Covering the spectrum: Meeting the challenge of electromagnetic spectrum domination

By Marc Couture
An industry perspective from Curtiss-Wright Defense Solutions

North Korea recently fired a missile across the Korean Peninsula and into the Sea of Japan. This latest threatening act highlights the increased volatility of the Pacific Region. Ongoing tensions in the Straits of Taiwan and China's construction of a string of artificial islands in the South China Sea also serve as stark examples of the need for effective SIGINT/ELINT [signals intelligence/electronic signals intelligence] coverage of the electro-magnetic spectrum (EMS) by the U.S. and its allies.

During a tactical situation, what would that look like? Achieving effective order of battle and viewing the whole EMS map at once has always been a challenge. First and foremost, the mission requires a stand-off platform that can simultaneously cover as many targets as possible. The number of surveillance assets, such as unmanned aerial vehicles (UAVs), that can be flown at once is limited. What's more, the number of radio frequency (RF) channels that could be integrated into a payload was limited on older VME systems to only one or two channels per 6U slot. Another hurdle was the exploitation of the resulting EMS data, which would typically need to be back-hauled to a human for analysis, introducing costly delays between data accumulation and decision-making. Until now, the impossible dream has been a cost-effective open standards approach for covering far greater swaths of the EMS, coupled with the ability to analyze and act upon that data in real time.

A couple of months ago in this space (November/December 2016 MilTech Insider) we wrote about the technology breakthrough made possible by the recently introduced Vesper family of multichannel wideband RF receivers (DRS Signal Solutions). These RF receivers provide greatly expanded EMS coverage and channel count, up to nine RF channels in a single 6U slot – compared to the two channels previously possible – that system developers have long sought. The DRS devices are available in cost-effective, [size, weight, and power] SWaP-optimized 3U and 6U VPX modules. When combined with supercomputing-class multicore Intel Xeon processors, the SIGINT data flowing from these RF receivers are able to generate real-time actionable intelligence: not just information about what a signal of interest is, but information that tells where the target is, in both space and time, thus enabling the warfighter to determine if the target is benign or a threat that needs to be attacked.

In the times since these open standard RF receivers were introduced, the potential that they deliver for SIGINT and ELINT applications has become clearer. Half of the story is the high frequency supported by the tuners: RF channel density for a 6U VME card in the past were limited to one or two channels able to cover a frequency range of 20 MHz to 3 GHz, and analog IF outputs were limited to a maximum 40 MHz instantaneous bandwidth. The new modules support as many as 10 RF channels per card, with intermediate frequency (IF) outputs more than doubled to 100 MHz instantaneous bandwidth. This improved performance brings us much closer to the goal of instantaneous coverage over as much of the EMS spectrum as possible, and for as long as possible.

The other half of the story is the benefits that come from the modules' support for 10 Gigabit Ethernet. Because the RF receivers support VITA's standardized VRT protocol (VITA 49/VITA Radio Transport) for transferring IF data between analog front ends and processing cores, a whole new level of flexibility is realized.

Figure 1 | The CHAMP-XD2 board plus associated updated RF receivers enable users to cover the electromagnetic spectrum during tactical situations and act upon the data in real time.

For example, using advanced multicast Ethernet modes, one tuner channel can send out its result to a subset of the Xeon D cores, or the data from multiple tuner channels can be aggregate to a single Xeon core. This support for standards-based switched Ethernet enables "all-to-all" connectivity, so any tuner channel can communicate with a Xeon core. This raises the bar on the ability of the SIGINT/ELINT system to correlate RF emitters in three-dimensional time and space, resulting in a magnitude of improvement in density. To duplicate the flexibility achievable from this commercial off-the-shelf (COTS)-based open standards approach using proprietary solutions would be extremely difficult, if not impossible.

Curtiss-Wright has developed high-performance embedded computing (HPEC) architectures that take advantage of the Vesper RF receiver's support for Ethernet and the VRT protocol in both 6U and 3U VPX systems. (Figure 1.)

***Marc Couture** is the senior product manager for Intel, PowerPC, and GPGPU-based digital signal processors in the ISR Solutions group at Curtiss-Wright.*

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