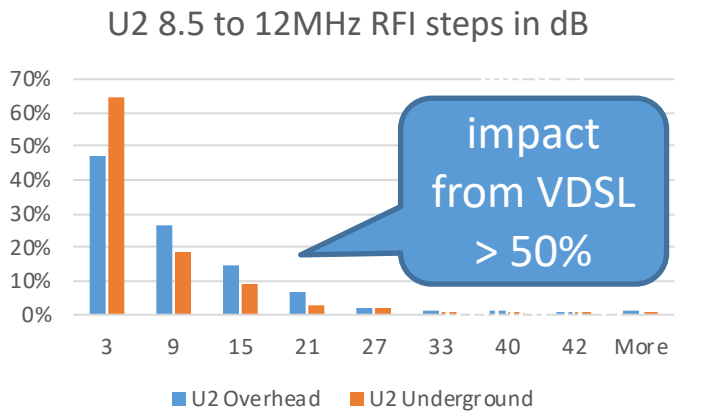


Upstream Downstream Transition Level Changes 1300 replies

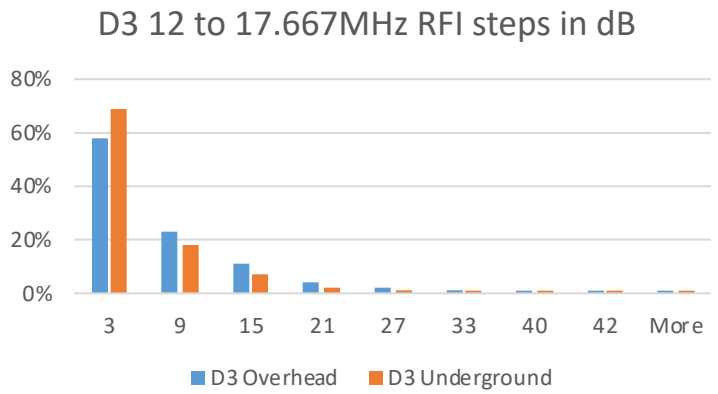








Upstream Downstream Transition Level Changes



55% reports show reception Impacted by VDSL

25% reports suffer seriously degraded reception

Conclusions
More suffer Upstream RFI than Downstream

Overhead dropwires
U2 RFI 53% >6dB 27% >12dB
U1 RFI 45% >6dB 20% >12dB
D3 RFI 43% >6dB 19% >12dB
D2 RFI 42% >6dB 21% >12dB
D1 RFI 31% >6dB 14% >12dB

RFI Levels only 5 to 10dB lower for underground feeds

VDSL Survey September 2017 conclusions

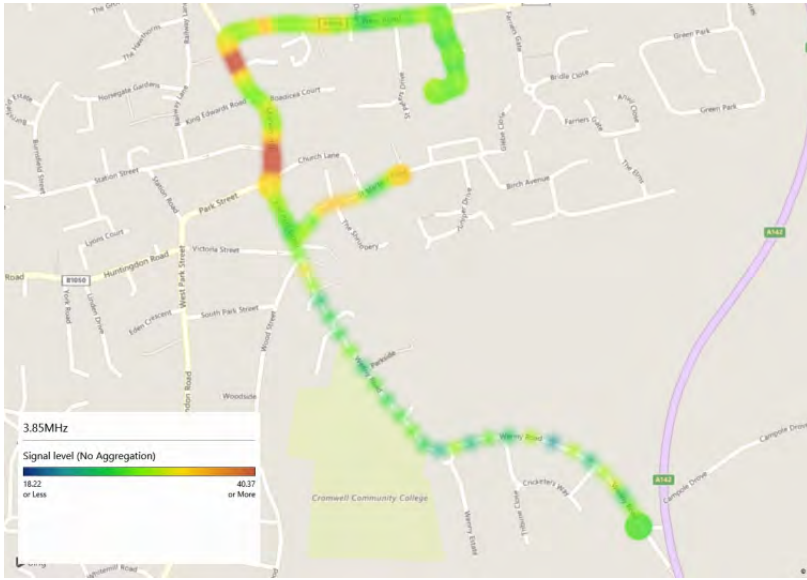
- Downstream RFI is strongest near to cabinet where it is the sum of more lines cf the sum of nearby neighbours' lines further away
- Upstream is strongest further from the cabinet as the modems use higher signal strength to overcome line losses in longer lines
- Overhead dropwires act as antennas and the RFI depends on their length and their proximity to amateur's antenna
- In house extension wiring also acts as antenna and causes RFI
  -RFI is worst if antenna in near field of overhead wires or extensions
- More than 50% of survey respondents are suffering from degraded signals because of VDSL

(Report in December 2017 RadCom)

Drive by Measurements

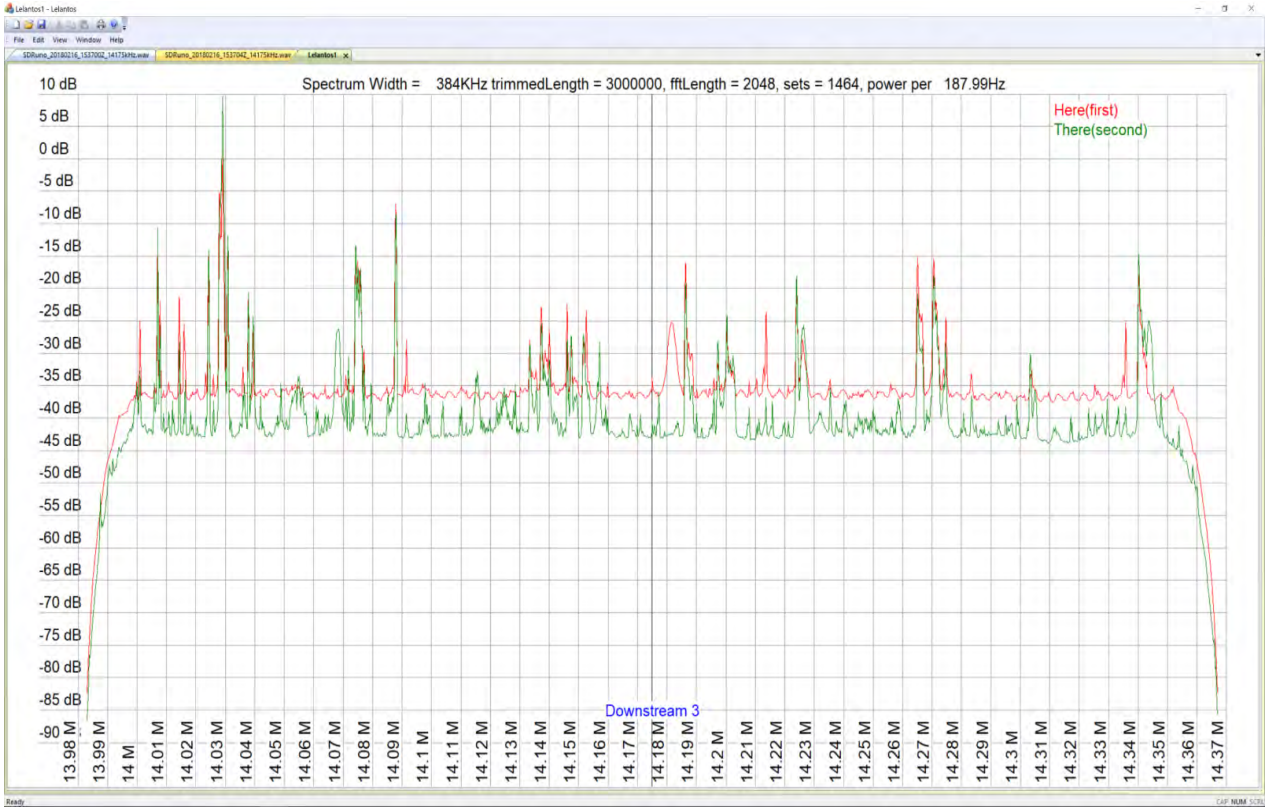
(Reported in January 2018 RadCom)

Drive by map PE16

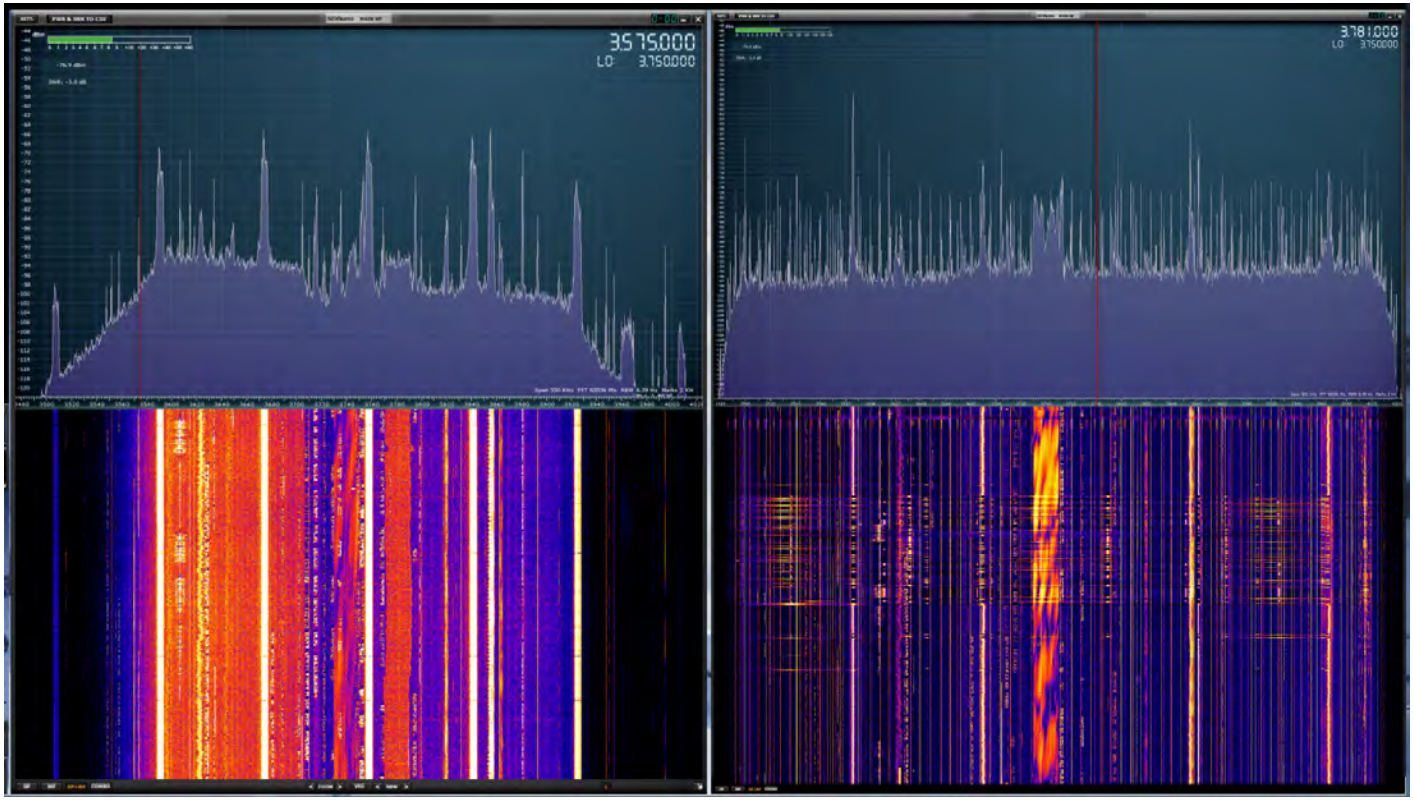


Upstream 1 shows very high RFI levels at amateurs location
A nearby location with more normal levels was chosen for comparison
These two sites used for “Here and There” testing SDR recordings made then analysed to compare signals received at both

Here and There results PE16 20m band



Here and There Spectra 80m band



So what is the impact of a 15dB rise in noise levels

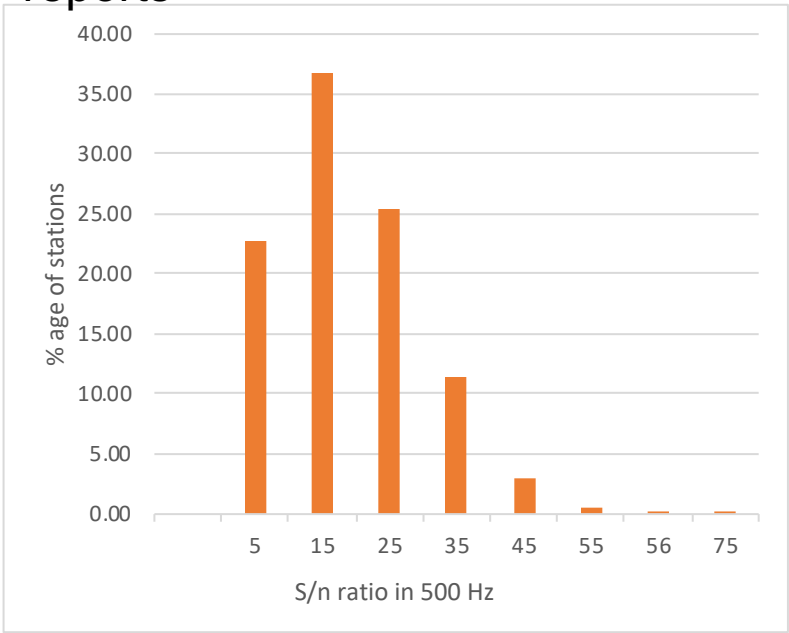
If the background noise from VDSL is raised by 15dB then

the number of signals received will be reduced by 60% (37 +23)

Research into propagation and robust modes relies almost entirely on signals with less than 15dB signal to noise

So >25% of amateurs lose more than 50% of signals in some bands because of VDSL Obstruction

Signal to noise results for 528,528 reports



Impact of VDSL2 on HF signals

- VDSL2 superfast broadband is present 24 hours a day 7 days a week -it is pink noise which degrades radio reception up to 17.7MHz
- 15dB increase in VDSL RFI levels means 60% of signals are obscured
- At some locations only a few percent of signals present (the strongest ones) can be received in the impacted bands
- **HOW CAN THAT BE ANYTHING BUT HARMFUL**
- Notching was designed in to avoid these problems
- VDSL2 upstream bands include International Emergency band (3.75 to 3.8MHz) and the low power digital and propagation reporting bands (10.1 to 10.15MHz)
- Other countries notch which eliminates the problem
  - Swiss regulator requires notching if ECC 09(02) levels are exceeded
- G.fast needs to be notched at the start as it goes up to 200MHz and will impact many radio services as well as amateur bands

Thank You for your attention

What needs to be done by Openreach to reduce RFI

- Improve Line Balance where necessary – we have a mechanism in place to request line balance on nearby lines via the EMC Committee but this improves <10% cases
- Clean-up self-installs - difficult for a neighbouring property but Openreach should fit NTE5C with Mk4 faceplate which also improves broadband speeds and increases immunity
- Remove upstream band interference by universally notching 10.1 to 10.15MHz with guard-bands and by increasing the D1 to U1 guard-band to always protect 3.7 to 3.8MHz emergency frequencies
- Selectively notch amateur bands in downstream (particularly 14MHz band) at affected premises
- Reroute the overhead cables so they are further from the amateurs' antennas when necessary
- Provide FTTP instead of FTTC at problem locations