Noise assessment of potential field sites
by
G3XSD/G5T

Firstly - Why?

IVARC has had a history of participating in field days*
Sites used come and go
When new sites or returns to sites are needed a site evaluation is wise
Is the site suitably electrically quiet?

We can’t afford to get it wrong!

We do it for fun! What if there is no fun?

* or similar, such as Guides Thinking Day On the Air

Context

A practical approach tailored to judging Field Day sites

- This is built around two Big Ideas
  - Measuring and then projecting how IVARC's kit would perform on site
  - Comparing results with the radio world's expectations fo such a site AND how the results compare with what that same kit achieves at G3XSD/G5T home QTH
- All this requires a lot of kit commonality and a way of matching instrument antennas with those used by IVARC
- Examples in this talk are from an assessment of Church Field, Compton

Projecting IVARC kit performance on potential site

- Measure ambient noise at G3XSD (QTH) with TinySA & standard antenna
- Measure at QTH with TinySA & CobWebb and W3DZZ
- Compare results and note differences between standard antenna &CobWebb/W3DZZ
- At potential site, use TinySA & standard antenna to measure ambient noise
- Apply differences to prediction model to how CobWebb/W3DZZ would perform at site

Other things to think about

What is ‘noise’ in this context?

How do we know what noise values to expect?

Antenna noise properties

The need to understand the properties of your instruments

Measurements, Calculations, and issues

Noise standard definitions

The noise at G3XSD QTH classified as a comparator

What is noise in this context?

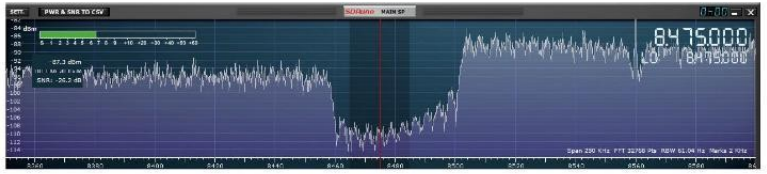
- Given that what we are after is wanted signals, noise is anything that adds to those signals in a detrimental way, making them harder to resolve i.e.
- Natural electrical noise; man-made electrical noise [deliberate or accidental]; Interference [deliberate or accidental];inherent component based electrical noise and so on. Anything that reduces the signal to noise ratio unacceptably.
- So why do we need to assess a site or sites now?
- We had to leave the Compton site some years ago because of excessive noise suddenly appearing. There being few other sites offered we need to discover if it was still the same or had it recovered.
- What are we expecting (to be acceptable?). Two sources of expectation: ITU understanding of typical environments; and comparative measurements locally

Key points in any context!

- Know what to expect when you see it - [know characteristics]
- Know what you see when you expect it- [recognise types of noise]
- Don’t measure anything if you don’t know what it should be
- If you can’t measure it, you know nothing about it! (paraphrase from Lord Kelvin)

Example - VSDL

The following diagram shows an expanded example of the 8.5MHz guard-band.



In addition, with an SDR receiver, the 4.3125kHz pattering of VDSL carriers may be observable on a waterfall display.

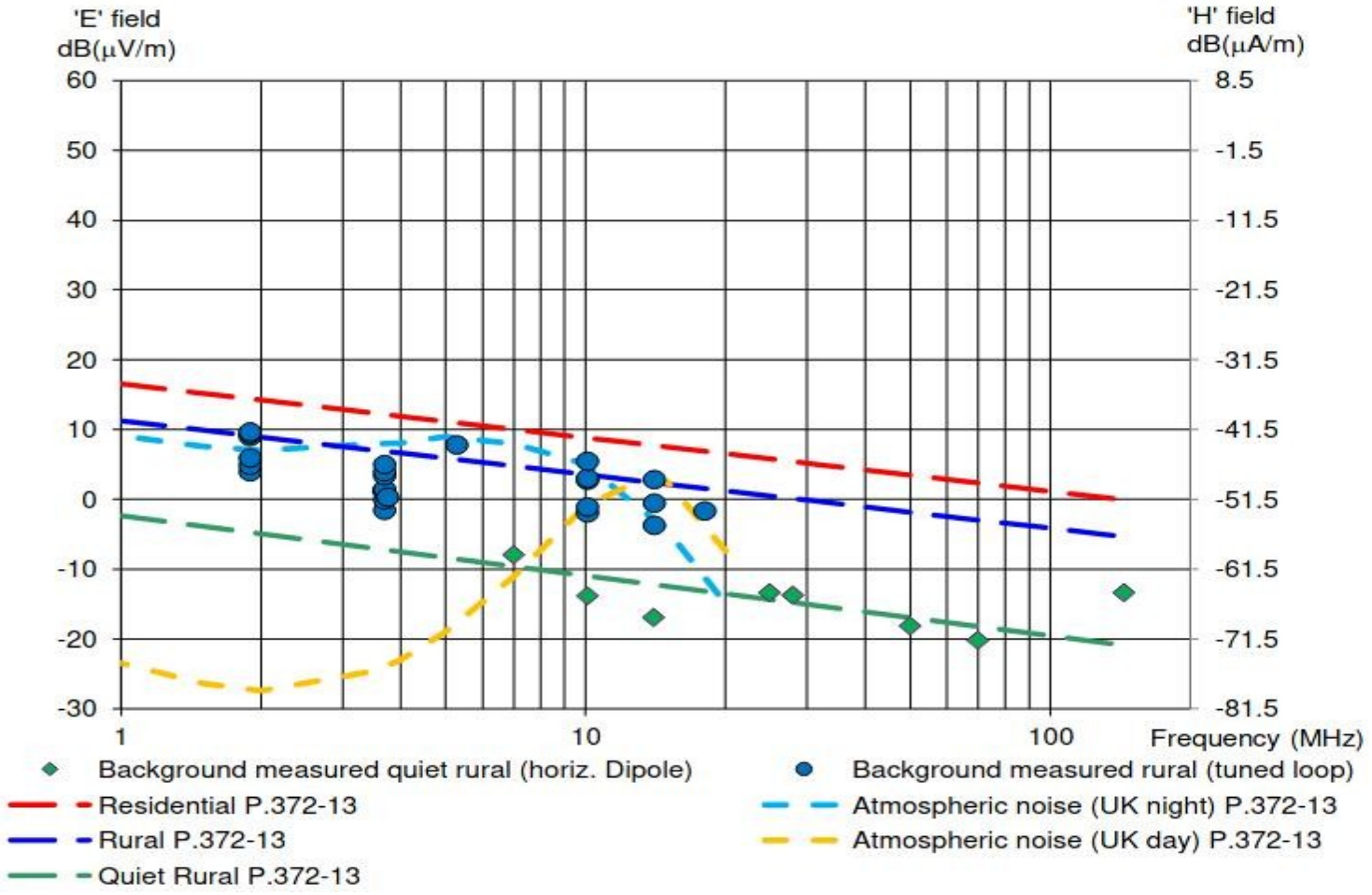
When looking for VDSL guard-bands, be aware that any particular VDSL system may not necessarily use all of the upstream and downstream bands so it may be necessary to check more than one of the guard-bands. For example, the diagram below shows the spectrum of a VDSL system using upstream band 2 (U2, from 8.5MHz to 12MHz), but not upstream band 1 (U1, from 3.75MHz to 5.2MHz).

- Guard Bands – here the 8.5MHz

  Note: lower noise before the guard band; higher above

- 4.3125kHz patterning

ITU environmental expectations



Antenna noise properties

- Antennas – all doublets/dipoles
  - ITU models
  - Cobwebb
  - W3DZZ

➔ All antennas passive and 50 ohms (‘ish’ in bands used)

➔ All antennas close to omnidirectional – used as inv Vee/ Halo

➔ Only TinySA whip varies -very small aperture – a short monopole

- Antenna Noise only significantly different when directional* or active** or different feedpoint impedence***

  * noise source from given bearing vs beamwidth

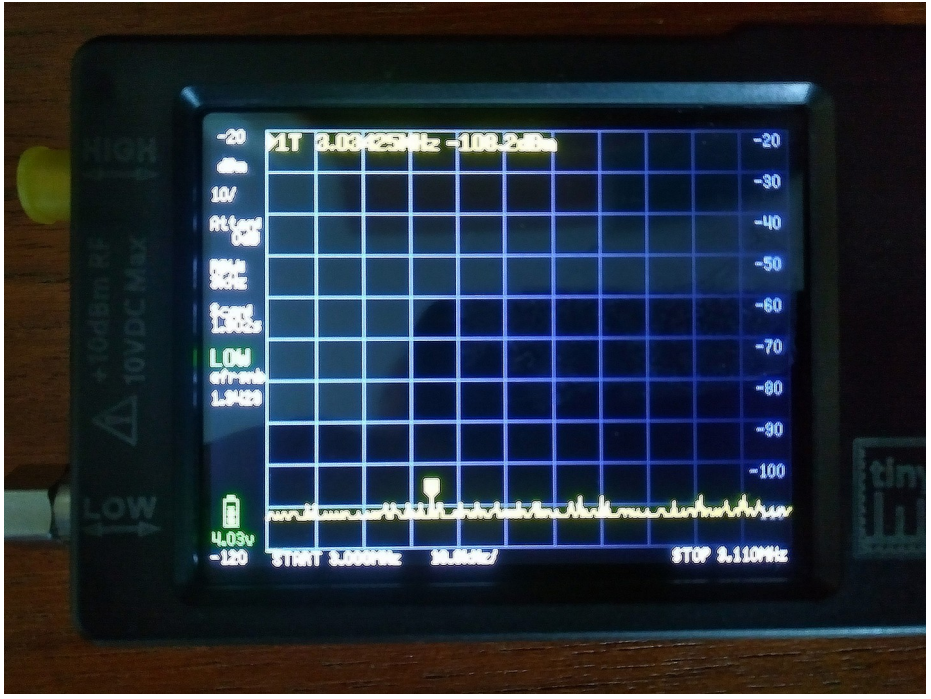
  **Noise Figure of amplifier

  ***Inherent thermal noise for other than 50 ohm resistive

- Natural Background (ambient noise) for all expected to be similar -

Tools 1 -Need to measure the noise floor of the instrument

- The instrument is a TinySA
- To do this you need a 50 ohm termination for the input
- Not provided with the TinySA, but is with the VNA device
- Noise floor is -112 dBm



Tools 2 - Role of Portable Communications Rx

- Attempt to identify any impulse/spurious signals seen on the spectrum
- Scan bands of interest to find any Spectrum Analyser RBW escapees – it is impossible to see spectral detail below the RBW
- A tool to trackdown sources

The roles and issues of the Tools

- TinySA and RBW
  - To give a picture of the part of the spectrum examined
  - Resolution Bandwidth of a Spectrum Analyser determines the detail with which the spectrum is resolved
  - TinySA has 3/10/100KHz/1MHz for RBW
  - Trade-off: Resolution Vs. Time to refresh; Sigs could be missed, e.g. conflated with others
- Portable Comms Rx
  - Scan the bands for possible missed man-made or other interfering signals
  - Track down the source of such noise signals
  - Identify the type of signal or nature of noise in question

Resolution Bandwidth vs. Sweep Range

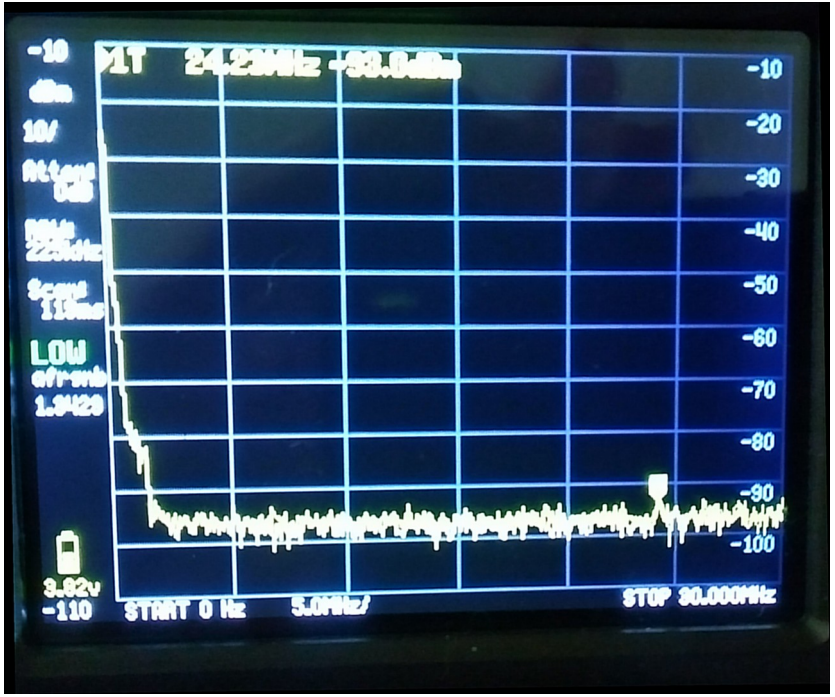
- The Resolution Bandwidth (RBW) plays and important role in resolving signals that are close together in the frequency domain.

- The RBW defines the bandwidth of the IF filter in a heterodyne receiver, and it controls the frequency resolution of the resulting spectrum – the smaller the RBW, the higher the spectral resolution, which means more peaks of frequencies are shown and distinguishable. If the resolution bandwidth is too broad, two frequncy componenents can easily be combined into one and it can be difficult to tell them apart.

  The RBW also defines the minimum sweep time, since smaller RBWs require longer sweep times, because narrow filter have longer settling times than wideband filters.
- Sweep Range is the difference between the start and stop frequencies.

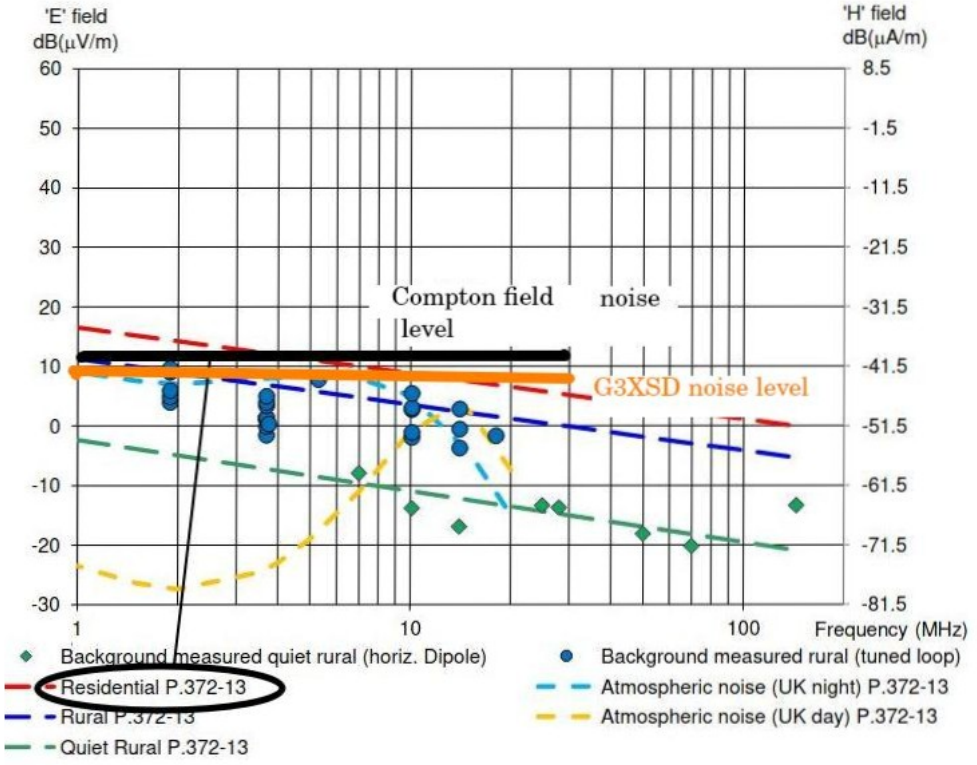
Ambient noise as -dBm or s points
(unfamiliar with -dBM or dBuV/m? Try S points!)

S-point	Microvolt	dBm
S9+10	= 160.00 µV	= - 63 dBm
S9	= 50.15 µV	= - 73 dBm
S8	= 25.13 µV	= - 79 dBm
S7	= 12.60 µV	= - 85 dBm
S6	= 6.31 µV	= - 91 dBm
S5	= 3.16 µV	= - 97 dBm
S4	= 1.59 µV	= -103 dBm
S3	= 0.79 µV	= -109 dBm
S2	= 0.40 µV	= -115 dBm
S1	= 0.20 µV	= -121 dBm



Compton field vs. G3XSD QTH – Ambient noise

- ITU expectation E field expressed as dB(uV/m)
- dBuV/m =dBm+10log(Z)+90*
- -96dBm=11dBuV/m**
- -99dBm=8dBuV/m**
- Places noise environments on near average of Residential expectations (1-30MHz)* or change Units on TinySA menu, or lookup table **@ https://www.cantwellengineering.com /calculator/convert/dBuV



Reference antenna results at Compton and G3XSD QTH dBm ambient noise

MHz	3.5	7	14	21	28
Reference Antenna at Compton field centre	-95	-95	-96	-96	-95
Reference Antenna at G3XSD QTH	-99	-97	-99	-99	-98
W3DZZ/Cobwebb at G3XSD QTH	-80	-84	-96	-99	-101
Difference dBm of Reference Antennas at The two sites	4	2	3	3	3
Predicted W3DZZ/Cobwebb at Compton	-76	-82	-93	-96	-98

Man Made Noise Results

- Checks ‘in bands’ only because of RBW concerns-choice 10kHz or 3kHz
- What to check* : characteristics;times;as defined in https://rsgb.org/main/files/2019/09/EMC-Leaflet-4-Interference-to-Amateur-Radio-Reception-v1.0.pdf

  *SMPS;LED lights;VDSL(between guard bands, training frequencies); Wind turbines; Industrial inductive machines; overhead power cables (50Hz/100Hz modulation, Corona Discharge(Arcing, Faulty Insulators)
- Some manifest as individual narrow band, some as fundamental and numerous harmonics, some as wideband hash, some present all the time, others at given times.
- VSDL interference 0.025-17.66MHz then Gfast to 106 or 212MHz
- Characteristic guardbands, 4.1325MHz patterning. Lelantos (RSGB app identifies upstream/downstreams thus confirms VSDL interference sources)
- . See :https://rsgb.org/main/files/2019/01/EMC-Leaflet-15-VSDL-v2-January-2018.pdf
- Get Lelantos here:

https://rsgb.org/main/technical/emc/vdsl-interference-reporting/

Compton man-made interference evident

- Nothing significant present
- 3 tests at different times and days (particularly week-ends)
- A little noisier than G3XSD QTH, but wholly workable
- Caveat: Like an MOT, results are valid on the day of testing only!!

gak 2/23