

PXIe Data Streaming and SPECTRO-X RF Analysis

X-COM Systems

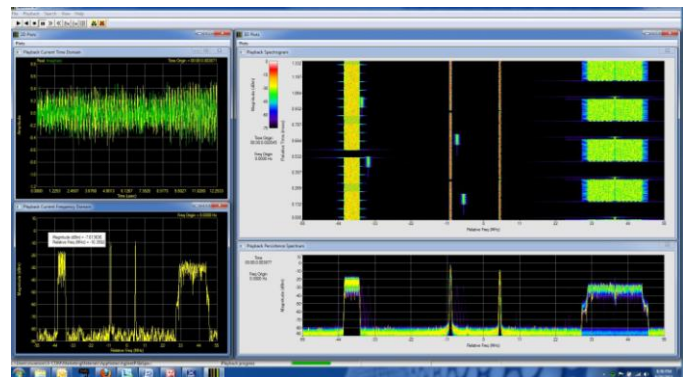
Systems and equipment designers working in the application arenas of electronic warfare, surveillance, radar and wireless data communications must often resolve why a new design works well in the lab but suffers degraded performance in its intended operational environment. The reasons can include multipath, adjacent channel interference, Rayleigh channel fading or scintillation or carriers transmitting in the desired band either intentionally or by error. To understand the root cause of the system degradation and then to prevent its occurrence once the system is deployed, the engineer requires two tools. They must first be able to record the operational spectral environment over a period of time that is long enough to guarantee capture of the anomalies. The second is a window through which those channel conditions can be viewed and analyzed.



PXIe for instrumentation, as derived from the Compact Peripheral Components Interface standard, has proven successful as a platform for the development of economical, “plug and play”, RF and signal processing modules that fit in a 3U bench top or rack mounted case. The Agilent M9392A vector signal analyzer and M9202A IF digitizer provide a compact cost effective solution for the streaming of RF spectrum with bandwidths up to 100MHz and center frequencies up to 26.5GHz. This economical, high performance capability, when combined with JMR Electronics’ BluStor® PCIe direct attached RAID0 storage arrays can provide more than 13 hours of spectrum memory.

Since initially the designer may only have a few cause and effect observations that could help narrow the time window for recording the troublesome channel environment, often the spectrum capture may be minutes or hours in length. An RF bandwidth of 100MHz requires 600MB/s to be streamed to the disk array and resulting files that can be terabytes in length. Visually scanning files that large for the intermittent occurrence of a jammer or some channel fading condition is inefficient at best. The X-COM

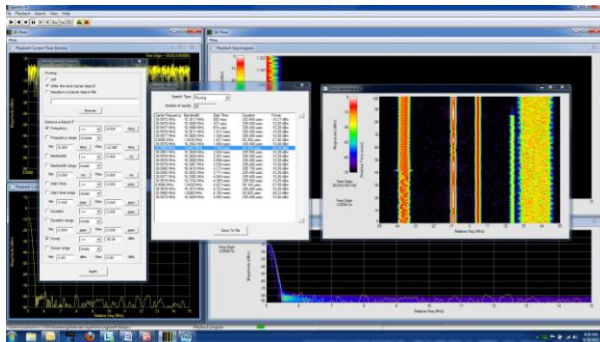
SPECTRO-X software application provides engineers the tools to first search through the file, independent of its length, in order to tag the location in time, frequency, duration and power of all carriers present. Using this data, an engineer can quickly parse the recording in to time segments containing unknown carriers that may warrant further investigation. Three tools in SPECTRO-X are available for this categorization. The first eliminates found carriers by applying user selected criteria such as power levels, center frequencies or time durations in combination with Boolean operators. This process can swiftly reduce the carrier list by discarding ones far from the desired carrier in frequency or too low in power to cause interference. Remaining carriers can further be identified by comparing their training sequences to those of known wireless standards or by correlating them to arbitrary waveforms that the user has either created in, for example MATLAB®, or that the engineer has “clipped” and saved from the spectrum capture. Remaining time segments containing unknown carriers of interest can then more easily be scrutinized and their effect on the desired signal quantified using the Agilent 89600B VSA software. The image below is a spectrum capture taken by an engineer wishing to understand why a LAN receiver in a battlefield environment shows intermittent bit error rate increases but works well in a lab environment. The spectrograms on the right side of the SPECTRO-X display show three, known cellular carriers, the wireless LAN spectrum on the far right and some intermittent frequency hoppers that are of a lower power level and appear interspersed throughout the spectrum recording. Since all carriers, other than the frequency hopper, are known and are far enough apart in frequency not to cause interference, the engineer can begin to isolate this potential jammer.



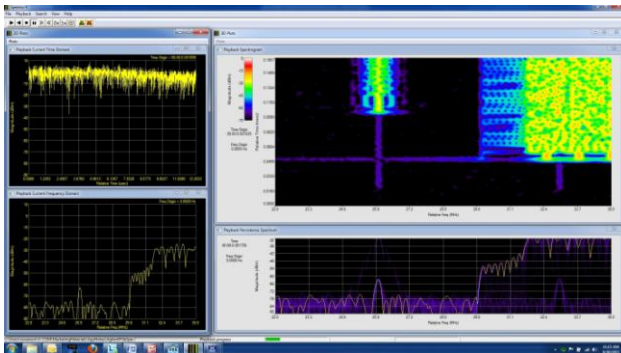
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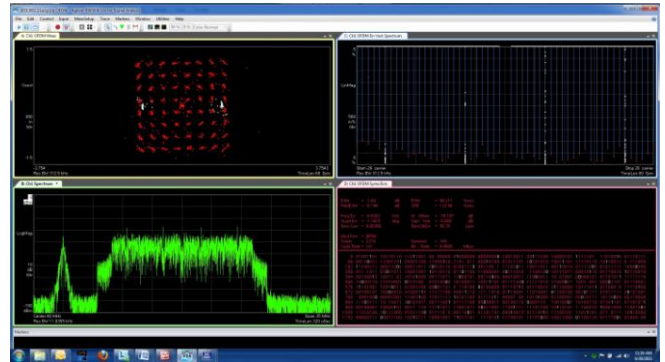
Using the carrier search and parsing tools of SPECTRO-X, the engineer searches for all instantiations of the frequency hopper and can quickly view at least one occurrence during the capture file (shown below) where it appears very close to the LAN spectrum.



By adjusting the displayed bandwidth and playback time in SPECTRO-X the engineer can further isolate this segment of the capture file and zoom in to such a level of detail that it is clear the problem is caused by a dual tone jammer. The "tail" of its un-modulated



carrier provides visual evidence of it landing in the middle of the LAN occupied bandwidth. Spectro-X has allowed the engineer to isolate a short portion of a very long capture file that points to, but does not completely verify, the root cause of the increased BER in the field. This verification is accomplished by clipping this time segment of the captured file and using it as the input file to Agilent's 89600B VSA software. Demodulation of the 802.11 a/g waveform (shown below) clearly identifies a disturbance in the symbol constellation when the jammer appears.



The combination of long RF spectrum captures with the ability to search for, parse and demodulate carriers of interest provides engineers with a very powerful tool kit to diagnose communication system anomalies. The complimentary features of the Agilent PXIe data streaming solution and VSA software along with X-COM's SPECTRO-X software speed the investigative process and help engineers rapidly determine the best path to a reliable, deployable system.