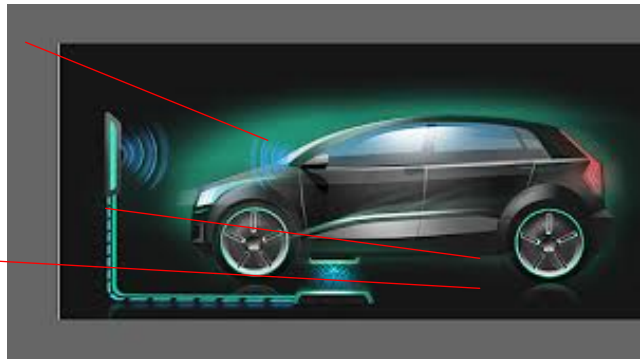
RF Noise can kill amateur radio!

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 lights, electricity savings lamps and RF heated cooking devices to mention but a few. An even greater disaster looming is Wireless Power Transmission for electric vehicles (WPT- EV).

Power generation unit

Receiver coil for power transfer

Charging pad



Wireless Power Transmission for electric vehicles represents a threat to the spectrum because of the powers involved (up to 22 kW) richness of the harmonic content of the emissions, the duration of charging (measured in hours) and the projected density of deployment in residential areas.

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 CISPR 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 (IARU) and other radio organisations call for stricter and more stringent limits, the industry is calling for more lenient limits. Another issue which is not taken into account is the cumulative effect of noise generating devices. Some discussions have started on 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 who will happily sell “noise generating” devices, leaving out filter circuits to cut costs.

IARU national amateur radio societies should increase the awareness of the rising noise problem on the HF bands and in some instances the VHF and UHF bands, and become actively involved in their national standards bodies and regulatory organisations to ensure that the problem of the increasing RF noise floor is continuously addressed.

An IEEE EMC paper authored by Koos Fockens PA0KDF, Peter Zwamborn PE1GEX and Frank Leferink, described tests carried out in 54 different locations in the Netherlands over the past decade, which showed there was a statistical 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 with varying densities of habitation, as well as city centres. As expected, the increase of the MMN floor was the highest in built-up areas.

The authors conclude 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 has confirmed the cumulative 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 conventional EMC standards it is assumed that only one single sub-system is present, in close proximity to the receiver but clearly that is not the case anymore!

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.

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 (Germany) is working on developing a system that is close to the ITU-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 2019/2020.

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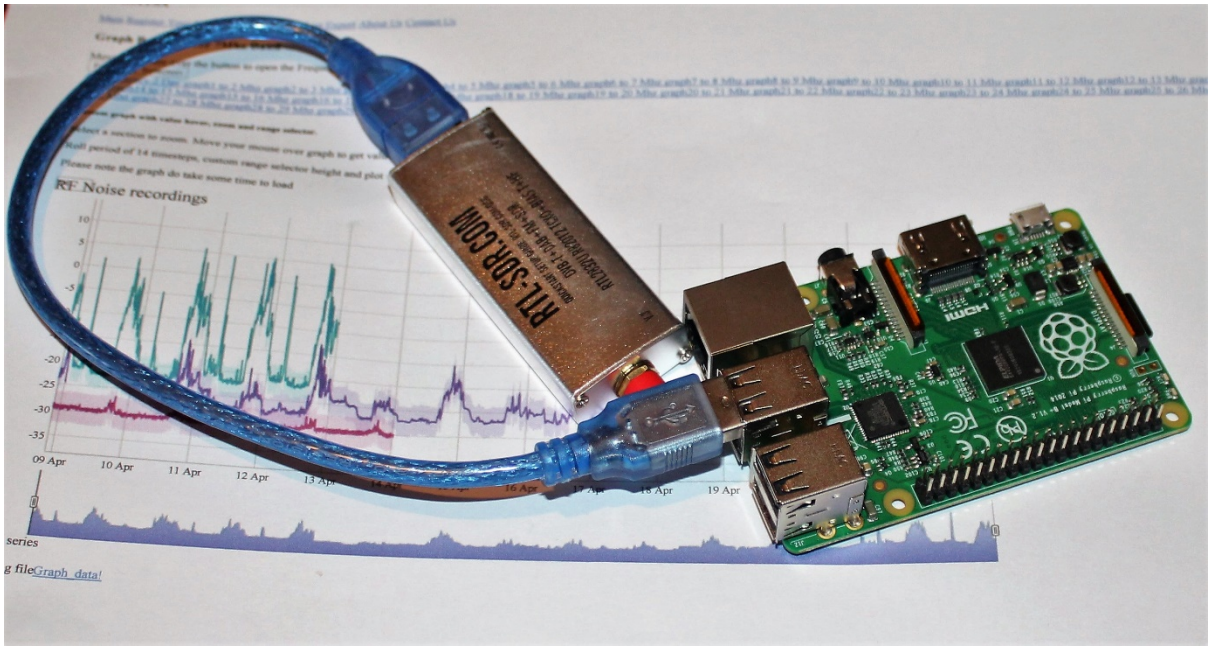
An ENAMS Receiver

A video in German gives more details of ENAMS: https://www.youtube.com/watch?v=vFYVpJ9FPZ8

The South African Radio League (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. The HF noise monitoring system takes a 12 x 1MHz bandwidth samples 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 the 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.

The data recoded is not calibrated. Individual stations use different antennas. The SARL is working on a project to include a calibration factor in the software and a system where each remote station is calibrated against a known standard.



Typical Raspberry Pi RF noise monitoring station using a RTL dongle as used by the SARL in South Africa

More details of the South African project are on http://rfnoise.amsatsa.org.za

The IARU Region 1 EMC Committee has formed an RF Noise Measurement Group which meets quarterly on a conference call (GoToMeeting) to share ideas and experiences. Currently one of the projects being considered is to develop a common database format so that the output from various monitoring stations can be loaded on a central sever for further analysis. Invitations to the RF Noise Monitoring Group discussions are sent to all Region 1 member societies.

National societies are encouraged to join the project and tackle unwanted noise before it becomes so bad that our bands become unusable.

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