

EMCC – RF Interference (RFI) Update

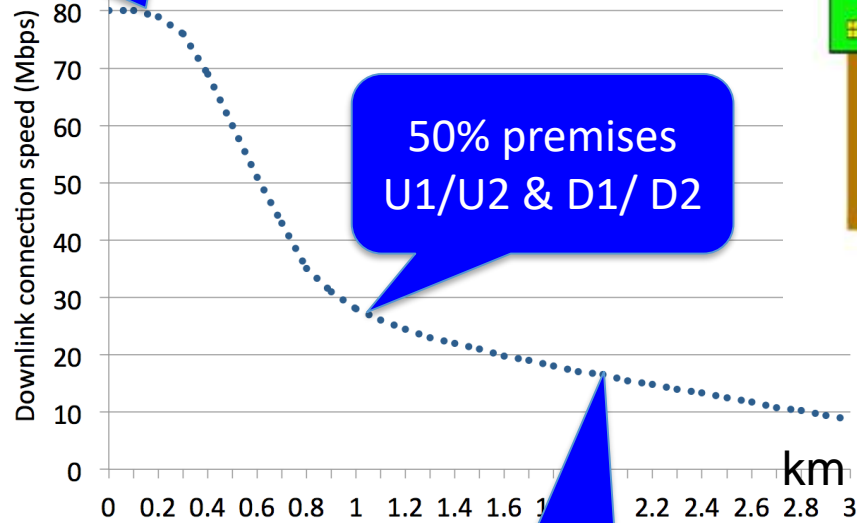
Dr John Rogers, M0JAV - Chairman EMC Committee



VDSL – Survey - drive by - results
Web site update and regional assistance
Standards and IARU activities
Focus towards 2022 Strategy

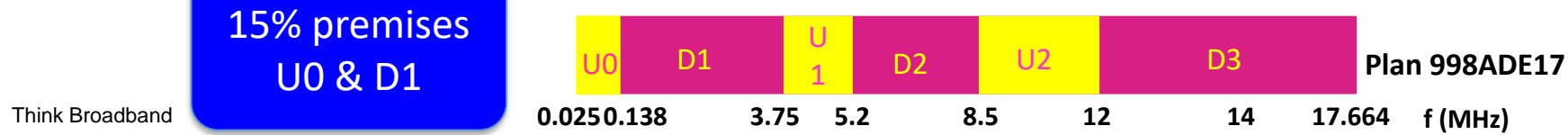


VDSL2 – Superfast Broadband FTTC

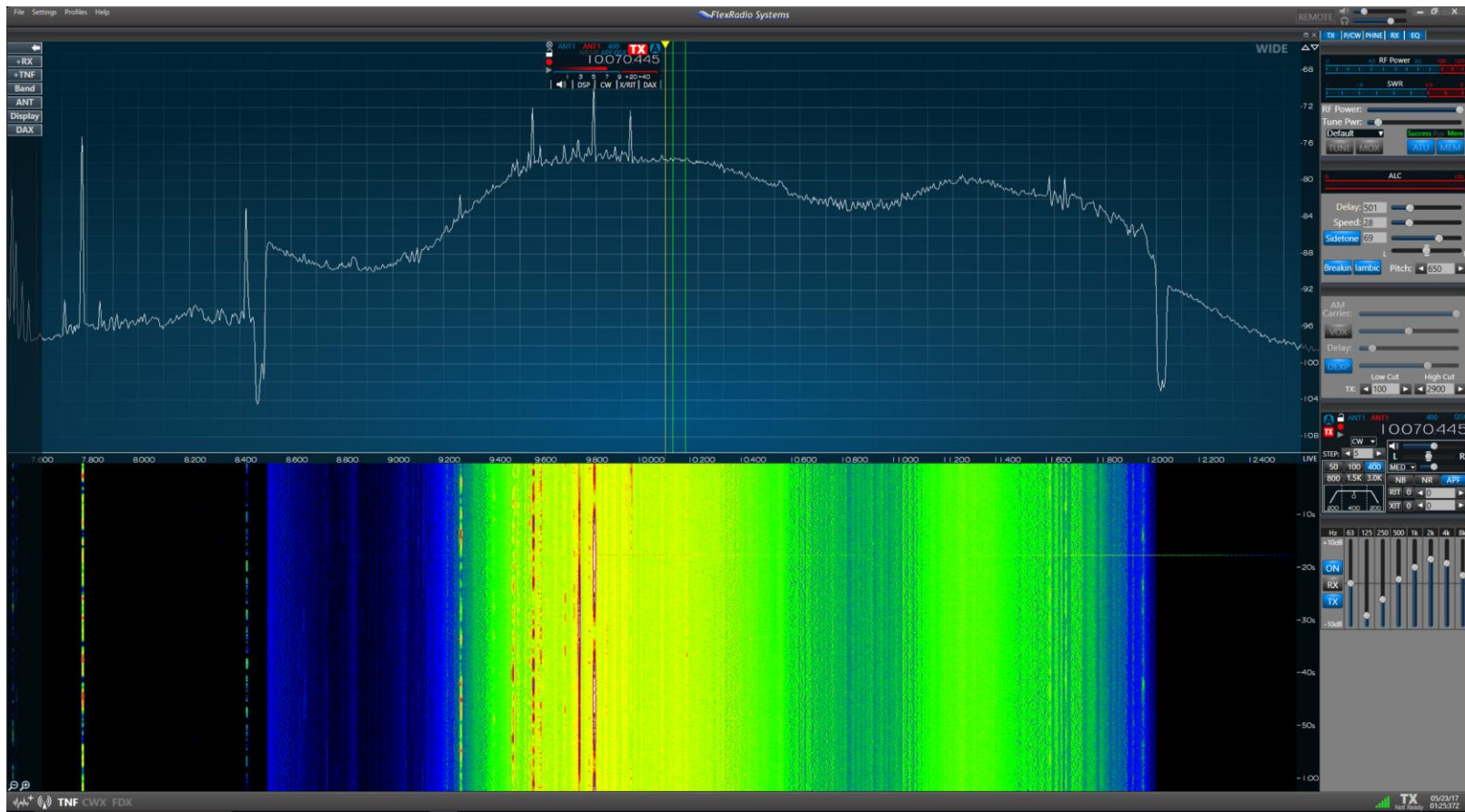


Often have RFI from many neighbours lines

Situation is worst when line balance problems exist on dropwires or in house extensions



D2<U2>D3 by 15dB and 25dB above background in notches



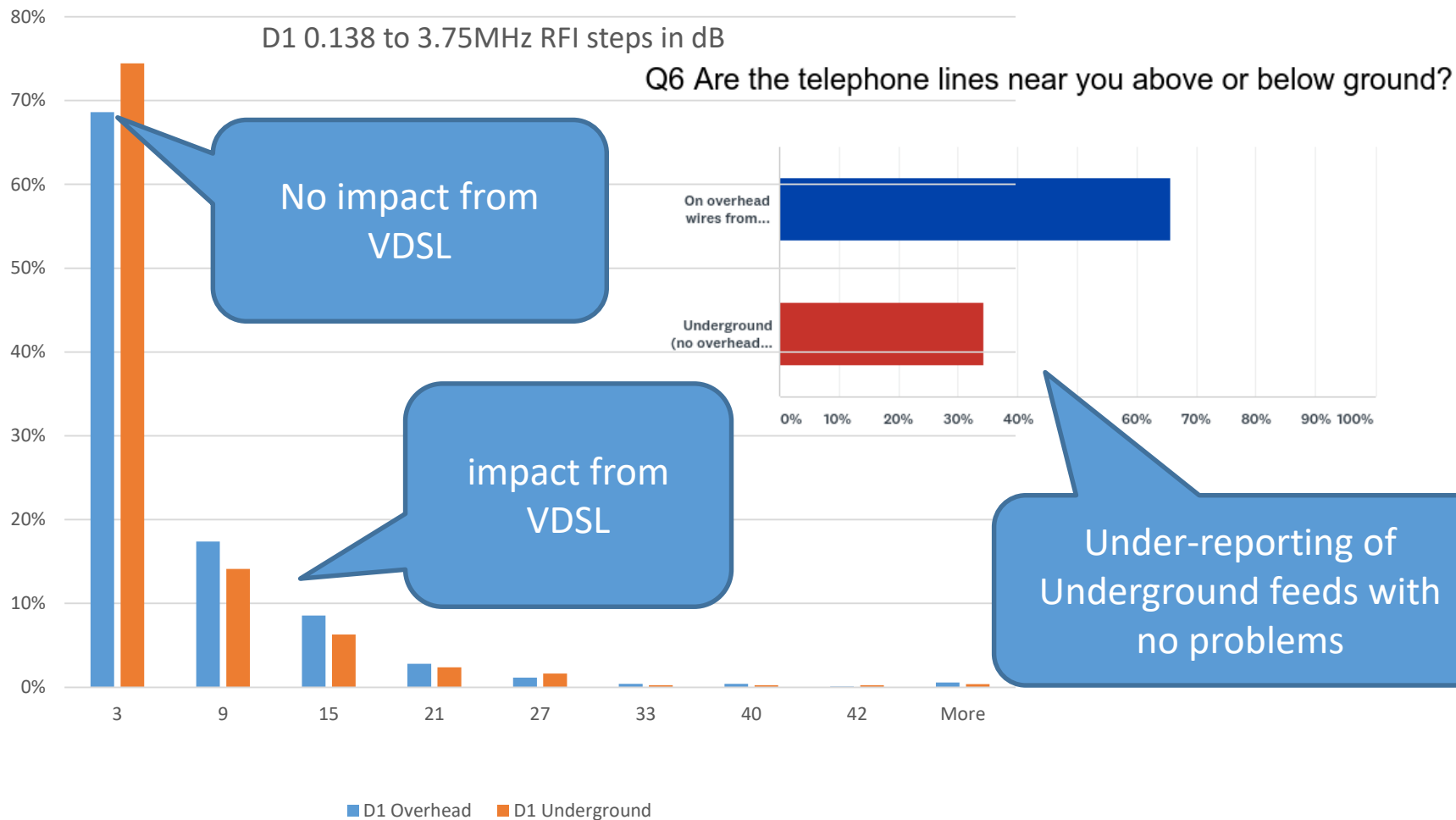
VDSL Survey September 2017

- VDSL RFI 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
- We only use the difference in levels at nearby frequencies which eliminates variation between receivers, antennas and S meters
- Measurements can also be made using spectra or waterfalls with a 1 or 2 second average to show mean level of VDSL RFI noise

Thanks to all of YOU who did the VDSL survey

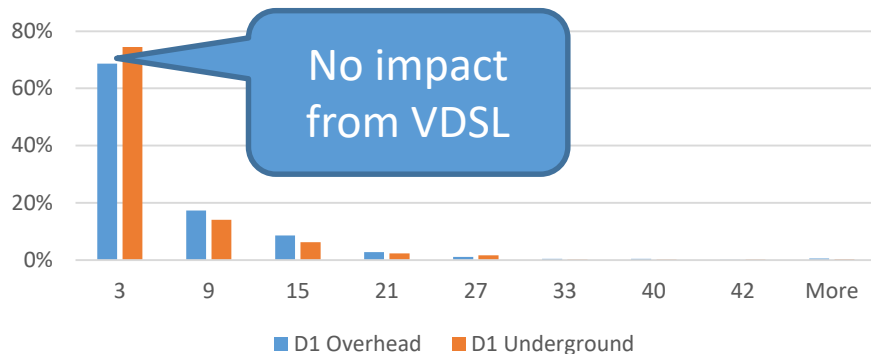
- How many responses did we get?
- How many of YOU responded?
- How many found VDSL RFI?
- Are the rest of you going to look?

Upstream Downstream Transition Level Changes

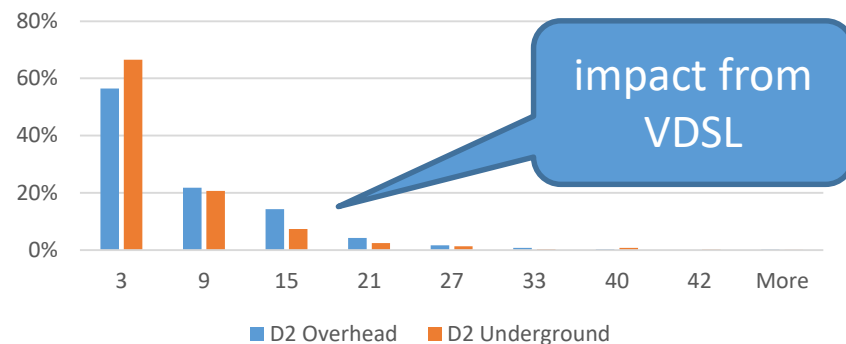


Upstream Downstream Transition Level Changes

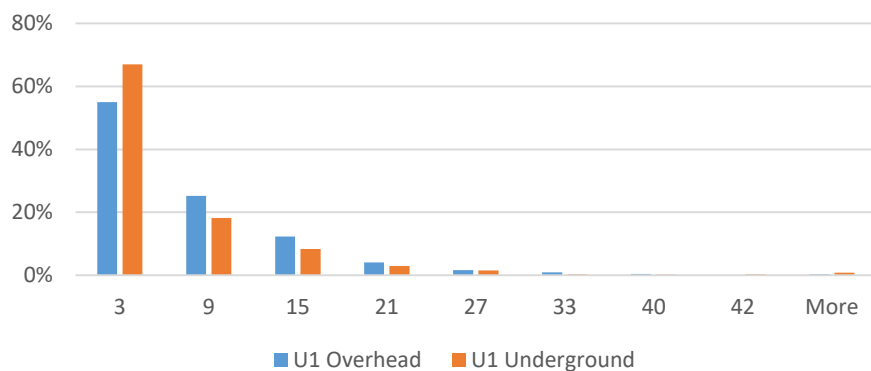
D1 0.138 to 3.75MHz RFI steps in dB



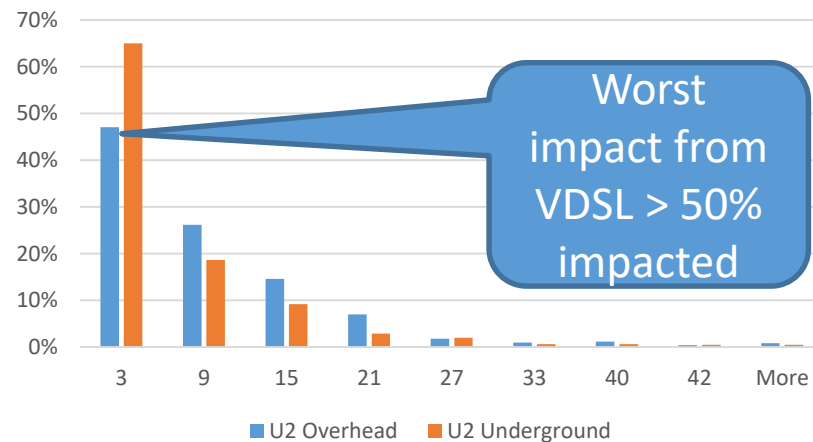
D2 5.2 to 8.5MHz RFI steps in dB



U1 3.85 to 5.2MHz RFI steps in dB

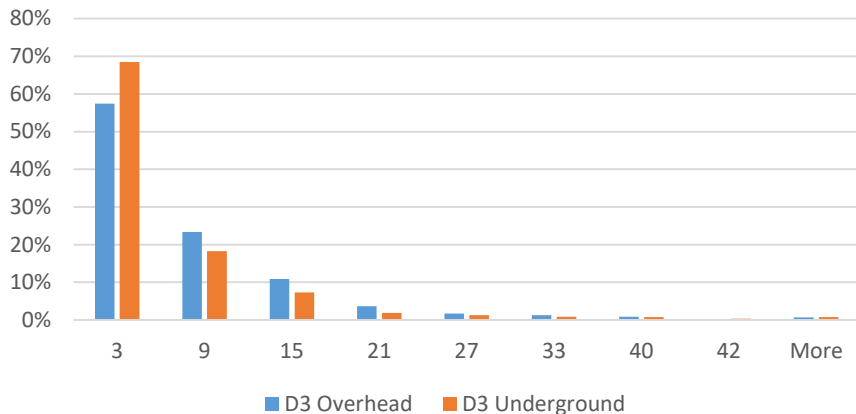


U2 8.5 to 12MHz RFI steps in dB



Upstream Downstream Transition Level Changes

D3 12 to 17.667MHz RFI steps in dB



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

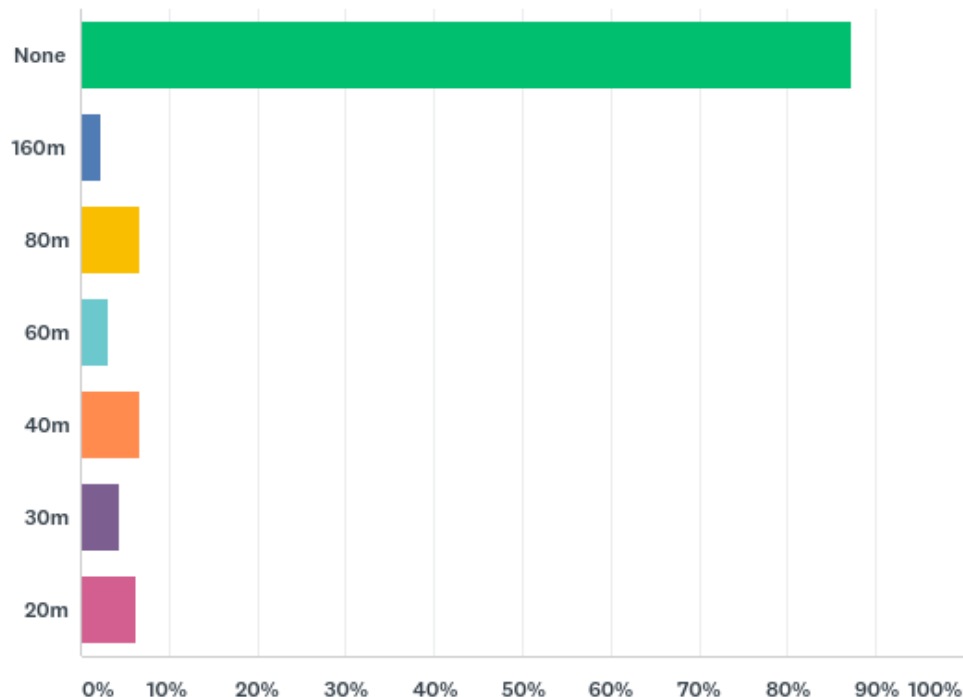
D2 RFI 42% >6dB 21% >12dB

D1 RFI 31% >6dB 14% >12dB

RFI Levels only 5 to 10dB lower for underground feeds



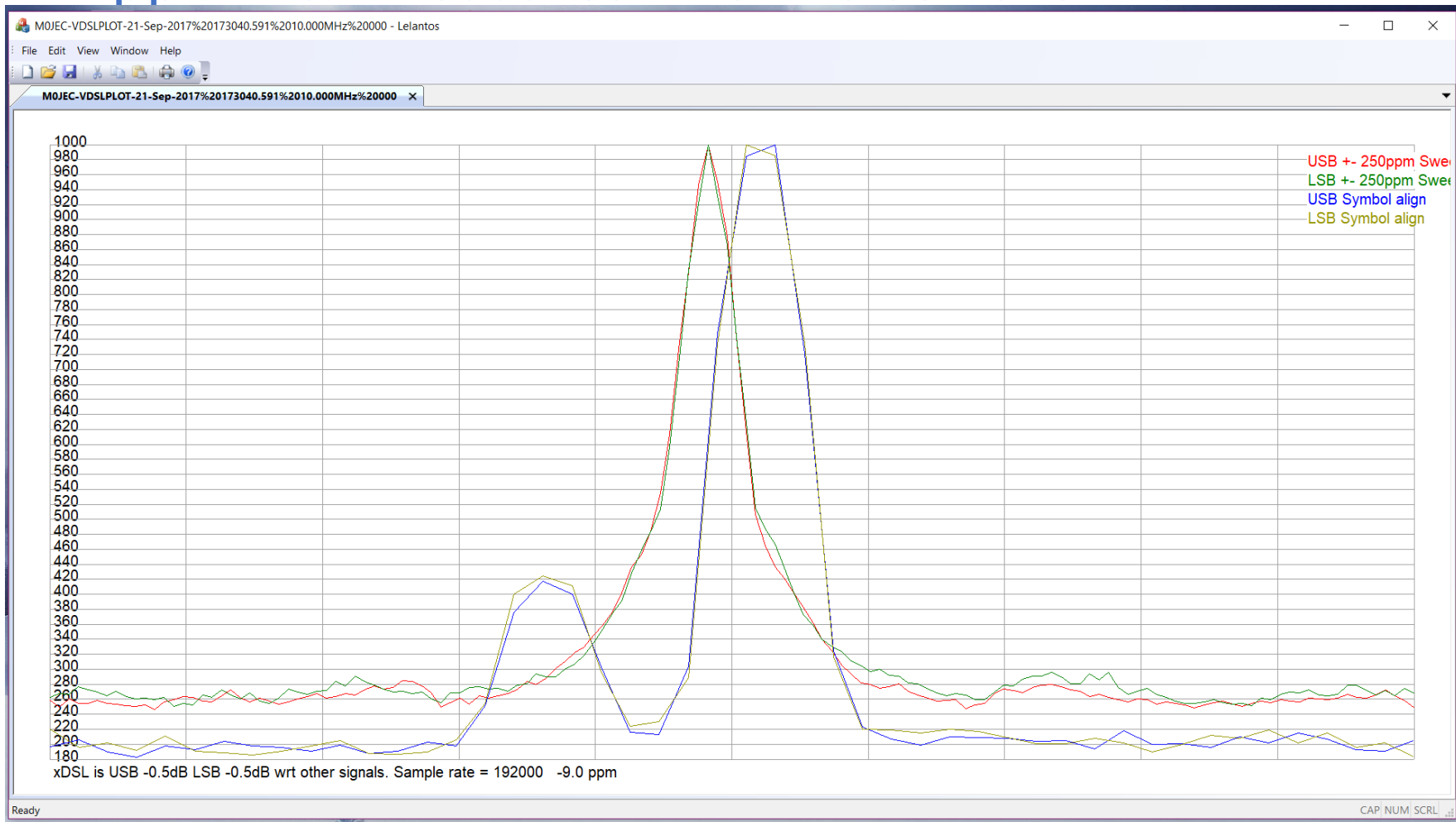
Q28 Do you see a comb of carriers near your transmit frequency after you transmit? If yes, on which bands? Select any which apply:



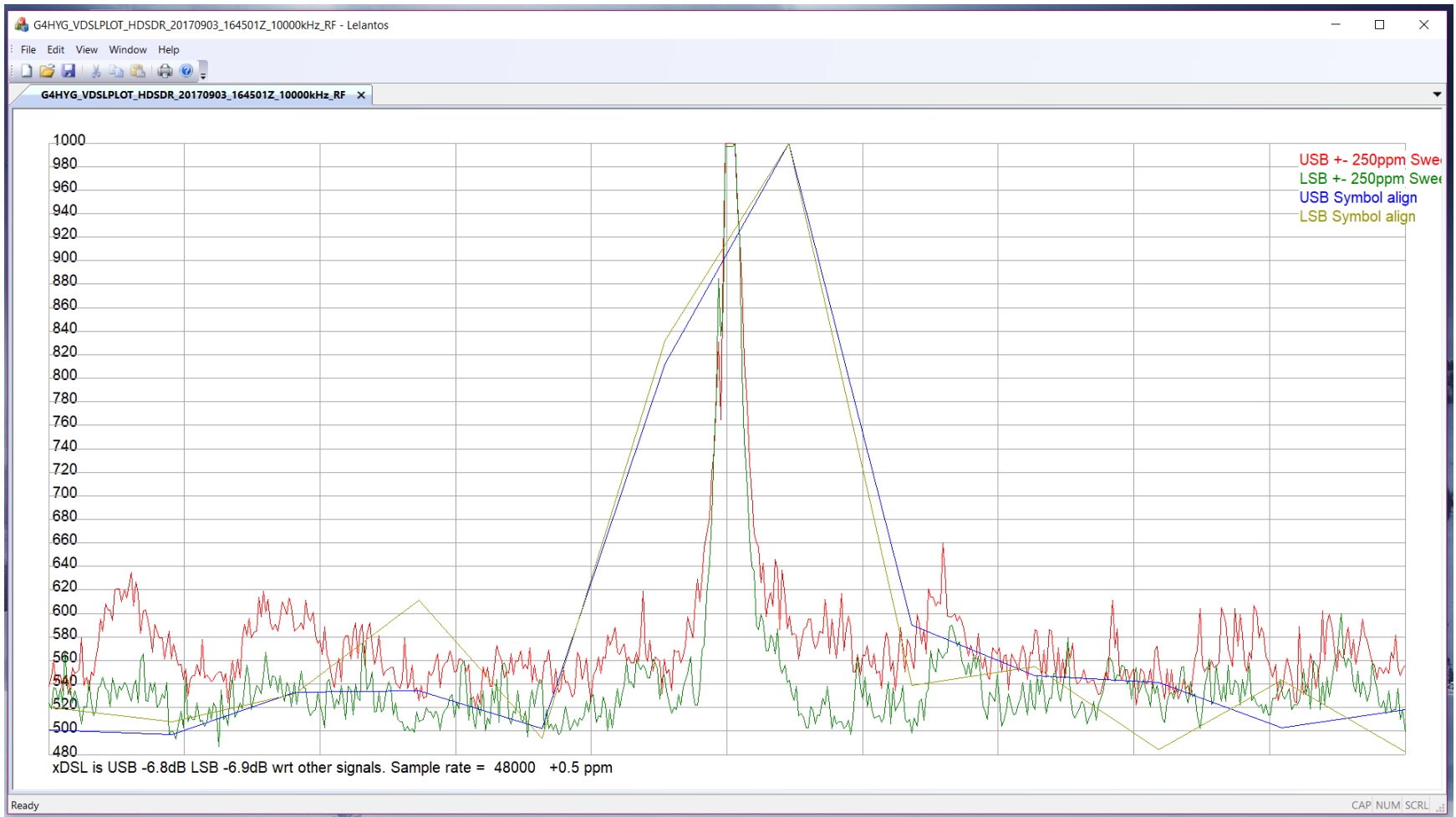
13% see 4kHz retraining tones after transmitting – these must cause an increase in VDSL BER



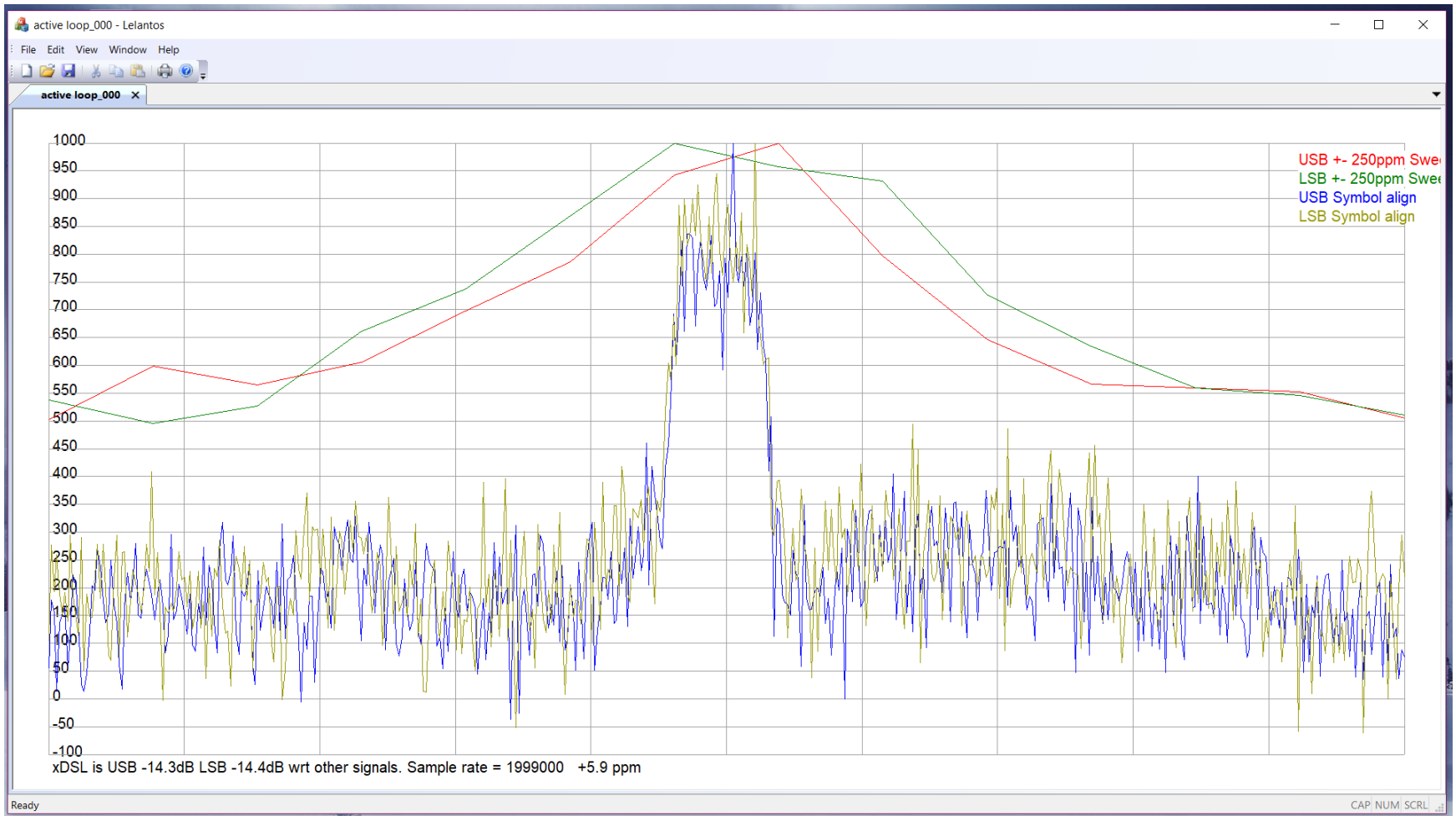
App which measures VDSL noise Level from .WAV



VDSL 7 dB below largest real signal



VDSL 14.4dB below largest real signal



VDSL Survey September 2017 conclusions

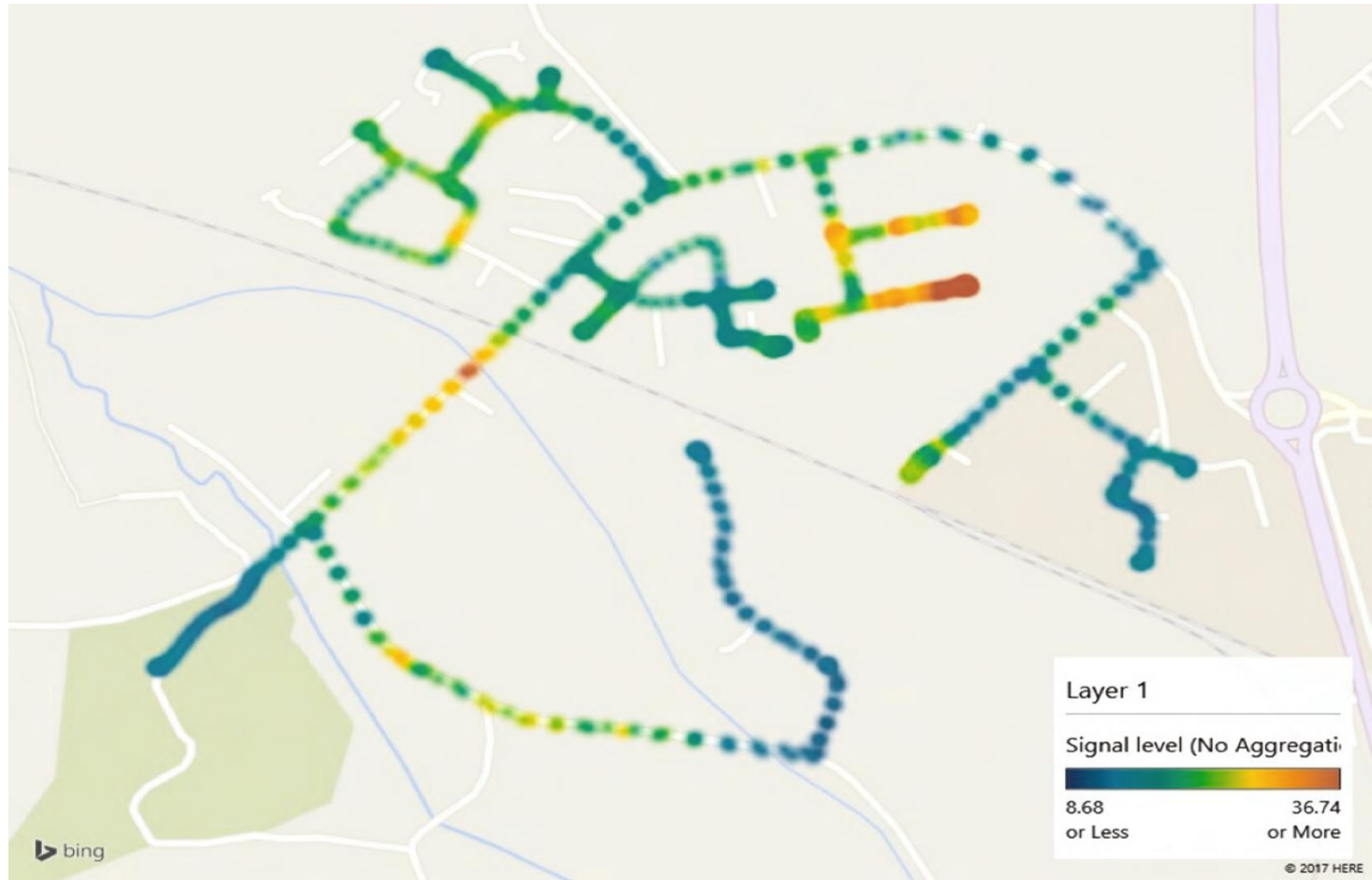
- Downstream is strongest near to cabinet - as it is the sum of many VDSL emanating from the cabinet whereas further from the cabinet it is only the sum of nearby neighbours' lines
- Upstream is strongest further from the cabinet as the modems use higher signal strength to overcome line losses in longer lines
- Overhead dropwires act as resonant antennas and the RFI depends on their length and their proximity to amateur's antenna
- In house extension wiring also acts as resonant antenna and causes RFI particularly near dense housing - flats or townhouses Sky Q has a third antenna the mains wiring connection for PLT
- 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



Drive by Measurements



Calibrated Drive by system measuring dB(uV/m)



3.85 MHz



Radio Society of Great Britain
Advancing amateur radio since 1913



theRSGB



@theRSGB

VDSL on all bands peak at 49dB(uV/m)

WR-G31DDC - 10Hz2016

File Options Memory Scheduler Plugins Help

13/08/2017 16:51:39



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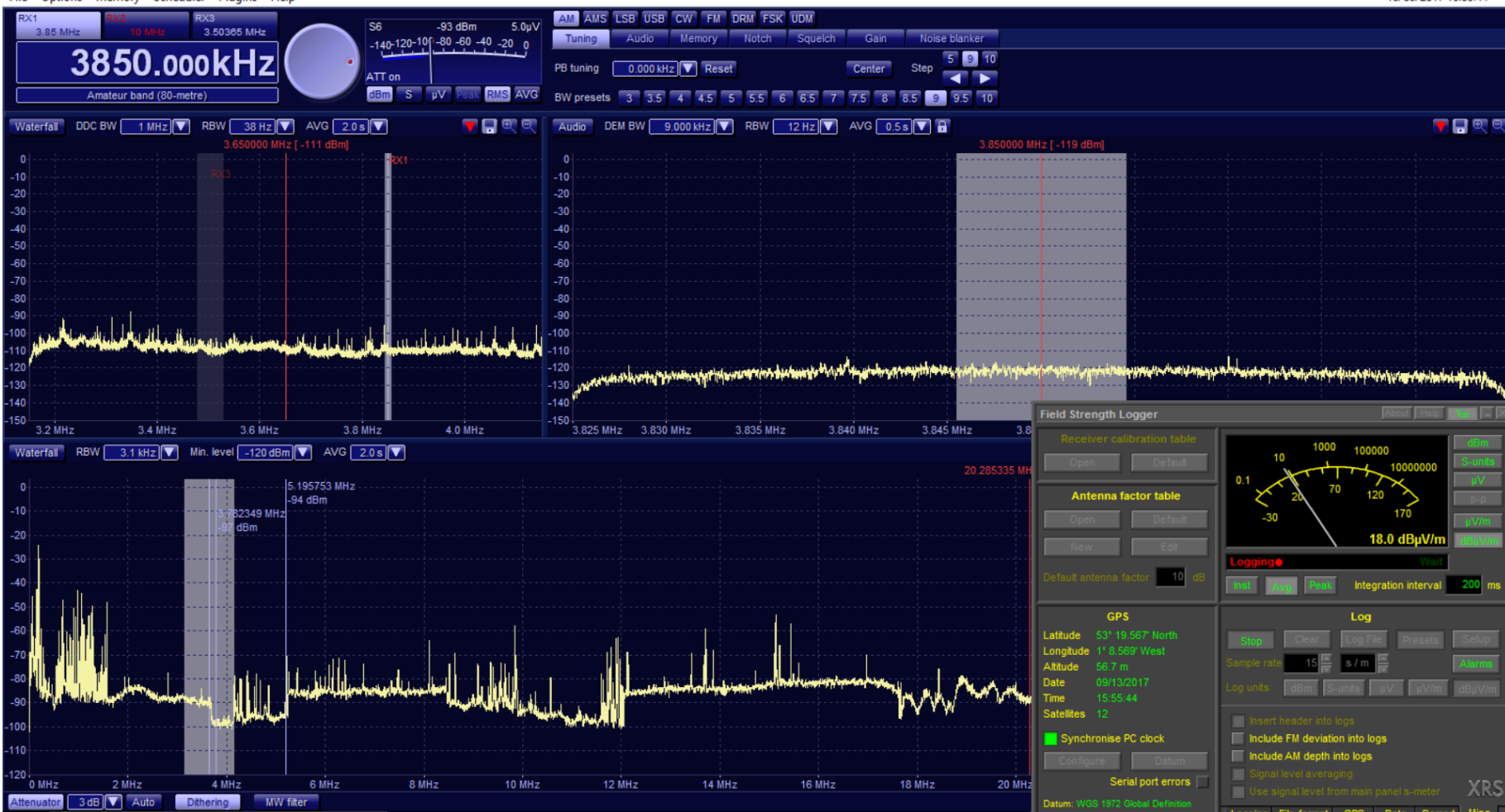


theRSGB



@theRSGB

Close to cabinet Downstream 1 & 2 & 3

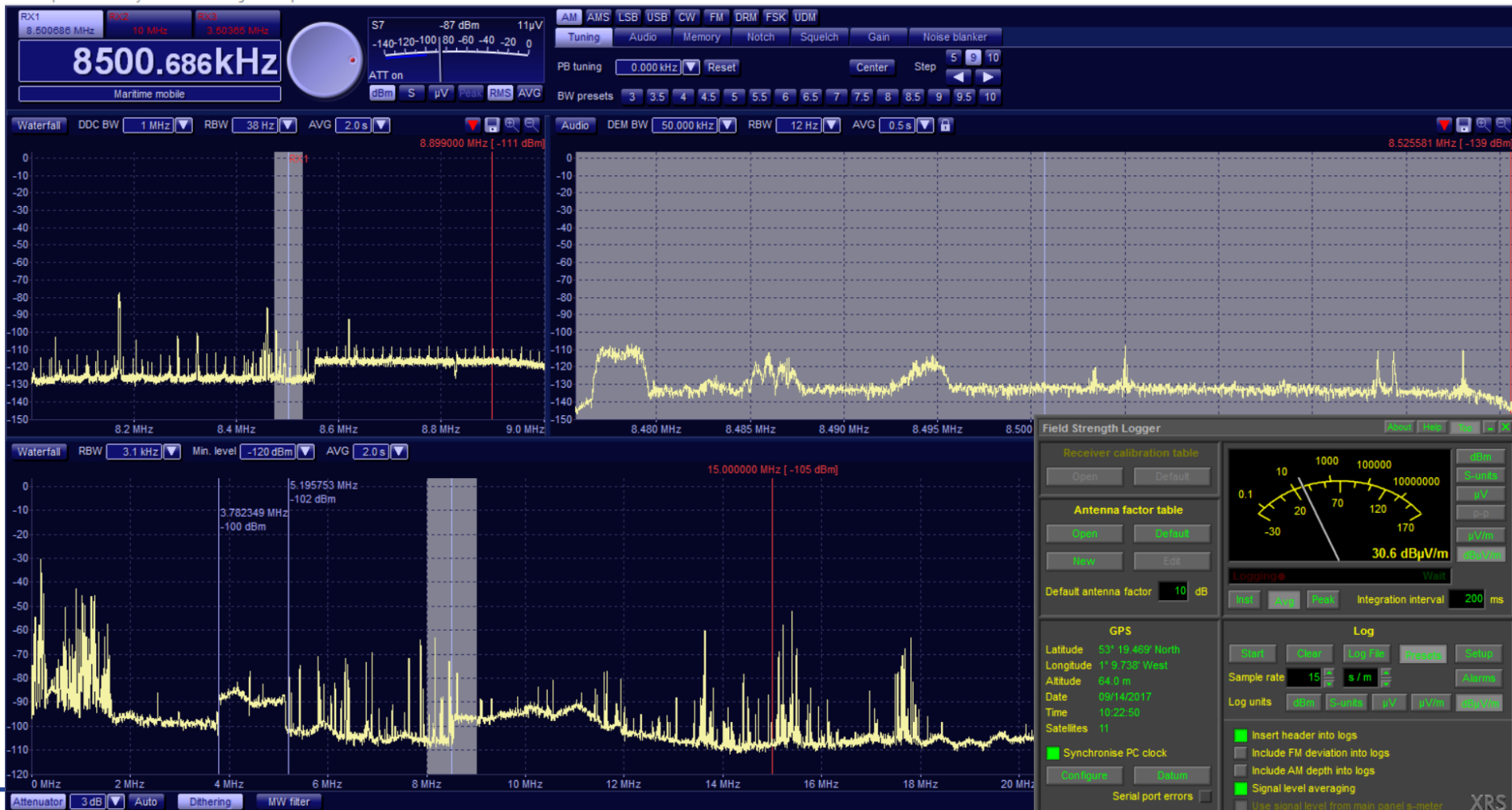


U1 and U2 high with unknown carriers

WR-G31DDC - 10H27016

File Options Memory Scheduler Plugins Help

14/09/2017 11:22:47



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Advancing amateur radio since 1913

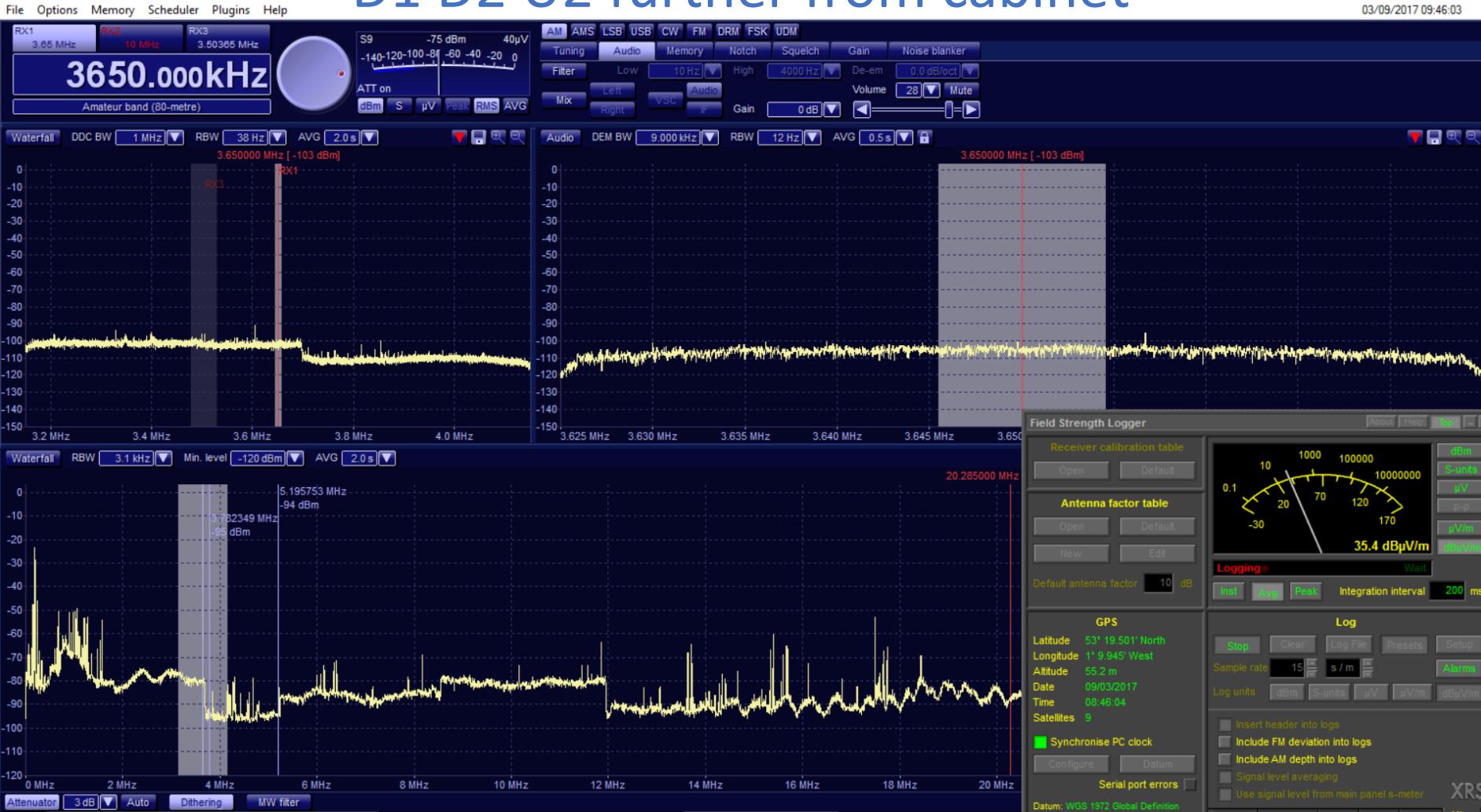


theRSGB



@theRSGB

D1 D2 U2 further from cabinet



Upstream 2



Upstream 1 plus other RFI

WR-G31DDC - 10H27016

03/09/2017 09:33:35

File Options Memory Scheduler Plugins Help



Radio Society of Great Britain
Advancing amateur radio since 1913

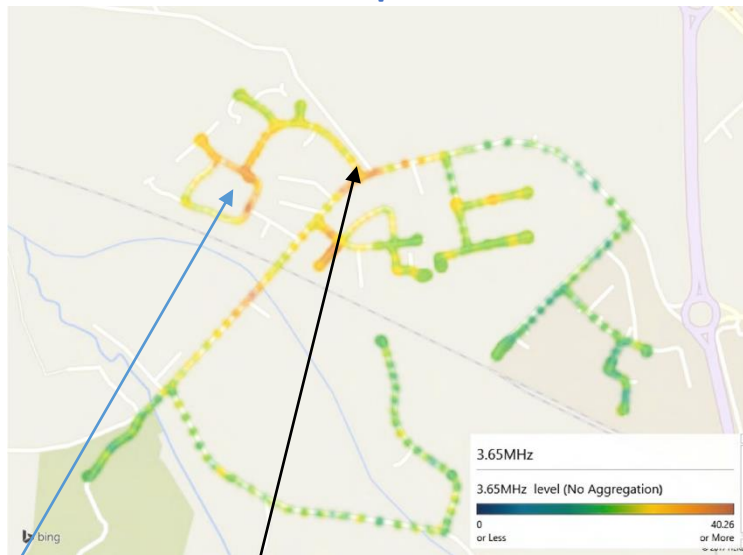


theRSGB



@theRSGB

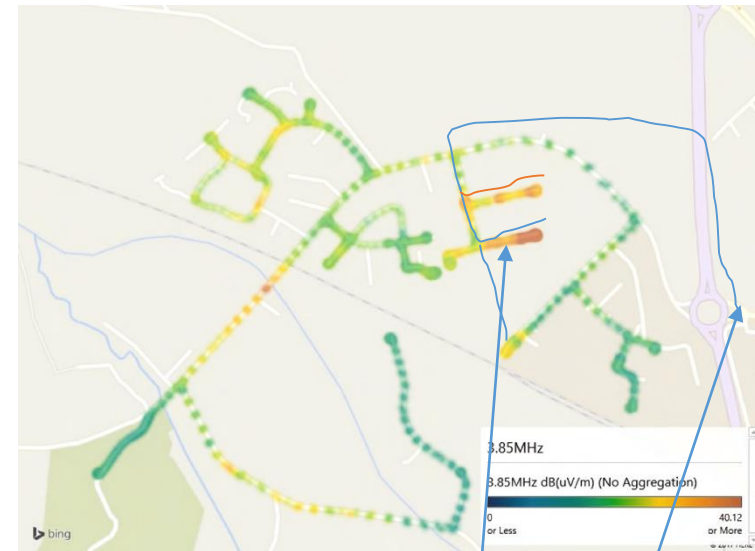
Comparison levels D1 & U1 to guardband



D1 stronger
close to cabinet 2

and where dense
townhouses

Guardband

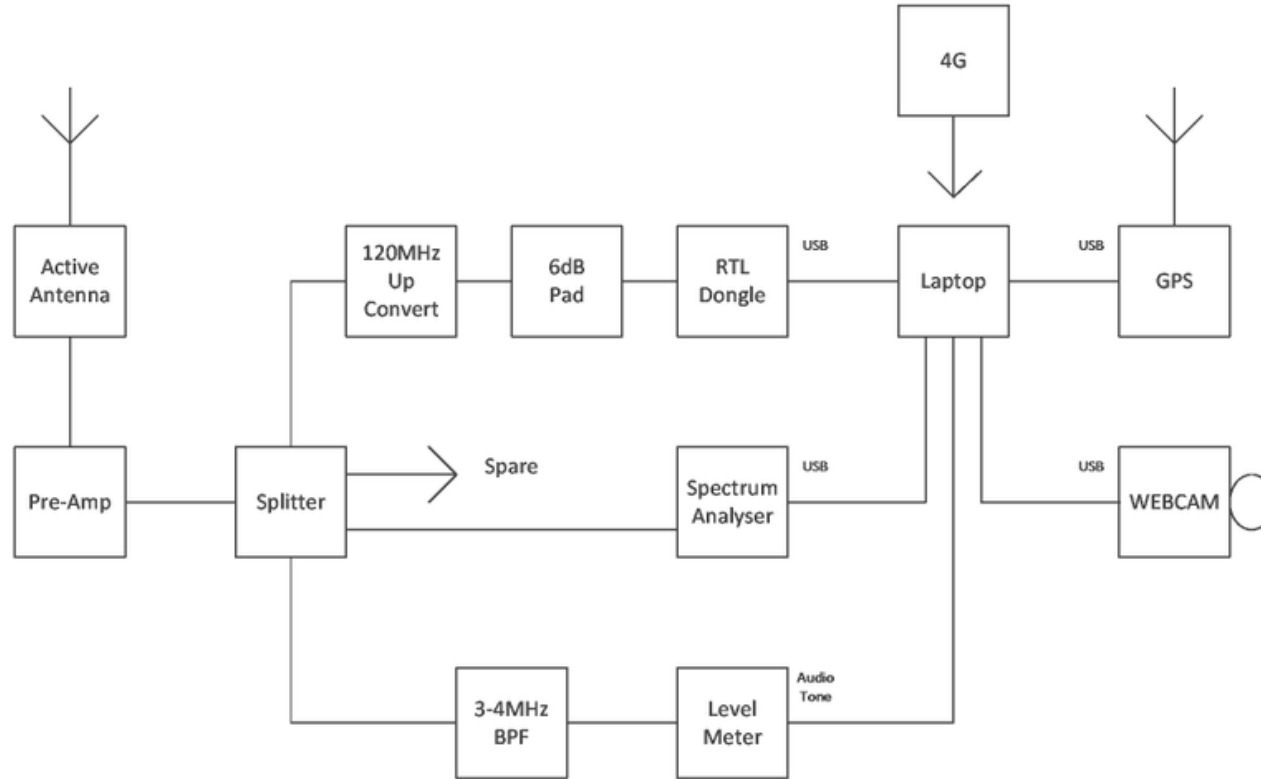


U1 stronger
furthest from
Cabinet 1

Signals low in
industrial estate all
connections
underground



G8JNJ Drive by setup



VDSL Location System – © G8JNJ - 2017

- Records spectrum
- Video
- Position on map
- Audible level
- RTL Dongle output

<http://www.g8jnj.net/vdsl>



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
- For each 10dB increase in this VDSL level above the background noise level over 80% of signals present 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**
- 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 not seeing the problem?? - underground cabling, better matched extensions no ringer wire, notching implemented or use FTTP

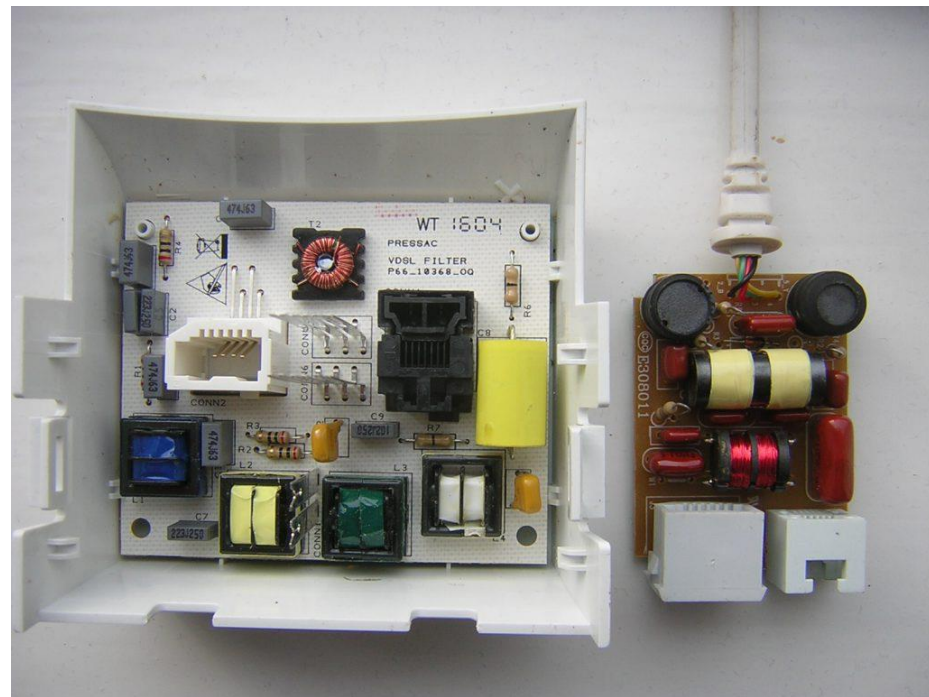
Can RFI be reduced by changing my antennas ?

- Get the antenna out of near field of telephone dropwire
Select a place where the RFI is lowest
- Try a loop receive antenna to see if you can null the RFI
- Try a current transformer around the telephone line or a small loop near it as the reference antenna for an analog RF noise canceller
- Try a mains filter on the modem or a suppressed power supply
- Use a remote receiver at a RFI free location
- Operate between the carrier comb frequencies

**Most people find it is still not enough
to restore weak DX signals**

Can it be reduced by changing phone connections?

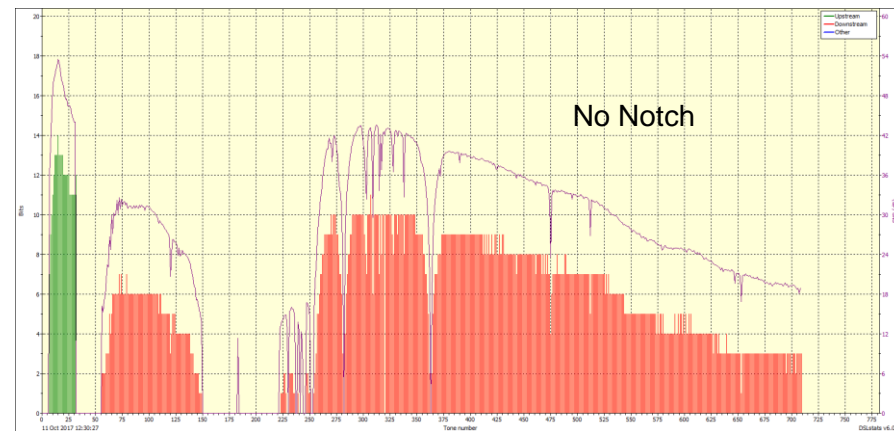
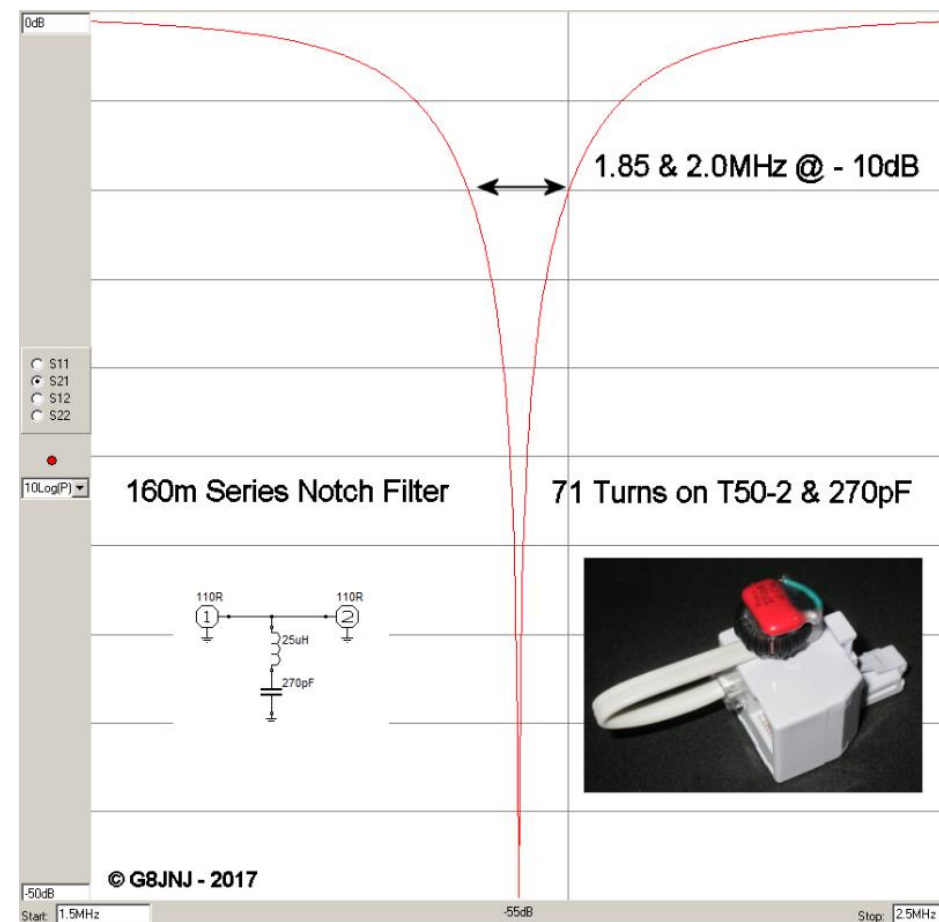
- Some things which might help
 - Use the NTE5c Mk4 faceplate it has better filtering than in line ADSL filters
 - Disconnect unused extensions and if possible all extensions they act as resonant antennas
 - Request via EMCC an Openreach line balance check for lines near you
 - Add a common mode filter to connection to modem
 - Add a notch filter or open circuit stub to stop amateur bands being used



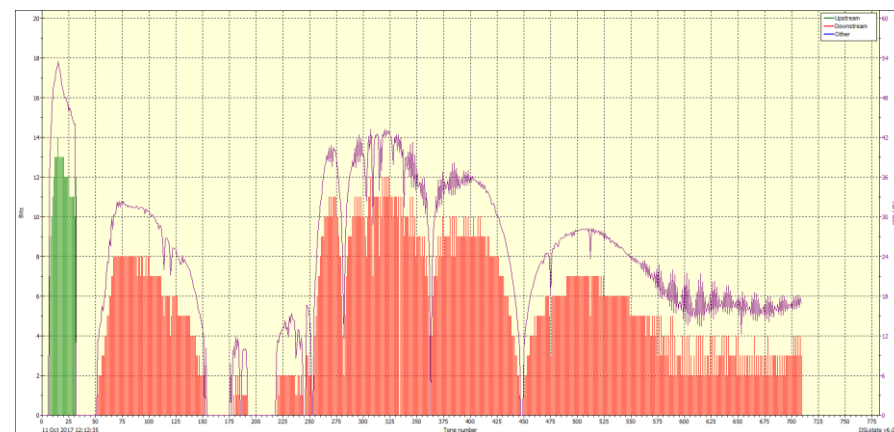
no universal fix found so far



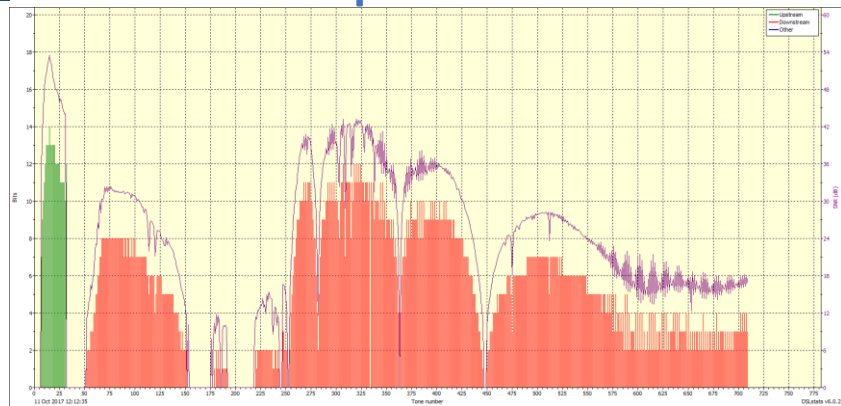
160m Notch Filter to reduce interference



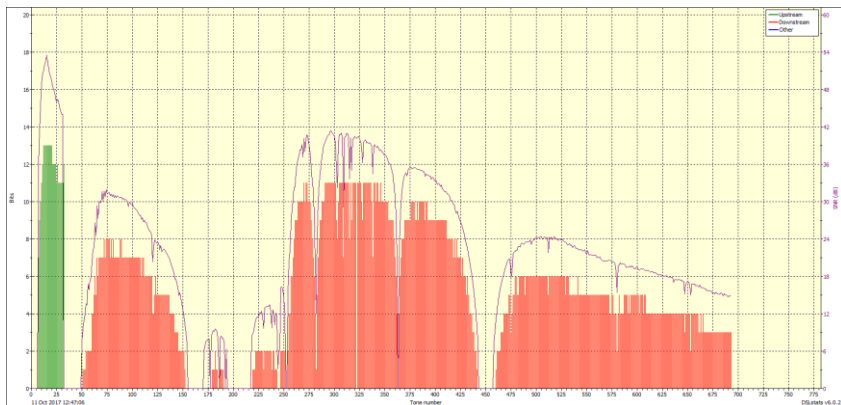
Bits per 4.3125 kHz tone



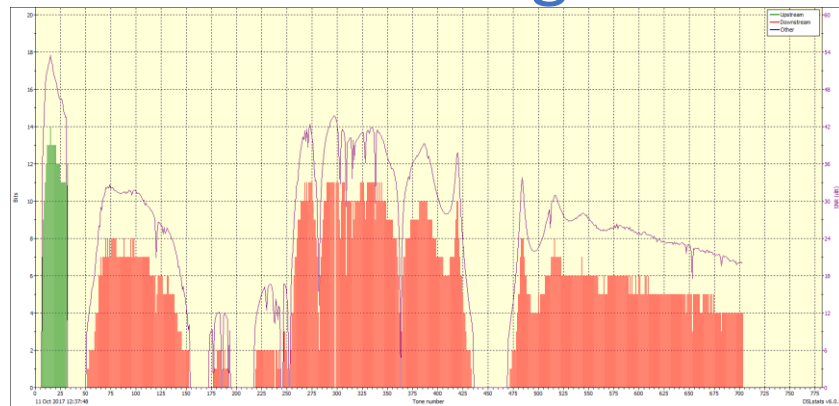
Comparison notch filter to transmitting CW



Notched



Transmitting & Notched



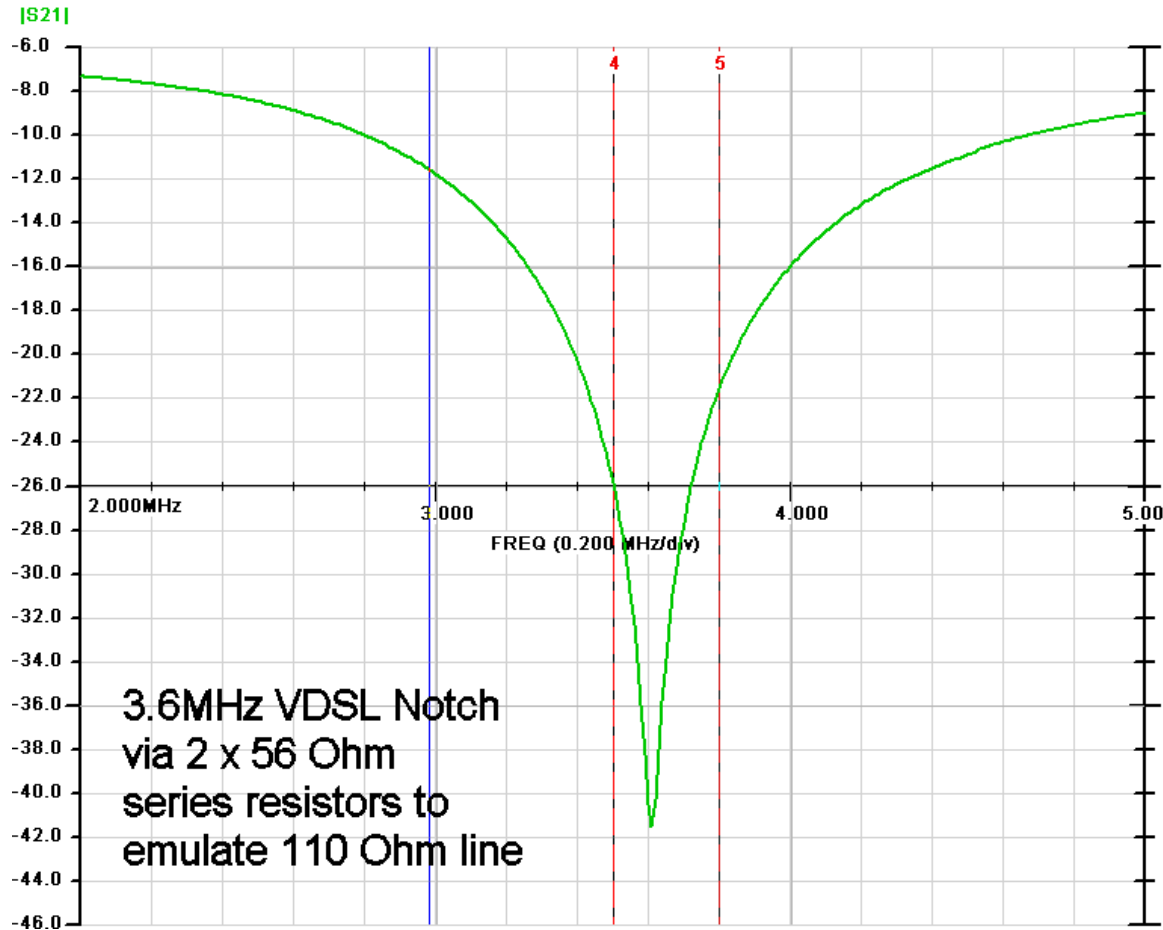
Transmitting

Frequencies knocked out by transmitting short burst of CW on frequency
Less impact if notch filter fitted
Some modems will loose sync when CW transmitted and VDSL will fail

Open circuit $\lambda/4$ wave stub on modem line



80m notch filter



4 μ H = approx 28 turns on a
T44-2 iron powder core and
a series 470pF silver mica

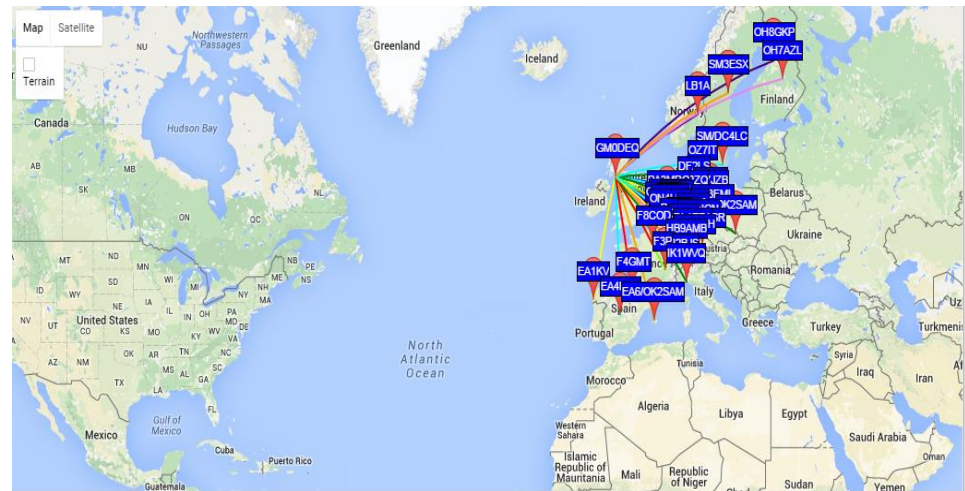
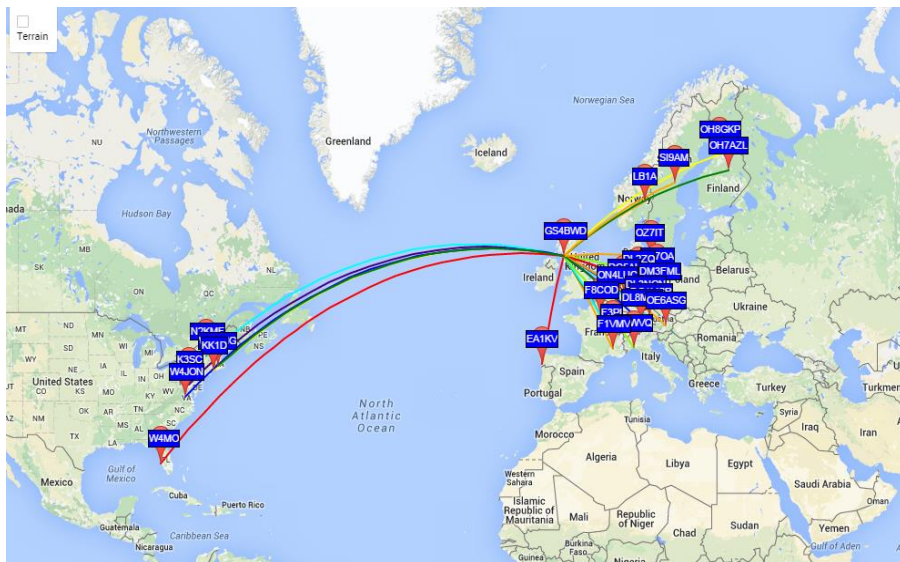
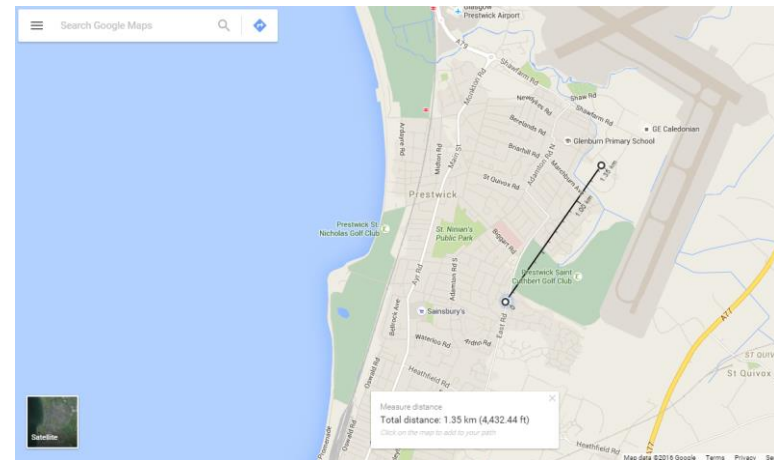
Harmful Interference Evidence to collect

- Remember need to demonstrate actual not potential Harmful Interference - no good just quoting RFI level
- **Here and There** – use two locations one with Interference and one close by without, use two equivalent set ups and log at both – automate if possible
- **Now and Then** – keep logs of contacts which were and were not made before the interference and contrast with situation now
- **With and without** – locate and either turn off or null the interference to show stations workable when Interference is absent

Here and There (GM0DEQ)

WSPR set up at two nearby locations (10.1MHz)
One suffering from VDSL2 RFI, the other not
Plots of signals received at same time for both

Notice absent of weak signals from USA



How could Openreach reduce Harmful Interference ?

- Improve Line Balance where necessary – mechanism in place
- Clean-up self installs - difficult when a neighbouring property
- 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 antennas when necessary
- Provide FTTP instead of FTTC at problem locations

What Services does EMCC provide?

- **Advice and Support**

- Help members with RFI problems
 - Help Desk, EMC Matters Forum and problem reporting
 - Self-diagnosis using EMC leaflets and RSGB website
- Increasing awareness through web pages and publications
 - Regular EMC column in Radcom – “EMC Matters”

- **Protect the Spectrum from RFI**

- Representation on Standards Committees
- Lobbying regulators, suppliers and service providers
- Investigations of interference from new technology
- Recommendations for emerging problems



Website Update

- [Is the interference real?](#)

First determine whether the interference is real, and is actually coming from the outside world, or whether the apparent interference is really being generated within the receiver itself

- [Is the source of the interference in your own shack or in your house?](#)

Because interference is more likely to be acute the nearer the source is to the receiver and its antenna, a very good starting point to look for an interference source is within the shack itself or within the amateur's own house

- [Is the interference coming from somewhere nearby your property?](#)

If the source is not within your own location, could it be coming from a neighbour's house or a nearby location?

- [Is the interference coming from a more distant source?](#)

If other amateurs can hear the same interference then it is probable that a more distant interference source is involved

- [Characteristics of the interference](#)

If the source of the interference is not obvious, or if there appears to be more than one source, then examining the characteristics of the interference may help identify the possible cause(s)

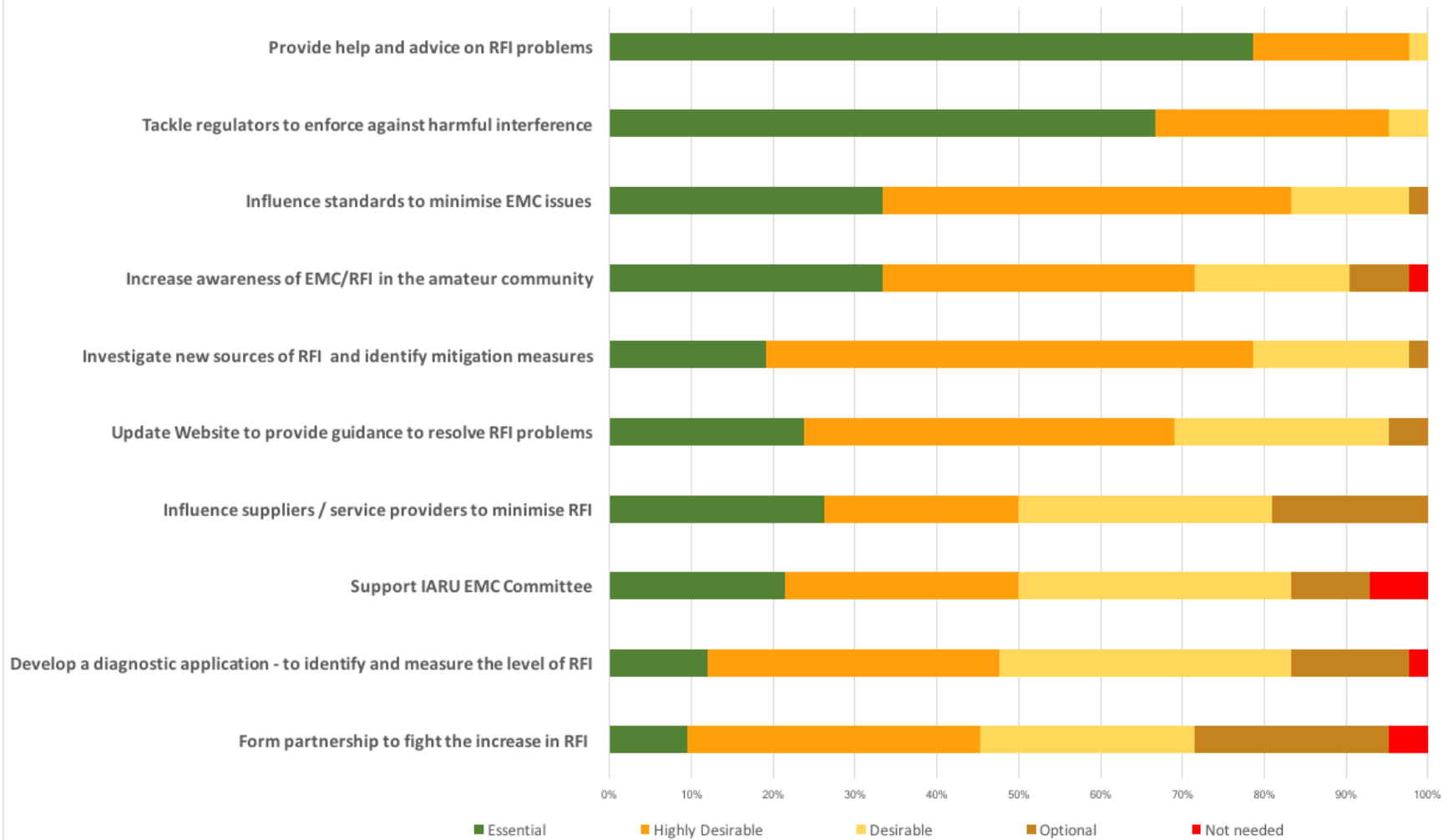
Standards Work

- Regular attendance of BSi EMC Standards Committee meetings
- Analyses of and contribution to draft Standards in development
- Coordinated tracking of EMC Standards - Focus on Measurement and Methods, Power Line Devices, Wireless Power Transfer, Solar PV and Wind Farm, Lighting
- Ranking Standards by importance to EMCC/RSGB using numeric scoring

IARU Conference C7 Outcomes

- Planning international noise floor measurement campaign including prior work done by national societies
- Influence national standards organisations to cover:
 - Wireless Power Transfer emission limits Input papers to CEPT WG SE21 and SE24 for Electric Vehicle charging
 - EMD from large structures like wind turbines
 - HVDC converter stations / undersea links from offshore wind farms
 - PLC standards for frequencies above 30 MHz and MIMO
 - Cigré limits for sub-stations
- Create a data store for interference observations

EMCC Task Priorities



Thank You for your attention

**Any Questions...
Just Ask!**

