The Dawning of a New Era in Portable Spectrum Analyzers
Broadband FFT Spectrum Analyzer

Today's evolving wireless networks employ multiple RF technologies over multiple bands and as more and more spectrum is utilized; congestion and interference will prevail as primary problems affecting service quality

- Call Blocking
- Poor Downlink Reception (Mobile)
- Desensitization of the Base Station Receiver (PIM)

To combat the negative side effects of spectrum growth (or crowding), RF engineers and field personnel need to have the right tools to monitor, capture, characterize and identify interference sources as friend or foe.

Conventional Spectrum Analyzers are not adequate

But until recently, the conventional sweeping spectrum analyzer was the only tool available. Of course this is better than using a mobile phone or laptop with data modem to assess interference in the network but it still requires a fair amount of expertise.

Since mobile phone transmission power levels (uplink) are much lower than Base Station transmission (downlink), interference problems tend to have a greater impact on the uplink bands. Ideally, field personnel would like to monitor an entire uplink band which is usually 15 MHz or greater for any ITU cellular band.

In practice, sweeping analyzers need to be adjusted for RBW, VBW (smoothing filter), and Span to balance sweep speed and obtainable noise floor. Again, it takes quite a bit of expertise and each case is different. But there are some rules of physics that come into play here. For instance, if the RBW is raised by 10 dB (10x), the sweep speed will increase but the obtainable noise will rise by 10 dB. Let's take an example based on analyzing a 15 MHz uplink band. Since interferers are unknown and can be steady-state or intermittent in nature, the analyzer should be set to a fairly fast refresh speed which would correlate to a RBW setting of 100 KHz (VBW setting of 30 KHz, Span 15 MHz).

Knowing the limitations of conventional Spectrum analyzers

Typically, sweeping analyzers have an obtainable noise floor of -164 dBm at RBW = 1 Hz. Thus, a RBW of 100 KHz is 100,000 times greater making the obtainable noise floor 50 dB higher or -114 dBm (10 dB for every 10x greater). One would think this may be good enough but actually it's not close unless the analyzer is connected to the base station's receive antenna which is getting more difficult to do nowadays with pole/tower mounted cell sites. Since most of the measurements will be conducted over-the-air from ground level, analyzers should have an operating noise floor closer to -130 dBm or lower.

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Thus, the RBW would need to be set to 1 KHz to have an obtainable noise floor of -134 dBm. But setting a legacy analyzer's RBW to 1 KHz with Span of 15 MHz makes the sweep speed too slow. Thus, users work around this limitation by breaking up the frequency span of interest into much smaller ranges to achieve the desired sweep speed. Of course, this is very prone to data gathering errors and the probability of missing an interfering signal is high especially if the signal is bursty or transient. Although, there are schemes to reduce the probability of missing a signal but they require users to employ a feature called Spectrogram which is used to record the spectrum of interest over a long period of time in hopes of capturing the elusive interfering signal. This of course does not end here since the recorded data needs to be sifted through and analyzed which can take hours and is also prone to interpretation error. And if desired signals are captured the next step is to identify them which again is another struggle for legacy analyzers. If interfering signals are broadband in nature (wider than 100 KHz) then sweeping analyzers will capture only segments of the true signal when active thus making identification nearly impossible under normal trace mode operation.

With access to the base station antenna ports decreasing, and crowding of the spectrum increasing, field personnel need a tool that can efficiently monitor and analyze the spectrum of interest without the complexity of the tool or procedure.

FFT Spectrum Analyzers are designed for today's signals

To help usher out the legacy sweeping analyzers is a new class of portable Spectrum Analyzers which utilize broadband FFT technology. FFT analyzers sample and parallel process large frequency spans of data (Analysis Bandwidth), 100's to 1000's of times a seconds allowing users to simultaneously monitor large spans of spectrum (10 -140 MHz) as opposed to sweeping and capturing narrowband samples based on the RBW setting (100KHz) and plotting sample points which are processed through a smoothing filter to soften (mask) the discontinuity of sequentially captured data.

The FFT analyzer uses much newer technology to essentially take digital pictures of its native sampling bandwidth (Analysis Bandwidth) thus greatly simplifying the use of the analyzer and ultimately allowing users to more efficiently and accurately capture, characterize and identify interferers.

FFT analyzers do not spin their wheels re-tuning to sweep narrowband segments of spectrum to capture an entire Span, instead they refresh the screen 1000's of times (effectively) faster thus enabling instant capture of short duration burst signals that may elude legacy analyzers for minutes, hours and even days. Wideband sampling allows the FFT to readily identify broadband signals. And since there's speed to burn, the RBW setting can be decreased to push down the obtainable noise floor for large spans. For example, setting the RBW of a 15 MHz FFT to 1 KHz provides an obtainable noise floor of -134 dBm compared to the legacy analyzer's

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-114 dBm (w/RBW @ 100 KHz) over a 15 MHz span. Thus, the FFT simplifies the procedure by eliminating the need to sectionalize the spectrum of interest to obtain a lower noise floor while providing fast re-trace speed which is essential for spectrum clearing activities.

Final Notes

As you can see, even explaining the FFT takes less words due to its simplicity in operation and use.

Thus, understanding the limitations of legacy sweeping spectrum analyzers is key to selecting the right tools for RF field personnel. And with the right tool in-hand, field personnel will be better equipped to address the growing interference problems and preserve the highest quality of service.

We recommend that you give an FFT Spectrum Analyzer a test drive and see how conventional Spectrum Analysis has been revolutionized by Broadband FFT Technology.

Sage Instruments has implemented a 15 MHz Analysis Band FFT Spectrum Analyzer in its UCTT 8901A advanced base station test platform and is available for purchase. In an addition, the UCTT is an advanced portable FFT Spectrum Analyzer, Signal Location Analyzer, Signal Analyzer, Antenna & Cable Analyzer, and real-time and complex Vector Signal Generator (LTE signals).

Practical Applications for Broadband FFT Real-Time Spectrum Analyzers

- Direction Finding & Signal Location (Triangulation)
- Spectrum Clearing
  [Legacy analyzers use error prone procedures requiring very slow, tedious antenna pointing to mitigate missed spectrum whereas FFT analyzers capture the entire spectrum of interest as fast as you can wave the wand]
- Using Persistence Color Histogram Trace view to assess signals within the noise floor

Future Applications

- Drive Testing with Multi-Channel Element Direction Finding Antenna
- FFT Analysis bandwidth increase to 25 MHz to help assess an entire communication band simultaneously.

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About Sage Instruments

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