Newcomers and Elmers Net
Getting Serious with Dongles – What They Can Teach Us
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Listening in to 10 Meter Radio Beacons

Radio beacons can be found across the RF spectrum from the LF (low frequency) band all the way up to bands inhabited by satellite signals. If you are a ham, shortwave listener or a QRP (low power) buff then a great place to start is on the 10 meter band, which is included on most table-top shortwave radios and even some portables. Beacon signals come and go with band conditions, emanate from different parts of the globe and provide one with listening challenges and hours of fun. So let's talk about 10m as it's a good place to start.

A good indicator of band conditions on 10m is via the 10m beacon band which ranges from 28.1 to around 28.3 MHz. In general, most stateside beacons are found from 28.2 – 28.3 MHz while DX (ex-US) beacons are heard from 28.1 – 28.2 MHz. However, I've heard DX beacons as high up as 28.297 MHz.

These stations provide hams and SWLs not only with code practice but with the adventure of hearing low power signals from around the globe. To get acquainted with what is on the air, check out the Ten-Ten International Net website which has one of best lists of beacons, along with a plethora of information on the band itself: http://www.ten-ten.org/index.php/resources/ten-meter-beacons . The Ten-Ten club has been around for many decades and is a good resource of information on 10 meters in general; one can even be issued a unique Ten-Ten ID number upon request. Then, when making 10m contacts you can exchange Ten-Ten numbers with fellow operators.

Beacons dot the globe with their low powered one-way signals and are a challenge. Hearing a beacons' very weak CW signal fading in and out with its' short message, usually starting with a series of "Vs" followed by the call, then by info such as location, wattage, grid square is a timeless source of pleasure.

There are literally hundreds of beacons to hear using your shortwave or ham radio, all coming in at different times of the day from places far and near. And there's no need to be in the shack; check them out using a portable radio because when band conditions are favorable, you're bound to hear them. And for those of you with RTL-SDR dongles, these miniscule radios are

perfectly capable of receiving beacons and have the added feature of "looking" at that portion of the spectrum both via the 2-MHz wide spectrum display and accompanying waterfall image. These dongles are an inexpensive entry into HF/VHF/UHF listening and cover all modes.

You can also purchase slightly better units which come able to handle frequencies below 25 MHz, usually by a process of upconverting. This opens up the HF bands to searching for signals, and can be a great benefit for checking propagation, finding weak signals, helping you get familiar with digital modes etc.

There are many, many kinds of signals out there, including weatherfax signals, Maritime broadcasts, aircraft navigation, military signals, all kinds of amateur digital modes and even police, fire and other public safety broadcasts.

What I wanted to do tonight was to talk more about the tools available for using these SDR dongles and how they might be used to expand your amateur radio horizons, as well as introduce you to the world of SDR, the coming wave of the future.

The SDR dongles require software to make use of their capabilities, and there are numerous programs available.

- Some of the more popular programs are SDR#, fldigi, MultiPsk, HDSDR, and many, many more. To see a list of many of the current programs and add-ons check out RTL-SDR.com
- I'll stick with SDR# as it is by far the most widely used program.
- While there may be little differences in screens and options depending on what SDR you are using, in general the program features are standard

There are options for the mode you want to use, such as SSB (U/L), CW, AM, FM (wide/narrow)

- There are numerous filters which can be set or added onto the software, and of course there are many add-on modules to allow specific manipulation of data, such as decoding digital P25 signals (not encrypted, of course!), trunk tracking for police/fire/business, signal analysis tools, and so on
- The two main aspects of the program are the spectrum trace (sometimes called spectrum analyzer) function and the waterfall function – these are the tools which will be used the most often

- Both of these software functions open up a world of information to you, more than what most modern radios can show you, and even radios including waterfalls and panoramic displays usually cannot show as much information or offer the amount of adjustment available with software like this

Let's start with the spectrum trace function

- Its primary purpose is to show a range of frequencies, called bandwidth, with an X/Y graph showing frequency bandwidth along the X-axis, and amplitude along the Y-axis
- The amplitude scale is measured in decibels, in this case going from a high of -20dBFS to a low of -130 dBFS (decibels Full Scale)
- When you move the mouse across the graph it shows at each point the decibels, frequency offset from center, and the signal-to-noise ratio based on the noise floor
- This means wherever there is a signal you can measure the signal peak to determine its strength, or compare it to a primary signal
- So for example, let's say you are hearing a DX station on 7.135 MHz and you have centered your software on that frequency; you can now see other stations around that center frequency and determine how strong they are, and from which side he strongest signal is coming
- You can also use this scale to determine how much of a filter to use to block or reduce the impact of that signal so as to improve the reception of your desired signal on 7.135 MHz
- Depending on the scale being used, or the bandwidth, you can see the peaks of signals even far away from your center frequency, which can also tell you how wide their signal is or if they are splattering.
- The greater the bandwidth being measured the smaller the signal width displayed, while the more you zoom in on a signal the wider it becomes and the narrower the bandwidth becomes
- Wide bandwidth lets you see more signals within the band, but zooming in on a smaller portion of the band allows you to see characteristics of a signal which might otherwise be missed
- Say for example the main signal is distorted a bit – zooming in on the main signal might reveal several lesser peaks on each side of the main signal indicating noise or distortion in the signal.
- Adjusting the necessary filters on the radio will show a cleaner signal and you can ack out again for a broader view of the band
- And depending on the mode you can see a carrier and two sidebands on an AM signal, or HD signals on either side of an FM broadcast station offering HD service, and so on

- The spectrum trace portion of the software can also help you determine interference issues based on the decibel levels of the interference
- You can identify electrical interference from a power supply, for example, and see where it is showing up across a band or multiple bands
- As you learn about signal shapes and what to expect based on the modulation scheme, you can also learn to tell when a signal doesn't look right and even diagnose the problem

The Waterfall

The waterfall is one of my favorite tools these days because it can show a lot of information not as easily detectable on the spectrum trace. While the trace shows signal strength/amplitude across the bandwidth, the waterfall shows you signals across the bandwidth over time

- Using a system of colors the waterfall can indicate intensity, while at the same time showing you how a signal changes over time
- Like the spectrum trace you can see individual signals, but you can also better see their intensity and when they interfere with yours or other signals
- The waterfalls are usually designed to coincide with the width of the band just like the trace function, but you can also see signal shapes in ways a trace simply cannot do
- One of the most useful functions of the waterfall in my study of them has been to identify RFI from various sources
- Each type of interference creates a different image on the waterfall, and after a bit you begin to recognize shapes and patterns, and instantly know your neighbor has turned on their plasma TV again
- You can easily use a waterfall display to identify local noise sources, such as a computer monitor or a leaky switching power supply
- And of course you can compare antenna performance as well as how different antennas react to interference
- As the waterfall travels down the screen not only do you see the passage of time with regard to signals, but you see horizontal elements as well, such as distortion, the effects of lightning strikes, hiccups in power, etc.
- You can also see very clearly the effects of applying various filters, tightening up or loosening band filters, as well as the effects of other signals across the band
- The waterfall will not give you amplitude in a measurable way like the signal trace function, only intensity as a guide to strength.

- For accuracy in measurements this is where the signal trace is invaluable, and most software packages allow both to be shown at the same time if desired
- The waterfalls follow the color temperature of natural light, with weaker signals in the blue area of the spectrum, while stronger signals become yellow and then the strongest ones red
- Some software packages allow you to set these colors as desired, but most follow the blue to red convention

As you might expect these dongles can be used for testing equipment as well as simply receiving signals.

- They can be used like a traditional spectrum analyzer with the appropriate software
- Nuts bout Nets is a company which has designed a "Poor Man's Spectrum Analyzer" package which includes a dongle, antenna, and their Touchstone Pro software for around $80
- If you already have a dongle you can get a demo of the program and used its reduced capabilities, or you can buy the full program for $49 and have a lot of the more common spectrum analyzer functions available to you
- You can test things such as splatter and frequency accuracy of your HT, PL tone deviation/purity, and a host of other things
- With the upconverters which add the HF frequencies to the dongles, even more opportunity for testing HF becomes possible, as well as all the monitoring capabilities I have mentioned
- Basically if starting fresh, for around $130 or less, plus any adapters you need for antennas or testing, you have a receiver capable of 100kHz to ~2 GHz, as well as control software, the spectrum analyzer software and capabilities, and all of it can fit in your pocket, especially if you have a compact computer.

More Stuff

- Using a dongle to evaluate antennas
- Useful for tuning an antenna or if directional, pointing it in the direction for best reception
- Useful for detecting band openings if your radio does not have a spectrum trace
- Watching the spectrum trace or the waterfall can let you know when you are seeing voice signals versus digital signals by the duration of the signal

- Of course if you are connected to a laptop you can go around the world testing for signals, especially useful when travelling. It would be a great way to find active repeaters, for example
- Another useful feature is mapping out various repeaters in your area for signal strength, location, and possible antenna choices and setup4215.3 ``````````