Keeping Spectrum Clean

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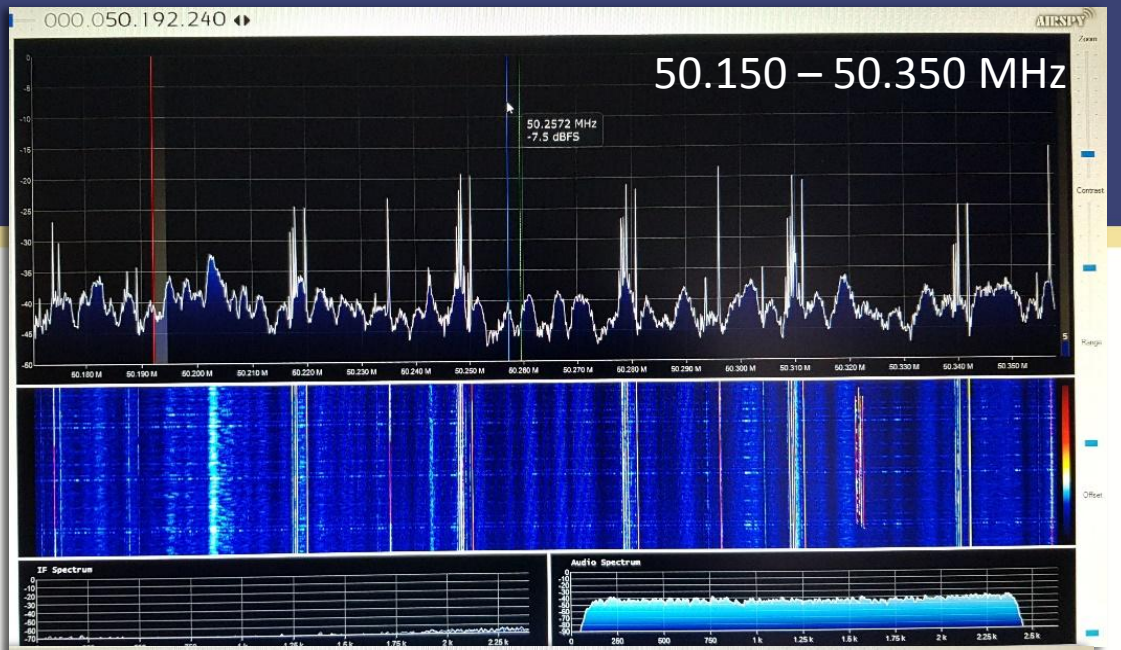
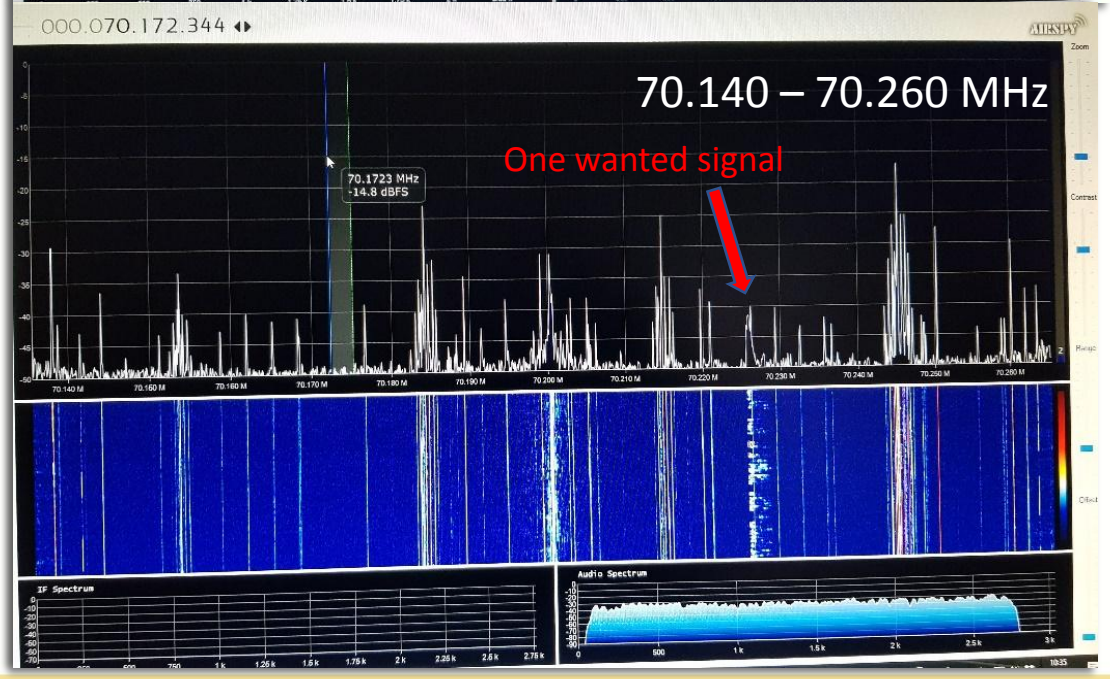
Amateur Radio

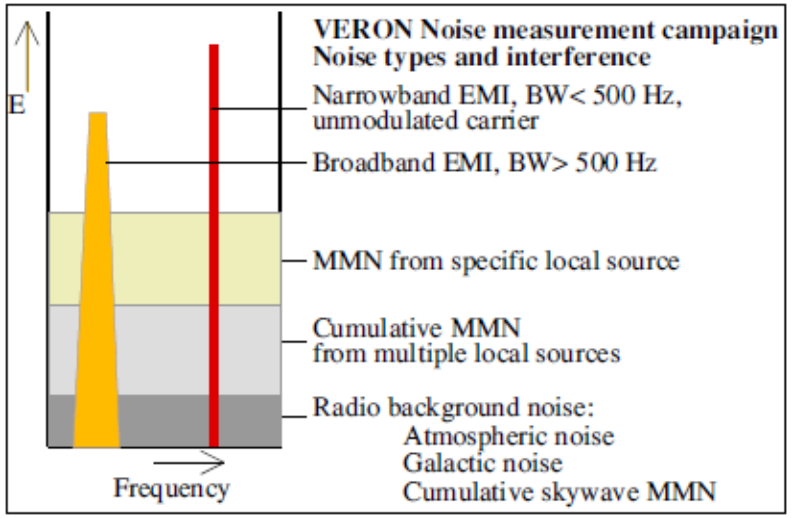
- Licences allow operation in specific frequency bands over the range 136 kHz to 250 GHz.
  - Some variations nationally
- Equipment can be characterised as having low noise receivers, high dynamic range, efficient antennas, multi-mode operation and SDR techniques common-place.
- A technical hobby that requires knowledge of electronic and radio communications engineering.
- Weak signal reception is the driving challenge.
- Electronic “smog” raising the noise floor on many bands.
- Impulse and narrow in-band spurii are common on most frequency ranges into UHF.





Man Made Noise Measurement Campaigns

- Measurements taken at 54 different locations
- There is a statistically significant increase of the MMN floor in comparison with the reference levels as given in Recommendation ITU-R P.372-13 (Radio Noise).
- Increase is highest in dense build-up regions like city centre, where increases up to 14dB averaged, with peak values over 20dB, exist.

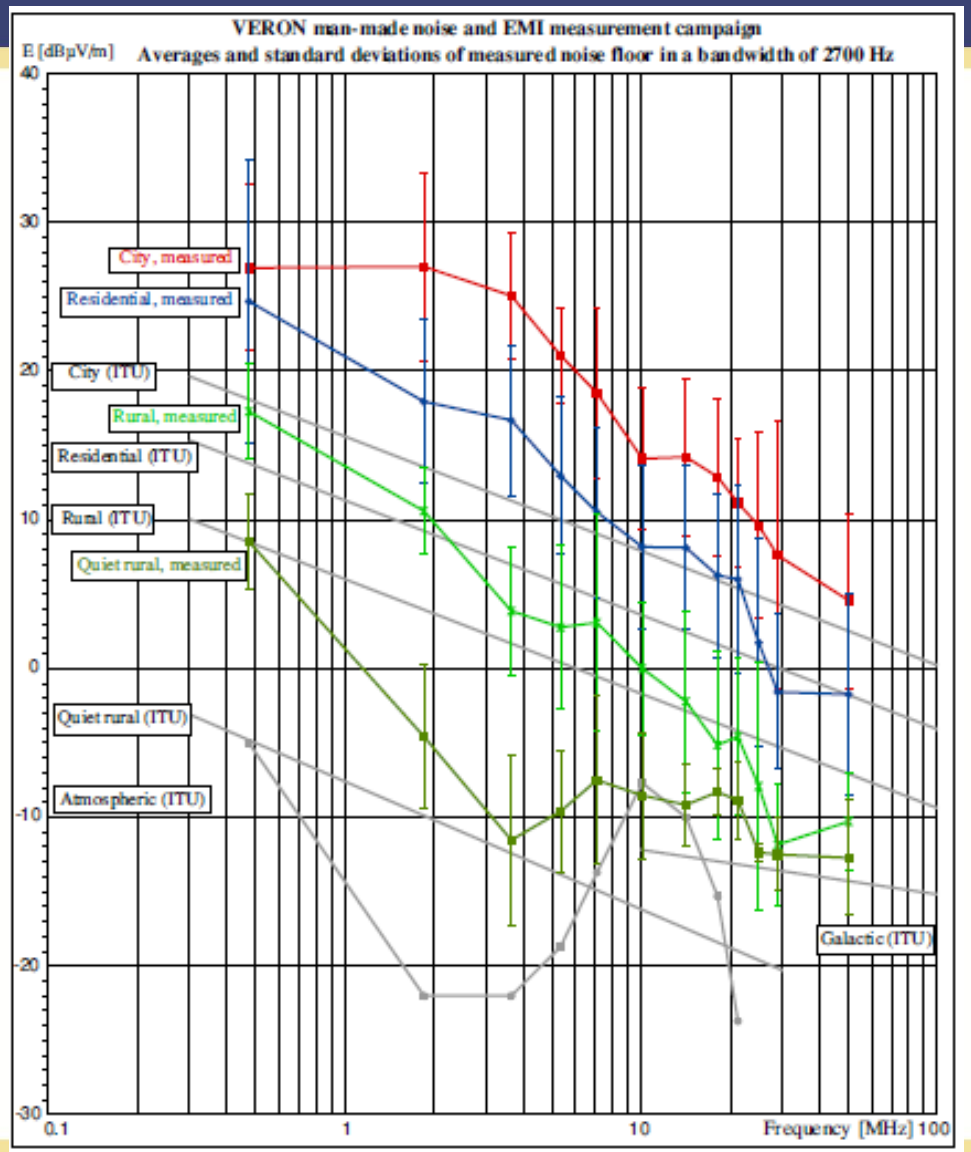


North Sea noise measurements (*BNetzA and German Maritime and Hydrographic Agency*) have indicated:

…..a communication degradation in the maritime mobile service by 10 to 15 dB, sometimes even up to 20 dB, in the HF bands.

Ref: PRELIMINARY DRAFT NEW REPORT ITU-R M.[HF NOISE AT SEA]. October 2017

Ref: Measurement Methodology and Results of Measurements of the Man-made Noise Floor on HF in The Netherlands
Koos (T. W. H.) Fockens, Peter (A. P. M.) Zwamborn, Frank Leferink



Non-radio emissions – “smog and birdies”

- Proliferation of Digital devices in the home.
  - IT and entertainment equipment
- Internet connectivity and data distribution.
  - Powerline distribution around the home
  - Subscriber Line connections into the home – ADSL/VDSL
- Proliferation of inadequately filtered switching power supplies.
  - USB Device chargers
  - LED low voltage lighting systems
- Solar panel installations.
  - Power optimisers.

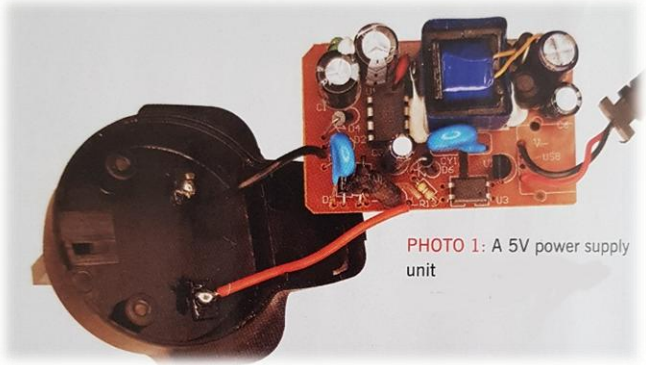


PHOTO 1: A 5V power supply unit

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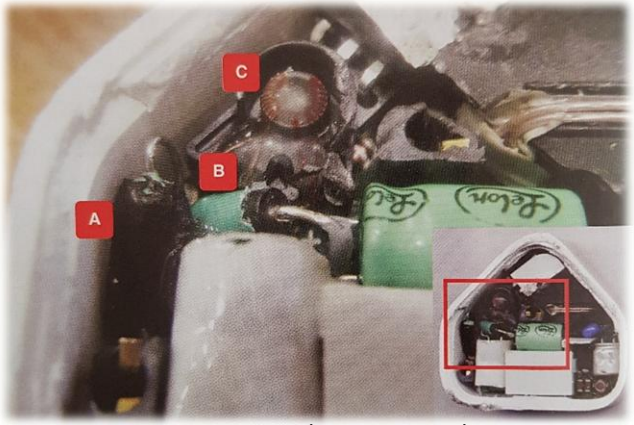

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Non-radio communication systems - DSL

- ADSL/VDSL 1.1 to 17.44 MHz
- G.Fast up to 106 / 212 MHz.

FIGURE 9: Comparison of two simultaneous recordings at different but nearby locations.

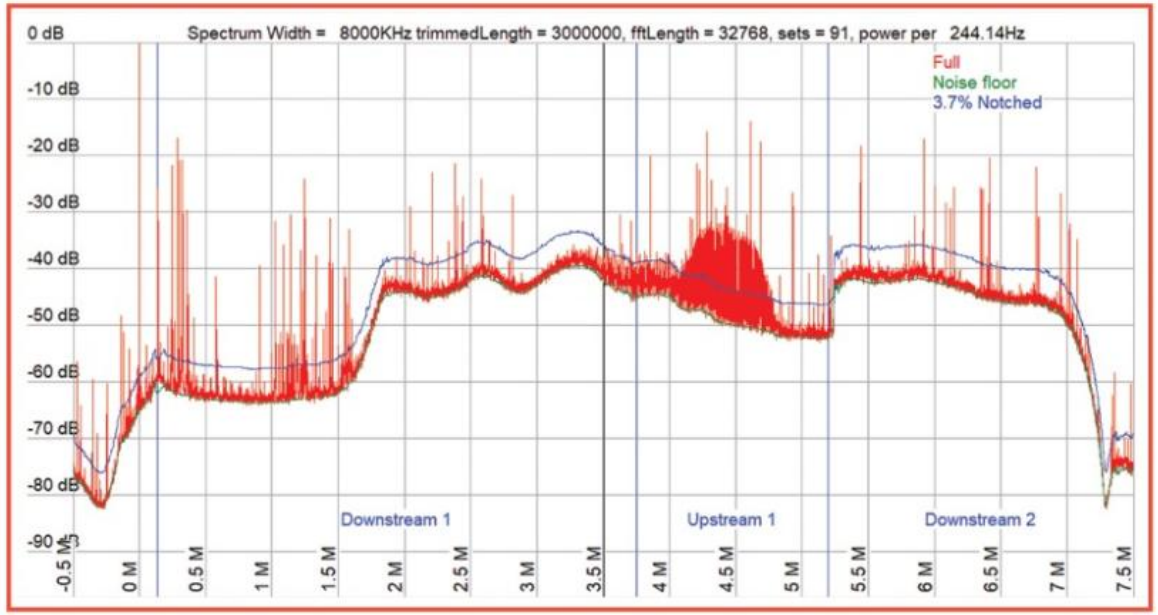


FIGURE 2: Recording from an SDRplay RSP1 centred on 3.5MHz.

- 14 MHz band recording
- Residential (red) and rural location (Green)
- VDSL interference looks like background noise

Figures from RSGB RadCom November 2018

Measuring VDSL interference

- *Lelantos* software developed by Dr Martin Sach
- VDSL signature difficult to isolate and identify

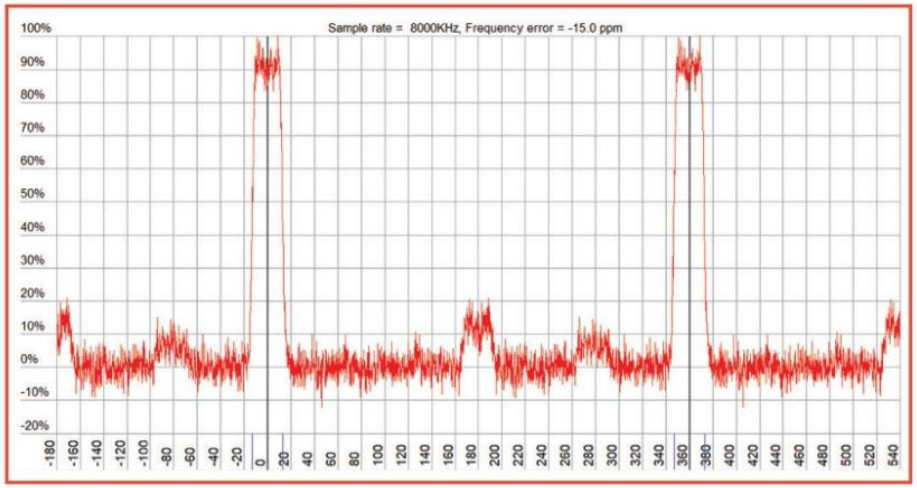
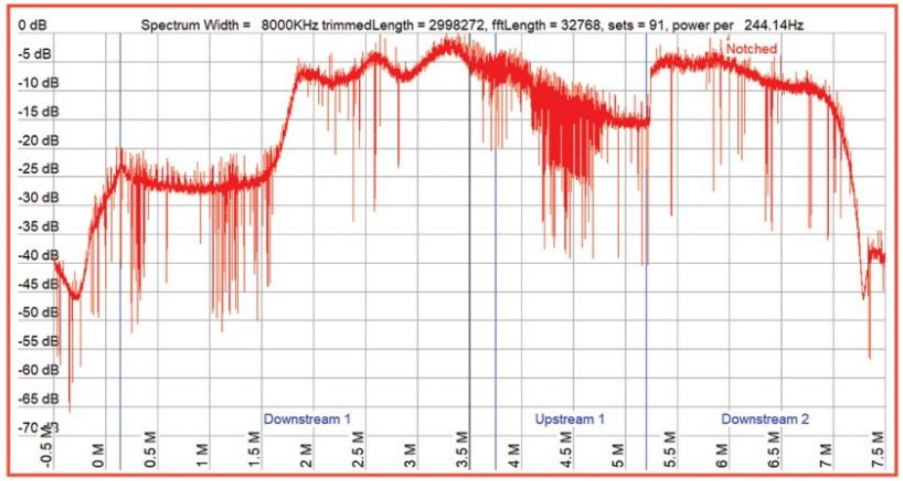


FIGURE 5: Variation of correlation with time.

- Remove narrow signals
- Some elements are predictable.
- Sync and cyclic extension



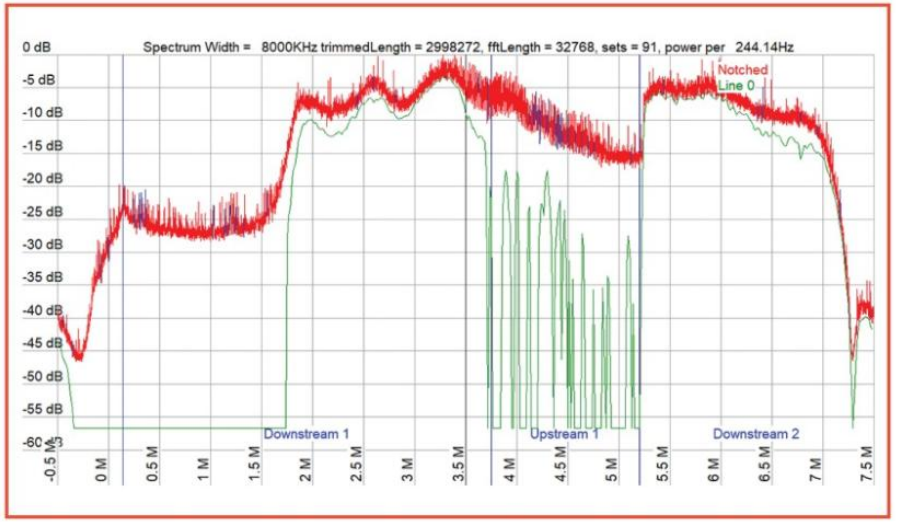
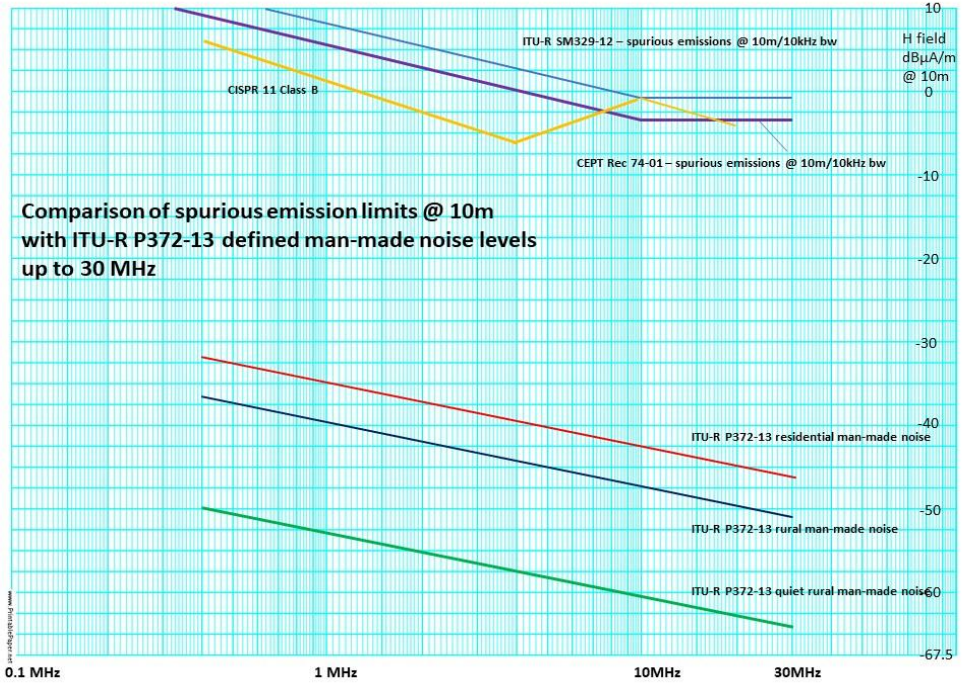


FIGURE 6: Analysis of first 8MHz file, DC-7MHz.

- Extract strongest interferer spectrum

Wireless Power Transfer – EV (79-90 kHz)

- The Amateur Service and other radio services (e.g. broadcasting, aeronautical…) have been contributing to work in CEPT (ECC Report 289 approved Jan 2019) and in ITU-R (SG1).
- Given the planned density of WPT-EV systems, it is calculated that there will be a widespread and serious impact on radio reception in the vicinity of WPT systems should spurious emissions, measured at 10 m be at the current limits of ERC Recommendation 74-01.
- An appropriate limit at 10 m would be: -46 dBµA/m at 300 kHz reducing by 7 dB per frequency decade to -60.0 dBµA/m at 30 MHz.
- This can be relaxed by 20dB if all WPT systems adopt a single common frequency of operation.
- Graph shows the modelled decay of emissions which are above the residential noise out to 1km @ 10 MHz.
- ITU-R is about to publish a report on WPT-EV with similar data and findings.
- CISPR is considering emission limits **about 30dB above** those that radio services feel are needed.



Graphical representation of emissions limits compared with background noise levels in Recommendation ITU-R P.372-13

Ref: Fig 33 - ECC Report 289

Concluding messages

- **We observe that:**
- EMC standards are slow to evolve. – CISPR process has not kept up with the evolving growth of multiple device types, installed density & duty cycle.
- Insufficient resources provided for effective market surveillance and removal of non-compliant devices.
- Enforcement activity sometimes falls between enforcement bodies.
  - Trading Standards or Spectrum Regulator?
- Increase awareness is needed amongst developers and manufacturers of non-radio systems of radio spectrum sensitivity to aggregated interference.
- Amateur service complaints are often dismissed as unimportant – but all radio services can suffer eventually.