Tektronix

Real-Time, Acquisition and Measurement Bandwidth

When talking about Real-Time Spectrum Analyzers, the concept of bandwidth can take on many forms. This short article addresses the various bandwidth terms and concepts, and what each of these mean in your RSA.

Real Time Bandwidth: This generally refers to the maximum capture bandwidth of the RSA. In other words, this is the widest bandwidth over which the RSA can capture/record signals over time. It is also the widest SPAN that the DPX Spectrum display can present “live” without sweeping, for real-time analysis. For the USB RSAs like the RSA300, 500 and 600 series, the real time bandwidth is 40MHz. The RSA5100B can be configured with up to 165MHz and the RSA7100A series can be equipped with up to 800MHz real-time bandwidth. This term is sometimes loosely used interchangeably with Acquisition BW.

Acquisition Bandwidth: While the RSA can acquire signals seamlessly over time with a bandwidth as high as the Real Time Bandwidth, this may not be desirable in many situations. For example, if the signal of interest is only 8MHz wide, then you would typically want to change the Acquisition BW to 10MHz or so. This has several desirable affects: It improves the SNR of the recorded signal by eliminating the noise associated with a wideband acquisition; it keeps signals outside of the band of interest from being included in the acquisition; and it increases the maximum acquisition time in some analyzers.

On RSA5100B series, when you reduce the Acquisition BW, the RSA implements this through a digital filtering/decimation process. Thus, the effective sample rate is lower which means that you can record longer events into memory. The Acquisition BW is typically set automatically by the RSA based upon the settings required by any active measurement displays. However, you always have the option of manually setting the Acquisition BW. Note that the Acquisition BW and the IQ Sample Rate are intimately tied together: wider BW = faster IQ sample rate.

The RSAs that use SignalVu-PC as the user interface (USB RSAs and RSA7100) perform a little differently. They always acquire data at the full real-time bandwidth, and perform the filtering and decimation down to the requested acquisition bandwidth inside the SignalVu-PC application. Thus, the maximum acquisition time is fixed at 2 seconds rather than being dependent upon the acquisition bandwidth as in the RSA5100B.

Measurement (Analysis) Bandwidth: Once an acquisition of IQ data has been made at a given acquisition BW, then the various measurements (displays) are calculated. By default, each measurement/display calculates its results from the IQ data at the acquisition BW that was used. However, under certain circumstances, it is desirable to apply additional filtering to the IQ data prior to calculating a particular measurement result. The purpose of this filtering may be to improve SNR for that measurement, or to eliminate an adjacent signal from the desired signal to be analyzed. For example, when performing a digital modulation analysis, the actual measurement bandwidth used is determined by the filter selections made in the demodulation settings.

Coupled with this is the ability to change the Measurement Frequency. Consider the following example: A frequency hopping communications device uses 8 channels that are 1MHz wide, spaced at 4MHz. With the acquisition BW set to the maximum real time BW of the USB-RSAs (40MHz), you can make an acquisition that captures the frequency hopping sequence of the device as it goes through each of the 8 channels. Once this wideband acquisition is made, you can then change the Measurement Bandwidth to something like 2.5MHz and change the Measurement Frequency to any of the channel frequencies and thus analyze/demodulate any of the desired channels individually. This "capture wide, analyze narrow" concept can apply in many situations, including the ability to examine things like frequency and phase settling time, etc.