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Subject: Increasing levels of the HF noise floor is a growing concern

Committee(s): C7

Summary: The lack of sunspots may hamper DX aspirations but, in a few years, the solar activity will pick up and the bands will be open on a more regular basis with DX roaring in. There is however another DX killer on the horizon – the increasing level of the RF noise floor which is created by man-made devices that most people use in their homes, LED light, electricity savings lamps and RF heated cooking devices to mention some. An even greater disaster looming is WPT, wireless power transfer for electric vehicles.

Text :

Increasing levels of the HF noise floor is a growing concern

National Societies should take action now!

The lack of sunspots may hamper DX aspirations but, in a few years, the solar activity will pick up and the bands will be open on a more regular basis with DX roaring in. There is however another DX killer on the horizon – the increasing level of the RF noise floor which is created by man-made devices that most people use in their homes, LED light, electricity savings lamps and RF heated cooking devices to mention some. An even greater disaster looming is WPT, wireless power transfer for electric vehicles.

It is true that not all these devices will cause interference as their design and manufacture includes filters and screening to mitigate interference. Currently international bodies such as CIPR are working on setting limits that these devices and equipment must meet. However, agreeing on limits is a long drawn out process as organisations like the International Amateur Radio Union and other Radio organisations call for stricter and more stringent limits, the industry on the other hand calls for the widest possible limits.

Another issue which is not taken into account is the accumulative effect of noise generating devices. Some discussions have started about this subject but are only at the stage of “Is it a problem and should it be investigated?”

Radio Amateurs cannot sit back, because even if the desired noise limits are agreed, there are many rogue manufacturers and dealers which happily sell the “noise generating” devices. Leaving out filter circuits to cut costs.

National Amateur Radio Societies should increase the awareness of a looming noise problem on the HF and in some instances the VHF and UHF bands and become actively involved in their national standards and regulatory organisations to ensure that the problem of the increasing RF noise floor is continuously addressed.

On 15 June 2016, the FCC office of engineering and technology technical advisory

council opened a noise floor technical inquiry in the form of ET docket no. 16-191 to seek answers to the following basic questions:

- Is there a noise problem?
- Where does the problem exist? Spectrally? Spatially? Temporally?
- Is there quantitative evidence of the overall increase in the total integrated noise floor across various segments of the radio frequency spectrum?
- How should a noise study be performed?

Unfortunately, most feedback was anecdotal and not accompanied by measured quantitative data. This is largely because the responders did not have the instrumentation resources nor the budget to provide the quantitative evidence being sought. Despite the scarcity of quantitative data submissions, one clear outcome of this TAC technical inquiry was an unmistakable consensus among the responders: A noise floor study is not only needed but overdue.

An IEEE EMC paper authored by Koos Fockens, Peter Zwamborn and Frank Leferink, showed that tests carried out in 54 different locations in the Netherlands over past decade there was a statically increase in the man-made radio noise (MMN floor) in comparison with ITU-R reference levels.

The paper, entitled “Measurement Methodology and Results of Measurements of the Man-made noise Floor on HF in the Netherlands”, refers to measurements made in various locations from lakes and woods at far distances from built-up areas to residential areas in various density of habitation and in city centres. As expected, the increase of the MMN floor was the highest in built-up regions.

The authors concluded that the data about man-made noise in ITU-R P.372 – 13 needs updating and made the suggestion for new values for the relevant parameters. Their measurement and analysis have confirmed the accumulation effect caused by the increasing density of interfering sources in close proximity. From their observations it can be concluded that the paradigm of MAN-MADE Noise has shifted over time. In conventual EMC standards it is assumed that only one single sub-system is present in the close proximity of the receiver but clearly that is not the case anymore!

At the 2017 IARU Region 1 conference in Germany considerable time was spent discussing EMC issues and the need for the monitoring of the RF noise floor. Two proposals emerged.

The DARC is working on developing a system that is close to the ITY-R measurement methods. They are using an active vertical antenna (active E-field probes). The receivers are based on a Red Pitaya (<https://www.redpitaya.com/>) using different input bandwidths. Each receiver has a dynamic range of 100+dB, by applying two receivers in parallel the dynamic range is extended significantly. DARC plans to roll out 50 systems during 2019.

The SARL is working on a different approach. It is encouraging radio amateurs to set up their own RF noise monitoring systems using a dongle and a Raspberry Pi. A number of stations are already in place and streaming data to a national server. The HF noise monitoring system takes a 12 x 1MHz bandwidth sample every 2

minutes using the RTL power utility and saves the measurements in a CVS file. The 2-minute scheduling is done with a Crontab calling a script in the HF-noise directory. The RF samples are taken at a 1MHz bandwidth from 1MHz to 30MHz, therefore 29 of CVS files are created and get appended as the measurements are made.

A Perl script utility is executed from a CRON scheduler to read the 29 CSV files and import their data into an RRD database. The RRD database then gets interrogated by another Perl script scheduled by a CRON job to generate the graph images and HTML files and get saved in the Apache web server graph directory which is then exposed on the local link http://localhost/hf_noise/graph/1Mhz_Power.php

The RRD database will then create the Hourly, Daily, Weekly, Monthly and Yearly averages and then generate the graphs every 2 minutes according to the parameters passed to the database.

The generated graphs are then displayed in a PHP page via an Apache web server with a PHP plugin. Trends can then be seen on the graphs over time.

The heat map is generated by a Python script from different CSV files and is saved in the `/var/www/hf_noise/images` directory and can be accessed on the local web server.

The data recorded is at this stage not calibrated data as individual stations use different antennas and dongle arrangements. The SARL is working on a project to develop a standard antenna which can be calibrated.

Currently the system is used to show trends over time at individual stations and has already been used by individual radio amateurs to resolve noise issues in their areas.

The system is under continuous development but as the SARL President, Nico van Rensburg said at the IARU Region 1 meeting, it is a start and is making radio amateurs more aware of the looming problems and start mitigating noise problems in their own area.

Link to the live system http://zr6aic.giga.co.za/hf_noise/images/ and http://localhost/hf_noise/graph/1Mhz_Power.php

More details are on <http://rfnoise.amsatsa.org.za>

Conclusion

National Societies are urged to take the increases in the RF Noise level seriously and participate in discussions about EMC at local level and where possible join their local standards organisation or institution where the problem is being addressed. Regulatory authorities must continuously be made aware that Radio Amateurs care about the continuous increases in the RF Noise Level, particular increases in Man Made Noise.

Proposal

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