A Summary of Spectrum Engineering, The Why and How

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For many years, Electromagnetic Spectrum has been treated as a commodity within the United States, with allocation shared between Government and private sector interests. Government spectrum managers, working with their industry counterparts, carved out slices of spectrum under the governance of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA) for commercial and government use, respectively. This relationship worked very well for many years due to the fact that electronic systems utilizing the spectrum, such as radar and satellite communications systems, were in designated bands. The solid-state revolution began to take hold aggressively in the early 1990s with an explosion of chip sets capable of performing the necessary functionality needed to support both the RF and signal processing infrastructures required for realizable high-speed wireless cellular communications. As the spectrum from UHF up through C band began to encounter greater congestion as a result of the influx of communications systems, the ability to manage a solution became rather tenuous at best. Since 2007 the US Navy has come to realize that in order to use spectrum, better engineering solutions are required to augment traditional spectrum management. These engineering solutions take the form of: (1) power amplifiers for radar and communications with lower levels of out-of-band emissions; (2) a waveform diversity approach for radar and communications that allow the requisite performance, but without adding to the out-of-band emissions; (3) antennas which support space-time diversity, thus allowing spectral compatibility in designated geographical zones; (4) adaptive software-defined receivers; and (5) bi-static/multi-static sensors, such as radars, that utilize the emissions of other users of the spectrum to support their operation.

This presentation, which will have a radar emphasis, will discuss: (1) some history as to when and how the spectrum climate began to change; (2) current work on power amplifiers that generates lower out-of-band emissions as well as their ability to adapt to a given power added efficiency while maintaining a specified adjacent-channel power ratio; (3) adaptive antenna technology supporting spectral diversity; (4) how receivers may be configured to mitigate the effects of interference; and (5) the employment of bi-static and multi-static techniques.